No Rush: A Smarter Role for Natural Gas in Clean Power Plan Compliance

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As utilities and regulators consider their strategies for complying with mandatory greenhouse gas (GHG) emissions limits under the U.S. Environmental Protection Agency's (EPA) forthcoming Clean Power Plan (CPP), natural gas has an important role to play. But a "dash to gas" approach, including a rush to switch fuels at existing plants, could leave many gas infrastructure assets unusable as soon as 2030. In this timeframe, the power sector will likely face greater greenhouse gas (GHG) emissions reductions than those called for in the CPP (30 percent overall below 2005 levels). A smarter approach will reduce the risk of stranding these assets by carefully weighing the place of gas on a least-cost, least-risk path.

The first step on a least-cost, least-risk path is concerted deployment of energy efficiency improvements. After demand-side options have been fully exploited, attention will focus on greater adoption of renewables. The prudent use of natural gas to facilitate the integration of renewables, among other things, will make it a

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key part of a bridge to a cleaner energy future. Finally, fuel-switching is another available strategy for reducing emissions from the generation mix, but it should not be undertaken without a full understanding of the risks involved. Several such risks are summarized below, many of them drawn from *Implementing EPA's Clean Power Plan: A Menu of Options*, a guide to technology and policy options for complying with the CPP recently published by the National Association of Clean Air Agencies (NACAA).[1] The *Menu of Options* explores a broad array of compliance opportunities in detail. Additionally, *Smart Gas Investment for a Risk-Aware Transition* also examines a least-cost and least-risk approach to the use of natural gas.[2]

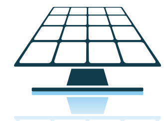
Cleaner (and Cheaper) Choices Come First

Possible pathways for decarbonizing the power sector tend to fall into three categories. The first category, a "microgrid" path, will focus on efficiency, distributed generation, and storage, and de-emphasize the role of the regional grid. The second category is "large-scale renewables," which relies largely on grid-scale wind and solar. The third category comprises a "back to baseload" approach in which gas retains a large role (along with nuclear energy) as a baseload resource, at least until carbon capture and sequestration technology can viably and cost-effectively come to market.[2] All of these pathways have a role for gas. But the "back to baseload" path, in which gas would be most prominent, depends on relatively high-risk and high-cost assets. It would involve investments that, given the emissions benchmarks that will need to be met in the 2030 timeframe, may be stranded well before the end of their 30- to 50-year useful lives. As cheaper, cleaner variable energy resources come on line in response to mandatory GHG emissions limits and reduce the capacity utilization of baseload resources—as modeling by the International Energy Agency predicts will occur[3]—large-scale investment in gas-fired resources will look increasingly questionable.

Energy efficiency, renewable energy, and demand response options can help states comply with the CPP at lower cost and lower risk. A gas-heavy approach could, in fact, crowd out needed investment in these options, delaying the transition to smarter system operations and practices necessary to reliably incorporate them. The gas fleet, rather than undergoing a large-scale build-out in anticipation of a future for which it is not well suited, could be optimized to complement cleaner resources. Such an approach will use gas as a genuine "bridge" to aid the wider-scale integration of renewables into the grid.

Building the Bridge

The United States has seen tremendous growth in wind and solar power over the past decade, and in the first half of 2014, more than half of all newly installed electric capacity in the United States came from solar power.[4] This growth in variable energy resources (VER) is having a positive impact on power sector GHG emissions, but it also creates new challenges for electric system operators. It has become common to discuss the challenge of meeting variations in supply arising from VER production as the "Integration Challenge."[5] Integrating new resources in a way that maintains reliable system operation is not unique to VERs. In fact, the legacy of a system dominated by very large, inflexible resources contributes to



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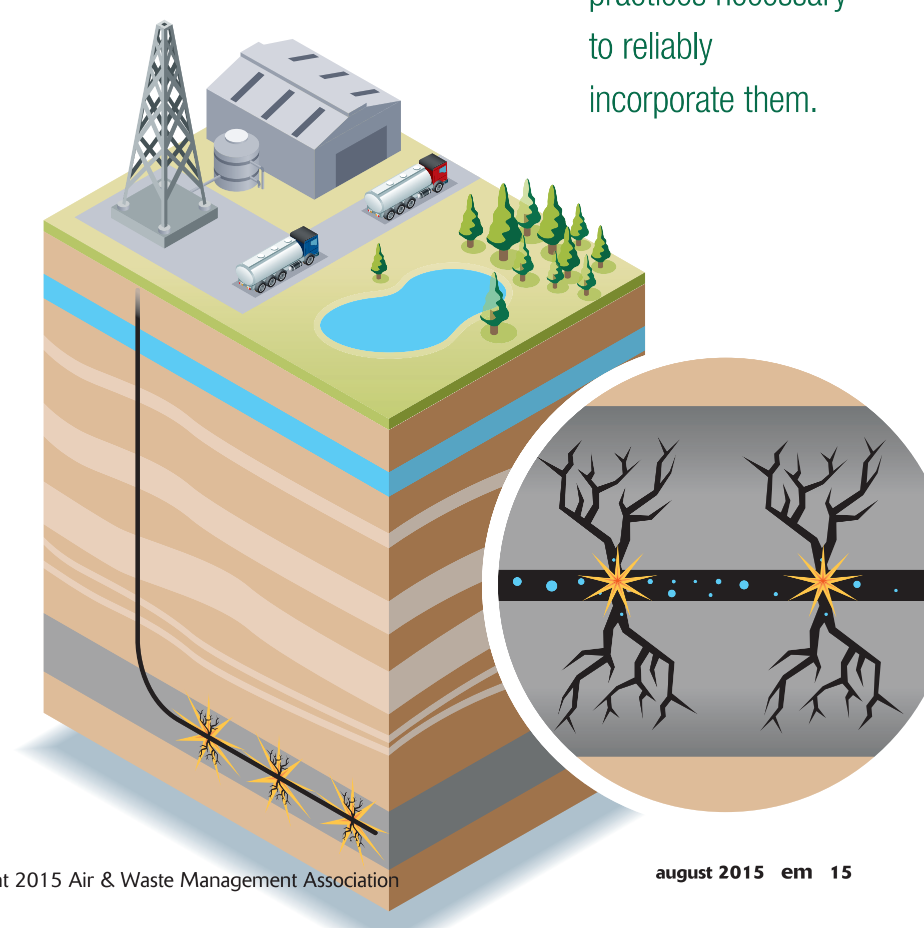

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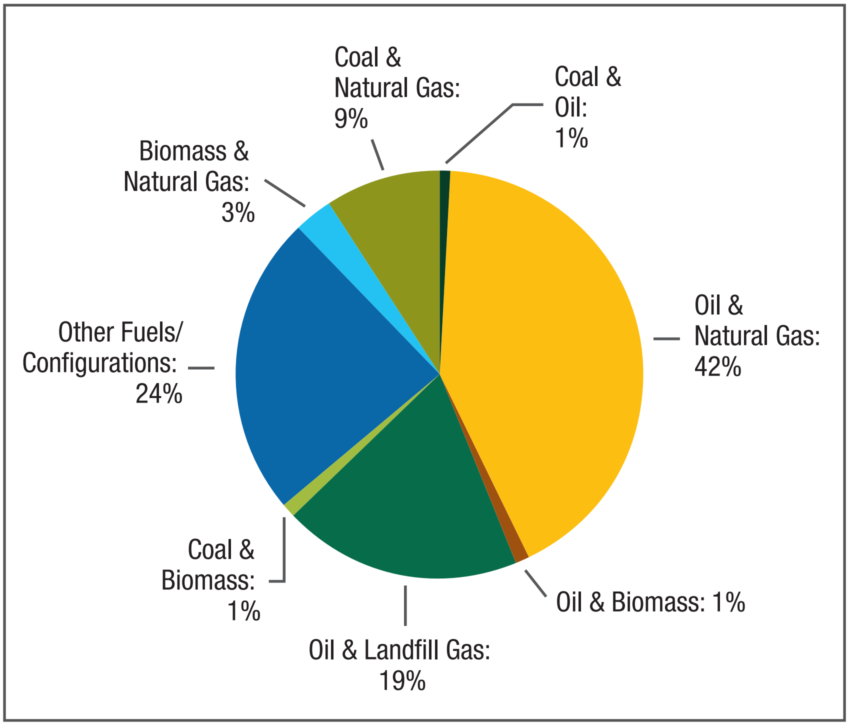

Figure 1: Cofiring Configurations Among U.S. Electric Generating Units (2012).

the integration challenge, because the addition of new, large, inflexible electric generating units (EGUs) has historically required extensive system planning. However, the variable and weather-dependent nature of some renewable resources presents a new kind of integration challenge. Electric system operators will have to adopt more flexible operational practices, and they will need access to more flexible resources in order to maintain system balance as the share of VERs grows. The "challenge" then becomes one of helping system operators find flexible resources to help balance higher penetrations of VERs.[6]

This is where natural gas typically joins the conversation, touted as an essential resource for dealing with the VER integration challenge. Natural gas-fired generation can indeed be a powerful tool to help with integration. Sometimes, however, lower-emitting demand-side approaches (e.g., energy efficiency, demand response (DR), time-varying rates and storage) or supply-side approaches (e.g., regional resource sharing, or placing advanced controls on wind and solar technologies and storage) can meet system integration requirements at much lower cost and with a much lower carbon footprint. Natural gas is a viable supply-side resource that can be used to balance a variable supply of energy from solar and wind. However, there are many lower-emitting strategies that system operators can take—on both the demand and supply sides—to smooth out the amount of energy required (i.e. the net demand once energy efficiency and renewable resources are deployed).[7]

The amount of variability that needs to be accommodated by the system operator can also be mitigated with smart, clean energy strategies that smooth out demand on a regional and local basis. On a regional basis, ten specific tools available for meeting the integration challenge at least cost are: Intra-Hour Scheduling, Dynamic Transfers, Energy Imbalance Markets, Improving Variable Generation Forecasting, Increasing Visibility of Distributed Generation, Improving Reserves Management, Retooling Demand Response to Meet Variable Supply, Utilizing Flexibility of Existing Plants, Encouraging Flexibility in New Plants, and Improving Transmission for Renewables.[8] Taking actions such as investing in specific types of energy efficiency, adapting how solar energy panels are used, using time-varying pricing, installing storage, and taking advantage of underutilized DR resources can be powerful tools for meeting the new integration challenge.[9]

While some new natural gas generation may be needed in some places, it should be employed as a complement to lower-emitting strategies in order to build a bridge to a much lower-emitting future. Because overinvestment in gas generation imposes financial and carbon risks on consumers and society, ensuring that lower-emitting resources and strategies are prioritized is paramount. Some opportunities to do so include:

1. **Investing in an Intelligent Grid:** Investment in state-of-the-art information, communications, and electric system control technologies is required to identify system needs accurately; communicate them clearly (through market and regulatory signals) to generators, consumers, and service providers; and enable smart responses.
2. **Making Electricity System Needs Transparent:** Improving transparency is essential to ensuring that market opportunities are available for clean energy resources, flexibility options

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such as demand response and distributed storage, and appropriate gas generation.

3. **Promoting Resource Inclusivity:** Gas generation, renewable energy, energy efficiency, demand response, and storage each offer energy services that should be allowed to compete fairly to meet consumer and electricity system needs.
4. **Procurement and Dispatch of Clean Energy Resources First:** Implement a "Clean First"[10] approach, whereby renewable energy, energy efficiency, and demand response are procured and dispatched before dirtier resources, and fossil fuel resources are used strategically to achieve a reliable and affordable portfolio that maintains a low-carbon trajectory.
5. **Supporting Effective Permitting of Beneficial Resources:** Policy enhancements are needed at the state, regional, and federal level to support collaboration among beneficial transmission, distribution, and generation. This will ensure that new projects are appropriately vetted and that approved projects are permitted quickly, and to discourage investments in unnecessary fossil generation.[2]

Natural gas can serve as a complement to the other strategies listed above, and as a bridge while additional strategies, technologies, and policies are developed.

Fuel-Switching: Methods and Risks

When considering an ongoing role for gas in the generation mix, one option is to switch existing plants from burning dirtier to cleaner fuels. This approach appears straightforward, but decisions about cost and fuel choices can make it a complicated endeavor.

Fuel switching generally takes one of three forms. The first applies in cases where an EGU can use multiple fuels and involves cutting back on the use of a higher-emitting primary fuel and increasing the use of a lower-emitting backup fuel. The second option is to blend or cofire lower- and higher-emitting fuels—for example, two different ranks of coal could be blended, or biomass could be cofired with coal. A 2012 Energy Information Administration (EIA) survey found that 1,980 of the multi-fuel generating EGUs in the United States have cofiring capability (most commonly for gas and oil) and the necessary regulatory approvals. Figure 1 shows the proportion of U.S. power plants equipped for cofiring according to which fuels they can use.

The third option is to modify, or repower, the EGU unit to use a lower-emitting fuel. Most of the dozens of projects that have been completed or planned in recent years involve repowering existing coal units to burn natural gas, such as Dominion Virginia Power's 227 MW Bremo Power Station in Bremo Bluff, VA. Another route is a coal-to-biomass conversion as done at DTE Energy Services' 45-MW power plant at the Port of Stockton, CA and at Eversource's 50 MW Schiller Station in Portsmouth, NH.

Input emissions factors for biomass fuels are difficult to pin down because there is considerable debate over whether biomass is carbon-neutral.[11] If regulators consider biomass fuels as fully or partially carbon-neutral, biomass utilization at existing coal-fired power plants could potentially play a role in reducing CO_2 emissions. Two studies conclude that a 5 percent CO_2 reduction from the North American electric power sector (roughly 100 Mt per year) could be achieved solely by cofiring biomass with coal at existing EGUs.[12,13]

In virtually all cases, fuel switching will either require capital investment, increase operations and maintenance (O&M) costs above the status quo, or both. In the context of mandatory GHG regulations for existing sources, the relevant question will be whether the resulting cost is less than that of other compliance options. NYSERDA's report on the RGGI states found that switching to natural gas was caused in large part by the drop in price relative to oil and coal, which should be considered in light of potential future price volatility. Studies of repowering costs are mixed, but the EPA concluded that it will on average be more expensive than other available options.[14]

Aside from cost questions, a fuel-switching approach should not be undertaken without a clear understanding of the risks involved. First,

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the strategy may have permitting implications for existing sources, possibly requiring revised operating permits or, for a repowering project, a New Source Review (NSR) construction permit. The potential that a repowering project could trigger costly federal NSR, Prevention of Significant Deterioration (PSD), or New Source Performance Standard (NSPS) requirements is relatively small but could happen if, for example, a repowering project resulted in greater utilization of the EGU and, in turn, higher emissions.

The lack of availability of firm natural gas pipeline capacity could also limit the potential for fuel switching. Extending a new pipeline connection to a power plant can be a lengthy and costly process. Even if a plant is connected, there may be seasonal limitations, as was seen in the U.S. Northeast in the cold winter of 2014. Many power plants found that they could not obtain gas because they did not have firm delivery contracts, and those that did have firm contracts were using nearly all of the existing pipeline capacity. Steps were taken to reduce these risks during winter 2015, but pipeline capacity remains a concern for plant operators.

Fossil fuel prices represent another uncertainty. Historically, oil and natural gas prices have been more volatile than coal prices. Hydraulic fracturing promises to reduce price volatility in the United States as much as it has reduced absolute prices. However, it remains to be seen if this promise will hold over the long term given natural gas' history of price swings.

Conventional wisdom focuses on the reliability of gas, but the flip side of this in the fuel-switching context is that any project that requires an EGU to go offline for an extended period of time may also raise reliability concerns. The likelihood will vary with the size (i.e., capacity) of the EGU, the duration of the scheduled downtime, and the amount of excess capacity available in the region to meet load during that period.

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Finally, power plants that have not previously utilized biomass or other alternative fuels may struggle to establish reliable supply chains. This is a classic chicken-and-egg dilemma: Generators will not switch fuels until they are certain of supply, but a supply chain will not materialize until there is sufficient demand for the fuel. Onsite storage of solid biomass fuels can also pose problems in terms of space, fire risks, or fugitive dust concerns. (These are already familiar issues at coal-fired plants, as are the techniques to address them.)

Conclusion

NACAA's *Menu of Options* explores a wide variety of strategies for complying with mandatory GHG emissions regulations, and it, as well as a fellow report *Smart Gas Investment for a Risk-Aware Transition*, explain how natural gas can play an important role in several paths forward for our electricity system. A danger exists, however, that the current low price environment will fuel a "dash to gas" that fails to consider longer-term risks and realities. Incurring costs to build large numbers of new facilities between now and 2030 runs a considerable risk of stranded investment. After 2030, the emissions from many of these plants may simply be too high to meet environmental requirements, and as a result some of these EGUs may become stranded assets. The current situation facing many coal-fired plants is instructive. Some are being updated for cofiring or repowering, as noted above, and these cleaner-burning facilities may find a role in a state's initial plan for CPP compliance. But the economics and other risk factors remain so challenging that many other coal-burning facilities are simply being shuttered. The same future could await gas-fired plants if large-scale construction is undertaken today with little thought given to longer-term cost and risk. Instead of embarking upon such a risky path, utilities and regulators will want to carefully consider how the role of natural gas can be optimized in creating a cleaner and more flexible future grid. **em**

References

1. National Association of Clean Air Agencies (NACAA). (2015, May). Chapter 9: Switch Fuels at Existing Power Plants. In Implementing EPA's Clean Power Plan: A Menu of Options. Available at: http://www.4cleanair.org/NACAA_Menu_of_Options.
2. Linvill, C. (2015, July) Smart Gas Investment for a Risk-Aware Transition. Public Utilities Fortnightly. Available at: http://www.fortnightly.com/fortnightly/2015/07/smart-gas-investment?page=0%2C0
3. International Energy Agency (IEA). (2014, February). The Power of Transformation: Wind, Sun and the Economics of Flexible Power Systems. ISBN PRINT 978-92-64-20802-5. pp. 162-164. Available at https://www.iea.org/bookshop/465-The_Power_of_Transformation.
4. Solar Energy Industries Association. (2014). Solar Energy Facts: Q2 2014. Available at: http://www.seia.org/researchresources/solar-market-insight-report-2014-q2
5. Western Governors' Association. (2012, June 10). Meeting Renewable Energy Targets in the West at Least Cost: The Integration Challenge. Prepared by the Regulatory Assistance Project. Available at: http://www.westgov.org/component/docman/doc_download/1610-meeting-renewable-energy-targets-in-the-west-at-least-cost-the-integration-challenge-full-report?Itemid=
6. For more on integrating renewables see National Association of Clean Air Agencies (NACAA). (2015, May). Chapter 20: Improve Integration of Renewables into the Grid. In Implementing EPA's Clean Power Plan: A Menu of Options. Available at: http://www.4cleanair.org/NACAA_Menu_of_Options.
7. For more information on net demand, see National Association of Clean Air Agencies (NACAA). (2015, May). Chapter 20: Improve Integration of Renewables into the Grid. In Implementing EPA's Clean Power Plan: A Menu of Options. Available at: http://www.4cleanair.org/NACAA_Menu_of_Options at page 20-4 et seq.
8. Baker, P., Bird, L., Buckley, M., Fink, S., Hogan, M., Kirby, B., Lamont, D., Mansur, K., Mudd, C., Porter, K., Rogers, J., & Schwartz, L. (2014, December). Renewable Energy Integration Worldwide: A Review. Montpelier, VT: The Regulatory Assistance Project. Available at: http://www.raponline.org
9. Ten Strategies to Align Loads to Resources include: 1. Targeted Energy Efficiency 2. Orient Solar Panels 3. Use Solar Thermal With Storage 4. Manage Electric Water Heat 5. Require New Large Air Conditioners to Include Storage 6. Retire Older Inflexible Power Plants 7. Concentrate Rates Into "Ramping" Hours 8. Deploy Electricity Storage in Targeted Locations 9. Implement Aggressive Demand Response Programs and 10. Use Inter-Regional Exchanges of Power. See Lazar, J. (2014). Teaching the "Duck" to Fly. Montpelier, VT: The Regulatory Assistance Project. Available at: http://www. raponline.org/document/download/id/6977.
10. RAP. (2010, September). Clean First: Aligning Power Sector Regulation with Environmental and Climate Goals. Available at: www.raponline.org/docs/RAP_CleanFirst_AligningPowerSector_2010_09.pdf.
11. In July 2011, the EPA decided to temporarily defer the application of PSD and Title V permitting requirements to CO2 emissions from biogenic stationary sources while it studied whether and how to regulate such emissions. However, that decision was vacated by the US Court of Appeals for the District of Columbia Circuit (DC Circuit) in July 2013. From a regulatory standpoint, the GHG reductions that may be achievable by switching to these fuels are thus uncertain.
12. Robinson, A., Rhodes, J. S., & Keith, D. W. (2003). Assessment of Potential Carbon Dioxide Reductions Due to Biomass-Coal Cofiring in the United States. Environ Sci Technol. 37 (22), 5081-5089. Available at: http://pubs.acs.org/ doi/pdf/10.1021/es034367q.
13. Zhang, Y., McKechnie, J., Cormier, D., Lyng, R., Mabee, W., Ogino, A., & Maclean, H. L. (2010). Life Cycle Emissions and Cost of Producing Electricity from Coal, Natural Gas, and Wood Pellets in Ontario, Canada. Environ Sci Technol. 44 (1), 538–544.
14. U.S. EPA. (2014, June). GHG Abatement Measures—Technical Support Document (TSD) for Carbon Pollution Guidelines for Existing Power Plants: Emission Guidelines for Greenhouse Gas Emissions from Existing Stationary Sources: Electric Utility Generating Units. Docket ID No. EPA-HQ-OAR-2013-0602. Available at: http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-ghg-abatement-measures.

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