PG&E Corporation.

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The Honorable Ernest Moniz
Secretary, United States Department of Energy
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Dr. John P. Holdren
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1600 Pennsylvania Avenue, NW
Washington, DC 20500

Mr. Daniel G. Utech
Special Assistant to the President for Energy and Climate Change, The White House
1600 Pennsylvania Avenue, NW
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Dear Secretary Moniz, Director Holdren and Mr. Utech:

On behalf of Pacific Gas & Electric Company (PG&E), I respectfully submit the attached comments to the Department of Energy's (DOE) Quadrennial Energy Review (QER). PG&E is one of the largest combined natural gas and electric utilities in the United States (U.S.), providing safe, affordable and reliable clean energy to more than 15 million people throughout a 70,000 square mile service area in northern and central California,

PG&E appreciates the time and consideration the Administration has devoted to this first Quadrennial Energy Review Report, focused on energy transmission and distribution infrastructure. We believe the analysis and findings of this QER will be very timely, given the billions-of-dollars of investment being made across the energy industry to make our electric and natural gas systems more reliable and resilient, and enabling them to seamlessly utilize and integrate new technologies. In order to maintain and accelerate this level of investment, clarity on key public policies is needed, along with recognition by local, state and federal governments that this critical energy infrastructure is vital to supporting future economic growth and expansion and fostering innovation throughout the economy.

The comments PG&E is submitting today explore the challenges and opportunities associated with facilitating this massive amount of investment over the coming five-to-ten years, with the goal of providing a set of policy recommendations for moving forward.

Again, PG&E appreciates the opportunity to participate in this important process, through the submission of these comments as well as our contributions to the QER Task Force Meetings in San Francisco, CA on the energy/water nexus and in Portland, OR on energy storage.

Best Regards,

Attachment

Vulnerabilities and Risks to the Management and Operation, Modernization and Expansion of Electric and Natural Gas Infrastructure

America's critical energy infrastructure -- those assets, systems, and networks that, if compromised, would jeopardize security, economic operations, or public health and safety -- is vulnerable to a range of disruptive threats. Weather, natural disasters, workforce shortages, market dynamics, and/or physical or cyber events (intentional or unintentional) are just several examples that have the potential to create significant impacts, ranging from local, short-lived service interruptions, as with a downed tree impacting a distribution power line, to widespread extended outages, as in the wake of Superstorm Sandy in 2012. Moreover, the impacts can also go beyond the ability to provide gas, electricity and petroleum products to customers and markets. They can affect investment decisions over the short- and long-term, which can have lasting consequences for our economy and national security.

While government's role may be limited in directly addressing these risks and vulnerabilities, it has a significant hand in responding to events and influencing investment decisions. Local, state and federal authorities are essential partners working with the private sector to coordinate, and at times facilitate, an effective response to significant or catastrophic events. In addition, public policy decisions and actions by these same government entities heavily influence the type, magnitude and pace of private sector investment decisions.

Investing to Lessen Vulnerabilities and Risks

Building, hardening and enhancing energy infrastructure is primarily accomplished through planning and investment decisions made by the private companies that own these assets, such as investor-owned utilities. Over the last several years, Pacific Gas and Electric Company (PG&E) has invested more than $6 billion in electric and natural gas infrastructure to enhance the safety, reliability, and resiliency of its systems and to facilitate the integration of clean energy technologies onto the grid. Electric and natural gas utilities throughout the country are making similar investments, with a record $34.9 billion capital expenditures made in 2012 on electric transmission and distribution systems and $19 billion on natural gas distribution infrastructure alone. These significant investments have strengthened the overall security and reliability of the nation's electric and natural gas delivery system, while also creating real additional benefits for electric and natural gas customers and the economy as a whole.

In order to maintain and accelerate this level of investment, clarity on key public policies is needed, along with recognition by local, state and federal governments that this critical energy infrastructure is vital to supporting future economic growth and expansion. Government influences these private sector investment choices through factors such as regulatory oversight and decision-making, funding for technology research and development, access to and sharing of information, permitting, and market incentives and disincentives. Decisions on the scope and type of infrastructure investments made today by both the public and private sector will have lasting impacts into the future.

Natural Gas Infrastructure

The "polar vortex," which brought freezing temperatures and hefty energy bills to millions of consumers as far south as Florida and Texas this past winter, drove this point home by highlighting the impacts of contrasting public policy choices made in different parts of the country with regard to natural gas delivery systems and storage. Natural gas prices for California customers tend to be consistent and relatively flat year-round, due to a capacity and storage policy adopted by the California Public Utilities Commission in the 1990s. This investment has provided delivery capacity and flexibility when it comes to gas pipeline and underground storage. For example this past winter, on a day when PG&E customers used more gas than in any other single day in the company's 108-year history, not only was demand met, but prices remained flat.

In contrast, New England and downstate New York struggled with extraordinarily high natural gas wholesale prices this winter. On some days, the price reached the equivalent of more than $12.00 per gallon of gasoline. Indications are that this primarily was due to insufficient natural gas pipeline capacity between the end markets in the Northeast and the ample gas supplies in the Marcellus and Utica shale regions, where customers enjoy prices comparable to those in the Gulf Coast.

In fact, two studies recently released by leading natural gas industry organizations, the American Gas Foundation and the INGAA Foundation, point to increased investment in infrastructure as one of the surest ways for the United States to fully realize the potential it has in its domestic natural gas resource base. This U.S. natural gas resource base, according to recent estimates, could supply current consumption for 90 – 150 years at a price that is expected not to exceed $5 per million British thermal units (MMBTU) for 20 years. (IHS Cera, January 2014). Infrastructure built to accommodate this resource base will amount to nearly $30 billion annually of investment for mid-stream projects alone, which includes gas transmission lines and storage (ICF International, 2014). Infrastructure investments by local distribution companies to capitalize on this abundance can provide opportunities to meet load growth, enhance energy security, and create jobs.

Electric Infrastructure

The benefits of forward-thinking infrastructure investment, along with public-private sector coordination, were also evident on April 16, 2013, when gunshots caused extensive damage to PG&E's Metcalf Transmission Substation near San Jose, California. PG&E employees responded expeditiously to the incident and worked in close coordination with the California Independent System Operator (CAISO) to manage the situation. PG&E, working with the CAISO, was able to effectively re-route supplies and shed load both during and after the event to prevent further damage to the facility and ensure that no customers lost power. The redundancies built into the system allowed PG&E to make repairs at the facility in a timely manner, without disrupting service. The ability to re-route power and maintain service to customers are the result of planning and coordination with the CAISO and proactive investments made in PG&E's electric grid – which were previously approved by regulators -- to

maintain overall reliability, regardless of the nature of the event. This kind of continued investment and coordination will be important going forward, as well.

Since the incident at Metcalf, PG&E has partnered closely with federal, state and local agencies to enhance the security of critical substations across our 70,000 mile service area and share information and best practices with others in our industry. In addition, the company is investing approximately $100 million over the next three years on substation security for its highest priority facilities. At the same time, PG&E continues to invest billions of dollars in electric transmission and distribution infrastructure to make it more resilient, more dynamic and better able to respond to threats and mitigate potential vulnerabilities. The incident at Metcalf underscores the importance of public-private sector cooperation in planning for and responding to unexpected events, as well as supporting and making investments for the future.

Assessing Vulnerabilities and Risks

As the Administration has rightly noted, now is the time to modernize and enhance the nation's energy infrastructure -- both to maximize the benefits of prior investments and make sure that current and planned investments support our economic goals for the future. In order to best understand the role government and public policy can play in helping to ensure the overall resiliency and strength of the nation's energy infrastructure, it is first important to understand the vulnerabilities of and risks to the current system, how that system – and potential threats -- will evolve over time, and what industry is doing or plans to do to address these threats.

Vulnerabilities and risks can impact all aspects of critical energy infrastructure and all along the investment continuum. These comments categorize threats and vulnerabilities as follows:

- **Managing and Operating Existing Infrastructure.** This category is defined as the natural gas and electric delivery infrastructure in operation today. The existing electric and natural gas infrastructure in this country was built primarily during the 20th century. This infrastructure is aging, which creates its own set of safety and reliability vulnerabilities and risks related to typical "wear-and-tear." At the same time, the ongoing operation and maintenance of existing critical infrastructure are also at risk due to such concerns as more extreme weather, natural disasters, cyber and physical events, current and future market dynamics, increasing interdependencies, and regulations and policies impacting existing asset operations and value, e.g., tax policy changes, environmental regulations.

  The convergence of electric and natural gas markets in many parts of the country is becoming more pronounced, with cost and service-related implications for both electricity and natural gas users. Efforts are underway at the Federal Energy Regulatory Commission (FERC), regional transmission organizations and the state level to manage these impacts. However, as policymakers address the convergence of these markets today, they also must weigh longer-term energy policy objectives, such as maintaining supply diversity, increasing renewable energy, or reducing greenhouse gas emissions.

Solving for one challenge, without recognizing longer term implications for other goals is critical, given the long-lived nature of gas and electric infrastructure.

Similarly, the severity and frequency of weather events is increasing and weather patterns are noticeably changing. The western part of the U.S. has experienced increased wildfires and droughts. At the same time, changes to weather patterns have shifted cloud coverage, winds, etc., impacting the operations of intermittent resources, such as wind and solar. Managing this variability will require investments in new technologies not only at the transmission level, but at the distribution level, as well as in energy storage. It is these types of interactions that must be factored into policymaking and investment planning going forward.

- **Modernizing the System.** This category encompasses those investments to upgrade, expand and enhance the system, resulting in a more resilient, more automated, and more dynamic system overall. These include investments in smart grid technologies to allow for additional energy efficiency programming, new pipes and wires, and new sources of power generation that will allow for the introduction of new end-use technologies into existing systems, such as electric and natural gas vehicles, large-scale renewable resources, distributed generation, or advanced end-use technologies. There are risks to this investment actually materializing on the scale currently contemplated – or needed – along with additional risks and vulnerabilities associated with integrating these resources into the system.

  More automation and reliance on computerized operations and networks increases risks associated with cyber threats. At the same time, unforeseen flaws in new technologies, such as equipment failure and incompatibility of platforms, could have significant consequences for system reliability, integration, and operations. The introduction of new technologies, some of which are not made domestically or rely on rare earth minerals, can also expose a system to additional supply chain and security risks. Finally, the upgrade and build out of the system requires a well-trained and educated workforce able to maintain the modernized system.

- **Expanding the System and Increasing Connectivity.** This category is defined as the investments planned to expand, interconnect and more fully integrate electric and natural gas systems. The electric and natural gas industries are poised to make well over a trillion dollars of investments through 2030. A significant amount of these investments will help to connect new energy resources, such as renewable energy projects and new gas supplies, to markets throughout the country. These investments are intended to expand the reach of existing infrastructure to connect markets and provide needed redundancies, allow for better coordination between markets, address the interdependencies emerging between electric and natural gas supplies, and support the continued growth of intermittent generation technologies, such as wind and solar.

A thorough understanding of the environmental, economic and reliability impacts of these dynamics is important and should serve as a foundation for investment planning and decision-making, both in the public and private sector. As load becomes more sensitive to power quality (e.g., as in the biotech industry and advanced manufacturing), expanding the system to connect and support significant amounts of intermittent resources -- both centralized and distributed – will also require additional investment in smart grid technologies to better anticipate supply/demand fluctuations and manage and respond to these dynamics in real time. Several European nations are facing these concerns today. Having significantly increased the intermittent resources on their systems, they have become more reliant on higher greenhouse gas-emitting resources for back-up power.

Expanding supplies to serve underserved areas – and by extension the infrastructure to connect them – could, in some cases, be met more cost-effectively through other means. In, California, regulators, investor owned utilities, publicly owned utilities and hundreds of other market actors are making more than $1 billion in energy efficiency investments as a means of meeting demand and deferring certain system expansions.

Investments to expand, connect and upgrade systems should therefore be made thoughtfully and with a recognition that the pace and scale of this investment will be impacted by several factors, including approvals and mechanisms for cost recovery, access to market information, current and expected market dynamics and acceptance, challenges with permitting and regulatory approvals, availability of well-trained and skilled workers, and access to necessary materials and supplies. Changes in policies that impact the affordability of capital expenditures, such as tax policies or regulatory and market structures that do not adequately provide for cost recovery, could increase the costs of these investments and/or discourage them altogether.

Evaluating Levels of Vulnerability and Risk

While there is clearly overlap among the issues impacting infrastructure development, investment and operations, some issues pose more of a risk or threat for one stage as opposed to another. Climate and weather-related events, for example, may be more of a concern during the operations stage versus the expansion stage. Below are definitions of these issues, as well as a table that identifies which issues most significantly impact each area.

- Physical Security: Refers to the man-made risks and vulnerabilities associated with physical assets, such as substations, compressor stations, pipes and wires, and electric generation facilities.
- Cyber Security: Refers to the risk and vulnerabilities of a more automated system for controlling and operating physical assets, as well as other areas such as the data associated with customer and system information. These risks can be posed by both intentional and unintentional acts.

- Climate/Weather-related impacts: Refers to the risks associated with extreme weather events, which include heat waves or cold spells impacting customer demand and/or the performance of equipment, droughts impacting hydroelectric supplies, and/or flooding impacting reliability and performance of physical assets.
- Natural Disasters and Occurrences: Refers to risks and vulnerabilities associated with events such as earthquakes, wildfires and hurricanes that could have catastrophic and widespread impacts on energy delivery and production facilities, as well as impacts from natural occurrences such as downed trees on power lines or the impact of tree roots on underground facilities such as pipelines.
- Supply Chain: Refers to the risks and vulnerabilities associated with the source, availability, security and integrity, impact, and cost of critical equipment and technology.
- Workforce: Refers to the risks associated with the availability of well-trained, well-educated and skilled workers to support all phases of infrastructure development, construction, operations and maintenance.
- Affordability/Access to Capital: Refers to the risks associated with changes to tax policy and financial market dynamics that could impact the ability to raise the necessary capital to make these investments, or the overall cost of capital, which has implications on customer rates.
- Market Structure and Regulation. Refers to the supply/demand dynamics in the market, policies related to cost recovery of infrastructure investment, including valuation of generation and natural gas capacity and storage, demand response, incentives for and return on investment, and energy efficiency, in addition to the impacts of local, state and federal permitting and environmental regulations on the diversity of energy sources, ongoing operations and expansion.
- Technology Integration. Refers to those supply-side and end-use technologies that can impact overall system dynamics and operational needs, including load balancing, voltage support, and power flows.

	Physical Security	Age	Cyber Security	Climate/ Weather	Natural Disasters	Supply Chain	Workforce	Affordability/ Access to Capital	Market Structure/ Regulation	Tech Integration
Operations	X	X	X	X	X	X	X	X	X	X
Modernization			X			X	X	X	X	X
Expansion			X			X	X	X	X	X

Public and Private Sector Roles

Guarding against/mitigating these risks is a shared responsibility between the private and public sector – or in other words, the system operator/owner and the government/regulator. However, there are examples in which one entity or the other bears a greater portion of that responsibility. While a system operator/owner can develop investment plans and submit a proposal for

regulatory approval and cost recovery, it is ultimately the regulator who will approve or deny the request. Alternatively, while it is government's responsibility to provide good access to education, it is incumbent upon the private sector to identify, hire and train its workforce to perform the required work.

PG&E conducts an annual enterprise wide risk management review to identify vulnerabilities and risks to safely, reliably and affordably providing electricity and natural gas service to our customers. The company uses this process to prioritize investment and attention, and identify strategies for mitigating risks, including action such as enhancing public/private sector coordination and partnerships and identifying public policy needs at the local, state and federal policy level. One risk is the inability to obtain timely permits to perform necessary maintenance and expansion work. Another risk is the shortage of skilled workers. Finally, there is the risk associated with balancing multiple objectives and priorities – whether those be cost, reliability, carbon performance, security – as regulators evaluate these proposed investments and determine which are prudent and which are not. This process can have the unintended consequence of advancing policies that have competing or incongruent impacts.

As a result of the company's efforts to identify risks and vulnerabilities, as well as plan for the future, PG&E has also identified and recommended associated public policies. Examples include:

- Natural Disasters and Occurrences
    - Emergency Response and Restoration: Ensure coordination with and among federal and state agencies to quickly obtain emergency permits and waivers for traveling crews and heavy equipment to bypass tolls and access restricted bridges and roadways. It is critical that procedures, processes, and a well understood chain of command be in place prior to large outage situations in order to avoid delays in transporting mutual assistance crews and materials to support response and restoration efforts. The response to Superstorm Sandy provides a good model for an effective response and restoration effort.
    - Prevention: Further clarify standards and requirements for vegetation management for gas and electric infrastructure to facilitate implementation of these programs for utilities and state regulatory commissions. This clarity would allow for better coordination with property owners and local officials to plant and replace downed vegetation that is most conducive to system reliability.
    - Improved Access to Federal Lands: Develop a process to share critical information with federal land management agencies, such as the Forest Service, and Bureau of Land Management, to better integrate emergency response procedures and protect assets, including facilitating improved cooperation and common emergency preparedness protocols and policies.

- Physical and Cyber Security
    - Information Sharing: Improve information sharing between the government and industry, which includes accelerating the process for providing security

clearances to relevant private sector executives with responsibility for critical energy infrastructure operations, security, and management.
  - Threat Analysis: Increase funding for the Department of Homeland Security's Regional Resilience Assistance Program (RRAP); and provide liability protection.
  - Information Protection: Strengthen and clarify protections for sensitive information provided to federal agencies with regard to critical energy infrastructure under the Freedom of Information Act.

- Modernizing Permitting
  - Accelerate Process: Continue the Administration's efforts to accelerate the permitting process by taking actions to harmonize and align federal, state and local processes, properly resourcing federal permitting agencies, and making the process more predictable.
  - Provide for Cost-Sharing: Ensure that all federal agencies have the ability to enter into cost-sharing agreements with the private sector for purposes of permit review.
  - Align Data Sets: Ensure that all federal and state agencies are working form a consistent set of data and assumptions for specific projects.

- Access to Capital
  - Tax Policy: Maintain the deductions for interest expense, excess deferred taxes, and dividends. Limitations or changes to the applicability of these policies would hinder the ability of capital-intensive companies, including utilities, to access affordable capital and spread out the costs of these investments equitably over a time period that mirrors the long lives of most electric and natural gas infrastructure and assets
  - Ensure a Reasonable Return on Equity (ROE) for Transmission Assets. When an ROE set at the federal level dips below a state ROE, it becomes more difficult to attract capital for projects such as transmission needed to cost effectively integrate renewable energy, and could skew investments toward smaller projects with higher returns and fewer associated jobs.

- Workforce Development
  - Reauthorize and transform the Perkins Act: Include additional grants and meaningful grant requirements that encourage employer participation to strengthen community college programs and workforce system partnerships that support skills training programs. Require that any programs developed using federal grant dollars make their curriculum publicly available to allow for increased collaboration and better use of resources.
  - Reauthorize the Workforce Investment Act (WIA): Continue additional funding for "one-stop" career centers and encourage collaboration across the workforce investment system so employers and job seekers can access a wider array of employment and training services. As part of reauthorization, increase the voice

of industry in the workforce investment system, including requiring greater industry representation on the Board of Directors at WIBs to ensure their efforts are aligned with the needs of local employers.

- Modify the Trade Adjustment Assistance Act Community College and Career Training Grants Program: Ensure grants are proportional to each state's economic contribution to the national GDP.
- Target Discretionary Funding: Encourage the Department of Energy to use discretionary funds to support additional training efforts for the energy and utilities industry and target training initiatives with industry consortia and associations. This funding could be used, for example, in partnership with community colleges, vocational programs, and to support high school redesign efforts.
- Transition Assistance: Allow for use of grant monies or discretionary funds to provide stipends or support for candidates participating in accredited training programs to help defer basic living costs., e.g., housing, food, transportation. Too often, potentially qualified job training candidates must make a choice between getting training that could lead to well-paying careers in the energy sector, or taking a series minimum wage jobs to maintain a basic standard of living.

- Cost Recovery
  - Provide clarity regarding expectations. State regulatory commissions have jurisdiction regarding the type and pace of investments made by utilities to harden, modernize and expand electric and natural gas distribution systems – and in some instances on the natural gas side, transmission systems. For cost recovery purposes at the state level, standards or prescriptive policies make cost recovery decisions easier, as it is especially helpful for resolving issues related to prudence, reasonableness and used and useful concerns. However, prescriptive standards may not offer enough flexibility in terms of accounting for regional differences or needs. Developing a common understanding between the federal and state government regarding roles, responsibilities and expectations will facilitate investment decisions by helping to provide a more consistent metric for cost recovery.
  - Ensure timely decision-making. The typical ratemaking process requires utilities to file applications, allows for intervention by interested parties, and ultimately results in a decision by the regulator. This type of thorough and inclusive process is critical to ensuring that the investments being proposed and made meet the overall policy objectives and needs to the state or federal and those served by the utility. At the same time, regulatory proceedings can become protracted, hinder the ability of utilities to make investments, thereby deferring maintenance on existing assets or delaying expansion or modernization activities. Establishing and adhering to clear, consistent and reasonable timelines for regulatory proceedings is critical.

- Recognize the value of the underlying critical energy infrastructure and establish rates structures that ensure alignment of system costs and benefits over the long term. Typical utility ratemaking structures were established during a period of increasing demand and vertically integrated systems and services. In a future characterized by higher levels of efficiency, increased deployment of distributed and intermittent resources, and proliferation of natural gas and electric vehicles, establishing equitable and sufficient rate recovery mechanisms are critical. Utilities have important and valuable roles as enablers and integrators in the deployment and operation of these new technologies, as well as a compact that requires the reliable, safe and affordable provision of basic gas and electric service to all customers connected to a utility's system. New ways of pricing the "network services" provided by utilities is critical and should be based on a tenet that those that use this critical energy infrastructure contribute to the cost of operating, maintaining and hardening these assets, as well as modernizing them to enable the proliferation of these new technologies. The Department of Energy has a critical role to play in highlighting, analyzing and helping to bring forth cost recovery models that achieve these multiple objectives and national priorities.

- Technology Deployment and Integration
  - Provide Clarity on Policy Goals and Objectives: Because these are long-lived investments, having clarity on both the short- and long-term objectives is critical, as it will inform the kinds of investments the private sector will make today. Without this clarity, there could be an over-reliance on one form of energy or one type of technology, leading to issues with regard to supply diversity, system over-build, or supply/demand imbalance. Once policy goals and objectives are identified, the Department of Energy should conduct scenario analyses to determine the impacts of different penetration rates on regional system dynamics, affordability, and greenhouse gas emissions