

Melissa Lavinson
Vice President Federal Affairs and Policy, Chief Sustainability Officer
PG&E Corporation

before the
Quadrennial Energy Review Task Force
on
Generating and Delivering Electricity to Meet GHG Targets

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Good morning Deputy Secretary Sherwood-Randall and members of the Quadrennial Energy Review Task Force (QER Task Force). I am Melissa Lavinson, Vice President of Federal Affairs and Policy and Chief Sustainability Officer at PG&E Corporation, the parent company of Pacific Gas and Electric – or PG&E.

I am pleased to appear before the QER Task Force on the issue of operating in a high greenhouse gas reduction environment. California has been a leader in advancing policies to reduce greenhouse gas emissions to levels necessary to effectively combat climate change. PG&E has been supportive of such policies and efforts, and has played a significant role in helping to achieve these reductions.

PG&E appreciates the time and consideration the Obama Administration is giving to the need to invest in and modernize our nation's electric infrastructure to make it more resilient, more flexible, and better able to meet both climate change goals and support the 21st century economy. The issues being explored here today – electric transmission, storage, distribution, end-use technology, low-carbon generation – are fundamental to enabling a future electric system that can seamlessly integrate new power generation and end-use technologies, thereby providing customers with more options and information and facilitating the deep greenhouse gas reductions necessary to mitigate climate change.

As background, PG&E is one of the largest combined natural gas and electric utilities in the United States (U.S.). Headquartered in San Francisco, California, with more than 23,000 employees, the company provides natural gas and electric service to more than 16 million people. PG&E owns and operates more than 160,000 circuit miles of electric lines in California, spanning a service area from Eureka in the north to Bakersfield in the south, and from the Pacific Ocean in the west to the Sierra Nevada in the east.

To meet our commitment to deliver safe, reliable, affordable and clean energy to our customers, we are implementing a multi-year, strategic plan aimed at modernizing our electric operations. Over the next three years, PG&E plans to invest more than \$8 billion to make the electric grid smarter, more resilient and better able to help California realize its vision for a low-carbon, clean-energy future. In fact, PG&E included some of these planned investments as part of its commitment in support of the American

Business Act on Climate Pledge, which was announced immediately prior to the 2015 United Nations Climate Change Conference (COP-21) in Paris.

PG&E is not alone. In fact, over the next decade, the electric utility industry is poised to invest nearly a trillion dollars to upgrade, expand and enhance our infrastructure. This nationwide effort to modernize the electric grid will ultimately result in more efficient, cleaner and more reliable energy services. Investments are being made at the transmission, distribution and customer levels, which include the deployment of smart meters, intelligent switches, synchrophasers and other technologies that provide better visibility, greater automation and more information.

As a result, this newer, smarter grid will benefit customers and our environment by:

- Improving electricity reliability;
- Facilitating the deployment of new end-use technologies, such as smart appliances, electric vehicles and energy management tools;
- Enhancing efficiency in electricity generation, transmission and distribution; and
- Supporting the integration of renewable resources, such as community and large-scale wind and solar and privately owned distributed energy resources.

California Policies and the Role of the Utilities

California is a proven leader on clean energy and environmental policy for the past several decades, and the state's utilities have a long history of supporting these policies through efforts that include investing in renewables, energy efficiency and infrastructure, among others.

Starting in the 1970s, for example, California became the first state to establish a utility business model that encouraged utilities to pursue aggressive energy efficiency programs and initiatives. The utilities' efforts have since helped establish California as a world leader in energy efficiency.

More recently, in response to clean air and climate change concerns, the state has increased its focus on renewable energy and greenhouse gas emissions reductions. In the early 2000s, the state put in place an aggressive renewable portfolio standard, which applied to the amount of electricity delivered to the customers of the state's investor-owned electric utilities. Today, California's electric utilities are leaders in providing renewable energy to our customers. These purchases have helped create thriving renewable energy markets and drive down technology costs. In 2006, California passed Assembly Bill (AB) 32, which created a cap-and-trade program that has been up and running successfully now for the past few years, demonstrating that, with the right flexibility and cost containment provisions built in, cap-and-trade can work to both drive down emissions and advance low-emitting technologies.

California has also taken important steps to ensure that increasing amounts of renewable energy can be effectively integrated into the grid. For example, California was on the forefront of deploying smart grid technologies, including automated metering

technology. PG&E has deployed 10 million of these meters, helping to create a platform for all kinds of advanced energy saving – and energy producing – end use technologies.

California utilities have been willing partners and stepped up to help drive innovation and progress. At PG&E today:

- More than 30 percent of the power we deliver comes from renewable sources.
- More than half PG&E's electric supply is from sources that are carbon free, when including hydro and nuclear.
- We have connected more than 230,000 solar customers, more than any other utility.
- There are also more electric vehicles on the road in PG&E's service area than anywhere else, and we are pursuing investments and partnerships in public charging infrastructure to support even broader adoption.
- We are pursuing large-scale solutions around battery and other storage technology, which we know will be critical in an era of increased renewables.

Implementing Greenhouse Gas Reduction Policies and Implications for Grid Investment

As the nation, as a whole pursues greenhouse gas reduction strategies more aggressively, we expect a fundamental shift in generation and the underlying electric infrastructure. For example, the U.S Energy Information Administration (EIA) expects total renewables used in the electric power sector to increase by 10 percent in 2016 and by 5.1 percent in 2017. This is on top of a tripling of renewable output over the last decade, including 95 percent growth in solar thermal and photovoltaics. In our service area alone, PG&E has connected more than 230,000 solar rooftops to the grid and, in 2016, we expect that we will connect, on average, more than 6,000 per month.

Given these increasing levels of intermittent renewable generation, the National Renewable Energy Laboratory (NREL) indicated that increased electric system flexibility is needed to balance electricity supply and demand. It identified a variety of supply- and demand-side options, including flexible conventional generation, energy storage, new transmission, more responsive loads, and changes in power system operations.

A smarter, modernized grid that successfully incorporates technologies like energy storage and other distributed energy resources can provide grid operators with tools to react to rapid changes in consumer demand by adjusting the electricity on the grid to match usage.

One of the unique aspects about the operation of the electric grid is the real-time nature of its functions. From production to transmission to delivery, it takes an entire integrated network, working together, that can withstand the elements and adapt to changing supply-and-demand dynamics in a split second. Unlike other commodities, electricity is essentially produced and used in real time. The amount of electricity put into the grid must always balance with the electricity being consumed. The ability to balance these supply and demand dynamics will become more challenging as more intermittent resources come on-line. This is because these intermittent resources operate differently than those the grid was originally designed to accommodate.

Today's electric grid was designed to move energy in one direction from a central place – e.g., larger and predictable baseload resources -- to the places where the power is needed – e.g., load centers with predictable usage patterns. Instead, what is needed for the future is a dynamic grid that can process and send out huge amounts of information to coordinate power flows among millions of contact points in multiple directions throughout the day.

Lessons Learned

PG&E has been very successful at integrating new clean-energy technologies and reducing emissions, demonstrating that we can achieve these goals and keep the grid reliable and stable. We have also shown that we can do this while keeping customers' bills affordable and allowing the economy to continue to grow and create jobs.

Among the lessons learned to date is that by policymakers partnering with utilities and leveraging their scope and scale, the pace of change -- and reach of the benefits from these efforts – can be significantly accelerated and expanded.

In order to achieve the steep reductions necessary in the next 20 to 30 years to avoid the worst impacts of climate change, we believe that it will be critical to recognize the vital role that utilities play, particularly as it pertains to decarbonization of the electric sector and the fundamental importance of the electric grid in achieving these reductions.

In California, we are now working toward achieving a 50 percent renewable standard by 2030 and the state, as a whole, has a goal of reducing greenhouse gas emissions by 40 percent below 1990 levels by 2030 and 80 percent below by 2050. These are far reaching reductions that further position California to lead the nation and the world into a low-carbon future.

The modern grid is the platform for connecting and integrating all of these newer, cleaner and more efficient technologies, so that they can work in concert and at scale to deliver the maximum benefits. This requires the grid to be capable of managing two-way power flows, and to be more dynamic and more resilient than it is today. For that reason, we need to continue to modernize our systems and make the investments that will facilitate the future we all want and know is possible.

A second key is re-thinking utility regulatory policy and adapting it for the realities of the 21st century.

Right now, the utility regulatory model is not keeping pace with the changes being driven by technology. This disconnect will undermine progress if we do not address it. It will be necessary to adopt new approaches to ratemaking, not unlike when California took the step of incentivizing energy efficiency a few a decades ago and pursued decoupling. The right policies will ensure there is adequate investment and equitable cost allocation to support continued modernization of the grid and the delivery of benefits of the clean energy economy to everyone, regardless of their direct participation or investment.

The third key is keeping the focus on the primary goal, which is reducing carbon emissions.

Keeping the focus on reducing carbon emissions, rather than on specific technologies or prescriptive emissions-reduction approaches, helps to maximize flexibility and allows business to innovate and create cost-effective solutions. If we keep the focus on reducing carbon and we maximize flexibility, business is going to find a way to innovate and create solutions.

To achieve these reductions, at least cost, we think it will be important for state and federal agencies to rethink how facilities get permitted and infrastructure built.

For example, more transmission will be necessary and availability of flexible resources, like hydroelectricity and pumped storage, will be needed to meet reduction goals. Not only do we need to look at maintaining and utilizing the low carbon assets that we have, today, but we need to recognize that in order to achieve the reductions in the timetable necessary, a fundamental transformation of infrastructure will need to occur. In fact, the investments we make in the next three-to-five years will form the basis of the magnitude of reductions we will be able to make 20-to-30 years from now.

Finally, in order to achieve these goals, there is a human element that must be front-and-center. The kinds of investments and infrastructure build-out and change-over contemplated requires a skilled and highly-trained workforce.

Investing in our employees and developing a 21st century workforce is critical to PG&E's future. Over the last decade, PG&E has invested more than \$60 million in youth educational programs to provide scholarships to aspiring youth to prepare students for the energy sector jobs of the future and help teachers create innovative classroom projects focused on energy and the environment. At the same time, we have made a significant effort to train and hire military veterans. Last year, we announced our "1,000 Careers Project," that has the goal of hiring 1,000 veterans into PG&E careers over the next seven years. We have supported that commitment through our flagship energy training program, PowerPathway. At the federal policy and government level, we believe that there is more that can be done to facilitate veteran hiring and training including:

- Aligning military and utility job classifications;
- Providing information on which military bases have a preponderance of personnel with the right basic skills; and
- Accessing military personnel during the off-boarding process – that is prior to leaving the military.

In addition, PG&E supports policies that encourage the private sector to do more, including the Honoring Investments in Recruiting and Employing American Military Veterans Act of 2015, a bipartisan bill that has been introduced in both the House and Senate. This bill outlines steps that the private sector can take to recruit, hire and retain military veterans.

Conclusion

Many new technologies are available or are emerging that will enable us to continue making significant reductions in greenhouse emissions. The key to achieving these reductions in a cost-effective and timely manner, however, lies in how effectively we are able to integrate these technologies to maximize their benefits. This is fundamentally more of a systems challenge than a pure technology challenge. The electric grid is an invaluable asset that offers the ability to address this – and address it at the scope and scale necessary -- if we are prepared to put the policies in place needed to drive and support smart investments to evolve it into a platform for the clean energy economy. California's experience already demonstrates the promise and potential of this approach, and the importance of leveraging this existing asset and the capabilities of utilities to accelerate this transition. It also shows, however, that further efforts are needed to evolve the utility business and regulatory model so that it continues to support this progress.
