Union of Concerned Scientists

Gas Ceiling

Assessing the Climate Risks of an Overreliance on Natural Gas for Electricity

Because of Oregon's strong renewable energy policies and its abundant wind resources, this natural gas combined-cycle plant in Hermiston now operates as a balancing plant to complement the area's recent growth in wind power.

The American electricity sector is experiencing its biggest transformation in half a century. Coal-fired electric power, which has dominated the sector for decades, is now declining, with natural-gas-fired power largely replacing it. This dramatic shift from coal to natural gas, with power from non-hydro renewables such as wind and solar growing as well, has helped reduce carbon dioxide (CO_2) emissions from the U.S. electricity sector to their lowest level since 1994 (EIA 2013a).

Despite this progress, natural gas is still a fossil fuel. In addition to producing heat-trapping CO_2 emissions when combusted, natural gas emits other global warming pollutants as it is extracted and distributed. For these and other reasons, a transition from a coal- to a natural-gas-dominated electricity system would not be sufficient to meet U.S. climate goals. This report explains why, and it suggests how to avoid a dangerous overreliance on natural gas.

A transition from a coal- to a natural-gas-dominated electricity system would not be sufficient to meet U.S. climate goals.

There is an urgent need to get this right. Americans are already experiencing damaging and costly extreme-weather events including droughts, wildfires, coastal storms, flooding, and deadly heat waves that are exacerbated by human-caused climate change. Given the 30- to 60-year lifetime of most new power plants, the choices we make now will greatly influence whether the worst impacts of climate change—among them the reaching of irreversible tipping points—can be avoided. Studies by the Union of Concerned Scientists (UCS) and others show that if we remain on a path toward an ever-growing reliance on natural gas, sufficient reductions of CO_2 and other global warming emissions will be increasingly unlikely and disastrous climate impacts could be intensified.

A natural-gas-centered energy pathway would also carry significant economic, environmental, and public health risks. For example, there is a real danger it could crowd renewable energy technologies out of the electricity market. This outcome would be a major step in the wrong direction. Instead, a diversified electricity system—with amplified roles for renewable energy and energy efficiency and a modest role for natural gas—would both limit the threat of climate change and mitigate the risks of an overdependence on natural gas.

The Electricity Sector in Transition

As recently as 2007, it still looked as if the future of the U.S. electricity sector would be coal-dominated. At that time, experts projected that the sector would continue down the path of greater coal-fired generation for the next several decades, with natural gas playing a limited role (EIA 2007).

But soon thereafter the picture began to change dramatically toward more natural gas and renewable energy, and in recent years this transition has accelerated. By

Photos: © Shutterstock (flame); Flickr/Scott Butner (Oregon plant)

Figure 1. **The Shares of Natural Gas and Renewables in the U.S. Electricity Mix Are Growing**

Coal's share of U.S. electricity generation shrank from 48 percent in 2008 to 37 percent in 2012, while natural gas grew to more than 30 percent and non-hydro renewables to 5.4 percent (EIA 2013b).

early 2013, power plant owners had announced plans to retire almost 56 gigawatts (GW) of coal-fired plants—17 percent of the U.S. coal fleet—and at least another 51 GW have been identified as economically vulnerable (Cleetus et al. 2012).

Natural gas generation increased by more than 50 percent between 2008 and 2012 to replace coal, and the share of non-hydroelectric renewable energy nearly doubled over the same period—the result of state and federal renewable electricity policies and of a recent decline in the cost of wind and solar power (Figure 1) (EIA 2013b). Wind power accounted for more than 35 percent of all new capacity installed from 2008 to 2012 (AWEA 2013). Similarly, total solar capacity expanded by a factor of five from 2009 to 2012 (SEIA 2013).

Given a combination of market and policy factors, coal's dominance will continue to wane. These factors include the advanced age of many coal plants, the rising cost of coal, the need to upgrade pollution controls to protect public health, low natural gas prices, the falling cost of renewable energy, reduced growth in electricity demand, and state policies on renewable energy, efficiency, and climate.

The Climate Risks of Natural Gas

As with any fossil fuel, burning natural gas for electricity generation results in the release of CO_2 and thus contributes to global warming. When combusted in a new, efficient, combined-cycle power plant, natural gas emits approximately 800 pounds of CO_2 per megawatt-hour—some 50 to 60 percent lower than the heat-trapping emissions from a typical new coal plant (NETL 2010). Nevertheless, natural gas plants are still far less attractive from a climate standpoint than cleaner and much lower-carbon alternatives such as energy efficiency and renewable energy.

These direct smokestack pollutants are not the only global warming emissions associated with natural gas. The drilling and extraction of the fuel from wells, and its distribution in pipelines, also results in the leakage of methane—a primary component of natural gas that is 25 times stronger than carbon dioxide at trapping heat over a 100-year period (NETL 2010; Forster et al. 2007). While there is still uncertainty about the precise quantity of these so-called fugitive methane emissions, preliminary studies and field measurements range from 1 to 9 percent of total natural gas production (Tollefson 2013; Cathles et al. 2012; Howarth et al. 2012; Petron et al. 2012; Skone 2012; Weber and Clavin 2012).

A well site in Upshur County, West Virginia—sitting atop the extensive Marcellus Shale Formation—shows a hydraulic fracturing operation. The drilling and extraction of natural gas, and its distribution in pipelines, also results in the leakage of methane—a more potent heat-trapping gas than carbon dioxide.

Photo: WVSORO/www.wvsoro.org

Florida's overreliance on natural gas—for more than two-thirds of its electricity generation in 2012—makes its economy vulnerable to price spikes. The use of solar energy at the Martin Integrated Solar Combined Cycle plant located in Indiantown, Florida (which combines concentrating solar power with natural gas power generation), will help reduce this vulnerability, but the Sunshine State is still far behind the rest of the country in investing in renewables and energy efficiency (Cleetus et al. 2012).

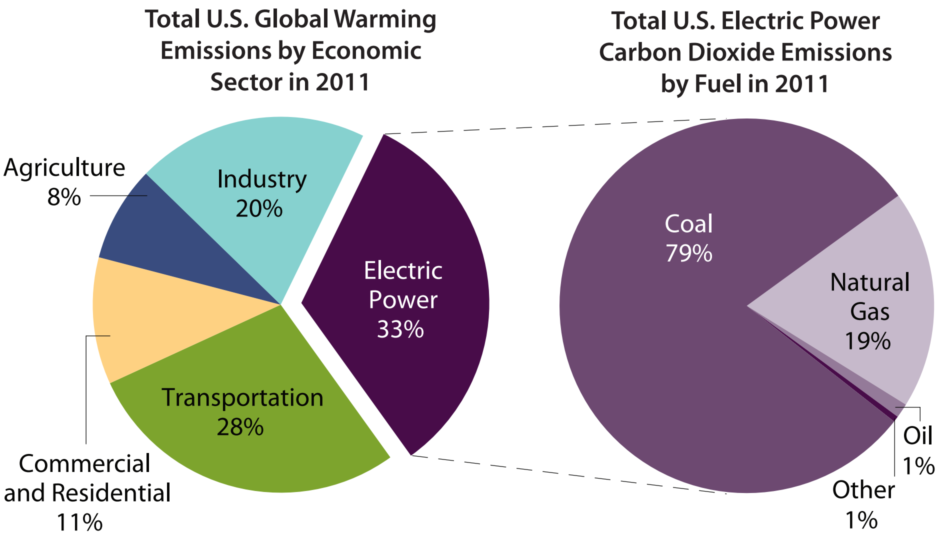
Higher levels of methane leakage reduce natural gas's climate advantages over coal while boosting the advantages that renewable energy and energy efficiency have over natural gas. Studies show that many cost-effective technologies are available to reduce much of the leaking methane, but stronger policies and regulations are needed to require the natural gas industry to deploy them (Bradbury et al. 2013; Harvey, Gowrishankar, and Singer 2012; IEA 2012b).

The Electricity Sector's Key Role in Reducing Global Warming Emissions

The electric power sector is the largest contributor to U.S. global warming emissions, accounting for one-third of total emissions in 2011 (Figure 2). While coal plants were responsible for almost 80 percent of electric sector CO_2 emissions in 2011, the share of emissions from natural gas is growing rapidly, rising from 15 percent in 2008 to 19 percent in 2011 and up to 24 percent in 2012 (EIA 2013c; EPA 2013).

We reviewed the findings of four recent analyses—studies by the U.S. Energy Information Administration (EIA), International Energy Agency (IEA), National Renewable Energy Laboratory (NREL), and UCS—that examined long-term effects on the U.S. power sector under various energy pathways (EIA 2013a; Rogers et al. 2013; IEA 2012a; NREL 2012). Each of these studies found that under current energy laws and regulations, U.S. natural gas generation would continue to increase over the next several decades—as much as tripling by 2050—to keep up

Figure 2. **The Electric Power Sector Is the Largest Source of Global Warming Emissions, and Coal Accounts for Most of the Sector's Share**



On the left, the electric power sector accounted for one-third of U.S. global warming emissions in 2011, according to the EPA. This does not include methane emissions from natural gas extraction and distribution, which accounted for 13 percent of industrial emissions in 2011, or 3 percent of total emissions. On the right, coal represented nearly 80 percent of combustion-related CO_2 emissions in the electric power sector in 2011 (EIA 2013c; EPA 2013).

Photo: NYTimes

Other Risks of Natural Gas Use

A significant increase in the nation's dependence on natural gas would pose many risks beyond climate change. The process of natural gas production, from exploration to the drilling of a well to the transportation of the fuel to its destination, involves a range of major environmental, economic, and social challenges.

Environmental and Public Health Risks

The production of natural gas, particularly the practice of hydraulic fracturing, or "fracking"—which has greatly augmented supplies from shale and other deposits—has several environmental and public health risks. They include the largely unknown composition of fracking fluid, the disposal and fate of waste fluid, industrialization of rural landscapes, increased traffic and air pollution, and the impacts of mining the sand needed for fracking. These impacts raise questions of environmental justice for disadvantaged communities in areas where fracking is occurring and where the resultant natural gas is processed.

Fracking also requires a tremendous amount of water. The U.S. Environmental Protection Agency (EPA) estimates that 70 billion to 140 billion gallons of water were used in 2011 for fracking an estimated 35,000 wells (EPA 2012b). A single well can require 3 million to 12 million gallons of water when it is first drilled (Breitling Oil and Gas 2012; NETL 2009). Conflicts between fracking and other water uses could pose potential risks, particularly when water supplies are tight.

Aside from water quantity, there is also the issue of quality. Between 15,000 and 60,000 gallons of chemicals are mixed with the water used in each fracking well, thereby potentially contaminating water supplies. A comprehensive EPA study of the potential impacts of fracking in drinking water identified a number of toxic chemicals including benzene, lead, and methanol in fracking fluids. In addition, the shale or rock formation itself is permeated with water that commonly includes dissolved solids, salts, metal ions, radioactive compounds, and other substances naturally occurring deep underground (EPA 2012b). Some of this water, known as "produced water," is released during the processes of drilling and hydraulic fracturing, and it continues being pumped to the surface as long as the well is producing oil and gas—a period of years or even decades. Thus, both drilling wastewater and produced water can be highly saline, toxic, or radioactive (Haluszczak et al. 2012; Rowan et al. 2011).*

The process of natural gas production involves a range of major environmental, economic, and social challenges.

Economic Risks

Volatile prices, potential shortages, and other economic costs add another dimension of risk to the expanded use of natural gas. Between 2000 and 2008, nearly 260 GW of new natural gas generating capacity were added in the United States, resulting in a 28 percent increase in natural gas use in the electricity sector (EIA 2013b). This increase contributed to wide fluctuations in the price of natural gas, with a high of \$10.79 in July 2008 and a low of \$1.89 in April 2012 (EIA 2013d). Utilities have responded to low prices over the past few years by investing in more natural gas power plants and ramping up existing ones. But many experts believe that these low natural gas prices are not sustainable over the long term. In fact, projections of the EIA show that prices are expected to rise 194 percent from 2012 levels by 2040 (Figure 3) (EIA 2013a).

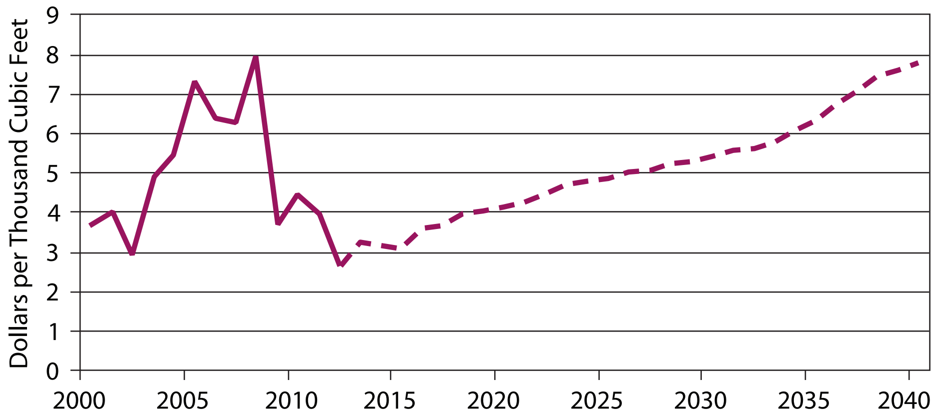
Uncertainties in the size of available supplies, combined with potential increases in natural gas demand for electricity and other uses such as home heating, industrial production, and transportation, could put pressure on prices. For example, during the winter of 2012–2013, cold temperatures in New England heightened demand for natural gas for home heating and put a strain on the region's electricity supply (Wald 2013). Such competing demands would only increase if natural gas use expanded in the electricity sector.

Added to these demand pressures, there is a growing desire in the gas industry to export natural gas from the United States to other parts of the world where prices are higher (Colman 2013; EIA 2013a). There is some debate over the actual impact that such exports would have on domestic natural gas prices (NERA 2012). However, it is clear that natural gas exports would be one more force in pushing prices upward.

All these factors suggest that doubling down on natural gas for electricity generation is not a wise long-term investment, because many of the natural gas plants would become less competitive as natural gas prices rise. Meanwhile, these plants' higher operating costs would be passed along to consumers in the form of rate increases (Banks and Taraska 2013).

* For an in-depth analysis of the state of the science, regulations, and publicly available information on hydraulic fracturing, refer to *www.ucsusa.org/HFreport*.

Figure 3. **U.S. Natural Gas Prices Are Projected to Increase** (Average Wellhead Price)



The EIA projects that natural gas prices will rise between now and 2040. The steady increase in the projection, however, does not capture natural gas price volatility, which may be significant (EIA 2013b, c).

with increasing electricity demand and to replace lost generation from retiring coal and nuclear plants (Figure 4).

Moreover, these four studies show that greater use of natural gas for generating electricity could contribute to that sector's overall increase in carbon dioxide emissions. Because of the continued dominance of fossil fuels and rising demand, emissions through 2050 would be 5 to 25 percent higher than today's levels (Rogers et al. 2013; IEA 2012a; NREL 2012). The EIA similarly projects that electricity-related CO_2 emissions would rise 12 percent above 2012 levels by 2040 (Figure 5, p. 6) (EIA 2013a).

Achieving a Low-Carbon Electricity Future

An electricity future with greater natural gas use and increasing carbon emissions is clearly the wrong path for the United States. To limit some of the worst consequences of climate change, the National Research Council (NRC) recommended an economy-wide carbon budget for the United States of 170 billion metric tons of cumulative carbon dioxide equivalent (CO_2eq) emissions from 2012 to 2050 (NRC 2010). This budget would cut power sector carbon 90 percent from current levels by 2050, with most of the reductions in the first 20 years, as part of an economy-wide emissions reduction goal of greater than 80 percent by 2050.

Government and academic researchers analyzed the NRC's carbon budget and calculated the electricity sector's contribution to the targeted reduction in economy-wide emissions (Figure 5) (Fawcett et al. 2009). Considering cost and available

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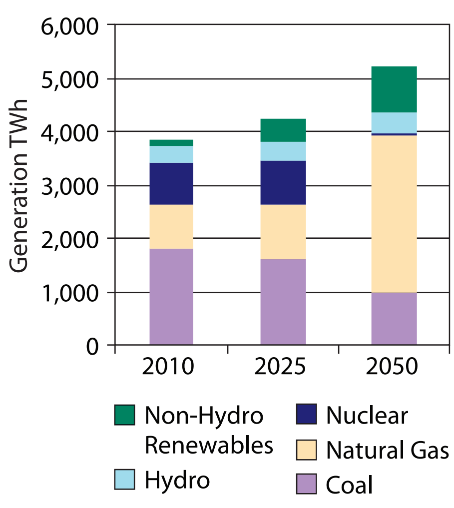
Figure 4. **Natural Gas Generation Projected to Increase Significantly by 2050**

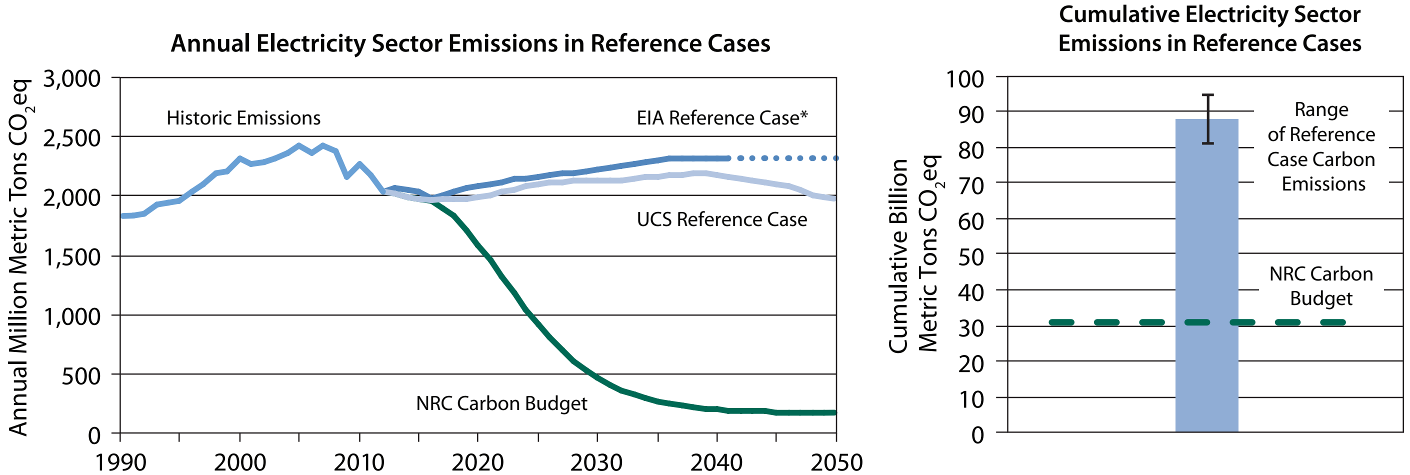


Natural gas generation grows, in the UCS reference case, to nearly two-thirds of the U.S. electricity mix by 2050 (Rogers et al. 2013).

Standards designed to increase the energy efficiency of home appliances and electronics help consumers save money on electricity bills by reducing energy demand. Efficient Energy Star televisions use 25 percent less power than conventional models, saving the consumer more than $200 over the life of the product in electricity bills (EnergyStar 2013).

Photo: © Thinkstock

Figure 5. **Emissions in the Reference Case Far Exceed the Carbon Budget**



On the left, annual U.S. electricity sector CO_2 emissions, as projected both in the EIA's Annual Energy Outlook 2013 and UCS reference cases, far exceed the NRC carbon budget for the electricity sector. On the right, the cumulative emissions from 2012 to 2050 for four reference case scenarios all exceed the carbon budget (EIA 2013a; Rogers et al. 2013; NREL 2012; IEA 2011; Fawcett et al. 2009).

* Because the EIA reference case is projected through 2040, we show constant emissions for 2040–2050.

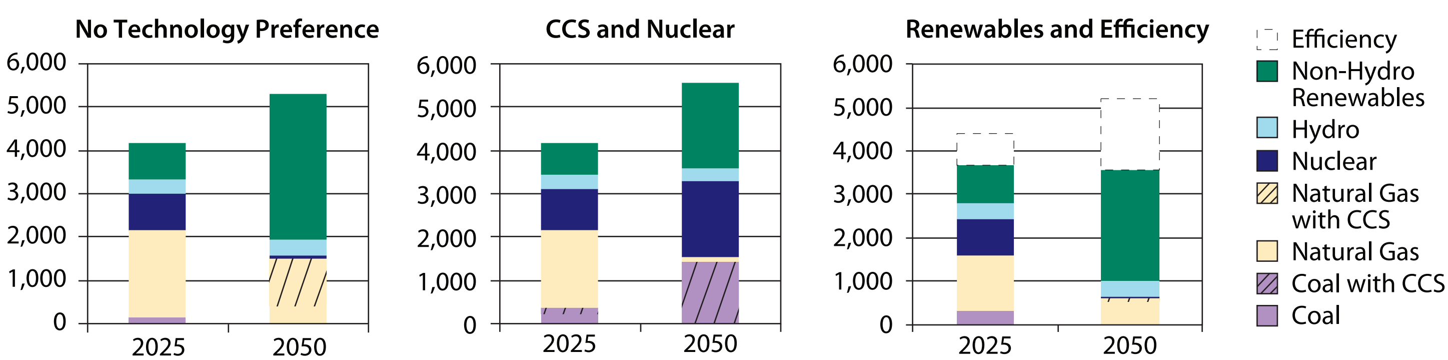
technologies, they concluded that emissions reductions in the electricity sector would account for more than three-quarters of total reductions between 2010 and 2050.

As noted earlier, the electric power sector offers the lowest-cost near-term opportunities for cutting carbon emissions, given the range of low- or no-carbon energy generation technologies currently available (Cleetus, Clemmer, and Friedman 2009; EIA 2009; EPA 2009; Fawcett et al. 2009). The 2013 UCS report *Water-Smart Power* showed that the United States could significantly reduce carbon emissions while maintaining a reliable, affordable, and much cleaner electricity system. The study examined a reference scenario and three possible energy pathways that meet the NRC's carbon budget:

- ***No technology preference:*** A pathway that lets the model choose which electricity generation technologies are the most cost-effective in meeting the carbon budget.
- ***Nuclear and CCS:*** A pathway that assumes large-scale deployments of coal with carbon capture and storage (CCS) and new nuclear power plants after 2020, reaching two-thirds of U.S. electricity generation by 2050.
- ***Renewables and efficiency:*** A pathway that assumes increased energy efficiency in buildings and industry would reduce U.S. electricity use by about 1 percent per year on average, and that the share of renewable energy would steadily increase to 80 percent of U.S. electricity generation by 2050.

The 2013 UCS study found that because of coal's high carbon emissions, almost all existing coal generation (without CCS)

Figure 6. **Different Pathways for the U.S. Electricity Mix to Reach the NRC Carbon Budget**



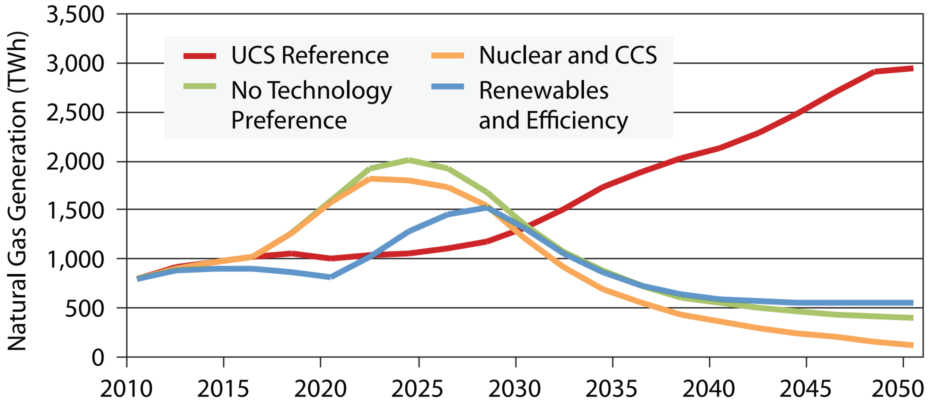
UCS modeled three possible electricity pathways for the United States to meet the NRC carbon budget. The No Technology Preference pathway leads to high levels of renewables; natural gas with CCS plays a modest role. The Renewables and Efficiency pathway leads to the lowest consumer electricity bills (Clemmer et al. 2013). Natural gas plays a more limited long-term role in all three pathways compared with the Reference Case.

is retired by 2030 under each of the pathways (Figure 6). It also found that while natural gas can play an intermediate role in temporarily replacing some of the decline in coal generation, its use must be scaled back considerably over the long term in order to meet climate goals (Figure 7).

For example, under the No Technology Preference pathway and the Nuclear and CCS pathway, natural gas generation increases significantly through 2025 to replace a large share of the generation from retiring conventional coal facilities, but natural gas then steadily declines through 2050. In comparison, much less natural gas generation is needed to meet electricity demand through 2026 under the Renewables and Efficiency pathway. In fact, natural gas generation is slightly below the Reference Case through 2020 before rising to its peak in 2028 under this pathway. Gas generation then steadily declines through 2050, on a trajectory similar to those of the other two pathways (Figure 7).

In addition to relying less on natural gas, the Renewables and Efficiency pathway has the lowest cost. Under this pathway, consumer electricity bills by 2050 are one-third lower than the Reference Case, as reductions in electricity use from energy efficiency more than offset the costs of investing in renewable energy technologies. In contrast, the Nuclear and CCS pathway is the most expensive, resulting in a 20 percent increase in consumer electricity bills by 2050 compared with the Reference Case.

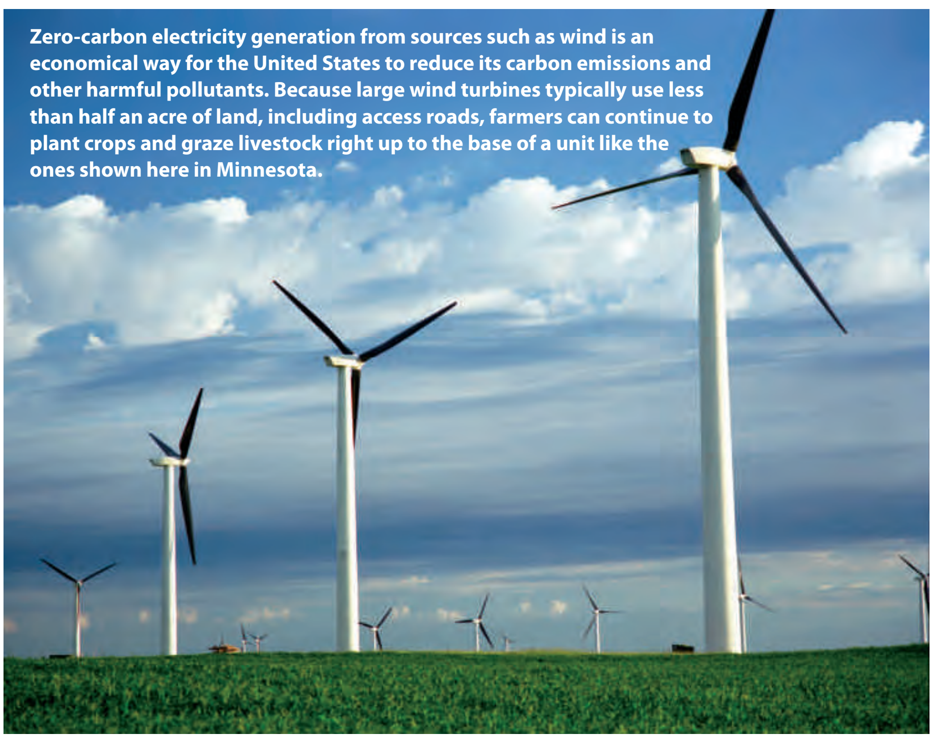
Figure 7. **In Carbon Budget Scenarios, Natural Gas Generation Grows in Short Term but Declines Overall**



A 2013 UCS study found that while natural gas generation could increase in the near term under a low-carbon electricity future, it plays a smaller role over the long term if emissions reduction targets necessary to limit the worst consequences of climate change are to be met. The study also found that the Renewables and Efficiency pathway could save consumers money while greatly reducing the risks of a potential overreliance on natural gas (Rogers et al. 2013).

Complementing the UCS analysis, the IEA and NREL studies also show that conventional natural gas is likely to play a limited role under a truly low-carbon electricity system:

- The IEA's *Golden Age of Gas* study made a number of policy and market assumptions that led to an increased global use of natural gas. These assumptions resulted in CO_2 emissions that were considerably higher than the NRC carbon budget, causing a long-term global average temperature increase of more than 3.5° Celsius (6° F) above pre-industrial levels—a level of warming associated with a high risk of catastrophic environmental and economic consequences (IEA 2011).
- In a more recent study, the IEA examined a scenario that assumed a global average temperature increase limited to 2° Celsius above pre-industrial levels, with electric power sector CO_2 emissions cut in half through heavy use of nuclear power generation and CCS, both at coal and



Zero-carbon electricity generation from sources such as wind is an economical way for the United States to reduce its carbon emissions and other harmful pollutants. Because large wind turbines typically use less than half an acre of land, including access roads, farmers can continue to plant crops and graze livestock right up to the base of a unit like the ones shown here in Minnesota.

Photo: © NREL

Benefits of Expanded Renewable Energy and Energy Efficiency

Investments in renewables and efficiency will put us on a cleaner and more stable track to meeting our global warming emissions reduction targets, compared with a track centered on natural gas. An economy with high levels of renewables and efficiency will also have a number of additional environmental and economic benefits.

Renewable energy is much friendlier to the environment than coal or natural gas. While natural gas emits lower amounts of air and water pollutants than coal, renewable wind and solar power emit none of these toxic chemicals (Machol and Rizk 2013).

Renewable energy sources also offer several economic advantages. On average, they are more labor-intensive than fossil fuel power plants. Therefore more jobs are created per unit of electricity generated from renewable sources than from fossil fuels (UCS 2009). Because they do not rely on fuels that are subject to price spikes or long-term price increases, renewables also add price stability for consumers. That is, an increased reliance on renewable energy and energy efficiency can provide a hedge that protects consumers from rising natural gas prices (Bolinger 2013; UCS 2009).

Finally, just as diversifying investments strengthens a financial portfolio, a diverse mix of clean energy sources and technologies in the electricity grid can fortify *its* "portfolio"—improving reliability in the process. Renewable resources are less vulnerable to prolonged interruptions in fuel supplies (stemming, say, from extreme weather), transportation problems, safety concerns, or security threats. And because renewable energy technologies are more modular than conventional power plants, the impact on the grid is usually insignificant when individual facilities experience outages.

natural gas plants. The IEA found that conventional natural gas generation (without CCS) increases in the near term but then, beginning in 2030, must heavily switch over to CCS technology in order to meet the study's emissions target (IEA 2012a).

- NREL's *Renewable Electricity Futures* study showed that renewable energy technologies available today could reliably supply 80 percent of U.S. electricity and cut carbon emissions nearly 80 percent by 2050 (NREL 2012). The NREL study found that, to meet its high renewables target, natural gas generation must steadily decline to 2.5 percent of total generation by 2050.
- Other studies have also shown that we can both reduce carbon emissions and lower electricity bills by deploying energy efficiency and renewable energy, given the right policies and incentives (EPRI 2010; Cleetus, Clemmer, and Friedman 2009; EIA 2009).

An Appropriate Role for Natural Gas

While simply replacing coal with natural gas in the electricity sector would not be an effective long-term climate strategy, natural gas does offer some important advantages in the near to intermediate term. With sufficient regulatory oversight, the fuel could play a modest though useful role in a clean energy future. For example, burning natural gas instead of coal results in a number of immediate public health and environmental benefits. Natural gas emits much lower amounts of soot and smog-forming pollutants, including nitrogen oxides, sulfur dioxide, and fine particulates, which contribute to asthma and a variety of other lung, and heart, conditions. Also, unlike coal, natural-gas-fired generation does not emit appreciable levels of mercury, arsenic, and other toxic substances that can cause adverse neurological effects in children and other health problems (EPA

Photo: © iStockphoto.com/Elenathewise

A natural gas combined-heat-and-power plant can provide heating, cooling, and electricity at up to twice the efficiency of the most advanced plant that only generates electricity, while reducing carbon emissions.

The EPA should finalize and implement strong standards for carbon dioxide and other harmful emissions from new and existing power plants, while ensuring that renewable energy and energy efficiency can be used for compliance.

2012a; CATF 2010; EPA 2010; Gentner and Bur 2010; NRC 2010; Trasande, Landrigan, and Schechter 2005).

In addition, natural gas could help complement renewable energy technologies within a diverse electricity system. Because natural gas generators can be ramped up and down quickly, they could support the integration of variable renewable resources (i.e., wind and solar photovoltaic) and contribute to a reliable electricity supply by providing the grid with greater flexibility (NREL 2012).

Given their quick ramping ability, natural gas generators will likely remain important as peaking power plants. Such plants are only used in times of extremely high electricity demand, such as during summer heat waves, and are relatively inexpensive to build.

Combined-heat-and-power plants, which produce both electricity and heat using natural gas as a fuel source, could play a role in a low-carbon electricity mix as well. These plants can reach efficiencies of up to 80 percent—twice as high as even the most efficient natural gas technology that generates only electricity (ORNL 2008).

Finally, the development of natural gas generators with CCS technology offers a potential way to expand the use of this fuel while still meeting global warming emissions reduction targets, as shown in the UCS and IEA studies above. However, adding carbon capture equipment to existing power plants or building new power plants with carbon capture technology is costly and greatly reduces plant efficiency. Moreover, the long-term viability of geologic carbon sequestration is uncertain and risky (Freese, Clemmer, and Nogee 2008). Retrofitting natural gas power plants with CCS would help reduce carbon emissions but would need to be accompanied by stronger state and federal policies to deal with methane leakage issues and other environmental risks posed by natural gas extraction and conveyance.

Recommendations

The U.S. electricity sector is in a state of flux as power companies retire old and inefficient coal power plants and the federal government develops much-needed standards to limit emissions of carbon and other pollutants. Because the choices we make now will determine our energy path for the next 40 to 50 years and beyond, the current shift from coal presents a tremendous opportunity to make smart decisions in securing a climate-friendly energy future.

It is critical that we build a diversified electricity system to meet both our short-term goal of minimizing economic and environmental risk and our long-term goal of climate change mitigation. As part of that effort, the United States should invest heavily in energy efficiency and increase renewable energy generation's share of the total power supply to 25 percent by 2025 and 80 percent by 2050 (Rogers et al. 2013; NREL 2012). In order to meet these goals we need to:

- **Enact strong federal standards for power plants.** The EPA should finalize and implement strong standards for carbon dioxide and other harmful emissions from new and existing power plants, while ensuring that renewable energy and energy efficiency can be used for compliance.
- **Adopt strong state and federal clean energy policies.** Policy makers at all levels of government should adopt

Lawmakers and regulators have many opportunities to make smart decisions to reduce the climate (and other) risks of using natural gas, while building a diversified and climate-friendly electricity system.

policies and programs such as renewable electricity standards, energy efficiency resource standards, tax incentives, and financing mechanisms to ensure the timely expansion of renewables and efficiency.

- **Strengthen regulations for natural gas hydraulic fracturing.** Strong state and federal laws and regulations are needed for monitoring, evaluating, and mitigating this process's potential risk factors related to public health and safety, as well as its broader climate, environmental, economic, and social impacts.
- **Improve resource planning by regional grid operators and utilities.** As old and inefficient coal plants are retired over the next decade, utilities and electricity regulators should incorporate the risks of an overreliance on natural gas into their long-term planning decisions.
- **Create a level playing field for all low-carbon technologies.** To ensure that zero-carbon and near-zero-carbon resources can compete fairly with natural gas and other fossil fuels, the United States should set limits designed to reduce heat-trapping emissions at least 80 percent below 2005 levels by 2050. The federal government should also put a price on carbon and require the natural gas industry to deploy technologies and practices that significantly reduce methane losses from natural gas drilling and pipelines. In addition, both the federal government and industry should increase research and development funding for low-carbon technologies such as renewable energy, energy efficiency, and carbon capture and storage.

As coal plants are retired over the next decade, utilities and electricity regulators should incorporate the risks of an overreliance on natural gas into their long-term planning decisions.

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