

**Testimony of Susan F. Tierney, Ph.D.**

**Before the U.S. House of Representatives  
Committee on Energy and Commerce  
Subcommittee on Energy**

**Hearing on  
“Powering America: Defining Reliability in a Transforming Electricity Industry”**

**September 12, 2017**

**Summary of Testimony**

Good morning, Chairman Upton, Ranking Member Rush, and Members of the Subcommittee. My name is Susan Tierney, and I am a Senior Advisor at Analysis Group. Thank you for inviting me to testify on this important topic. I am testifying on my own behalf at today’s hearing.

As you have heard from other witnesses today, the U.S. electric power system is undergoing a major transition. The changes have been driven predominantly by low natural gas prices, which have led to competition with output at coal plants. Flat electricity demand and declining costs of wind and solar power have played a much smaller role in the changing electricity mix. There is little doubt that the transition will lead to a power system with a resource mix and consumption patterns quite different from what the industry has experienced in recent decades. Contrary to what many public officials say, today’s electric system is more diverse than in the past, and has contributed positively to declines in the overall cost of living.

These changes are taking place in the context of some important continuities, however, perhaps most notably the electric industry’s successful maintenance of power-system reliability. Even so, a common occurrence in the industry is for observers to raise reliability concerns whenever technology, market or policy trends are affecting the balance of resources in the system and when some parties feel their particular interests will be adversely affected. The recent Grid Study by the Department of Energy itself sprang from Secretary Perry’s stated concerns about whether certain policies were adversely

affecting electric reliability. Raising the reliability red flag is a powerful tool in public discussions because reliability simply cannot be jeopardized.

But policy and/or market changes rarely if ever actually end up in reliability problems. Nevertheless, these discussions play an important role in focusing the attention of the industry on taking the steps necessary to continue to ensure reliable electric service to Americans.

The Federal Power Act, with the changes introduced with the Energy Policy Act of 2005, has contributed substantially to supporting the tools needed to assure a reliable power supply. The electric industry's many players are keenly organized and strongly oriented toward safe and reliable operations. There are well-established laws, rules, practices, procedures, agreements, investments, regulations, and enforceable standards that ensure reliable operations of the system, day in and day out. Even as low gas prices put financial pressure on all generating technologies, the system remains reliable.

Although Secretary Perry raised questions about whether "baseload power is necessary to a well-functioning grid," the DOE Staff Report appropriately identifies 'baseload' as an economic, rather than technology-specific concept, and recognizes that many of the coal plants that retired since 2002 were not operating as 'baseload' at the time of their retirement.

Indeed, reliability itself is a technology-neutral concept. As noted in NERC reviews of reliability, what is required to maintain a reliable system is a portfolio of resources in sufficient quantity that together can meet the system's operational needs for voltage support, frequency control, reactive and real power, ramping and load following capability, and the other essential reliability services needed to maintain operational reliability. Various simplifying terms used historically to describe the way power plants were operating – e.g., "baseload," "intermediate," and "peaking" – were for convenience, not to

describe essential reliability services, or what technologies or fuels were required to maintain reliability.

And despite how many observers have characterized the content of the study, the Grid Study itself does not support a finding that "baseload" resources are essential to the reliability of the power grid. The Report appropriately describes the many reliability services provided capably by various types of generating technologies.

There are, however, some interesting strains in the evolving power system. I discuss them in my full testimony, but I want to highlight four of them in particular: the growing interdependencies of the gas and electric industries; the increasing tensions arising from states' adoption of policies that affect prices in competitive wholesale markets; the need for better attention to electric-system resiliency and for R&D on modernizing the grid; and the implications of market conditions for existing nuclear plants that provide electricity without carbon emissions.

Improved coordination across the natural gas and electric industries is an issue of high and increasing importance, as noted in a number of recent reports (including the Grid Study and a July 2017 National Academy of Sciences committee report on electric-system resiliency, on which I participated). The latter stated that the "conventional wisdom is that the electric industry will become even more dependent upon natural gas than it has in recent years, and the natural gas industry looks to a future in which significant growth in demand depends upon developments in the power sector. For the electric system to become more reliable and resilient, attention must be paid to assure robust systems and practices across the two industries." FERC has authority to address electric system reliability issues, but not on the natural gas side. I encourage Congress to consider whether legislative modifications are needed to the Federal Power Act and/or the Natural Gas Act in light of the growing interdependencies of the two industries.

Regarding state policies and wholesale power markets: Few if any of the people who currently sit in state decision-making positions with responsibility for electric-industry matters were in those positions at the time their states decided to restructure their electric industries and to join a wholesale market regulated by FERC. It is not reasonable to expect that states will honor allegiance to the design of FERC-regulated markets more than their local objectives for economic development, clean energy, affordable power, distributed energy systems, mitigating climate change, and so forth. States will likely continue to adopt laws promoting one type of resource over another, and this will likely continue to raise tensions with FERC's responsibilities under the Federal Power Act. This deserves more congressional attention.

Given the essential role of electricity in modern society, the grid needs not only to be reliable but also more resilient. At a time when so many people are suffering from the impacts of flooding, wild fires, hurricanes and other severe weather events, I don't need to spend time explaining why improved grid resiliency is important. The range of potential disruptive events is broad, and the system needs to be designed to handle high-impact events ranging from severe weather to cyber attacks. This is the point of the recent National Academy Committee's grid report, and was an important finding and recommendation in the DOE Grid Study. Given that grid reliability and resiliency are so important, Congress and the Administration should be supporting more, rather than less, funding for R&D on modernizing the grid. The DOE's Electricity Advisory Committee (which I chaired until last month) recently endorsed such R&D as an essential federal function that is in the national interest.

Finally, in spite of what had been anticipated at the time Secretary Perry called for a new analysis, DOE's new Grid Study concluded that retirements of the least-efficient coal-fired power plants have resulted largely from fundamental market forces. This situation differs from that of existing nuclear

units that are currently under financial pressure in wholesale markets where prices (and revenues) are tied to low gas prices: In contrast to coal plants, nuclear plants produce power without carbon emissions, and yet wholesale markets provide little if any compensation for this attribute. This market failure works to the detriment of nuclear plants and other non-carbon emitting generating technologies, like hydropower, wind, solar, and energy efficiency as well. Premature retirements of safely operating nuclear plants is of concern for this reason. Several states have been stepping up to address this issue in the absence of federal action.

### **Full Testimony**

My name is Susan Tierney, and I am a Senior Advisor at Analysis Group, Inc., a 700-person economic consulting firm headquartered in Boston, Massachusetts, with other U.S. offices in California, Colorado, Illinois, New York, Texas, and Washington, D.C.

I appreciate the opportunity to testify today on the critically important topic of electric-system reliability.<sup>1</sup> I am testifying on my own behalf at today's hearing.<sup>2</sup>

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<sup>1</sup> As indicated in my attached CV, I have been involved in issues related to public utilities, ratemaking and electric industry regulation, and energy and environmental economics and policy for over 25 years. During this period, I have worked on electric and gas industry issues as a utility regulator and energy/environmental policy maker, consultant, academic, and expert witness. I have been a consultant and advisor to private energy companies, grid operators, government agencies, large and small energy consumers, environmental organizations, foundations, Indian tribes, and other organizations on a variety of economic and policy issues in the energy sector. Before becoming a consultant, I held several senior governmental policy positions in state and federal government, having been appointed by elected executives from both political parties. I served as the Assistant Secretary for Policy at the U.S. Department of Energy from early 1993 through summer 1995. I held senior positions in the Massachusetts state government as Secretary of Environmental Affairs; Commissioner of the Department of Public Utilities; and Executive Director of the Energy Facilities Siting Council. My Ph.D. in regional planning is from Cornell University. I previously taught at the University of California at Irvine, and recently at the MIT. I am a Visiting Fellow in Policy Practice at the University of Chicago's Energy Policy Institute; and a member of the advisory councils at New York University's Policy Integrity Institute, Duke University's Nicholas School for the Environment, and Columbia University's Center for Global Energy Policy. I currently sit on several non-profit boards and commissions, including as chair of the Advisory Council of the National Renewable Energy Laboratory; chair of ClimateWorks Foundation; a director of World Resources Institute, the Energy Foundation, Resources for the Future, the Keystone Center, and the Alliance to Save Energy. I am a member of the NYISO's Environmental Advisory Council; and just completed service as the chair of the Department of Energy's Electricity Advisory Council and a member of the National Academy of Sciences committee on resiliency of the U.S. electric system. I was co-lead convening author of the Energy Supply and Use chapter of the National Climate Assessment, served on the Secretary of Energy's Advisory Board, and chaired the Policy Subgroup of the National Petroleum Council's study of the North American natural gas and oil resource base. Previously, I served as co-chair of the National Commission on Energy Policy, as a representative to

Although the nation's mix of electric generating resources has always changed over time, it is increasingly evident that the U.S. electric power system is now going through a major transition. The current changes have been driven by several things: fundamental shifts in the prices of fuels for power generation (in particular, natural gas); improvements in cost and performance of traditional and renewable generating technologies; the rapid emergence of many types of distributed energy resources including energy efficiency; preferences of customers, large and small; and state and federal policies promoting the development and commercialization of advanced energy technologies. There is little doubt that the transition in the industry will lead to a power system with a resource mix and consumption patterns quite different from the ones to which the industry has grown accustomed in recent decades. The increasing diversity of generation supply has lowered wholesale electricity costs in most parts of the U.S. and has contributed to recent declines in consumers' overall cost of living.<sup>3</sup>

These changes are taking place in the context of some important continuities – perhaps most notably the electric industry's successful maintenance of power-system reliability. Even so, a common occurrence in the industry is for observers to raise reliability concerns whenever technology, market or policy trends or events are affecting or may affect the balance of resources in the system. Such reliability concerns have been raised regularly over decades in the face of industry changes. It is a particularly powerful tool in public discussions, because reliability simply

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committees of the North American Electric Reliability Council; and a member of the National Academy of Sciences' Committee on Enhancing the Robustness and Resilience of Electrical Transmission and Distribution in the United States to Terrorist Attack.

<sup>2</sup> As indicated on my "Truth in Testimony" form, I am testifying on my own behalf, and neither on behalf of a governmental entity nor a non-governmental entity (other than myself). I have not received a federal grant (or subgrant) or contract (or subcontract) during the current fiscal year or either of the two preceding fiscal years.

<sup>3</sup> This paragraph is excerpted from a report I recently co-authored and which I have included as Attachment 1 to my statement: Paul Hibbard, Susan Tierney and Katherine Franklin, "Electricity Markets, Reliability and the Evolving U.S. Power System," June 2017. [http://www.analysisgroup.com/uploadedfiles/content/insights/publishing/ag\\_markets\\_reliability\\_final\\_june\\_2017.pdf](http://www.analysisgroup.com/uploadedfiles/content/insights/publishing/ag_markets_reliability_final_june_2017.pdf).

cannot be jeopardized. Sometimes the warnings spring from genuine concerns, such as the need to address localized reliability impacts of potential plant closures; other times they reflect a first line of defense by opponents of the changes underway in the industry, or those potentially adversely affected. The recent Grid Study by the U.S. Department of Energy itself sprang from Secretary Perry's stated concerns about whether certain policies were adversely affecting electric security and reliability. So, there's a discernible pattern: the prospect of change riles people up in various ways, leading to new reliability assessments, careful evaluations of new and upcoming challenges, and concrete steps to lower the chances of reliability problems occurring.

In fact, policy and/or market changes rarely if ever actually end up adversely affecting electric system reliability. A vast network of entities and organizations, combined with a complex set of reliability laws, rules, practices, systems, and procedures, ensures this outcome. Nevertheless, these discussions play an important role in focusing the attention of the industry on taking the steps necessary to continue to ensure reliable electric service to Americans.

The Federal Power Act, including the changes that were introduced by the Energy Policy Act of 2005, has contributed substantially to supporting the tools needed by the industry to assure a reliable supply of power for Americans on a 24/7 basis. EPACT gave the Federal Energy Regulatory Commission increased authority to assure reliability through an industry standard-setting board (the North American Electric Reliability Corporation, or NERC) establishing mandatory standards to be implemented in the bulk power system, backed up by FERC's new enforcement capability.

The electric industry's many players are keenly organized and strongly oriented toward safe and reliable operations. There are well-established procedures, regulations, and enforceable standards in place to ensure reliable operations of the system, day in and day out.<sup>4</sup> Among other things, these "business-as-usual" procedures include:

- Assigning specific roles and responsibilities to different organizations, including regional reliability organizations, grid operators, power plant and transmission owners, regulators, and many others;
- Planning processes to look ahead at what actions and assets are needed to make sure that the overall system has the capabilities to run smoothly;
- Maintaining secure communication systems, operating protocols, and real-time monitoring processes to alert participants to any problems as they arise, and initiating corrective actions when needed; and
- Relying upon systems of reserves, asset redundancies, back-up action plans, and mutual-assistance plans that kick in automatically when some part of the system has a problem.

There are some interesting strains in the system, however. In particular, I want to call attention to the following four imperatives: the need to address issues relating to growing interdependencies of the gas and electric industries; the increasing tensions among state policies affecting prices in wholesale markets; the need for better attention to electric-system resiliency and for R&D related

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<sup>4</sup> This paragraph and the bullets below it are an excerpt from a 2015 report I co-authored and which I have included as Attachment 2 to my statement: Susan Tierney, Paul Hibbard and Craig Aubuchon, "Electric System Reliability and EPA's Clean Power Plan: Tools and Practices," February 2015, [http://www.analysisgroup.com/uploadedfiles/content/insights/publishing/electric\\_system\\_reliability\\_and\\_epas\\_clean\\_power\\_plan\\_tools\\_and\\_practices.pdf](http://www.analysisgroup.com/uploadedfiles/content/insights/publishing/electric_system_reliability_and_epas_clean_power_plan_tools_and_practices.pdf).



to grid modernization; and the implications of market conditions for existing nuclear plants that provide electricity without carbon emissions.

The August 2017 Staff Report to the Secretary on Electricity Markets and Reliability (the "DOE Grid Study" or the "Staff Report") included a number of findings on these issues, and I agree with many of them, as I explain further below. But before I do, however, I need to distance myself from the Grid Study's original premise, grounded in the Secretary's April 14<sup>th</sup> letter directing the staff to prepare the report, is that "baseload power is necessary to a well-functioning grid." The Staff Report appropriately identifies that 'baseload' is an economic, rather than technology-specific concept, and recognizes that many of the coal plants that retired since 2002 were not operating as 'baseload' at the time of their retirement.<sup>5</sup> Historically, this phrase has applied to plants (such as nuclear and coal plants) that were expensive to build but cheap to operate, such that they ran around the clock. However, they are not the only types of technologies capable of providing around-the-clock power supply and other functions necessary for reliable electric system operations, as noted in the DOE Staff Report.

Reliability is a technology-neutral concept. As noted in NERC reviews of reliability, what is required to maintain a reliable system is a set of resources in sufficient quantity that together can meet the system's operational needs for voltage support, frequency control, reactive and real

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<sup>5</sup> "Many of the power plants that retired between 2002 and 2016 were used for baseload generation in the past, but were no longer operating in that role at the time of retirement due to changes in electricity market dynamics. With the sustained drop in natural gas prices, for example, natural gas-fired combined-cycle (NGCC) plants are currently a less costly source of baseload generation than coal or nuclear power in many regions of the country." Grid Study, page 6 and also on page 39 " Low-cost, abundant natural gas and the development of highly-efficient NGCC plants resulted in a new baseload competitor to the existing coal, nuclear, and hydroelectric plants." Grid Study, page 13. "To date, however, the data do not show a widespread relationship between VRE penetration and baseload retirements." Grid Study, page 50.

power, ramping and load following capability, and so forth. While not all of a system's resources are equal when it comes to the attributes they provide to system operators to manage operational reliability, what is important is that the mix of resources available to system operators can in aggregate, and in combination with system operator actions, provide the essential reliability services needed to maintain operational reliability. In other words, various simplifications used historically to describe the way resources were being used – e.g., "baseload," "intermediate," and "peaking" – were used for convenience and simplicity, not to describe essential reliability services, or what was required to maintain reliability. The power system needs the combination of energy, capacity, and flexibility to maintain reliability.

Despite how many observers have characterized the content of the study, the Staff Report does not support a finding that "baseload" resources are essential to the reliability of the power grid. The Report appropriately describes the many reliability services provide in the past and today by various types of generating technologies.

There are some findings of the Grid Study with which I agree. (The quoted text in the bulleted paragraphs below is from the Grid Study.)

- The nation's "centrally-organized markets have achieved reliable wholesale electricity delivery with economic efficiencies in their short-term operations...[and] are currently functioning as designed—to ensure reliability and minimize the short-term costs of wholesale electricity—despite pressures from flat demand growth, Federal and state policy interventions, and the massive economic shift in the relative economics of natural gas

compared to other fuels." This is the same conclusion my co-authors and I reached in a study we produced in June 2017. (See Attachment 1 to my testimony today.)

- "Market designs may be inadequate given potential future challenges. VRE [variable renewable energy]—with near-zero marginal costs and if at high penetrations—will lower wholesale energy prices independent of effects of the current low natural gas prices...requiring careful consideration of continued market evolutions." This is a point I made in a statement before the Federal Energy Regulatory Commission at its May 2017 Technical Conference<sup>6</sup> and in a prior statement at FERC's 2013 Technical Conference on Capacity Markets.<sup>7</sup> (Attachments 3 and 4 to my statement here today.)
- "While power plants retire for a variety of reasons, several factors have contributed to recent retirements and continuing pressure for additional retirements. The biggest contributor to coal and nuclear plant retirements has been the advantaged economics of natural gas-fired generation." Also, these "trends have placed a premium on flexible output rather than the steady output of traditional baseload power plants. This flexibility is generally provided by generation resources. However, nongeneration sources of flexibility—such as flexible demand, increased transmission, and energy storage technologies—are being explored as ways to enhance system flexibility." These are points I have made in two reports: one, on the implications of current wholesale power markets for existing coal plants;<sup>8</sup> the other on the

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<sup>6</sup> Comments of Susan F. Tierney before the Federal Energy Regulatory Commission, Docket No. AD17-11-000, State Policies and Wholesale Markets Operated by ISO New England Inc., New York Independent System Operator, Inc., and PJM Interconnection, L.L.C., May 2 2017. <https://www.ferc.gov/CalendarFiles/20170426151811-Tierney,%20Analysis%20Group.pdf>.

<sup>7</sup> Comments of Susan F. Tierney before the Federal Energy Regulatory Commission, Docket No. AD13-7-000, September 9, 2013. <https://www.ferc.gov/CalendarFiles/20130911145004-Tierney%20Comments.pdf>.

<sup>8</sup> Susan Tierney, "Why Coal Plants Retire: Market Fundamentals as of 2012," February 16, 2012, [http://www.analysisgroup.com/uploadedfiles/content/news\\_and\\_events/news/2012\\_tierney\\_whycoalplantsretire.pdf](http://www.analysisgroup.com/uploadedfiles/content/news_and_events/news/2012_tierney_whycoalplantsretire.pdf). Susan Tierney,

implications for existing nuclear plants of current market conditions *and* the absence of policies to compensate suppliers of electricity from technologies with no carbon emissions).<sup>9</sup>

- "Markets need further study and reform to address future services essential to grid reliability and resilience. System operators are working toward recognizing, defining, and compensating for resource attributes that enhance reliability and resilience (on both the supply and demand side). However, further efforts should reflect the urgent need for clear definitions of reliability and resilience-enhancing attributes and should quickly establish the market means to value or the regulatory means to provide them." This is a point I made in the reports and comments I noted previously, as well as in a recent report of the National Academy of Sciences ("NAS") Committee on Enhancing the Resilience of the Nation's Electric Power Transmission and Distribution System (on which I served as a committee member).<sup>10</sup> Note that the NAS report found that "a resilient system is one that acknowledges that outages can occur, prepares to deal with them, minimizes their impact when they occur, is able to restore service quickly, and draws lessons from the experience to improve performance in the future."<sup>11</sup>
- "Society places value on attributes of electricity provision beyond those compensated by the current design of the wholesale market. Americans and their elected representatives value the various benefits specific power plants offer, such as jobs, community economic

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"The U.S. Coal Industry: Challenging Transitions in the 21<sup>st</sup> Century," September 2016, <http://www.analysisgroup.com/insights/publishing/the-u-s--coal-industry--challenging-transitions-in-the-21st-century/>

<sup>9</sup> Susan Tierney, "Don't let nuke plants go too fast," The Hill, July 15, 2015. <http://thehill.com/opinion/op-ed/247858-dont-let-nuke-plants-go-too-fast>.

<sup>10</sup> National Academies of Sciences, Engineering, and Medicine. 2017. Enhancing the Resilience of the Nation's Electricity System. Washington, D.C.: The National Academies Press: <https://doi.org/10.17226/24836>. (hereafter referred to as the "NAS Report") <https://www.nap.edu/catalog/24836/enhancing-the-resilience-of-the-nations-electricity-system>.

<sup>11</sup> NAS Report, page 1-6.

development, low emissions, local tax payments, resilience, energy security, or the national security benefits associated with a nuclear industrial base. Most of these benefits are not recognized or compensated by wholesale electricity markets, and this has given rise to a variety of state and private efforts that include keeping open or shutting down established baseload generators and incentivizing VRE generation." This is a point I made in my comments at FERC's Technical Conferences, noted above.

- "Fuel assurance is a growing consideration for the electricity system. Maintaining onsite fuel resources is one way to improve fuel assurance, but most generation technologies have experienced fuel deliverability challenges in the past." I have made this point in many of the studies noted above.
  
- "Recent severe weather events have demonstrated the need to improve system resilience. The range of potential disruptive events is broad, and the system needs to be designed to handle high-impact, low probability events. This makes it very challenging to develop cost-effective programs to improve resilience at the regional, state, or utility levels. Planning, practice, and coordination on an all-hazards basis and having a mix of resources and fuels available when a major disturbance occurs are both essential to fast response. Work still remains to identify facilities that merit hardening; stage periodic exercises and drills so that governmental agencies and utilities are prepared for emergencies; and ensure that wholesale electricity markets are designed to recognize and incentivize investments that would achieve or enhance resilience-related objectives." This is consistent with our Committee's findings in the recent National Academy of Science report on grid resiliency.

I agree with some -- but not all -- of the recommendations made by the DOE staff in their report to Secretary Perry. For example, I agree with the following recommendations -- and have previously stated similar positions in various public settings.

- "FERC should expedite its efforts with states, RTO/ISOs, and other stakeholders to improve energy price formation in centrally-organized wholesale electricity markets." This is a worthwhile focus on FERC's attention, as I have previously conveyed to the FERC itself.
- "Where feasible and within its statutory authority, FERC should study and make recommendations regarding efforts to require valuation of new and existing ESS [Essential Reliability Services] by creating fuel-neutral markets and/or regulatory mechanisms that compensate grid participants for services that are necessary to support reliable grid operations,,,,. [This could include more study of] mechanisms for enabling equitable, value-based remuneration for desired grid attributes—such as ERS, fuel availability, high resilience, low emissions, flexibility, etc.—with alternative market and non-market structures." As my co-authors and I describe in detail in our June 2017 study (Attachment 1 to this testimony), different generating technologies -- both conventional and advanced energy technologies -- provide different reliability services, and no technology provides all of the services required to keep the system operating reliably. Wholesale markets should include compensation for these differentiated services.
- FERC should continue to "evaluate ongoing capacity market reforms." And, "with significant amounts of near-zero marginal cost generation available, security-constrained economic dispatch of BPS based on marginal costs may not sufficiently compensate resources

for all fixed and variable costs. Academic and other research should be expanded in this area, to include capacity market reforms and the role of capacity markets in a higher VRE/low marginal cost system." I have stated my view in my comments at the 2013 and 2017 FERC Technical Conferences that capacity markets as currently structured may not be sustainable, especially in light of current energy-market conditions based on low natural-gas costs and with increasing shares of resources having high fixed costs and no-to-low operating costs. This, too, is one of the reasons why many states are now taking action (e.g., encouraging long-term bilateral contracts with certain generators; establishing policies like zero-emission credits), and, in the process, creating the kinds of tensions with the Federal Power Act that have led to major court cases and opinions in recent years.

- "DOE should support utility, grid operator, and consumer efforts to enhance system resilience. Transmission planning entities should conduct periodic disaster preparedness exercises involving electric utilities, regional offices of Federal agencies, and state agencies...DOE should focus R&D efforts to enhance utility, grid operator, and consumer efforts to enhance system reliability and resilience....Focus R&D on improving VRE integration through grid modernization technologies that can increase grid operational flexibility and reliability through a variety of innovations in sensors and controls, storage technology, grid integration, and advanced power electronics. The Grid Modernization Initiative should also consider additional applications of high-performance computing for grid modeling to advance grid resilience." The Staff Report's recommendations point to the significance of a robust portfolio of grid-modernization research, something that the DOE's

Electricity Advisory Council (which I chaired until last month) endorsed as an essential federal function in the national interest.<sup>12</sup>

- "Utilities, states, FERC, and DOE should support increased coordination between the electric and natural gas industries to address potential reliability and resilience concerns associated with organizational and infrastructure differences." I agree strongly with this point, as I explain further below.
- "EIA [the Energy Information Administration] and NERC should examine ways to improve power generator fuel delivery data collection; additional data on fuel deliveries and potential disruptions would further improve forecasting necessary for electric reliability planning." This would be helpful in enhancing visibility about fuel supplies to power plants.
- "Develop policy metrics and tools for evaluating BPS [bulk power system]-wide provision of resilience and considering all aspects of the electricity system that contribute to resilience, including regional generation characteristics, imports and exports, fuel supply and storage, transmission capability, DR [demand response], electricity storage, inertia, and other factors that determine the ability of grid operators to provide reliable electricity supplies.... Each RTO/ISO should strive to explicitly define resilience on its system and conduct resource diversity assessments to more fully understand the resilience of different resource portfolios. Federal, state, and local work to define and support system-wide resilience is also needed."

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<sup>12</sup> Susan Tierney, Chair, Electricity Advisory Committee, to Patricia Hoffman, Acting Assistant Secretary for Electricity Delivery and Energy Reliability, "New Technologies Require A Modern Grid: Report on the Department of Energy Grid Modernization Initiative," June 2017, [https://energy.gov/sites/prod/files/2017/06/f34/EAC%20-%20New%20Technologies%20Require%20a%20Modern%20Grid%20Report%20on%20the%20US%20DOE%20GMI%20-...\\_0.pdf](https://energy.gov/sites/prod/files/2017/06/f34/EAC%20-%20New%20Technologies%20Require%20a%20Modern%20Grid%20Report%20on%20the%20US%20DOE%20GMI%20-..._0.pdf). (Included as Attachment 5 to this testimony.)



The recent NAS Report makes similar findings and recommendations on the need for resiliency metrics.

So, while I am in agreement with many of the Grid Study's recommendations, there are others with which I disagree. I do not agree with the Staff Report's recommendations relating to "energy dominance" and do not believe that those recommendations logically follow from the factual findings in the Grid Study itself. Furthermore, I disagree with the recommendations relating to modifications of the Environmental Protection Agency's New Source Review program for coal-fired power plants. Retirements of coal-fired power plants are largely the result of fundamental market forces, and not New Source Review. In fact, such retirements have rendered the system more diverse, not less: the retirements of many of the least-efficient coal-fired power plants, combined with the increase in gas-fired generation and output at central-station and distributed wind and solar facilities, and the availability of new systems to manage certain loads have supported a more diverse and reliable system.

Further, coal-fired power plants benefit from the absence of carbon-control policies in most parts of the nation – a benefit that, by the way, nuclear power does not get. This market failure works to the detriment of nuclear plants and other non-carbon emitting generating technologies, like hydropower, wind, solar, and energy efficiency as well). This is the attribute of nuclear technologies for which most wholesale power markets fundamentally fail to provide much (if any) compensation. Premature retirements of safely operating nuclear plants deserves differential attention from coal-fired power plants as a result. Unfortunately, the Staff Report did not draw this inherent distinction between the attributes of power supplied by nuclear plants relative to

coal-fired power plants. Several states have been stepping up to address this issue in the absence of federal action.

Finally, with regard to the issue of improved coordination of the natural gas and electric industries, I want to make one additional comment: This is an issue of high and increasing importance, with attention called to this by the recent NAS Report, by the FERC, by parties associated with the North American Energy Standards Board ("NAESB"), and many others. As summarized in the NAS Report: "The conventional wisdom is that the electric industry will become even more dependent upon natural gas than it has in recent years, and the natural gas industry looks to a future in which significant growth in demand depends upon developments in the power sector. For the electric system to become more reliable and resilient, attention must be paid to assure robust systems and practices across the two industries." FERC enjoys authority to address electric system reliability issues, and has rate-making and other regulatory authority over segments of the natural-gas industry. But there are portions of the electricity and natural-gas supply chains (e.g., natural-gas production) that are not regulated by a reliability entity. Much of the discussion on the gas/electric system interdependency issues relates to deliveries of gas on a just-in-time basis to an electric system that increasingly requires dispatch of nimble and fast-ramping gas-fired power plants. But there are also other imperative concerns that also need to be addressed, notably the need for cyber security on the gas side to bring it in line with the electric side, which itself is in increasing its own cyber-control systems. For multiple important reasons, Congress needs to pay special attention to whether there are legislative modifications needed to the Federal Power Act and/or the Natural Gas Act.

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**Hearing on “Powering America: Defining Reliability in a Transforming Electricity Industry”**  
**September 12, 2017**

**Summary of Testimony**

Good morning, Chairman Upton, Ranking Member Rush, and Members of the Subcommittee. My name is Susan Tierney, and I am a Senior Advisor at Analysis Group. Thank you for inviting me to testify on this important topic. I am testifying on my own behalf at today’s hearing.

As you have heard from other witnesses today, the U.S. electric power system is undergoing a major transition. The changes have been driven predominantly by low natural gas prices, which have led to competition with output at coal plants. Flat electricity demand and declining costs of wind and solar power have played a much smaller role in the changing electricity mix. There is little doubt that the transition will lead to a power system with a resource mix and consumption patterns quite different from what the industry has experienced in recent decades. Contrary to what many public officials say, today’s electric system is more diverse than in the past, and has contributed positively to declines in the overall cost of living.

These changes are taking place in the context of some important continuities, however, perhaps most notably the electric industry’s successful maintenance of power-system reliability. Even so, a common occurrence in the industry is for observers to raise reliability concerns whenever technology, market or policy trends are affecting the balance of resources in the system and when some parties feel their particular interests will be adversely affected. The recent Grid Study by the Department of Energy itself sprang from Secretary Perry’s stated concerns about whether certain policies were adversely affecting electric reliability. Raising the reliability red flag is a powerful tool in public discussions because reliability simply cannot be jeopardized.

But policy and/or market changes rarely if ever actually end up in reliability problems. Nevertheless, these discussions play an important role in focusing the attention of the industry on taking the steps necessary to continue to ensure reliable electric service to Americans.

The Federal Power Act, with the changes introduced with the Energy Policy Act of 2005, has contributed substantially to supporting the tools needed to assure a reliable power supply. The electric industry’s many players are keenly organized and strongly oriented toward safe and reliable operations. There are well-established laws, rules, practices, procedures, agreements, investments, regulations, and enforceable standards that ensure reliable operations of the system, day in and day out. Even as low gas prices put financial pressure on all generating technologies, the system remains reliable.

Although Secretary Perry raised questions about whether “baseload power is necessary to a well-functioning grid,” the DOE Staff Report appropriately identifies ‘baseload’ as an economic, rather than technology-specific concept, and recognizes that many of the coal plants that retired since 2002 were not operating as ‘baseload’ at the time of their retirement.

Indeed, reliability itself is a technology-neutral concept. As noted in NERC reviews of reliability, what is required to maintain a reliable system is a portfolio of resources in sufficient quantity that together can meet the system’s operational needs for voltage support, frequency control, reactive and real power, ramping and load following capability, and the other essential reliability services needed to maintain operational reliability. Various simplifying terms used historically to describe the way power plants were operating – e.g., “baseload,” “intermediate,” and “peaking” – were for convenience, not to describe essential reliability services, or what technologies or fuels were required to maintain reliability. And despite how many observers have characterized the content of the study, the Grid Study itself does not support a finding that

"baseload" resources are essential to the reliability of the power grid. The Report appropriately describes the many reliability services provided capably by various types of generating technologies.

There are, however, some interesting strains in the evolving power system. I discuss them in my full testimony, but I want to highlight four of them in particular: the growing interdependencies of the gas and electric industries; the increasing tensions arising from states' adoption of policies that affect prices in competitive wholesale markets; the need for better attention to electric-system resiliency and for R&D on modernizing the grid; and the implications of market conditions for existing nuclear plants that provide electricity without carbon emissions.

Improved coordination across the natural gas and electric industries is an issue of high and increasing importance, as noted in a number of recent reports (including the Grid Study and a July 2017 National Academy of Sciences committee report on electric-system resiliency, on which I participated). The latter stated that the "conventional wisdom is that the electric industry will become even more dependent upon natural gas than it has in recent years, and the natural gas industry looks to a future in which significant growth in demand depends upon developments in the power sector. For the electric system to become more reliable and resilient, attention must be paid to assure robust systems and practices across the two industries." FERC has authority to address electric system reliability issues, but not on the natural gas side. I encourage Congress to consider whether legislative modifications are needed to the Federal Power Act and/or the Natural Gas Act in light of the growing interdependencies of the two industries.

Regarding state policies and wholesale power markets: Few if any of the people who currently sit in state decision-making positions with responsibility for electric-industry matters were in those positions at the time their states decided to restructure their electric industries and to join a wholesale market regulated by FERC. It is not reasonable to expect that states will honor allegiance to the design of FERC-regulated markets more than their local objectives for economic development, clean energy, affordable power, distributed energy systems, mitigating climate change, and so forth. States will likely continue to adopt laws promoting one type of resource over another, and this will likely continue to raise tensions with FERC's responsibilities under the Federal Power Act. This deserves more congressional attention.

Given the essential role of electricity in modern society, the grid needs not only to be reliable but also more resilient. At a time when so many people are suffering from the impacts of flooding, wild fires, hurricanes and other severe weather events, I don't need to spend time explaining why improved grid resiliency is important. The range of potential disruptive events is broad, and the system needs to be designed to handle high-impact events ranging from severe weather to cyber attacks. This is the point of the recent National Academy Committee's grid report, and was an important finding and recommendation in the DOE Grid Study. Given that grid reliability and resiliency are so important, Congress and the Administration should be supporting more, rather than less, funding for R&D on modernizing the grid. The DOE's Electricity Advisory Committee (which I chaired until last month) recently endorsed such R&D as an essential federal function that is in the national interest.

Finally, in spite of what had been anticipated at the time Secretary Perry called for a new analysis, DOE's new Grid Study concluded that retirements of the least-efficient coal-fired power plants have resulted largely from fundamental market forces. This situation differs from that of existing nuclear units that are currently under financial pressure in wholesale markets where prices (and revenues) are tied to low gas prices: In contrast to coal plants, nuclear plants produce power without carbon emissions, and yet wholesale markets provide little if any compensation for this attribute. This market failure works to the detriment of nuclear plants and other non-carbon emitting generating technologies, like hydropower, wind, solar, and energy efficiency as well. Premature retirements of safely operating nuclear plants is of concern for this reason. Several states have been stepping up to address this issue in the absence of federal action.

My full testimony provides support for these and other comments, and I appreciate this opportunity to share it with you.