POWERING THE FUTURE

ENSURING THAT FEDERAL POLICY FULLY SUPPORTS ELECTRIC RELIABILITY

U.S. SENATOR
LISA MURKOWSKI

113TH CONGRESS

AN *ENERGY 20/20* WHITE PAPER

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Dear Reader,

Just before I released my *Energy 20/20* policy blueprint last year, I chose a photo showing the Earth at night for its cover. What still strikes me as compelling about that image – and now about the cover of this document – are the lights visible from space. Concentrated heavily in developed parts of the world, and particularly here in America, those lights clearly illustrate why "energy is good" – and why federal energy policy cannot and must not be taken for granted.

If we could zoom in on individual towns and cities, those lights would tell a remarkable story about the ever-growing importance of electricity to our daily lives. For decades now, we have been accustomed to electric power on demand. We expect electricity to flow instantly, whenever we need it, for as long we need it, with only the rarest of interruptions.

All of this is made possible through the extensive series of power plants and power lines that constitute the electric grids in the "Lower 48." Although the vital importance of those systems is too often overlooked, collectively "the grid" is without doubt a sustaining source of our high standard of living and a key enabler of our national prosperity.

Over time, one of the most critical aspects of the electric grid – its reliability – has steadily improved. Today, outages on the Bulk Power System generally occur only in a handful of exceptional circumstances. Yet there are new factors and forces that are rapidly changing our energy supply mix in a manner that could fundamentally alter or degrade the system all segments of the industry have so carefully built. Among these are a mass of new environmental regulations that have contributed to the closure of many existing power plants and threaten to impact even more and, increasingly, subsidies and preferences for certain forms of power generation and use that may be leading to unintended consequences.

This white paper presents the case for greater awareness and engagement on electric reliability. Enhanced coordination between regulators and regulated entities as well as clearer voices about potentially looming problems is crucial – as are policy improvements that can and should be made by Congress.

As always, I thank you for engaging on this issue and I encourage comments on the ideas presented here and welcome the ensuing dialogue.

Sincerely,

Lisa Murkowski
United States Senator

The American Powerhouse

By and large, American electricity is American energy. Virtually all of the nation's electricity, and the vast majority of fuel used to generate it, is produced domestically. The electric power sector accounts for the lion's share – approximately 40 percent – of annual energy consumption in the United States. While the U.S. generated 4,048,000 gigawatt-hours (GWh) in 2012, it imported less than two percent of total consumption – a mere 47,000 GWh in net terms – from neighboring Canada and Mexico.[1] This stands in marked contrast to the transportation sector, which still relies on petroleum imports for a substantial share of overall consumption.[2]

Fortunately, diversity is a key characteristic of the U.S. electric system. No single source of energy provides a majority of the nation's power and each makes a distinct contribution to the nation's portfolio of electric generation resources. Coal still accounts for the overall largest source of electric generation but its use is declining. Together, natural gas and nuclear constitute roughly half of today's total net generation.[3] And renewables, both at the utility-scale and via distributed generation,[4] are adding to our resource mix at an ever-increasing rate.[5]

Geography, of course, plays a role in this diverse mix of generation resources. Illinois leads the nation in nuclear; Texas, in coal and wind; Washington, in hydropower; California, in solar.[6] West Virginia, New York, Pennsylvania, Ohio and Maryland share the abundant Marcellus Shale, an historic natural gas discovery.

The geographic diversity of our nation's resources is also highlighted by the fact that we do not have a single, unified national transmission grid. Instead, "the grid" actually comprises three separate networks of interconnected individual systems – the Western, Eastern, and Texas Interconnections – that are, in turn, integrated with one another only marginally.[7]

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[1] ENERGY INFORMATION ADMINISTRATION, MONTHLY ENERGY REVIEW (January 2014), Table 7.1 Electricity Overview. This is not to understate the significance of our bilateral trade in electricity on a day-to-day basis. In particular, the Quebec Interconnection is very important to New England electricity markets.

[2] EIA, MER (Jan. 2014), Table 7.1 Electricity Overview.

[3] Coal accounts for 37 percent of electrical generation, while natural gas accounts for a full 30 percent and nuclear for 19 percent. EIA, MER (Jan. 2014), Table 7.2a. Electricity Net Generation: Total (All Sectors).

[4] "Distributed generation" refers to energy sources, such as solar rooftop panels, located behind the retail meter or connected to a micro grid where the intent is to remove some load or demand from the system of integrated electric generation, transmission, and distribution facilities. DAVID B. RASKIN, THE REGULATORY CHALLENGE OF DISTRIBUTED GENERATION, 4 Harv. Business L. Rev. 38, 39, n.5 (2013).

[5] EIA, ANNUAL ENERGY OUTLOOK 2014 (EARLY RELEASE) 11 (2014). Hydroelectric power accounts for 6.8 percent, while biomass wood accounts for 0.9 percent, biomass waste for 0.5 percent, geothermal for 0.4 percent, solar/photovoltaic for 0.1 percent, and wind 3.5 percent. EIA, MER (Jan. 2014), Table 7.2a. Electricity Net Generation: Total (All Sectors).

[6] EIA, ELECTRICITY DATA BROWSER, *available at* http://www.eia.gov/electricity/data/browser/ (last visited Jan. 31, 2014).

[7] Nevertheless, for the convenience of the reader, this paper will refer to "the grid" in the singular. Notably, even our nation's electricity markets vary by region. However, specific electricity market issues are beyond the scope of this paper.

An Evolving Grid

A complex interaction of the power of the free market, geography, state and federal policies, and technological advancement has resulted in the modern electric grid. No other network on Earth provides as much power to as many people as reliably and affordably as the American electric grid.[8]

The Energy Mix Injected Into The Grid Is Changing

American electricity generation is always dynamic, although, until recently, change has come only slowly. The oldest operating power plants in the U.S. are hydroelectric dams, some of which were built about the time the automobile was invented.[9] As a share of net generation, coal has been "king" for decades, but its use has fallen as natural gas use has risen.[10] Over the past decade, natural gas has even surpassed nuclear power as a share of total net generation.[11] Renewables have climbed at an impressive rate, with wind power claiming the nation's largest source of new electric capacity additions in 2012.[12] In contrast, petroleum – the second most important fuel source for electricity in 1977 – has dropped to virtually zero.[13]

Looking forward, the Energy Information Administration (EIA) projects that natural gas use will increase sharply and actually surpass coal to become the dominant source of energy for electricity production by 2040. During this time period, EIA predicts a smaller but still significant increase in renewables and only a minor fluctuation in nuclear power.[14] While EIA believes coal and nuclear sources will continue to play an important role in our resource

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[8] Although the affordability of electric service is largely beyond the scope of this paper, it is very nearly as crucial to our national well-being as electric reliability. The questions of reliability and affordability are inescapably intertwined. And at present, the opportunities for comparably reliable and affordable electric service without a grid connection are extremely rare if not practically non-existent, in contrast to the situation in telecommunications today where wireless networks provide an alternative to wireline. The goal should be that America has energy, taken together, that is abundant, affordable, clean, diverse and secure. *See* LISA MURKOWSKI, ENERGY 20/20: A VISION FOR AMERICA'S ENERGY FUTURE 4-5 (Feb. 4, 2013).

[9] Today's hydropower industry undertakes well-planned measures to protect the environment in which it operates through voluntary efforts and via the licensing process. In 2012, hydropower accounted for almost 7 percent of total net generation and 56 percent of renewable generation. EIA, MER (Jan. 2014), Table 7.2a Electricity Net Generation: Total (All Sectors).

[10] Total net electricity generated from coal dropped from 48.2 percent to 37.4 percent between 2008 and 2012. *Id*.

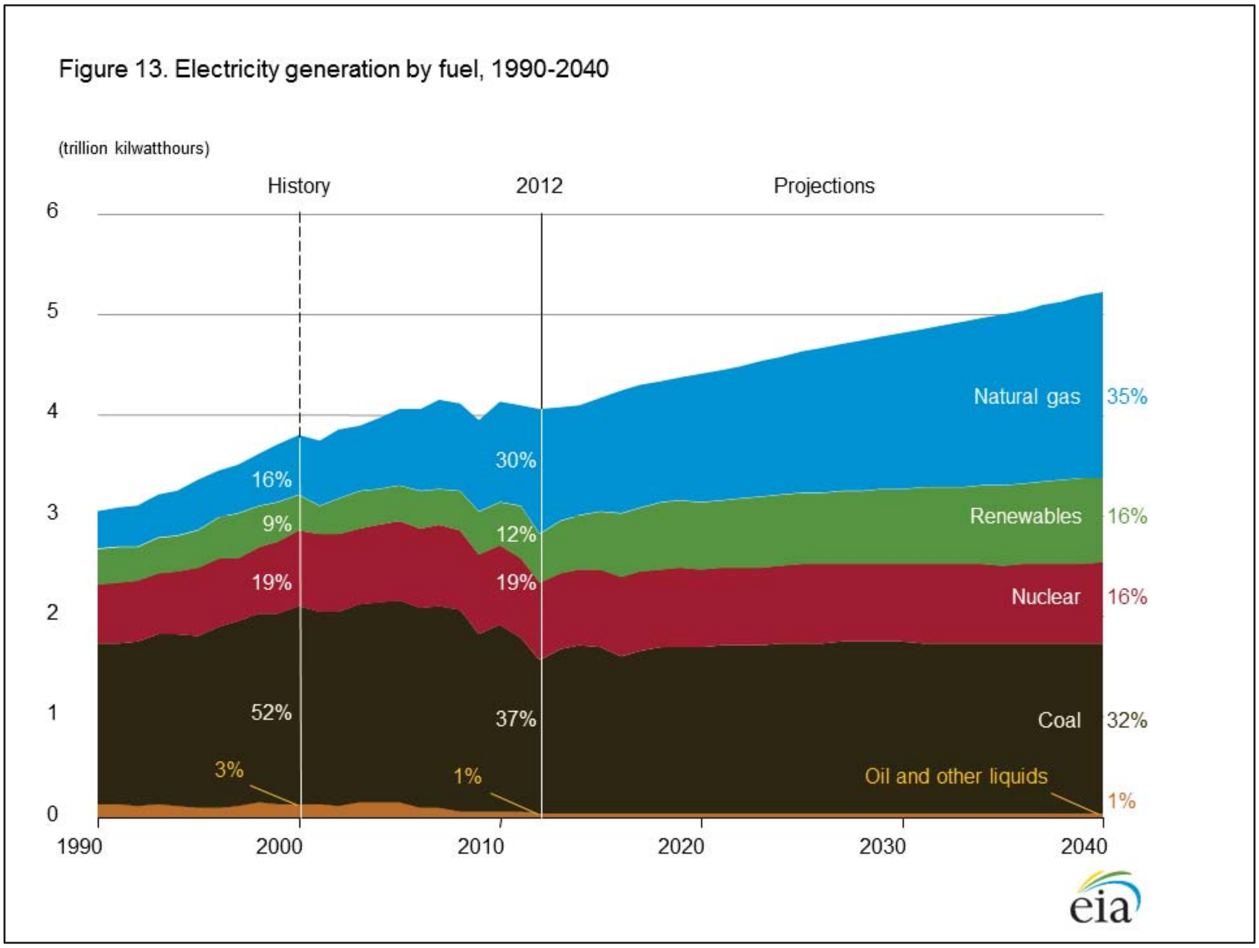
[11] *Id*.

[12] With 13.1 gigawatts of new capacity added in 2012, U.S. wind power installations were more than 90 percent higher than in 2011. Today wind power represents over 60,000 megawatts of capacity. DEPARTMENT OF ENERGY, WIND TECHNOLOGIES MARKET REPORT iv, 3 (2013). *See also* AMERICAN WIND ENERGY ASSOCIATION, U.S. WIND INDUSTRY SECOND QUARTER MARKET REPORT 2013 (2013). Still, it should be noted that installed capacity is not commensurate with electricity produced. Wind power in particular has a wide discrepancy due to multiple factors, including intermittency. The average wind capacity factor is only 31.8 percent. EIA, 2012 DECEMBER EIA-923 MONTHLY TIME SERIES FILE (2012).

[13] EIA, MER (Jan. 2014), Table 7.2a Electricity Net Generation: Total (All Sectors). Even this small share can be important when systems must operate at peak. For example, New England relied significantly on oil for electricity generation during the recent polar vortex weather system. VAMSI CHADALAVADA, INDEPENDENT SYSTEM OPERATOR NEW ENGLAND, THE NEW ENGLAND POWER POOL PARTICIPANTS COMMITTEE REPORT 12-20 (Feb. 6, 2014) *available at* http://www.iso-ne.com/committees/comm_wkgrps/prtcpnts_comm/prtcpnts/mtrls/2014/feb72014/coo_report_feb_2014.pdf (last visited Feb. 6, 2014). Also, rural Alaska continues to generate electricity by burning diesel fuel (that is barged or flown in) because it is not economical to run transmission lines over the large distances between small communities of fewer than 500 residents.

[14] EIA, ANNUAL ENERGY OUTLOOK 2014 (EARLY RELEASE) 14-15 (2014).

portfolio, these projections are always subject to change – particularly as new federal rules and regulations are issued.[15]



Source: EIA, Annual Energy Outlook 2014 (Early Release)

Natural Gas Is Taking A More Prominent Role

With natural gas production in the U.S. at record levels, resource base estimates continue to increase nearly every time they are reassessed. This has, in turn, led to a steep decline in domestic natural gas prices since 2008.[16] Natural gas has dominated new capacity additions over the past 20 years. From 2001 to 2010, nearly 150 coal-fired generators were retired in net terms, while over the same period more than 1,000 gas-fired generators came on-line in net terms.[17]

The prospect of natural gas as an affordable and, as a practical matter, abundant source of electricity on par with coal over the long-term could be leading many players in the electric power sector to shift to natural gas. Nevertheless, long-term price stability could remain a

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[15] EIA's projections do not take into account the potential impact of future regulations on new plant builds or retirements.
[16] EIA, NATURAL GAS PRICES *available at* http://www.eia.gov/dnav/ng/ng_pri_sum_dcu_nus_m.htm (last visited Jan. 31, 2014).
[17] EIA, ELECTRIC POWER ANNUAL (2001-2010), Tables 1.5 and 2.6, Capacity Additions, Retirements and Changes by Energy Source. According to EIA, most coal-fired power plants are more than 30 years old.

challenge for natural gas.[18] The Congressional Research Service recently asserted that "fuel cost to generate electricity is the key in the decision to switch from coal to natural gas generation" and also pointed out that "a recent drop in natural gas prices has been enabled by increasing supplies . . . If the production can be sustained . . . then a long term relatively inexpensive supply of natural gas could result."[19] Fuel cost is not the only variable in the equation but it is undoubtedly a significant market factor. The extent of this so-called "structural shift" is the subject of much debate in the industry.

In any case, while certainly welcomed for its significant economic benefits, natural gas as a fuel for electric generation presents its own challenges. Greater coordination and analysis is needed to better understand and plan for the increasing role that natural gas will play in the power sector. Gas is now performing more of a hybrid role – providing peaking and baseload power and helping to smooth out intermittent resources. Gas storage capacity is improving with compressed natural gas and liquefied natural gas but large quantities of gas storage are and will continue to be required for electric generation. Additionally, new sources of gas supply and increasing use of gas for power generation could require a physically more robust gas pipeline network, as well as firmer, longer-term contracting to assure the levels of electric reliability that are increasingly expected if not required.[20] Even more fundamentally, both gas and electric supply and delivery systems will need to take gas demand attributable to electric generation into account to a greater extent than today.[21]

The Continued Loss Of Coal Capacity

A number of federal regulations proposed and promulgated by the Environmental Protection Agency (EPA) are widely expected to result in legal challenges and further coal plant retirements.[22] In practical terms, an EPA rule has the effect of capping power plant emissions at

[18] Volatile gas prices this winter led the PJM Interconnection and the New York Independent System Operator to seek temporary relief from FERC for their $1,000 per MWh price cap; FERC granted both requests. 146 FERC ¶ 61,041 (2014) (PJM); 146 FERC ¶ 61,061 (NY-ISO). PJM is now seeking from FERC a price cap waiver through March 31, 2014, the rest of the winter heating season. *See* PJM INTERCONNECTION, ANSWER OF THE PJM INTERCONNECTION TO COMMENTS AND PROTESTS (FERC Docket No. ER14-1145) *available at* http://www.pjm.com/~/media/documents/ferc/2014-filings/20140203-er14-1145-000.ashx (last visited Feb. 10, 2014).

[19] RICHARD CAMPBELL ET AL., CONGRESSIONAL RESEARCH SERVICE, PROSPECTS FOR COAL IN ELECTRIC POWER AND INDUSTRY 5 (2013). According to CRS, natural gas prices for electric power generation overall have been relatively low since about 2009-2010 but increasing demand for power generation use may cause upward pressure on natural gas prices, particularly if there is a significant lag between this demand and new production. Also, more natural gas power generation may require new infrastructure.

[20] "Ultimately, the challenges we face with gas and electric coordination is a good problem to deal with as it's partially the result of abundant domestic gas resources. But the challenges are serious, very real, and somewhat urgent, especially in New England and the Midwest." *American Energy Security and Innovation: The Role of Regulators and Grid Operators in Meeting Natural Gas and Electric Coordination Challenges,* House Subcommittee on Energy and Power of the Committee on Energy and Commerce, 113th Cong. (Mar. 19, 2013) (statement of Philip Moeller, Commissioner, FERC).

[21] *See* PHILIP MOELLER, REQUEST FOR COMMENTS OF COMMISSIONER MOELLER ON COORDINATION BETWEEN THE NATURAL GAS AND ELECTRICITY MARKETS (Feb. 3, 2012); *see also* FERC, GAS-ELECTRIC COORDINATION QUARTERLY REPORT TO THE COMMISSION (Sept. 19, 2013).

[22] For example, just last month the State of Nebraska filed suit against the EPA, claiming the EPA's recently proposed greenhouse gas new source performance standards for power plants violates the Energy Policy Act of 2005. Nebraska is challenging EPA's reliance on carbon capture and sequestration projects as "adequately demonstrated." *State of Nebraska v. United States Environmental Protection Agency,* Case No. 4:14-cv-3006.

fixed levels for particular pollutants by a certain point in time. The cost to comply with these rules can be very significant, as compliance may require retrofitting, the purchase of new technology (if such technology is even commercially available),[23] costly downtime for installation, and mandatory upgrades to existing infrastructure – all of which can be exacerbated by the limited availability of skilled labor and necessary equipment.

Broadly speaking, EPA rules, in effect, target older coal power plants, although some rules will clearly impact the construction of new coal power plants.[24] In terms of new plant construction, federal regulations can tip – and are now tipping – a multitude of investment decisions from one generating resource to another. For existing plants, when the owner determines that new regulatory compliance costs have rendered the facility uneconomic, then it will simply seek to retire the plant. Some units will, however, be deemed "must run" for reliability purposes. That is, the grid operators may not allow a plant to be retired if they determine that the loss of that baseload capacity could cause grid instability or lead to power disruptions. Indeed, PJM Interconnection, the Regional Transmission Organization tasked with ensuring adequate electricity supply for 61 million people in 13 states plus the District of Columbia, has refused to allow the closure of three coal plants in Ohio, deeming the 885 MW of power generated by these plants as essential for electric reliability.[25]

The Rise Of Renewables

Various state and federal policies, such as renewable energy requirements and financial incentives such as grants and tax credits[26] have caused or compelled a significant deployment of intermittent energy resources at the utility level and, at an increasing rate, the customer level. For example, with 13.1 gigawatts of new capacity added in 2012, U.S. wind power installations were more than 90 percent higher than in 2011.[27] Today, wind power constitutes over 60,000 megawatts of capacity,[28] representing a 1,347 percent increase from 2001.[29] And with 9,177

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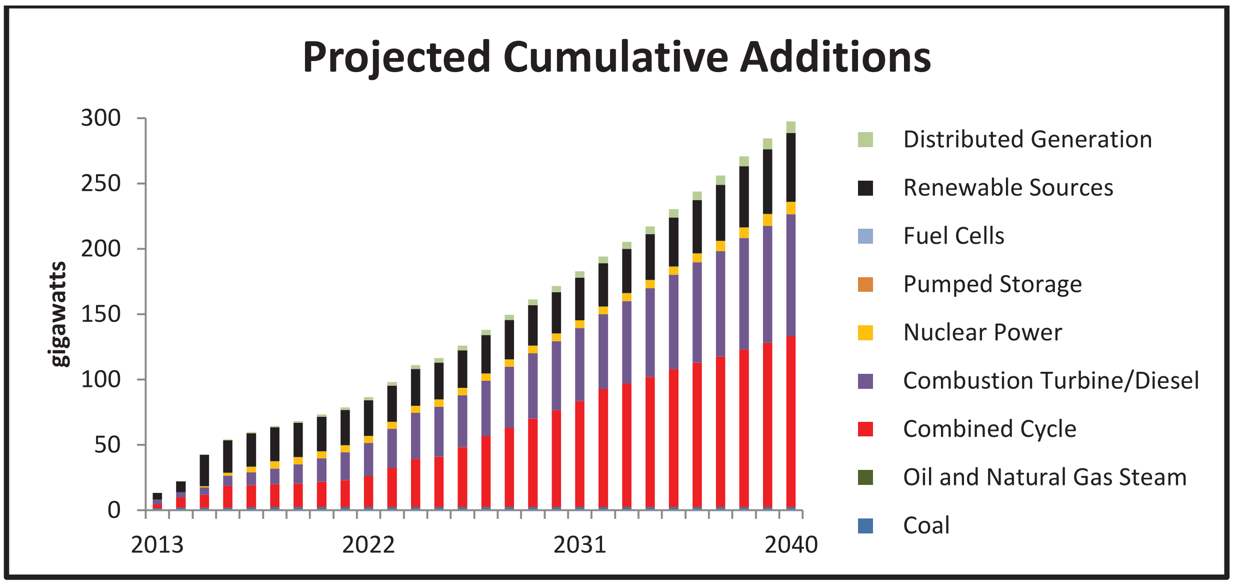
[23] Kevin Holewinski & Daniella Einik, EPA'S PROPOSED NEW SOURCE CLEAN AIR ACT STANDARDS AND CARBON CAPTURE AND STORAGE TECHNOLOGY *available at* http://www.lexology.com/library/detail.aspx?g=b31efb54-741d-472c-912a-8e83465dbbf7 (last visited Feb. 4, 2014).
[24] Environmental Protection Agency, *Standards of Performance for Greenhouse Gas Emissions From New Stationary Sources: Electric Utility Generating Units* 79 Fed. Reg. 1,430 (proposed Sept. 20, 2013) (to be codified at 40 C.F.R. pt. 60).
[25] In 2012, First Energy Corp. scheduled closure of three Ohio coal plants rendered uneconomic by the EPA Mercury Air Toxics Standards (MATS), which takes effect in 2015. The grid operator, PJM Interconnection, LLC, deemed the 885 MW of power generated by these plants essential for electric reliability. PJM, ZONAL COST ALLOCATION FOR RETAINING ASHTABULA 5, EAST LAKE 1-3 AND LAKE SHORE 18 GENERATORS *available at* http://www.pjm.com/~/media/planning/gen-retire/2012-2015-zonal-cost-allocation-for-retaining-ashtabula-east-lake-and-lake-shore-generators.ashx (PJM states there will be reliability issues without these plants). PJM entered a "must run" agreement with First Energy to keep the grid stable. JIGNASA GADANI, OFFICE OF ENERGY MARKET REGULATION, FERC (2013) *available at* http://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=13155277 (last visited Feb. 10, 2014) (FERC letter accepting rates under reliability must run agreement). At a FERC Technical Conference convened to discuss electric reliability, Midwest Independent Transmission System Operator commented, "Reliability in the Midwest will be severely challenged throughout the implementation period of the proposed [EPA] rules…In order for MISO to meet its reliability obligations, generator outage requests will be denied in order to maintain adequate supplies." *See* MIDWEST INDEPENDENT TRANSMISSION SYSTEM OPERATOR, COMMENTS OF THE MIDWEST INDEPENDENT TRANSMISSION SYSTEM OPERATOR, FERC Reliability Technical Conference Docket No. AD12-1-000, 2 (November 22, 2011).
[26] The federal production tax credit expired on December 31, 2013.
[27] DOE, WIND TECHNOLOGIES MARKET REPORT iv (August 2013).
[28] *Id.* at 3.

megawatts installed, solar power capacity in the U.S. has made dramatic gains as well, increasing by 93 percent from 2011 to 2012.[30]

Innovation and new technology are American strengths that deserve encouragement. For example, we should continue to fund basic energy research and development. It is well known that deployment of a new technology such as distributed solar can face hurdles, especially in network industries. Understandably, however, whether and to what extent government should intervene to encourage technology deployment is a hotly debated question. Thus it is no surprise that questions surrounding deployment of distributed resources have presented some controversy. In the best case, competition in deployment and use between established and emerging technologies would occur based upon the merits of the technologies themselves. Where public policies intervene, the policy challenge, especially during a transitional period, is to balance competing issues. For the electric grid, reliability and affordability must remain the core considerations, and no electric generation resource should be the victim or the beneficiary of undue discrimination.



Source: EIA, Annual Energy Outlook 2014 (Early Release)

[29] AMERICAN WIND ENERGY ASSOCIATION, U.S. WIND INDUSTRY SECOND QUARTER MARKET REPORT 2013 – AWEA MEMBER VERSION 4 (2013) *available at* http://awea.files.cms-plus.com/FileDownloads/pdfs/AWEA2Q2013WindEnergyIndustryMarketReport_Executive%20Summary.pdf (last visited Feb. 4, 2014).

[30] Approximately 91 percent of installed solar capacity is solar photovoltaic. Data compiled by EIA staff. EIA, ELECTRIC POWER MONTHLY (Jan. 2014), Table 6.2B *available at* http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_6_02_b (last visited Feb. 6, 2014). EIA, FORM EIA-860 DETAILED DATA (Jan. 2014) *available at* http://www.eia.gov/electricity/data/eia860/xls/eia8602012.zip (2012) and http://www.eia.gov/electricity/data/eia860/xls/eia8602011.zip (2011) (last visited Feb. 6, 2014). EIA, NOVEMBER 2013 EIA-860M (Jan. 2014) *available at* http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_6_01 (last visited Feb. 6, 2014). EIA, ELECTRIC POWER SALES, REVENUE, AND ENERGY EFFICIENCY FORM EIA-861 DETAILED DATA FILES (Jan. 2014) *available at* http://www.eia.gov/electricity/data/eia861/zip/f8612012.zip (2012) and http://www.eia.gov/electricity/data/eia861/zip/f86111.zip (2011) (last visited Feb. 6, 2014). EPA, FORM EIA-826 DETAILED DATA (Jan. 2014) *available at* http://www.eia.gov/electricity/data/eia826/xls/f8262013.xls (last visited Feb. 6, 2014).

The Critical Issue Of Electric Reliability

Federal policy debates surrounding energy generally, and to some extent electricity specifically, have tended in recent years to emphasize production, with industry participants, other stakeholders, and public officials arguing in support of their favored resource. This is the so-called "upstream" side of the equation. As important as energy production, however, is its conversion into a usable form and its transportation. Of further importance is the capacity to transmit that energy "downstream" continuously without interruption, particularly during hours of peak demand when its consumption may be most vital.

In stark contrast to far too many around the globe suffering in energy poverty with limited or no access to electricity, for most Americans the light turns on when they flip the switch.[31] Keeping the lights on, however, is a highly complex undertaking, requiring extensive planning and coordination. The lack of few efficient and commercially viable large-scale electricity storage mechanisms becomes more important as the energy resource mix changes and requires an electric grid that is both flexible and resilient. This is especially true when baseload generation is taken offline and grid fundamentals change.

The Grid Was Designed For An Earlier Supply Mix

Conventional wisdom would have us believe that the injection of more electricity onto the grid, regardless of duration, is always a good thing, but our grid operators can attest to the reality of today's situation. Instead of relying only on controllable and dispatchable units to meet demand, grid operators are grappling with intermittent resources that run only when the wind blows or the sun shines, along with distributed generation units that permit customers not only to receive electricity but also to transmit power back onto the system.[32] These resources introduce greater variability into the grid in contrast to the traditional situation where baseload plants predominately provide power to the grid on a consistent and predictable basis. With the increased penetration of renewables, our grid managers are now forced to back-off and cycle down baseload generation.[33] Not only is this constant ramping putting more stress on generating assets, it is forcing our grid to operate in a way for which it was not designed. These transformative changes require an even closer consideration of ancillary services, such as voltage control and frequency response, that are necessary to maintain grid reliability.

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[31] Approximately 1.3 billion people in developing countries have no access to electricity and 2 billion have only limited access. CHARLES EBINGER & JOHN BANKS, THE ELECTRICITY REVOLUTION 5 (2013).

[32] One of the potential benefits of distributed generation can be to stave off the need to build new transmission. However, it is important to recognize that it is changing the way the existing grid must operate. In *The Electricity Revolution*, the authors note that distributed generation is giving rise to what some are dubbing "prosumers" where end-use customers are becoming both producers and consumers of electricity. EBINGER & BANKS at 4. Prosumers often call on net metering policies in approximately 40 states that allow retail customers, including commercial and industrial customers, to offset their electricity purchases from the grid with energy generated behind the retail meter, such as rooftop solar panels. Net metering is valued at the bundled retail rate for electricity which does not include grid-related costs and may allow owners of distributed generation to sell their energy at two to six times the wholesale market price for energy. RASKIN at 40-41.

[33] NERC & CALIFORNIA INDEPENDENT SYSTEM OPERATOR, 2013 SPECIAL RELIABILITY ASSESSMENT 14 (2013); *accord* N. KUMAR ET AL., NATIONAL RENEWABLE ENERGY LABORATORY, POWER PLANT CYCLING COSTS iv (2012).

Electric customers and even policymakers can take ancillary services for granted but these services are crucial. For example, voltage collapse – a failure of voltage control – has significantly contributed to several major blackouts.[34] In a sense, we have been warned by these earlier events. The nation's Electric Reliability Organization (ERO), the North American Electric Reliability Corporation (NERC), identifies additional ancillary services and ramping capability as key drivers for incorporating these new, alternative resources to the grid.[35] Moreover, who pays for these services, as well as the transmission needed to connect intermittent resources to the grid, is a key policy question. Finally, as distributed generation grows, NERC assesses that with a "significant amount of DERs [Distributed Energy Resources] online, the inability to remain interconnected, stable, and functional during and after a system disturbance presents a significant risk to the BPS [Bulk Power System]."[36]

Will Today's Grid Be Less Reliable Than Even Two Years Ago?

Generally we have a healthy and effective national electric grid, but on occasion demands on the system or damage to it will outstrip the grid's ability to respond. Outages can be caused by weather, criminal activity (both physical and cyber-related), human error, fires, lightning, and other events. According to NERC, the grid experienced just three so-called "high-stress days" in 2012. All three occurred in the Eastern Interconnection and were caused directly by Superstorm Sandy and the derecho that impacted Midwest and Mid-Atlantic states.[37]

The Bulk Power System (BPS) has already been challenged in 2014. The deep freeze brought on by January's polar vortex resulted in at least 50,000 megawatts of power plant outages.[38] The electric industry has an impressive history of learning and improving from these system challenges. Among other things, what we learned from the Polar Vortex is that for one key system 89 percent of the coal capacity that is slated for retirement next year was called upon to meet demand. [39] We also learned that nuclear power plants operated at over 90 percent capacity

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[34] Voltage collapse occurs when an increase in load or loss of generation or transmission facilities causes voltage to drop, which causes a further reduction in reactive power from capacitors and line charging, and still further voltage reductions. If the declines continue, these voltage reductions cause additional elements to trip, leading to further reduction in voltage and loss of load. *See* NERC STEERING GROUP, TECHNICAL ANALYSIS OF THE AUGUST 14, 2003 BLACKOUT *available at* http://nerc.com/docs/docs/blackout/NERC_Final_Blackout_REort_07_13-04.pdf (last visited Feb. 4, 2014); *see* NATURAL RESOURCES CANADA & US DEPARTMENT OF ENERGY, FINAL REPORT ON THE IMPLEMENTATION OF THE TASK FORCE RECOMMENDATIONS 17-19 (addressing the "direct causes of the August 14, 2003 blackout"), 29-31, 34-35 (2006); *see also* Richard Pérez-Peña & Eric Lipton, *Elusive Force May Lie At Root of Blackout*, N.Y. TIMES, Sept. 23, 2003 at A20.

[35] NERC, LONG TERM RELIABILITY ASSESSMENT 2013 25 (2013). The Energy Policy Act of 2005 (2005 Act) placed the primary regulatory responsibility for reliability with the Electric Reliability Organization (ERO) designated by FERC. As expected when the 2005 Act became law, FERC designated the North American Electric Reliability Corporation (NERC) as ERO.

[36] *Id*. at 26. In a joint report, NERC and CAISO warn that "[i]f variable energy generators are developed on a large scale at the distribution system level, then any impact of this penetration on the transmission system will need to be analyzed. A large majority of DERs are not visible to BPS operators." NERC & CALIFORNIA INDEPENDENT SYSTEM OPERATOR at 23.

[37] NERC, STATE OF RELIABILITY 2013 6 (2013).

[38] FERC, FERC STAFF UPDATES COMMISSION ON RECENT WEATHER EFFECTS ON THE BULK POWER SYSTEM 12 (2014) *available at* http://www.ferc.gov/legal/staff-reports/2014/01-16-14-bulk-power.pdf (last visited Feb. 10, 2014).

[39] Nick Akin, *Fourth Quarter 2013 Earnings Webcast of American Electric Power* (Jan. 27, 2014) (6:11-7:08) http://www.aep.com/investors/eventspresentationsandwebcasts/imageviewer/default_stretchy.htm?show=small#.

through the event, demonstrating their consistency, resiliency, and reliability.[40] This should serve as a wake-up call to the continued importance of baseload capacity.

Over the long-term, the large number of forecasted coal and nuclear baseload plant retirements[41] has led some analysts to speculate that the grid may be unable to function as reliably as it did in 2012.[42] Replacing this retiring baseload capacity, while managing an increasingly variable energy mix is the central challenge of electric reliability in the coming decades.[43] Instead of promoting even greater reliability and fuel diversity, however, government policies are instead creating challenges for baseload generation.

Retirement Math

Will The Federal Government Get A Failing Grade?

Notably, net summer capacity for domestic coal power plants stood at approximately 315 gigawatts in 2011.[44] Simple arithmetic reveals a significant problem that industry, government regulators, and Congress must pay attention to and address. Numerous analyses have been conducted on the retirement math by the experts and the results are noteworthy if not alarming. According to the EIA, nearly 27 gigawatts of coal-fired capacity is planned to retire during the 2012 to 2016 period.[45] More than nine gigawatts were retired in 2012 alone.[46] The EIA also projects in its annual reference case that nearly 50 gigawatts of this baseload capacity may retire by 2020.[47] The National Renewable Energy Laboratory predicts 33 gigawatts of coal retirements through 2026, while industry estimates range as high as 73 gigawatts through 2025.[48] These estimates align with the Government Accountability Office's (GAO) analysis, which found an additional 15.7 to 25.2 gigawatts of capacity may be retired through 2020 on top of the 30.4

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[40] US NUCLEAR REGULATORY COMMISSION, POWER REACTOR STATUS REPORTS (2014) *available at* http://www.nrc.gov/reading-rm/doc-collections/event-status/reactor-status/2014/ (last visited Feb. 6, 2014).

[41] Just last year four nuclear reactors were closed, and a fifth unit is scheduled to shutdown in 2014. Two of these facilities, the Kewaunee plant in Wisconsin and the Vermont Yankee plant in Vermont, cited economic reasons as the basis for their closures even though the facilities received license renewals. Financing options are limited for new nuclear power and high construction costs are viewed as one of the stumbling blocks to more extensive nuclear development. For example, the Vogtle units in Georgia are estimated to cost $13.5 billion and the Summer units in South Carolina are estimated to cost $11.6 billion. MARK HOLT, CONGRESSIONAL RESEARCH SERVICE, NUCLEAR ENERGY POLICY 3-6 (2013).

[42] CENTER FOR STRATEGIC AND INTERNATIONAL STUDIES, RESTORING US LEADERSHIP IN NUCLEAR ENERGY 27 (2013) ("In many parts of the country, nuclear plants anchor the electric grid and help to assure the continuous, reliable availability of affordable, high-quality electricity services on which our economy – and our defense systems – depend. As these plants retire, large quantities of new baseload capacity will be needed to assure continued grid stability.")

[43] Satisfying new demand from population and economic growth can also challenge reliability but EIA predicts that electricity demand will increase by less than 1 percent per year by 2040. EIA, ANNUAL ENERGY OUTLOOK 2014 (EARLY RELEASE) 14 (2014).

[44] EIA, Annual Energy Review 2011 Table 8.11b Electric Net Summer Capacity: Electric Power Sector, 1949-2011 (2012) *available at* http://www.eia.gov/totalenergy/data/annual/showtext.cfm?t=ptb0811b (last visited Feb. 5, 2014).

[45] EIA, TODAY IN ENERGY: 27 GIGAWATTS OF COAL-FIRED CAPACITY TO RETIRE OVER NEXT FIVE YEARS *available at* http://www.eia.gov/todayinenergy/detail.cfm?id=7290 (last visited Feb. 4, 2014).

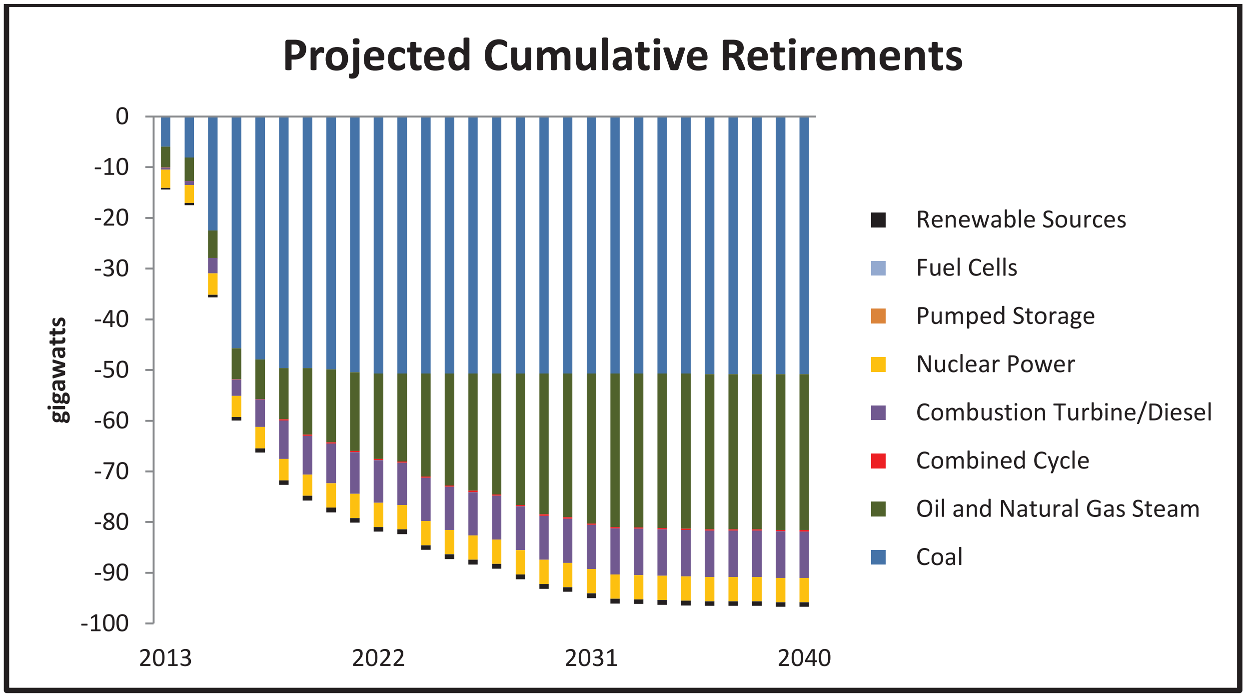
[46] *U.S. coal-fired power plant retirements top 9,000 MW in 2012*, REUTERS, July 27, 2012 *available at* http://www.reuters.com/article/2013/01/04/utilities-coal-usa-idUSL1E9C352P20130104 (last visited Feb. 4, 2014).

[47] EIA, AEO 2014 (EARLY RELEASE) Table A9 Electricity generating capacity (2014) *available at* http://www.eia.gov/oiaf/aeo/tablebrowser/#release=AEO2014ER&subject=0-AEO2014ER&table=9-AEO2014ER&region=0-0&cases=full2013-d102312a,ref2014er-d102413a (last visited Feb. 4, 2014).

[48] EIA, ANNUAL ENERGY OUTLOOK 2013 99. *See also* ICF INCORPORATED, CURRENT STATE AND FUTURE DIRECTION OF COAL-FIRED POWER IN THE EASTERN INTERCONNECTION (2013).

gigawatts that are already slated for retirement.[49] NERC experts have determined that coal plant peak generation will decline substantially, with a net reduction of 35.1 gigawatts by 2023.[50] Notably, as more plant retirement data has become available, NERC projections have risen substantially since 2012, more than doubling its prior projection of 16.3 gigawatts in anticipated retirements.[51]

Estimates obviously vary and the market is not static, but these numbers indicate that approximately 10 to 20 percent of existing coal capacity could be retired by the middle of the next decade. This deficit will have to be met, according to the projections, by more natural gas and renewable generation. It remains to be seen whether those resources, coupled with greater reliance on end-use consumer behavior for demand response efforts and other energy efficiency measures, will rise to meet that deficit quickly enough.



Source: EIA, Annual Energy Outlook 2014 (Early Release)

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[49] GOVERNMENT ACCOUNTABILITY OFFICE, SIGNIFICANT CHANGES ARE EXPECTED IN COAL-FUELED GENERATION, BUT COAL IS LIKELY TO REMAIN A KEY FUEL SOURCE 17 (2012).

[50] NERC, LONG TERM RELIABILITY ASSESSMENT 2013 at 10-11. For fossil-fuel plants generally, NERC accounts for 25 GW retirements since 2012, and estimates retirements to continue for 10 years largely in response to the confluence of final and potential environmental regulations, low natural gas prices and other economic factors. *Id.* at 3. NERC estimates that 85 gigawatts of fossil-fired retirements will occur by 2023. *Id*. Additionally, in 2010, experts at the Federal Energy Regulatory Commission (FERC) conducted an "informal, preliminary assessment" that, while heavily caveated and based only on an incomplete picture, concluded that 81 gigawatts of coal-fired generation was either "likely" or "very likely" to retire. Although dismissed by the then FERC Chairman as a "back of the envelope" calculation at the time, the Chairman elected not to conduct a formal assessment. *The American Energy Initiative (Day 12): The Impacts of the Environmental Protection Agency's New and Proposed Power Sector Regulations on Electric Reliability*, House Subcommittee on Energy and Power of the Committee on Energy and Commerce, 112th Cong. (Sept. 14, 2011) (statement of Jon Wellinghoff, Chairman, FERC); *see also Senator Murkowski's Questions to FERC, EPA on Electric Reliability* (2011) *available at* http://www.energy.senate.gov/public/index.cfm/2011/8/ii-e4a227e1-9ec8-4b24-ad3a-1fc0d9c28462 (last visited Feb. 5, 2014).

[51] NERC, LONG TERM RELIABILITY ASSESSMENT 2013 at 10-11.

Federal Regulations Should Not Be Proposed In A Vacuum

Although it is difficult to disaggregate precisely how many of the projected coal retirements are due to environmental regulations, rather than to the other broader forces described above, there are early indications. According to the GAO, "[a]vailable information indicates that existing and potential future regulations may make it more expensive to generate electricity using coal, thus affecting coal's future use."[52] Additionally, NERC recently determined that coal plant retirements will be particularly rapid between 2014 and 2016 when EPA's Mercury and Air Toxics rule becomes effective.[53]

The concern is not just one single rule, but rather it is the accretion of rules and the process by which they are unrelentingly proposed and implemented, as if in a vacuum. Multiple EPA rules will impact the utility industry; particularly, the following suite of regulations continues to draw the most attention:

1. **Cooling Water Intake 316(b) –** Stringent fish mortality and water intake velocity standards, without regard to site-specific factors, may make the standards unachievable.
2. **NAAQS Ozone –** Controversial air quality standards that have been challenged in court.
3. **NAAQS PM2.5 –** Additional air quality standards based on questionable cost-benefit studies.
4. **Regional Haze –** Air quality standards designed to remove, over a forty-year time span, any pollution causing an 'impairment of visibility' in Class I areas that will potentially force any power plant emitting visible emissions to cease operation or apply as of yet undeveloped emissions control measures.
5. **GHG NSPS for New Units –** Greenhouse gas emission standards designed to support President Obama's climate change agenda will likely eliminate coal as an option for affordably meeting demand growth.
6. **GHG NSPS for Existing Units –** An expansion of greenhouse gas emission standards from new to existing coal plants, which could exacerbate the already steady stream of power plant retirements.
7. **Coal Ash –** Regulation of the storage and containment of coal ash, a byproduct from power plants, which could further drive up compliance costs at new and existing plants.
8. **Reconsideration of the Mercury and Air Toxics (MATS or Utility MACT) Rule –** One of the most costly and stringent regulations, EPA was forced to respond to considered and persistent concerns over reliability as the rule was in the last stages of development before being issued in December 2011.[54]

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[52] GAO, SIGNIFICANT CHANGES ARE EXPECTED IN COAL-FUELED GENERATION, BUT COAL IS LIKELY TO REMAIN A KEY FUEL SOURCE 27 (2012).
[53] NERC, LONG TERM RELIABILITY ASSESSMENT 2013 at 10-11. Note that many of the listed EPA regulations will have impacts later than 2014-2016.
[54] *See Senator Murkowski's Questions to FERC, EPA on Electric Reliability* (2011) *available at* http://www.energy.senate.gov/public/index.cfm/2011/8/ii-e4a227e1-9ec8-4b24-ad3a-1fc0d9c28462 (last visited Feb. 5, 2014). This rule is still subject to reconsideration.

EPA is statutorily required to estimate the effects of its proposed and promulgated rules. EPA estimated that MATS would result in 4.7 gigawatts of coal-fired capacity retirements by 2015.[55] EPA also projected 4.8 gigawatts of coal-fired capacity retirements by 2014 as a result of its Cross-State Air Pollution Rule, which dealt with fine particular matter.[56] The estimates described above dwarf these numbers. Direct comparisons are again difficult because EPA's projections are limited to the impact of specific rules. EPA has not sought from NERC or the Federal Energy Regulatory Commission (FERC or the Commission) an analysis examining the impact of all of its rules in concert with one another. This has left the agency's personnel with broad discretion to attribute changes to outside forces of their choosing. Yet energy analysts have consistently cited EPA regulations as a major reason for retirements of baseload capacity.[57] And even EPA has conceded one of its individual rules could result in "localized reliability effects."[58] Ultimately, the precise numbers matter far less than the magnitude of the discrepancy between EPA's numbers and nearly everyone else's.

The federal agencies have long been on notice regarding the potential consequences of EPA regulations to grid stability. In 2012, GAO warned that the relevant federal agencies – the Department of Energy, FERC, and EPA – "have not established a formal, documented process for jointly and routinely monitoring industry's progress and, absent such a process, the complexity and extent of potential reliability challenges may not be clear to these agencies."[59] The Federal Government simply cannot afford to ignore this red flag and risk failing the test of electric reliability by refusing to examine the impacts of its own policies.

The Challenge

If the retirement assessments described above are accurate in broad terms – and recent experience suggests they are – then environmental rules, federal and state policies to advance renewable energy and distributed generation, wholesale electricity market rules, and potentially other federal regulations are likely to add to the challenge the U.S. electric grid already faces to maintain reliability, let alone improve it. Although widespread and persistent BPS outages do not

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[55] EPA, REGULATORY IMPACT ANALYSIS FOR THE FINAL MERCURY AND AIR TOXICS STANDARDS 3-17 (2011). Labor unions – including the International Brotherhood of Electrical Workers and the Utility Workers Union of America – forecast that MATS alone will result in 55 gigawatts of coal plant retirements and the loss of approximately 250,000 jobs. NEWTON JONES ET AL., LETTER TO CHAIRMAN WYDEN AND RANKING MEMBER MURKOWSKI (2014) *available at* http://1.usa.gov/1b6xV2V (last visited Feb. 6, 2014).

[56] EPA, REGULATORY IMPACT ANALYSIS FOR THE FEDERAL IMPLEMENTATION PLANS TO REDUCE INTERSTATE TRANSPORT OF FINE PARTICULATE MATTER AND OZONE IN 27 STATES; CORRECTION OF SIP APPROVALS FOR 22 STATES 262 (2011).

[57] *See, e.g., U.S. coal-fired power plant retirements top 9,000 MW in 2012*, REUTERS January 4, 2013 *available at* http://www.reuters.com/article/2013/01/04/utilities-coal-usa-idUSL1E9C352P20130104 (last visited Feb. 4, 2014).

[58] In its final rule, EPA stated that "Although we do not expect to see any regional reliability problems, we acknowledge that there could be localized reliability issues in some areas – due to transmission constraints or location-specific ancillary services provided by retiring generation – if utilities and other entities with responsibility for maintaining electric reliability do not take actions to mitigate such issues in a timely fashion." EPA, *National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units* 77 Fed. Reg. 9409 (Feb. 16, 2012) (40 CFR Parts 60 and 63).

[59] GAO, BETTER MONITORING BY AGENCIES COULD STRENGTHEN EFFORTS TO ADDRESS POTENTIAL CHALLENGES 1 (2012). Note that NERC must be part of an inter-agency process.

appear to be in the offing, there is a quiet consensus that the risk of "localized" effects is growing, which may threaten reliability for a region such as a metropolitan area or a larger electric sub-region covering part of one or more states. The costs of ensuring that even "localized" effects do not occur will accumulate over time. This is especially true if other federal policy threats to baseload generation persist. And it is also true that given that the electricity flows through the grid at the speed of light, "localized" effects can too quickly spur cascading outages that cause widespread blackouts.

Federal Agencies Must Work Together And With Industry To Ensure Grid Stability

At a minimum, federal agencies with a stake in the matter, notably FERC and EPA, must communicate honestly, effectively, and in a timely and transparent manner through a formal and documented interagency process. Government agencies have a responsibility to work together to ensure that their actions do not increase the risk of electric reliability disruptions. Most important in this regard, FERC must be an unambiguous champion for reliability. The Commission is the federal agency with the ultimate statutory responsibility for reliability. EPA clearly has critical obligations with respect to air and water quality. In meeting those obligations, however, it should not pursue an industrial planning agenda to drive technology through regulation and should be required to take carefully into account the views of reliability regulators FERC and NERC. [60] Now is the time for a vigorous, candid discussion of ideas for amending the Federal Power Act to provide for a more formal interagency process to ensure the reliability of the grid and amplify the contributions that independent analysis can bring to bear.[61]

For their part, entities with the legal and commercial responsibility to keep the lights on – and these are primarily providers and transmitters of electricity – should not be circumspect about the risks that interconnected electric systems face. In the 2005 Act, Congress recognized the electric industry's important voice when it called for robust stakeholder participation in establishing mandatory reliability standards. These professionals and the organizations that employ them are less comfortable discussing the difficult topic of how government action may be increasing risks for electric reliability. Being regulated, entities within the electric industry are naturally reserved. It is plausible also that they do not want the mere discussion of risk – even for a moment – to be seen as "crying wolf" on reliability. That is certainly understandable, but the potential impact of federal regulation on electric reliability – including but not limited to environmental regulation – is a topic that we cannot ignore with the hope that it will simply go away.

[60] As the agency ultimately in charge of ensuring the nation's electric reliability, FERC should work closely with the ERO to engage fully on this issue with a formal report of the cumulative effect of government regulations on baseload capacity and the reliability of the grid.
[61] Legislation has been introduced this Congress to address portions of this problem, but policymakers need to take a broad view with the goal of preempting and mitigating reliability problems before they occur.

A Call For Action

Now is the time to gather facts concerning the impact of policies intended to promote the introduction of new generating technologies with an eye to clarifying the federal role with respect to these emerging issues. Industry, regulators, and other leaders should share their candid views more vigorously, "letting the chips fall where they may." We need greater confidence that the ongoing improvements we seek in electric system performance will be appropriately balanced. The reliability of electric service, along with its affordability and environmental performance, must be continuously maintained and improved. At a minimum, our federal government agencies must formally review and recognize the realistic and predictable consequences of their regulatory actions and Congress should conduct more regular and comprehensive oversight to establish the facts on which reforms should be based. It may also be time to consider regulatory and even legislative reforms that will ensure a more robust role for electric reliability professionals in evaluating environmental rules.