

## Post-Election Prospects for Natural-Gas-Fired Generation

*The extraordinary growth of gas-fired generation during President Obama's first term has upended power markets across the country. But how will gas-fired power fare during the next four years? And how much will the outcome be impacted by the federal energy and environmental policies that the Administration and Congress can shape? This essay provides some preliminary answers to these questions.*

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*"The Stone Age did not end because we ran out of stones; we transitioned to better solutions."*

– DOE Secretary Steven Chu's resignation remarks, Feb. 1, 2012

The extraordinary growth of gas-fired generation during President Obama's first term has upended power markets across the country. And the impact has not only been felt by aging coal-fired generators. As the *Wall Street Journal's* Rebecca Smith wrote in January 2013: "today, U.S. utilities are encountering something they never expected: Some natural-gas-fired power plants are cheaper to

run than nuclear units," which once promised virtually unlimited "free electricity."<sup>1</sup>

But how will gas-fired power fare during the next four years? And how much will the outcome be impacted by the federal energy and environmental policies that the Administration and Congress can shape?

This essay provides some preliminary answers to these questions. We start, however, with a brief disclaimer: while some contend that the recent gains for gas-fired electricity are a consequence of an alleged

“War on Coal” by the President, we do not see it that way. Instead, it is our view that a confluence of factors lies behind the rise of clean generation, which includes gas-fired power alongside renewables.

The key economic, technological, and regulatory trends began to reach a critical stage circa 2008. It was then that hydraulic fracturing technologies began unlocking vast quantities of natural gas from shale rocks. In 2008, consumer behavior and electricity demand also changed due to a deep recession, drastically reducing the demand for coal-fired and other sources of power. But as the economy began to recover, and electricity demand picked up – especially from industrials – natural gas was ready. Meanwhile, federal regulators were also getting ready to make the electricity sector reduce their harmful air and water pollution.

The net results have been striking. In 2007, coal produced about 49 percent of the country’s electricity, compared to 21.5 percent for natural gas and 2.5 percent for wind, solar, and other non-hydro renewable resources.<sup>2</sup> Through November 2012, coal’s share of generation slipped to 37 percent, while natural gas’ contribution surged to 31 percent and non-hydro renewables produced 5 percent of the nation’s electricity.<sup>3</sup> The latter statistic reflects steadily falling installed costs for residential and commercial solar PV systems<sup>4</sup>; costs for wind turbines are also declining.<sup>5</sup>

The benefits of this power switch to the nation’s economy and environment are profound. As budgets – from the federal and state levels down to households – felt the pinch of the prolonged economic recession, natural gas provided industries and ratepayers with much needed relief by putting downward pressure on electricity prices. During 2012, wholesale electricity prices in New England fell by

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nearly 23 percent to their lowest levels since 2003, in part because of low natural gas prices.<sup>6</sup> Wholesale prices in New York for 2012 were the cheapest in the 12-year history of the state’s competitive electricity market.<sup>7</sup>

On the environmental side, emissions of acid rain causing sulfur dioxide, harmful air toxics like mercury, and other air pollutants are decreasing as natural gas displaces coal electricity generation. In the first quarter of 2012, U.S. energy related CO<sub>2</sub> emissions were the lowest since 1992.<sup>8</sup>

But again, what happens now that last year’s elections are

settled? Will the underlying market trends continue to build natural gas’ share of electricity at the expense of coal power plants, or will political and regulatory factors play a larger role shaping the nation’s electric sector?

In our opinion, natural gas will continue to play a prominent role and the market share gains experienced during President Barack Obama’s first term will stabilize. Natural gas’ role could also increase further, especially given the devastating effects of Superstorm Sandy in 2012 and subsequent calls for action on climate change.

The opportunity for increased gains, however, will likely require the government to play a more pro-active role and for the Administration to press ahead with carbon rules for the power sector. Otherwise, the growth we have seen in recent years from gas-fired electricity – and the large associated public health, climate and ratepayer benefits – may stall, curtailing the potential payoff from the country’s unparalleled natural gas resources.

## I. Current Economic Drivers

### A. Fuel prices

In 2012, natural gas prices hit decade lows, which made natural gas power plants cheaper to operate than their coal-fired counterparts. This led system operators to dispatch natural gas-

fired power plants more often, and at the expense of coal (and some nuclear) power plants. As mentioned previously, the low gas prices also reduced power prices, which in turn reduced operating margins for coal-fired generators in competitive markets like PJM and ISO-NE.

When natural gas prices fall below about \$5/MMBtu, efficient natural gas combined-cycle power plants begin displacing inefficient coal plants – particularly those using higher-cost eastern coals – in the dispatch order (Figure 1). At around \$2.50/MMBtu, natural gas combined cycles begin to dispatch before power plants consuming some of the nation's cheapest coal from the Powder River Basin.

With natural gas prices in 2012 falling below \$2/MMBtu, it is no wonder that utilization of gas-fired facilities increased while coal capacity factors plummeted.

The challenging operating environment forced some owners of coal-fired capacity to shutter their facilities.

The outlook for natural gas is for continued abundant supplies and affordable prices, which will continue to favor gas-fired generation. The Energy Information Administration's latest *Annual Energy Outlook* forecasts sub-\$5/MMBtu gas through 2020.<sup>9</sup> That is likely to stabilize natural gas' share of electricity generation near current levels, wholly apart from any new federal policy initiatives.

### B. Long-term levelized costs

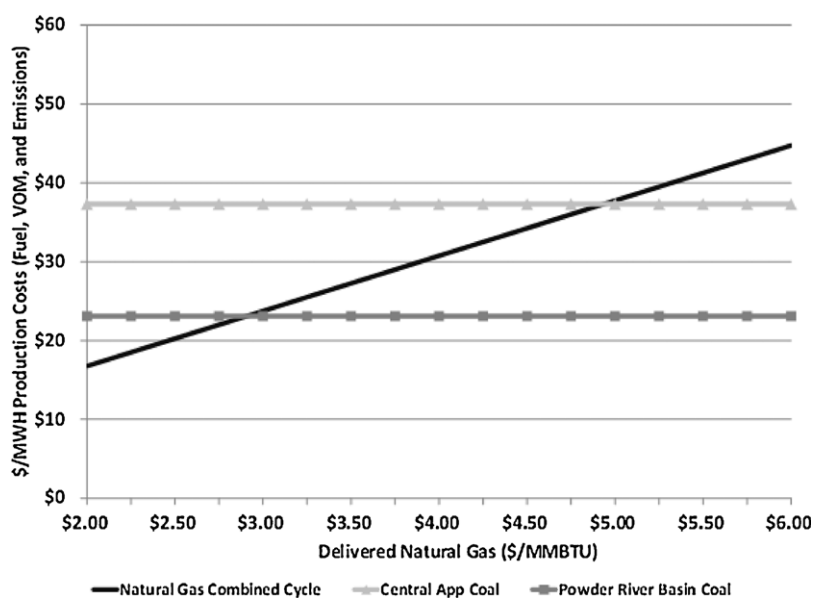
Our levelized cost analysis also shows that natural gas plants and wind power are the cheapest forms of new generation (Figure 2). This analysis accounts for capital costs for construction,

fixed operations, and maintenance expenses, as well as variable operational costs – such as fuel, emissions costs, and variable O&M – over the life of the asset. Thus, it is no surprise that wind and natural gas dominated the new builds nationwide in 2012. Over 8,700 MW of new natural gas capacity was added last year.<sup>10</sup>

And while natural gas additions lagged new wind installations by about 2,000 MW, wind does not receive full capacity credit for reserve margin purposes due to its intermittency. Therefore, if system operators need to replace large quantities of capacity due to coal retirements, natural gas plants will likely make up the majority of the replacement capacity.

### C. A paradigm shift

The evolving mix of sources used to generate electricity, especially the large growth of intermittent renewable sources, is creating a paradigm shift in the U.S. As more wind and solar are added to the grid, a greater emphasis must be placed on flexible generation such as natural gas, to back up these renewable resources.<sup>11</sup> System operators will need more flexible units that can ramp up and down quickly to preserve grid reliability when the wind stops blowing or clouds roll over solar arrays. Most legacy baseload resources (nuclear and coal) are not as adept in managing these emerging fluctuations in demand and generation.



**Figure 1:** Break-Even Power Plant Production Costs for Natural Gas-Fired Units at Various Delivered Fuel Prices Compared to Coal-Fired Units

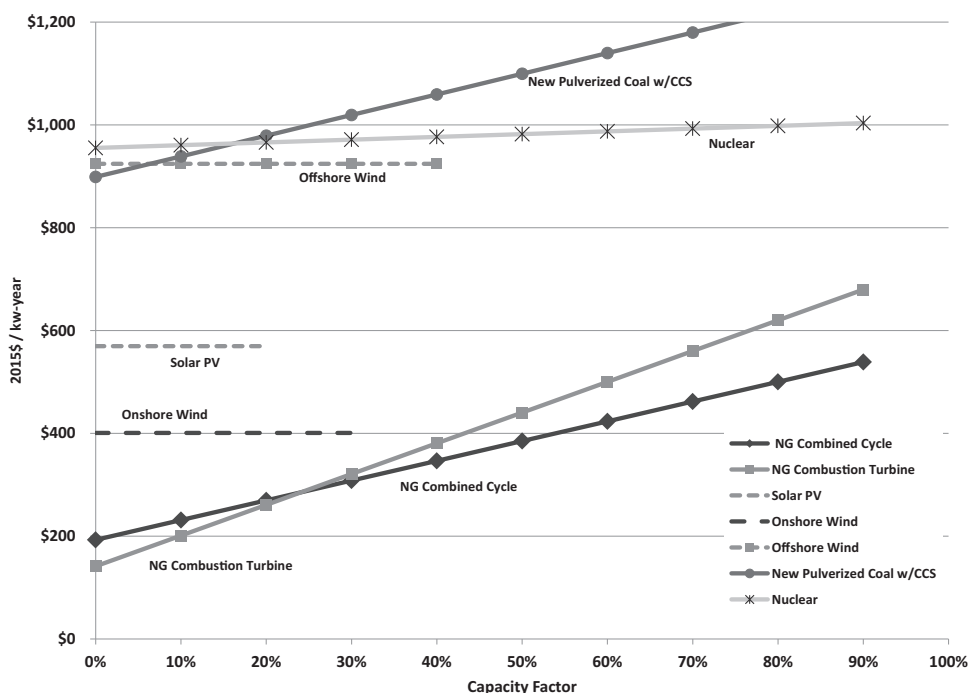


Figure 2: Levelized Cost for New Power Plants

## II. Environmental Drivers

Further growth of gas-fired power may also be helped by new environmental policies. Natural gas-fired generation results in lower emissions of dangerous pollutants targeted by major federal environmental statutes such as the Clean Air Act (CAA) and the Clean Water Act (CWA). Compared to coal power plants, gas-fired generators emit no mercury, de minimis amounts of sulfur dioxide (SO<sub>2</sub>) or particulate matter, create less haze, and emit approximately half the amount of carbon dioxide (CO<sub>2</sub>).<sup>12,13</sup> Gas-fired power plants also use far less water and do not leave harmful waste products in significant volumes, such as coal ash.

Not surprisingly, therefore, natural gas has long been recognized as a technology that

can be readily deployed to replace inefficient old high-polluting coal plants. However, during President Obama's first term, the merits of gas-fired power as an environmental compliance option won much greater attention in the face of new efforts by the Environmental Protection Agency (EPA) to further reduce power plant pollution.

While the White House deferred some proposed actions (e.g., tighter ozone national ambient air quality standards), and the courts rejected EPA's revised plans to curtail cross-state transport of SO<sub>2</sub> and other pollutants, the Administration seems likely to move ahead on a variety of fronts including stricter rules concerning water use (e.g., for power plant cooling) and solid waste disposal (e.g., regarding coal ash). These standards will

also favor gas-fired power over coal.

In addition, the agency is expected to finalize its proposed rules for limiting greenhouse gases (GHGs) from new power plants and it will be under considerable pressure to adopt limits on such emissions from existing plants. All such measures would advantage lower carbon sources of generation, such as natural gas.

We turn now to a fuller review of several relevant EPA power plant initiatives.

### A. Mercury and air toxics standards

After an extensive multi-year proceeding, in December 2011, the EPA issued Mercury and Air Toxics Standards (MATS) for major electric generating units – the first nationwide limits on

power plant emissions of mercury and other hazardous air pollutants, such as arsenic, acid gas, nickel, selenium, and cyanide. These new standards, together with the agency's revised Cross-State Air Pollution Rule, discussed below, constituted the most significant steps to clean up pollution from power plant smokestacks since the Acid Rain Program of the 1990s.

Combined, the EPA estimated that its new rules would prevent up to 46,000 premature deaths, 540,000 asthma attacks among children, 24,500 emergency room visits and hospital admissions, resulting in up to \$380 billion in annual benefits.<sup>14</sup> The new MATS primarily impacts those coal-fired power plants – roughly 40–45 percent of existing generators – which have yet to deploy sufficient pollution control technologies (e.g., baghouses, scrubbers, activated carbon injection, etc.). In comparison, the emissions from gas-fired power plants are not implicated by the MATS, and can serve as important compliance alternatives to preserve system reliability and affordable service.

### B. Cross-state pollution

Under the CAA, upwind states must prevent power plants within their borders from emitting certain kinds of pollution that travel across state lines and contribute significantly to a downwind state's "nonattainment" of the EPA's

national ambient air quality standards (NAAQS).

In August 2011, EPA published a new regime called the Cross-State Air Pollution Rule (CSAPR) to replace the EPA's 2005 Clean Air Interstate Rule, which was struck down by the courts. CSAPR applies to 28 upwind states and curtails power plant emissions that contribute to ozone or fine particle pollution in other states by primarily reducing

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annual SO<sub>2</sub> and NO<sub>x</sub> emissions. Given the cleaner emissions profile of natural gas units, CSAPR would have spurred greater use of natural gas electricity as system operators reshuffled their dispatch orders to meet emissions caps.

In August 2012, however, a federal appellate court again voided the EPA's cross-state rule. This time the court said that the agency exceeded its authority because, in order to meet the NAAQS in certain downwind states, the EPA had required some states to reduce their pollution beyond that which they actual contributed to a downwind state's

nonattainment. The Court also said the EPA had not allowed states the initial opportunity to implement the required reductions with respect to sources within their borders, but rather had simultaneously issued its own plans to implement those obligations at the state level.

The EPA later asked the court to reconsider its decision, but the request was denied.<sup>15</sup>

### C. Regional haze

Under the CAA, states must initially submit State Implementation Plans (SIP) to EPA for meeting defined NAAQS. Among other things, these plans must address pollution that causes visibility impairment over a wide geographic area – known as regional haze – and must ensure that in-state emission plans do not interfere with measures required by another state's SIP. EPA has an obligation to create a federal implementation plan (FIP) when a SIP is deemed inadequate.

Power plants that were to participate in CSAPR's trading program were allowed to use that program to meet regional haze requirements. But since the court vacated CSAPR there is regulatory uncertainty surrounding those power plants. Will they be required to install best available retrofit technology (BART) for compliance? No matter how it shakes out, natural gas power plants will likely gain from either reduced generation from the affected coal plants or their retirement.

In December 2011, in a closely watched Oklahoma case, after finding the state's own SIP plan did not protect downwind states, the EPA adopted a FIP requiring Oklahoma's dirtiest and oldest coal-fired power plants to reduce harmful air pollution by 95 percent within five years. The EPA said this could be done by switching to natural gas or by retrofitting the six units with dry flue gas desulfurization technology, commonly known as "SO<sub>2</sub> scrubbers."

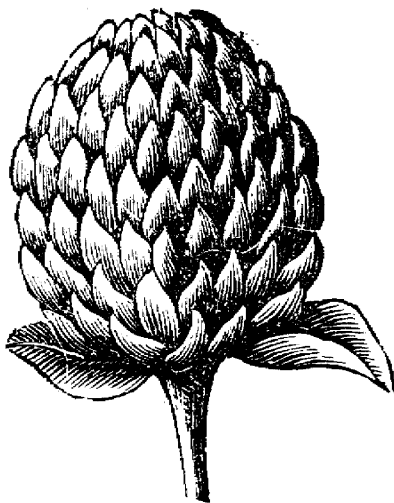
The benefits of fuel-switching – by either repowering with gas or replacing coal plants with gas-fired facilities – have also been recognized by Obama's EPA in connection with other state plans, such as Colorado's. The EPA recently approved Colorado's plan to reduce regional haze based on the states' Clean Air-Clean Jobs Act,<sup>16</sup> which called for the retirement of some coal generation while building more gas-fired facilities and renewables.

#### D. Greenhouse gas emissions

After languishing during much of President Obama's first-term, climate change and greenhouse gas emissions reductions moved back to the forefront during the election season following the devastating effects of Superstorm Sandy. As the President said in his second inaugural speech: "[w]e will respond to the threat of climate change, knowing that the failure to do so would betray our

children and future generations."<sup>17</sup>

Just how the Administration will make good on that pledge, however, is still uncertain. One likely vehicle is the EPA's proposed limits on GHG emissions from fossil fuel-fired power plants – sources that are now responsible for approximately 40 percent of all



[U.S.] anthropogenic CO<sub>2</sub> emissions."<sup>18</sup>

The agency's Proposed Rule establishes New Source Performance Standards (NSPS) for electric generating units with a limit of 1,000 lb./CO<sub>2</sub> per MWh. EPA based this standard "on the performance of widely used natural gas combined cycle (NGCC)...technology."<sup>19</sup> Thus, these inherently low-emitting NGCC units literally "set the standard" and would not be required to install additional control equipment to reduce GHG emissions.

The NSPS do not necessarily rule out new coal-fired plants, however. That is because the Proposed Rule would allow such

plants to comply with the 1,000 lb. CO<sub>2</sub>/MWh standard on a 30-year average basis, meaning that coal plants would have up to 10 years to install carbon capture and sequestration (CCS) technologies.

In basing the Proposed Rule's emission standard on NGCC units, EPA found that these facilities qualify as the "best system of emission reduction" for carbon dioxide, as they are "far less polluting" than coal power plants and emit only about 50 percent of the CO<sub>2</sub> emissions of per unit of energy generated.<sup>20</sup>

EPA also found that a typical new state-of-the-art pulverized coal facility, even one that *meets* recent federal air quality regulations, would still have "considerably greater" emissions of other pollutants than a NGCC facility, including emissions of sulfur dioxide, NO<sub>x</sub>, toxic metals, acid gases, and particulate emissions

In short, the Proposed Rule recognizes that, when it comes to carbon, natural gas units are a major foundation for the nation's clean energy future. As EPA noted: "natural gas-fired plants are the facilities of choice" in the power sector and that new sources can "readily comply with the proposed emission standards by choosing to construct a NGCC unit."<sup>21</sup>

The EPA is expected to finalize this NSPS for future plants during the next year or two and then turn its attention to curtailing GHG emissions from existing plants. That will be a much more protracted task. While there is a

broad consensus that the EPA has a legal obligation to tackle this problem, its options may be more limited.

Retrofitting most coal-fired (or gas-fired) plants for CCS is probably both infeasible and uneconomic.<sup>22</sup> That has led some environmental groups, such as the Natural Resources Defense Council (NRDC), to suggest that EPA could meet its obligation by setting steadily declining state-specific generator performance standards (i.e., CO<sub>2</sub> emission limits) which would reflect each state's existing fuel mix.<sup>23</sup>

States with more carbon-intensive units would have higher target emission rates but a greater differential between their starting and target rate. The targets would be designed to reduce nationwide CO<sub>2</sub> emissions by 26 percent from 2005 levels by 2020 and 34 percent by 2025 but would give states considerable leeway in deciding their preferred mix of generation and the role for efficiency (demand management). Under NRDC's associated modeling work, however, efficiency and coal-fired plant retirements account for the great bulk of GHG reductions.

### III. The Next Four Years

For the nation to see the full potential of a clean and affordable electricity system, additional policy action is needed on several key issues.

Let's start with reliability. To preserve reliability, competitive

energy market structures must send adequate price signals to producers and power plant developers to deliver the right mix of resources to the grid. The Federal Energy Regulatory Commission (FERC) will likely need to weigh in on this subject as regional transmission markets reform their existing rules to incentivize flexible generation.



This can be done by compensating generators via ancillary service products, as the California network operator (CAISO) has proposed.<sup>24</sup> FERC support for such measures will help grow cleaner power and avoid future reliability problems.

The interdependence between natural gas and electric delivery systems has already won some new attention from FERC. This interest has been triggered by the fears of some market participants that a greater reliance on gas-fired generation will raise infrastructure issues (pipeline adequacies; supply disruption). While concern may be exaggerated, FERC must ensure that pipeline infrastructure

developments keep pace with the growing demand in the electric power sector. Doing so will reduce reliability risks and will allow more electricity customers to be served by cleaner, more affordable power.

Finally, as noted earlier, the Administration's action on climate and GHG reductions will have a profound impact on the role of natural gas. Climate came back to the political forefront following the devastation along the east coast from Superstorm Sandy. On the one hand, the storm provided another preview of the overwhelming effects of sea level rise and more powerful storms on infrastructure and our economy. On the other hand, Sandy exposed the vulnerability of our electricity system.

Natural gas can play an important role in mitigating climate change risks while bolstering the resilience of our electricity system. The country's natural gas supply performed exceedingly well during Superstorm Sandy. In contrast, the electrical grid relying on centralized power stations and long transmission lines, experienced prolonged outages from the storm.

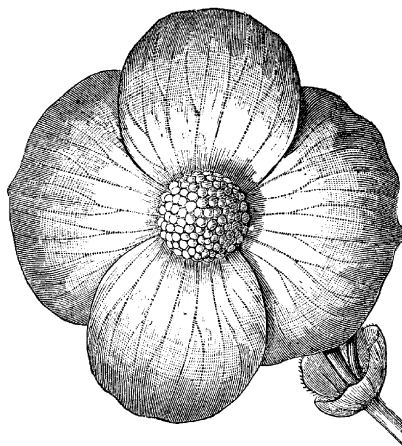
The *New York Times* highlighted the comparative success of the natural gas system during Superstorm Sandy. Industrial customers, housing communities and entities that had gas-fired combined heat and power (CHP) systems – like New York University (NYU) – were able to disconnect from the failing power

grid and produce their own electricity and heat during the storm.<sup>25</sup> NYU installed their system on the merits of cost savings and environmental benefits,<sup>26</sup> and the storm proved the added benefit of reliability that CHP and microgrid systems can provide.

The Administration can promote CHP and microgrid systems – that incorporate small-scale natural gas generators along with distributed renewable energy – to increase the security of the nation's electric grid. In fact, President Obama signed an Executive Order in August 2012 setting a goal of installing an additional 40 GW of CHP systems by 2020.<sup>27</sup> The Administration and government agencies can lead by example and use natural gas-fired CHP and microgrids to power their buildings and high-security areas such as military installations. Doing so will provide an added boost to local economies, improve air quality, accelerate the adoption of such systems in the private sector, and reduce electricity reliability risks by diversifying the system.

If the Administration is serious about reducing GHG emissions to avoid catastrophic costs from climate change, a more concerted effort to upgrade the electric power sector to cleaner resources is the best place to start. In 2010, 34 percent of the nation's GHGs came from the electric power sector, and coal was responsible for over 80 percent of the sector's CO<sub>2</sub> emissions.<sup>28</sup>

The previously mentioned environmental regulations that will result in additional coal power plants retirements puts the electric sector on a trajectory of declining GHG emissions. The Administration has proposed a plan for reducing GHG emissions from new power plants. But plans for reducing GHG from existing electric generating units are still



uncertain. Will the EPA require efficiency improvements from coal power plants or take a different tack such as proposing a utility-sector-only cap-and-trade program, as some have advocated? Congress might also weigh in with carbon taxes or a Clean Energy Standard (CES) to provide a runway for declining GHG emissions. Will the action be enough to mitigate climate change risks?

The good news is that policymakers have powerful resources at their disposal to reduce GHG emissions: abundant and affordable supplies of domestic natural gas. And, of course, America also has no dearth of wind or solar radiation.

U.S. energy-related CO<sub>2</sub> emissions were the lowest they've been since 1992 because of natural-gas-fired electricity and renewables. The expansion of domestic natural gas supplies and subsequent reduction in price has played an especially strong role in the market-driven decline in GHG emissions. *In other words, reducing GHG emissions is no longer an expensive proposition because lower-cost electric generating options are already driving the country in that direction.* A smart climate policy would stay the course and potentially accelerate the country's take-up of cleaner resources.

One closing note: Some climate scientists have argued that the environment cannot afford a shift from coal to natural gas, and instead requires a direct and immediate shift from coal to zero-carbon resources.<sup>29</sup> We do not think this is technically or financially feasible. Instead, in the near term, we believe the best course is to leverage domestic natural gas supplies to create a bridge to lower-carbon resources.<sup>30</sup> Simply put, deploying affordable natural gas power plants and increasing the utilization of existing facilities will make the shift to zero-carbon emitting resources less arduous and more politically viable than a flash cut to nuclear power and renewables which, as we have already noted, are increasingly incompatible grid mates.

Or as Michael Levi put it in a recent essay in *Climatic Change*, "natural gas can serve as a hedge



against the possibility that it will be more difficult to move away from coal than policymakers desire or can achieve."<sup>31</sup> For this and other reasons, we believe that when it comes to climate and energy policy during the next four years, the Obama Administration should double down on natural gas as well as renewables and efficiency. ■

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29. See Nathan Paul Myhrvold and Ken Caldeira, *Greenhouse Gases, Climate Change and the Transition from Coal to Low-Carbon Electricity*, ENVTL. RES. LETTERS, Feb. 2012, at <http://iopscience.iop.org/1748-9326/7/1/>

[014019/pdf/1748-9326\\_7\\_1\\_014019.pdf](http://1748-9326_7_1_014019.pdf).

30. The size and duration of that bridge will likely depend on the potential for next-generation CCS-ready gas-fired generators. Our Foundation held a high-level professional forum on this issue in 2011. See Conference Proceedings for *From a Bridge to a Destination: Gas-Fired Power after 2020*, at [http://www.cleanskies.org/wp-content/uploads/2012/03/ACSF\\_conference\\_03-13-12\\_webres.pdf](http://www.cleanskies.org/wp-content/uploads/2012/03/ACSF_conference_03-13-12_webres.pdf).

31. Michael Levi, *Climate Consequences of Natural Gas as a Bridge Fuel*, CLIMACTIC CHANGE, Jan. 2013.