Natural Gas – A Briefing Paper for Candidates

Hydraulic fracturing and horizontal drilling, processes used to extract natural gas from underground shale formations, have unlocked vast new domestic reserves — an unexpected abundance that has overturned many of America's assumptions about energy. Every major-party candidate for public office in 2012, Republican or Democrat, must understand this new energy reality. And though each candidate's position on natural gas development is likely to begin with a recognition of shale gas's economic and energy security benefits, mastery of the issue requires a deeper level of understanding. Shale gas also brings with it a set of serious risks to public health and the environment — including impacts to water, air, land, local communities and the earth's climate. At the local level in areas where shale gas production is intense, legitimate concerns over health and environmental impacts are shared by Republican, Democratic, and independent voters alike. No candidate's position on natural gas can be considered complete unless it addresses these impacts.

In 2001, shale gas accounted for just 2% of America's natural gas supply. Today, it accounts for more than 30% — while more than 90% of all new oil and gas wells being drilled in the U.S. make use of hydraulic fracturing. As unconventional natural gas production spreads into populous regions that are not accustomed to intensive industrial activity, its impacts have made it the object of intense local opposition, as manifested in the July 28th "Stop the Frack Attack" rally in Washington D.C and others like it in state capitals around the country. The environmental and public health concerns of local communities must be addressed if natural gas companies are to maintain their social license to operate.

Economic Benefits

While a majority of Americans remain unfamiliar with hydraulic fracturing, or "fracking," according to a recent University of Texas poll, many will certainly applaud the economic benefits of low-cost natural gas. The natural gas revolution is driving:

- Job creation across the value chain, with rising demand for technical and professional services, for steel, pipelines and storage facilities, and for all the ancillary goods and services that arise in support of a rapidly growing industry

- An unexpected expansion in the American chemical industry, with Dow and DuPont now building new plants close to shale formations. "If you had told me 10 years ago I'd be standing up on this podium making this announcement [about Dow's $4 billion investment in four new Texas chemical plants], I would not have believed you," Dow CEO Andrew Liveris

said in April. "The cost of energy, the cost of feedstocks ... was pricing the United States out of the market," he said. But the shale "miracle" changed that.[*]

- A revival in U.S steelmaking and other manufacturing industries. Nucor, which uses natural gas to make steel, is building a $750-million facility in Louisiana, just eight years after shutting down a similar plant in the same state.[†]

- A new sense of the potential for U.S. energy independence and energy security.

Environmental Benefits

Increased development of shale gas could yield substantial environmental and public health benefits while helping the U.S. energy infrastructure become cleaner and less carbon-intensive. This highly desirable outcome will only be achieved, however, if the resource is developed responsibly. The potential exists because natural gas:

- Produces only about half the carbon dioxide of coal when burned.
- Produces about a third as much of the smog-forming nitrogen oxides that come from burning coal.
- Produces almost none of the mercury and sulfur dioxides that come from burning coal or oil.

For this reason, fueling power plants with natural gas instead of coal can dramatically cut conventional air pollution, can help reduce greenhouse gas emissions from the power sector and could help turn the tide against mountaintop removal mining and other environmentally disastrous industry practices. And because natural gas-fired power plants can cycle up quickly, they can be a nimble enabler of intermittent renewable energy sources in combination with demand response and emerging large-scale energy storage technologies.

Critically, if U.S. industry and regulators are successful in measuring and reducing methane pollution, which undermines natural gas' role as a lower carbon alternative to coal and oil, the shale gas revolution can also bring a reduction in short-term radiative forcing — the driver of global climate change — over the next several decades. Leak reduction will determine how much of a role natural gas can play in a clean, low carbon future.

In short, natural gas could be a win-win — benefiting both the economy and the environment — if we do it the right way. The right way means putting tough rules and mandatory environmental safeguards in place that protect communities and reduce methane pollution. There is no question that domestic unconventional gas supplies are leading to coal-fired power plants being retired. The public recognizes this benefit, but the jury is still out on whether shale resources can be produced responsibly. It's no simple task to strike a balance between public safety and the development of

[*] "Cheap Natural Gas Feeds Chemical Industry Boom," *The Houston Chronicle,* April 19, 2012
[†] "Natural Gas Signals a 'Manufacturing Renaissance," *The New York Times,* April 10, 2012

this crucial energy resource, but it is essential that we do so. Americans deserve assurance that the economic, environmental and energy security benefits of shale gas development will be realized without sacrificing their health, safety, or the protection of the environment.

Clearly there are environmentally sensitive areas that should be off limits to natural gas development. And just as clearly there are some areas where intensive development will occur. Environmental Defense Fund is working with partners from academia, civil society, and industry to identify and minimize the impacts from the full range of gas development activities. Horizontal drilling and hydraulic fracturing attract significant press attention, but the issues of gas production are much broader than that.

Specific Areas of Concern

EDF sees five areas in which strong rulemaking is necessary:

- *Mandating greater transparency in industry operations.* Having good data is a prerequisite to understanding and mitigating risks, and it's the first step toward winning back a badly damaged public trust. Regulators should require, and companies should embrace, disclosure policies that mandate reporting of not only the chemicals used in hydraulic fracturing, but also chemicals used in drilling and operating wells – as Ohio Governor John Kasich has advocated. Transparency should also be brought to other aspects of industry operations, such as detailed reporting of air emissions, chemical characterization of waste streams and tracking and reporting of water use and waste disposition. Company compliance histories should also be catalogued and reported, so companies with good records can get the credit they deserve and bad actors can be identified and pushed to improve performance.

- *Modernizing rules for well construction and operation.* Poor well construction and operation can lead to groundwater contamination and to blowouts that can endanger lives and foul the surface environment. In response, EDF is working with regulators and key stakeholders to strengthen rules for proper construction and operation of hydraulically fractured wells. While stronger regulatory oversight of well construction is needed, no one should try to suggest that hydraulic fracturing itself is risk free. Both aspects of well development need strong oversight.

- *Strengthening regulations for waste and water management*. Poor handling, storage and disposal of production fluids and other wastes is a major issue; chemical spillage is the leading cause of groundwater contamination from gas development activities. In response, EDF is pressing for measures to reduce spills, improve the use and handling of chemicals, and assure proper disposal (or recycling) of produced water. As mentioned above, a key missing ingredient here is better data on the chemical composition of waste streams. To be confident that handling, treatment and disposal practices are sufficient, authorities must know what substances are being handled. Finally, headline-grabbing reports of earthquakes connected to shale gas development have been linked to the waste disposal method known as deep well

injection, not to hydraulic fracturing itself. This issue points to the need for improved seismic analysis prior to permitting of deep injection wells.

- *Improving regulations to protect local and regional air quality.* Air emissions resulting from the production, storage, processing, and transportation of natural gas can threaten public health. Leaks and routine venting during the extraction, processing and transportation of natural gas result in emissions of greenhouse gases and, depending on the local composition of unprocessed gas, other pollutants that contribute to locally- and regionally-elevated air pollution. In 2009, an SMU study estimated that the combined amounts of volatile organic compounds (VOC) and nitrogen oxide (NOx) emissions from oil and natural gas production in the Barnett Shale of North Texas were comparable to amounts of those emissions from the roughly 4 million cars and trucks in the adjoining Dallas Fort-Worth metro area. Fortunately, widely available and cost-effective remedies exist: repairing worn equipment, using "green" well completion techniques and eliminating venting are just a few. In the past five years, for example, Southwestern Energy says it has cut the cost of capturing stray emissions from $20,000 a well to close to zero. The company is capturing an average of 16 million cubic feet of gas that would otherwise have been released or flared. Southwestern also uses special pop-off valves to make sure natural gas is not released into the air from well casings. If pressure causes a valve to open, the gas is captured in a closed loop that returns it to the system, saving the resource. These systems cost just $600 to $1200 a piece.

- *Developing innovative strategies to reduce community impacts*. The cumulative impact of infrastructure development, traffic, noise, lights, and the like can overwhelm communities and intrude on sensitive ecosystems and habitats; none of this is easily addressed through conventional regulatory approaches. Instead, EDF recommends that states and local governments bring together stakeholders for scientifically based, bottom-up planning processes designed to address unique local needs. Likewise, the right of local communities to regulate the location of gas development through local zoning ordinances must be preserved. Gas operations shouldn't receive special carve-outs from traditional local powers that other industrial activities must comply with.

President Obama has voiced his commitment to domestic energy production through safe and responsible natural gas development, declaring that "America will develop this resource without putting the health and safety of our citizens at risk." EDF would like to see Governor Romney and other candidates across the land call for the same careful balance. Far from being an example of regulation that chokes economic growth, strong oversight of natural gas development is necessary to ensure the sector's continued growth, by avoiding the public backlash that could slow or even derail natural gas development.

The Role of Regulation

EDF is pushing for rapid regulatory reform in the states where the vast majority of onshore natural gas production is occurring, and relying on federal action in key areas where agencies have specific authority and capacity to act. Our goal is to make sure that the carbon benefits ascribed to natural gas are real and sustained, and that the rush to develop the nation's natural gas reserves does not trample environmental quality or the health of communities.

The United States needs stronger state and federal oversight of natural gas production; such regulation must evolve as technology evolves. With a keen focus on the 14 states that have about 85% of onshore gas reserves, EDF recommends that candidates speak in favor of getting the rules right at the state level. Depending on their point of view, national candidates may see this state-level rulemaking as a necessary prelude to comprehensive federal regulation, or as a state-level process that obviates the need for federal regulation. Either way, it is clear that if states fail to implement effective oversight, an increased federal role will become inevitable.

In reality, the federal government and the states have a *shared* responsibility to ensure that our air, land and water are safe wherever hydraulically fractured wells are drilled. While much more remains to be done to ensure shale gas development is safe for people and the environment, important progress is currently underway at the federal, state and local levels.

The EPA, for example, has adopted rules to reduce air pollution from oil and gas development activities that, while needing improvement, are an important step. Likewise, some states have moved quickly to update their oil and gas rules. The wave of state regulations requiring disclosure of hydraulic fracturing fluid chemicals is an example of how states can quickly address concerns when the right motivation is in place. Appropriately, states are beginning to recognize the need to quickly address other concerns. Ohio, for example, recently adopted strong rules for the construction and operation of both production wells and disposal wells. Pennsylvania recently did the same. Wyoming and Colorado have been leaders on controlling air pollution from oil and gas operations. None of these rules is perfect, but they show that progress is possible with the right leadership.

Reducing Methane Leakage

In the absence of responsible natural gas oversight, increased reliance on the resource could result in a future in which the U.S. emits as much or more climate disrupting pollution as it does with our current energy mix.

This outcome is possible if enough *uncombusted* natural gas is allowed to leak into the atmosphere from well sites, gas processing plants, pipelines and distribution systems. Though it burns cleaner than coal, uncombusted natural gas is extremely damaging to the climate: It is mostly made up of methane, a greenhouse gas far more potent than carbon dioxide. (For the first 20 years after it is

emitted, a pound of methane is 72 times more potent as a heat-trapping emission than a pound of carbon dioxide. Over 100 years, a pound of methane is 25 times more potent as a greenhouse gas than a pound of carbon dioxide.) Small amounts of natural gas are lost into the air as it makes its way from the wells and through the processing and pipeline system that brings it to consumers; the cumulative impact of those leaks is highly significant.

The potential for damaging methane leakage will only grow if, as expected, the use of natural gas expands in the coming years. Now and in the future, the United States cannot afford to be wasting a valuable American energy resource by allowing unchecked leakage to occur. As Americans, none of us should be content to stand idly by and let this important resource be squandered through fugitive emissions and unnecessary venting. Nor can we ignore the national security consequences of allowing our climate to deteriorate through easily avoidable greenhouse gas pollution. Reducing methane emissions isn't just an environmental issue, it's an important part of any candidate's plan for domestic energy security.

Uncertainty remains about just how much methane is currently being emitted along the supply chain, from the well site to the end-user. Estimates vary widely — from less than 2% to more than 7% of total production. The Environmental Protection Agency (EPA) has estimated the methane leak rate at about 2.3%, while a study by the National Oceanic and Atmospheric Administration (NOAA) suggested that in northern Colorado it might be roughly twice as high. If the higher estimates turn out to be correct, the leaks could eat up the short-term climate benefit equivalent to closing one-third of the nation's coal plants. If the lower EPA estimate is correct, leak rates of two to three percent still leave significant and cost-effective greenhouse gas reductions on the table. Accurate measurement of actual leakage rates is a crucial next step.

A recent paper by Alvarez et al. published in the *Proceedings of the National Academy of Sciences* identified the critical leak rates at which use of natural gas would produce climate benefits at all points in time. The study found that natural gas can always produce a greenhouse gas advantage over other fossil fuels for electric power and transportation, including the conversion of much of the nation's 3.2 million big rig trucks, if methane leakage rates are capped at 1%.[*]

Though methane is a far more potent climate disruptor than carbon dioxide, it is also more short-lived; it breaks down in the atmosphere over time. The permanent, long-term solution to climate change involves stabilizing CO_2 emissions. However, the shorter time frames affected by methane

[*] Other papers, such as Myhrvold and Caldeira (*Environ Res Lett*, 2011) and Cathles (*Geochem Geophys Geosyst*, 2012), have employed alternative metrics and technical approaches that tend to diminish the near-term effects of methane emissions on climate. The diverse array of human and natural systems impacted by climate change make it difficult to find a single metric, e.g. temperature, that is universally relevant to policy. While it can be useful to consider multiple metrics, the simplicity, transparency, and relatively low uncertainty of the *cumulative radiative forcing* metric used by Alvarez *et al*. makes it particularly useful in policy formulation. EDF would be pleased to discuss these issues in greater detail.

emissions are also crucially important because they increase the risk of undesirable climate outcomes in the near future. Accelerated rates of warming mean ecosystems and humans have less time to adapt to climate change. Given the dire need for concerted global action on climate change, current energy policy should, at a minimum, abide by a "Do No Harm" policy: no policy should contribute to increased climate forcing on any time frame.

There is no technological barrier to reducing leakage. We just have to do it. That's enormously encouraging. As mentioned above, many practices and technologies are already being used in states such as Colorado and Wyoming to reduce gas losses, which result in greater recovery and sale of natural gas, and thus increased economic gains. The return on the initial investment for many of these practices is sometimes as short as a few months and almost always less than two years. In these tough economic times, it would seem wise to eliminate waste, save money and reduce environmental impact.

Candidates should come out in favor of rules to measure and limit methane leakage at a level that avoids short term climate damage. In the coming days, Environmental Defense Fund would be pleased to present the elements of a possible approach. As crucial voices in the public debate, candidates have the opportunity to take a leadership position on the methane leakage issue; if influential office-seekers choose to do so, others will likely follow. This would mark a major step on the road to safe and sustainable development of America's shale gas resource.

The first order of business is getting the data necessary to better understand where the leaks are occurring and under what conditions, then using that data to reduce leaks and ensure that natural gas will help mitigate climate change. Such as strategy could yield enormous environmental and health benefits on a global basis.

No candidate in 2012 can afford to stand against transparency and public access to data. Such a candidate would be out of step with the public mood and the public interest. We need to get information on methane leakage out there. It needs to be presented in useful, user-friendly formats so the public can look at it and start to understand what’s going on. We need our regulators to be able to slice and dice this data, so they can identify challenges and opportunities.

As mentioned, the good news is that leaks can be detected, measured – and reduced. EDF is currently collaborating with industry and academic partners on a series of five major scientific studies designed to quantify the methane leakage rate across the natural gas supply chain. The five studies are on: the production of natural gas, natural gas processing, long-distance pipelines and storage, local distribution systems and natural gas vehicles. For the production study, we are working with the University of Texas and nine major natural gas companies to determine the leak rates from their wells. For the local distribution module we are working with Duke University, Harvard University and Boston University. EDF aims to complete the entire study by December 2013 and to submit the results of each module for publication.

Conclusion: Improving Corporate Performance

The natural gas industry has a credibility problem. This diverse industry, made up of hundreds of drilling companies ranging from tiny operations to huge multinationals, cannot afford to regard strong environmental performance as a luxury or a marketing strategy. It is a public right, and a requirement for continued corporate operation.

Improved performance is clearly in industry's bottom-line interest, whether by reducing wasted product lost to leaks, reducing regulatory and financial risk, or earning back the public trust. Companies will benefit from this too. First, because good data and good science lays the foundation for having fact-based conversations about risks and how to mitigate them. And second, because transparency is an end in itself.

Candidates should encourage natural gas executives not to wait for slow-moving producer associations to reach agreement. By speaking in favor of common-sense environmental strategies, such as disclosure and green completions, some leaders in the natural gas industry are already charting the path forward. They are proving that industry can meet new standards, such as the EPA's air quality rules for oil and gas drilling, and thrive.

Candidates can perform a valuable public service — and help their own campaigns — by shining a light on these industry leaders, and by calling on industry to join the emerging coalition that's now speaking out in favor of getting the rules right for natural gas.