Union of Concerned Scientists

EXECUTIVE SUMMARY

The Natural Gas Gamble

A Risky Bet on America's Clean Energy Future

HIGHLIGHTS

As power producers retire aging coal plants they are turning to natural gas to generate electricity at an unprecedented rate. While this shift is providing near-term environmental and economic benefits, a dramatically expanded use of natural gas to generate electricity leads to complex risks including persistent price volatility and climate-changing emissions.

This analysis reveals that the dangers of an overreliance on natural gas can be overcome by greatly expanding the use of renewable energy and energy efficiency in our power supply. By making smart energy choices today, we can accelerate the shift to a truly clean, affordable, and diverse energy economy, cut carbon emissions, and create healthier, more productive communities.

The U.S. electricity sector is in the midst of a major change, as power producers shift away from coal to natural gas as their primary fuel. While this rapid shift is providing important near-term environmental and economic benefits, strong evidence suggests that becoming too reliant on natural gas poses numerous complex risks, including persistent price volatility, climate-changing emissions from combustion and the leakage of methane, and water and air pollution from natural gas production. Our analysis shows that a wholesale shift to natural gas makes less economic sense than would prioritizing investments in renewable energy and energy efficiency. A more diversified energy mix will result in an affordable and climate-friendly power sector. With sensible policies in place, natural gas could play a useful—though more limited—role in a clean energy system, especially if it came to be seen not as a replacement for coal but rather as an enabler of grid flexibility in support of renewable technologies.

A Historic Shift from Coal to Cleaner Forms of Electricity

From 2007 to 2013, coal's share of the U.S. electricity mix declined from about half to just 39 percent while natural gas generation's share grew from 22 percent to 27 percent (EIA 2014a). Higher coal prices, standards aimed at limiting harmful pollution from coal-fired power plants, and sharp declines in natural gas prices driven primarily by U.S. shale gas production are leading utilities to choose natural

The recent surge in natural gas power generation, made possible by increased domestic supplies and low natural gas prices, offers important benefits compared with coal, including reduced air and water pollution, lowered smokestack carbon emissions, and greater flexibility of the power grid. However, the dramatic expansion of natural gas also leads to complex risks that should not be ignored. A power system dominated by natural gas exposes consumers to price volatility and makes it much harder to achieve long-term global warming emissions reduction goals.

gas over coal for meeting electricity demand. The choices being made in the power sector today to replace retiring coal power and meet our growing electricity needs merit further examination because they will have major consequences for our economy, health, and climate for decades to come.

The Natural Gas Gamble examines the risks and near-term rewards of the recently growing contribution of natural gas combustion to electricity generation and explores the costs and benefits of various possible energy pathways as the United States transitions to a low-carbon economy. We present the findings of an analysis of the national electric sector which highlights how renewable energy and energy efficiency can reduce the risks of overreliance on natural gas, cut carbon emissions, and contribute to a diverse and well-balanced clean energy supply. This analysis also outlines a more balanced role for natural gas in a carbon-constrained power sector.

Risks and Rewards of the Natural Gas Surge

The burning of natural gas instead of coal to generate electricity offers important and immediate benefits, including reduced air and water pollutants emanating from power plants, fewer smokestack carbon emissions, less power plant water use, greater flexibility of the power grid, and renewed economic development in gas-rich regions of the country. These advantages, along with the current economic favorability of natural gas, have led some states to increase rapidly their dependence on natural gas. In just five years, Florida has increased the share of its electricity generated from natural gas from 44 percent to 62 percent. Many other states, including Virginia, Delaware, Ohio, and Pennsylvania, are following a similar path.

However, these rewards must be carefully weighed against the risks associated with this rapid adoption of natural gas as the electricity sector's new fuel of choice. Central among these risks is historical and continued natural gas price volatility. Despite the shale gas surge, upward pressure on prices is likely to result from increases in demand for natural gas for electricity and other competing uses (including home heating, industrial production, and transportation), uncertainties about supply, and potentially increased exportation of U.S. natural gas. Such price volatility can harm consumers and the economy.

Smokestack emissions from natural gas combustion are significantly cleaner than from coal combustion; however, the extraction, distribution, and storage of natural gas result in the leakage of methane, a powerful global warming gas 34 times stronger than carbon dioxide at trapping heat over a 100-year period. Methane leakage diminishes the climate advantages of natural gas over coal. Furthermore, increasing our reliance on natural gas could delay the deployment of much cleaner renewable energy, putting us at greater risk of failing to meet the level of emissions needed to avoid the worst consequences of climate change (Newell and Raimi 2014; Shearer et al. 2014; EMF 2013; Fleischman, Sattler, and Clemmer 2013).

Natural gas production, particularly hydraulic fracturing, also presents serious risks to public health and the environment. These risks include potential contamination of drinking water supplies by chemicals used in hydraulic fracturing and air pollution from natural gas operations (EPA 2012a; Haluszczak et al. 2012; EPA 2011; Rowan et al. 2011).

If natural gas use continues to grow, the industry will need to invest in costly new infrastructure, including pipelines and processing and storage facilities. These investments may lock us into a high-carbon future. And, as public pressure to address climate change grows, much of this costly infrastructure will have to be abandoned, rendering it a "stranded asset." Given limited financial resources and growing climate risks, investment in renewable energy infrastructure would involve less risk to consumers and the economy as a whole.

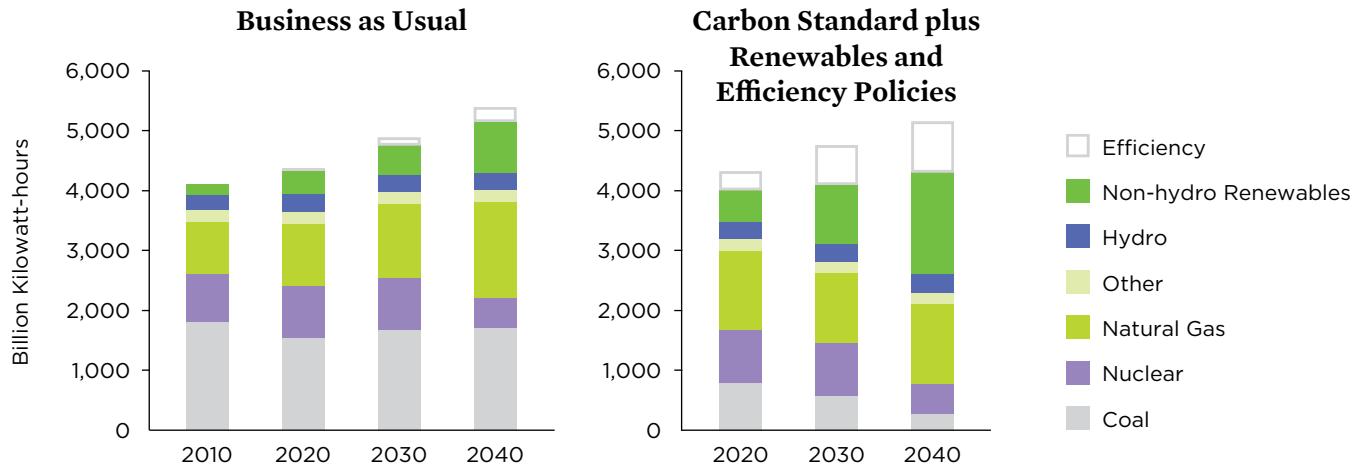
Investing in Renewable Energy and Energy Efficiency: A Better Path Forward

Using the Energy Information Administration's National Energy Modeling System, we analyzed the effects of climate and clean energy policy scenarios on the electricity sector, consumers, the economy, and carbon emissions for the period through 2040. We examined three main scenarios: the Business as Usual Scenario (the projected path of the U.S. electricity sector without changes to current policies); the Carbon Standard Scenario, which places a declining limit on carbon emissions from the U.S. electricity sector to achieve at least a 45 percent reduction from 2005 levels by 2030 and at least a 65 percent reduction by 2040; and the Carbon Standard plus Renewables and Efficiency Policies Scenario, which includes similar emissions limits as the Carbon Standard Scenario plus a suite of strengthened renewable energy and energy efficiency policies. We also separately examined the impact of different natural gas prices on the outcomes of these scenarios.

Our analysis reveals the following key findings:

- A business-as-usual electricity future would put the United States on a pathway of greater natural gas use, rising carbon emissions, and higher natural gas and electricity prices (Figure ES-1). In a Business as Usual scenario:
  - Total natural gas use is projected to increase by nearly 18 percent between 2013 and 2040, with the power sector representing the largest share of this increase at 49 percent.

FIGURE ES-1. U.S. Electricity Generation, Business as Usual, and Carbon Standard plus Renewables and Efficiency Policies Scenarios



In the Business as Usual Scenario, the United States burns more natural gas than currently, even though the contribution of non-hydro renewables increases, to meet the projected growth in electricity demand. Although coal generation is projected to decline through 2016, due primarily to low natural gas prices and retirement of some older plants, model projections show that it rebounds some in the later years of the forecast in response to rising natural gas prices and growing electricity demand. The U.S. electricity generation mix would be cleaner and more diverse if a carbon standard were combined with strong renewables and efficiency policies. In the Carbon Standard plus Renewables and Efficiency Policies Scenario, the share of non-hydro renewables grows six-fold to 39 percent of total generation by 2040, energy efficiency reduces electricity demand by 16 percent, and the share of natural gas generation remains mostly constant.

  - Power sector natural gas prices are 2.3 times higher in 2040 than in 2013, and average consumer natural gas prices nearly double.
- By replacing gas- and coal-fired generation with renewables and efficiency, the Carbon Standard plus Renewables and Efficiency Policies Scenario results in a total electricity resource mix portfolio that is 14 percent less sensitive to long-term fluctuations in fossil fuel prices.
- Implementing a carbon standard along with renewable energy and energy efficiency policies results in long-term savings on consumer energy bills as it cuts carbon emissions and raises carbon revenues. While investments in renewables and efficiency result in net costs of $19 billion in 2020, consumers would see annual net savings add up to $40 billion by 2030, rising to $59 billion by 2040.
- Increasing the share of renewable energy and energy efficiency is an important way to hedge against economic and climate risks in a future that includes uncertain natural gas prices. This strategy helps lower consumer electricity bills and carbon emissions under a range of possible future natural gas price scenarios.
- Electricity bills in 2040 are lowest in the Carbon Standard plus Renewables and Efficiency Policies Scenario with baseline and high gas price forecasts.
- In 2020, the societal benefits of pursuing carbon emissions reductions are 2.6 times greater than the consumer compliance costs, or nearly $36 billion. By 2040, the compliance costs of the Carbon Standard plus Renewables and Efficiency Policies Scenario are actually slightly lower than business as usual, primarily because of lower fuel expenses as we shift to more renewable energy and energy efficiency. As a result, the net societal benefits grow to nearly $170 billion in that year (Figure ES-2, p. 4).
- Combining a carbon standard with renewable energy and energy efficiency policies can reduce power plant carbon emissions 70 percent below 2005 levels by 2040. As part of a global effort to help limit some of the worst consequences of climate change, further reductions in U.S. power sector carbon emissions will be needed by midcentury.

An electricity sector that will burn increasing amounts of natural gas, emit more and more carbon, and contribute to higher natural gas and electricity prices is clearly unacceptable. Our analysis shows that a combination of a carbon standard with complementary renewable energy and efficiency policies can cut power plant carbon emissions significantly while reducing our long-term reliance on natural gas, lowering costs, and providing important public health benefits.

Working Toward an Appropriate, Balanced Role for Natural Gas

Our analysis indicates there is a strong need for changes in policy if we want to minimize the pitfalls of an overreliance on natural gas. Investing more heavily in renewable energy and energy efficiency can put us on a smarter, shorter, and less risky pathway toward a more affordable, reliable, and diversified electricity system that delivers not just short-term economic and environmental gains but also the long-term goal of addressing climate change.

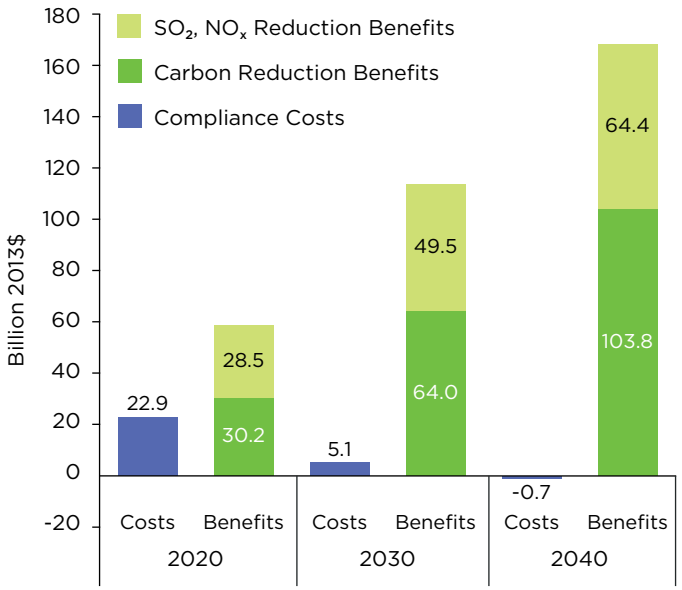
The Environmental Protection Agency's Clean Power Plan—a forthcoming federal standard designed to limit power sector carbon emissions—provides a valuable near-term opportunity for utilities, regulators, and policy makers to accelerate the transition to an electricity system powered primarily by renewable energy and energy efficiency (Cleetus et al. 2014a). States play a crucial role in ensuring the success of the Clean Power Plan and should prioritize the use of renewable energy and energy efficiency to meet as much of their emissions reduction target as possible.

Policy makers should adopt additional or strengthen existing policies to hasten the deployment of renewable energy and energy efficiency resources. Such policies should include renewable electricity standards, energy efficiency resource standards, carbon pricing programs, extended tax incentives and other financial incentives for renewable energy and energy efficiency, and deployment of combined heat and power systems.

Strong state and federal laws and regulations are also needed to limit methane emissions from natural gas operations and to address the risks to public health and safety resulting from hydraulic fracturing. We must also modernize the U.S. electric grid and the rules that govern it as we transition away from coal to a cleaner, more modern, and efficient electric system.

The choice is clear: As the nation moves away from coal, setting course toward a diverse supply of low-carbon power sources—made up primarily of renewable energy and energy efficiency with a balanced role for natural gas—is far preferable to a wholesale switch to natural gas. By making smart energy choices today, we can transition to a more consumer-friendly and diverse electricity system, achieve cost-effective CO_2 emissions reductions, and face fewer risks stemming from an overreliance on natural gas.

FIGURE ES-2. Benefits and Costs of Policies That Limit Carbon Emissions, relative to Business as Usual Scenario



Our modeled scenarios show that the benefits of transitioning to cleaner power clearly outweigh the costs. "Compliance costs" are the incremental costs of deploying a cleaner generation mix in our Carbon Standard plus Renewables and Efficiency Policies Scenario relative to costs included in our Business as Usual Scenario. "Benefits" are the monetized damages avoided by reducing emissions of carbon dioxide (CO_2), sulfur dioxide (SO_2), and nitrogen oxides (NO_x).

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