The Shale Revolution and Climate Change

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Introduction

The shale revolution has dramatically increased US production of natural gas and oil, with complex and important implications for greenhouse gas emissions. This issue brief describes the near-term effects on climate change, potential longer term impacts, and the crucial role of government policies.

Short Term Impacts

In 2016, the US energy sector emitted roughly 5,200 million metric tons of carbon dioxide, the lowest level since 1993. Numerous studies have demonstrated that the leading cause of these reductions has been the displacement of coal by natural gas in the electricity sector, where CO_2 emissions have fallen by 25% since 2007. This displacement has been led by the availability of a low-cost supply of natural gas, brought about by the shale revolution.

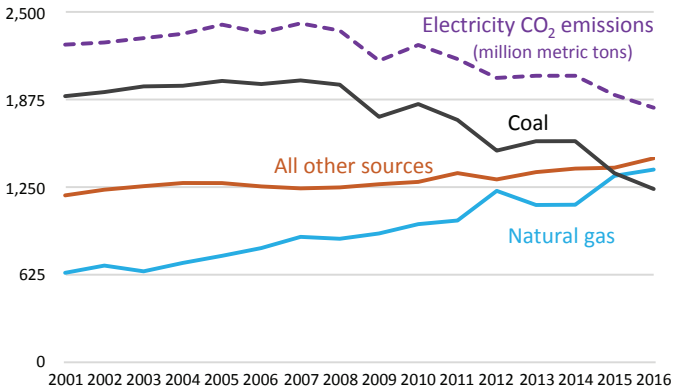
Methane Emissions

The primary component of natural gas is methane which, when burned, produces heat, water, and CO_2. However, methane is also a greenhouse gas which is shorter-lived, but traps heat more effectively than CO_2. When it escapes into the air from a well, pipeline, processing facility, or any other piece of equipment, methane's impact on the climate is roughly 84 times more powerful than CO_2 over a 20-year time frame and roughly 28 times more powerful over a 100-year time frame.

If more than about 4% of the natural gas produced in the United States is emitted as methane (rather than being burned), the climate benefits of gas's displacement of coal disappears over a 20-year time frame. If the time frame is 100 years, the leakage rate would have to be more than 8% for natural gas to be a climate loser relative to coal.

In recent years, the US EPA's estimates of domestic methane emissions have come under question, leading researchers to conduct dozens of studies to determine the amount escaping from natural gas (and oil) systems. While there is still some uncertainty, the most in-depth studies and the majority of evidence point to leakage rates in the range of 1.5% to 3.0%, well below the levels needed to negate natural gas's climate benefit over coal. Still, additional efforts to reduce methane emissions would further improve natural gas's carbon footprint.

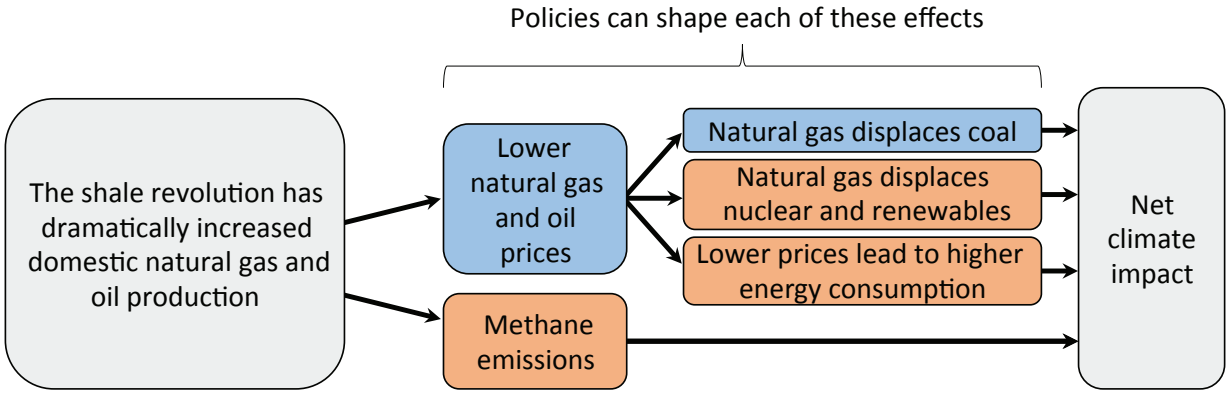
Figure 1. Net Electricity Generation by Fuel (TWh)



Data source: US Energy Information Administration

* This is one of a series of issue briefs based on *The Fracking Debate: The Risks, Benefits, and Uncertainties of the Shale Revolution* (Columbia University Press, 2017) by Daniel Raimi. Raimi is a senior research associate at Resources for the Future.

Figure 2. Climate Change



Long-Term Impacts

Despite the near-term climate benefits of low-cost natural gas, multiple studies have demonstrated that—over the coming 25 to 30 years—the shale revolution may not be a net benefit for climate change. This finding stems from two main causes.

First, low cost natural gas does not just make coal-fired electricity generators less competitive, it also competes with zero-carbon sources such as nuclear, wind, and solar power. Low natural gas prices have contributed to the closure of multiple nuclear reactors in recent years, and incentivized power generators to build new natural gas, rather than wind or solar plants. Second, the shale revolution's impact on energy prices—lowering the price of natural gas, oil, and electricity—encourages higher overall energy use. While low energy prices are a boon for consumers, they lead to greater consumption, thereby increasing emissions.

When researchers take into account all of these effects, including the displacement of coal and the issue of methane emissions described above, most results show that the shale revolution—in the absence of policy (see next section)—is neither a climate savior nor a climate villain.

The Role of Policy

While the shale revolution alone is unlikely to dramatically alter the trajectory of domestic greenhouse gas emissions, it opens an important window of opportunity for climate policy that is unique to the United States. With an abundant supply of low-cost natural gas, US policymakers can achieve substantial additional reductions in greenhouse gas emissions at low cost. The clearest opportunity to achieve this comes in the electric power sector, where natural gas can continue to displace coal-fired generators.

At the same time, well-designed climate policies would seek to reduce methane emissions across the vast infrastructure of domestic oil and natural gas systems (notably, some states have implemented such policies, and some operators have implemented voluntary programs to reduce emissions). They would also recognize that preventing the worst effects of climate change will require far greater emissions reductions in the coming decades. Researchers at RFF and elsewhere have shown that the most efficient policies to achieve these long-term goals center on pricing greenhouse gas emissions and investing in research and development for the next generation of energy technologies.

In summary, the shale revolution has created substantial climate benefits in the near term, and provided an even larger climate opportunity in the long term. Whether the United States will take advantage of that opportunity depends largely on policy decisions made in Washington, DC.