

Quadrennial Energy Review

Second Installment

Electricity: Generation to End Use Stakeholder Meeting #6

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Los Angeles, California

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Opening Remarks

CHRIS KELLEY: Well, good morning, everyone. I'd like to welcome you to the 6th Public Meeting for the second installment of the Quadrennial Energy Review, focused specifically on the electricity system from generation to end use. Welcome to those of you here in Los Angeles at the beautiful Tom Bradley room at the LA City Hall. I'd also like to welcome those of you joining us via live streaming on the web. My name is Chris Kelley. I'm with Energetics, we are an energy consulting firm supporting the Department of Energy on this QER effort. I have the distinct honor of being today's facilitator, and we'll be hearing from a number of speakers today. But before we get started I'd like to refer to a few housekeeping notes.

First, the QER Task Force welcomes comments from the public. If you wish to make a comment and have not yet signed up at the entrance desk you may do so at any time today. For those joining via live stream, you may also submit comments at www.energy.gov/QER.

So we have an outstanding set of speakers. Their comments and presentations can be found after today's session also at the same website. www.energy.gov/QER. Before we get started, I'd like to read a short statement about the purpose of this meeting. Pursuant to the Federal Advisory Committee Act, the purpose of today's meeting is to ask for is your individual input or your organization's input regarding electricity from generation to end use and provide a forum to exchange information. To that end it will be most helpful to us for you to provide these recommendations and information based on your personal experience, your individual advice, information or facts regarding this topic. The object of this session is not to obtain any group consensus or position, rather, the U.S. Department of Energy and U.S. Department of Agriculture is seeking as many recommendations as possible from all individuals at this meeting.

So with that, allow me to introduce Dr. Karen Wayland, the Deputy Director for State, Local and Tribal Cooperation at DOE's Office of Energy Policy and Assistance Analysis, she'll introduce our next speakers.

DR. KAREN WAYLAND: Thank you, Chris, and again, I'm Karen Wayland. My team is responsible for the stakeholder engagement part of the Quadrennial Energy Review, which you'll hear much more about from our up-coming speaker, but this is an administration wide effort to seek recommendations for how we will modernize our energy infrastructure and this time around we're looking at the electricity sectors, specifically. I want to thank the city of LA for letting us use this gorgeous room. It's absolutely beautiful. And I've been in it a couple times now. But it doesn't get old. It's a gorgeous -- I think it's probably the best building, the best room that we've had since we have been doing these meetings. And it's my pleasure to introduce now the Deputy Mayor, Barbara Romeo; she oversees critical city services and I was just telling her that I want her job because her portfolio is really fabulous and fun and very relevant for we call the QER. She oversees water and power, transportation, Recreation and Parks, libraries, the zoo, animal services and a host of other services that are critical to the city. Prior to her appointment, she served in the public workforce where she worked on water conservation and LA river revitalization which is an ongoing issue. We were just talking about that. So without further ado, the Deputy Mayor.

(Applause.)

DEPUTY MAYOR ROMEO: Thank you. On behalf of Mayor Garcetti, I want to thank you and welcome everyone to City Hall and thank you for coming this morning. And thank you to the

Department of Energy for inviting me here today. As in my introduction, I am the Deputy Mayor and I do have a privilege on working on some pretty cool stuff. But first, before I go into my speech, I want to congratulate the Department of Energy on your second installment of the Quadrennial Energy Review. Through Secretary Moniz and Deputy Secretary Sherwood Randall's leadership, the department has taken on such an important leadership role in this country on clean energy and on the advanced energy grid. We are happy today to talk about electricity generation and the delivery of energy services. This is a topic we think on a lot in Los Angeles. In my capacity, the relevant department that was mentioned, is the Department of Water and Power. The Department of Water and Power is the largest municipal utility in the country. On the power side, we are charged to reliably provide electricity to 1.4 million customers at the lowest cost and as cleanly as possible. We take this charge very, very seriously. In L.A. we are on track to procure 33 percent of our power from renewable sources by 2020 and we are well on our way to 50 percent of renewables by 2030. How are we doing this? First we have a sustainability plan that the mayor released over a year ago, that lays out the numbers of actionable steps in that direction. We plan to be completely off coal by 2025 and we are doing everything we can to replace that coal generator power with renewables and efficiencies. In fact, we plan to deliver at least 15% of all electricity needs through efficiency over the next decade. This is the most ambitious target of any large utility in the country. Thank you, Marcy. For the last three years running, L.A. has been number one in solar energy of any of the cities in the U.S. and while recently released sustainability plan report shows that we are still not hitting our ambitious goals in local solar, thanks to a collective city effort in this past year from DWP and the Department of Building and Safety, the momentum is definitely growing. Last year alone, local solar installations grew by 20 percent, this propelled in part by our streamlining of our permitting and interconnection process. Areas where the Department of Energy has been particularly active in is front. To put these actions into the big picture, every two years we are comprehensively updating our integrated resources plan, which allows us to strategically plan ahead for how we marry our policy goals with our clean energy and our greenhouse gas reductions, but with meeting people's energy needs in a cost effective way.

So these are the questions that the QER can help us address. We are entering into a new era, not just in Los Angeles, but actually in California and hopefully beyond California where carbon free energy is becoming a dominant source of energy in our portfolio. And we are figuring out how to do this at the same time as we are adding electric vehicles to the road at expedient levels. So this is a very exciting time for the City of Los Angeles and for our department. This is something that a few years ago naysayers said it could not be done. So we are doing it and in so doing it, it raises a new question on the role of the utility, the role of different resources, of different pricing structures, the role of the customer and the role of the third parties developing these new technologies and strategies at a pace faster than sometimes we more often in government can actually adapt to. These are the types of new issues arising that while authority – but actually a sign that we are actually moving in the right direction for the environment, for the economy and most importantly, for the consumers. What I mean by this is, we need clean energy, innovation and choice. Now these things are moving in the right direction, when it comes to the growth of clean energy, when we have experiences like the Aliso Canyon natural gas leak, we are reminded that we still face a number of hurdles. The existing infrastructure on which we still depend is very old and maybe, just maybe, the experience at Aliso Canyon tells us that relying on natural gas, as we have been, as our main source for the grid stability, has some downsides. Some downsides for the climate, some downsides for reliability and some downsides for safety. All of this is to tell us that we have to do what we are already going to do, a little faster and a little better. I'm proud and thankful for the Department of Water and Power, for their commitment to examining closely the role of natural gas, including by modeling in their upcoming IRP process a fossil fuel free scenario. Did you guys hear that? A fossil fuel free scenario. Thank you again, Marcy. These challenges and opportunities are some of the topics you are all going to be tackling today. I thank the Department of Energy for coming to L.A. for this regional stakeholder meeting. We need your best minds, your best innovation, your best funding – and thank you for that – to support our continued progress. President Obama and the entire Department of Energy have done so

much nationally, internationally, to make progress on clean energy accessibility. We look forward to continuing to work together and I wish you all a great discussion today. Thank you again for coming to Los Angeles.

[Applause]

DR. KAREN WAYLAND: Before I announce our next speaker, I would like to acknowledge that we have the staff from Representative Cardin is here and I want to thank you very much for your support and look forward to working with you if you have any questions after the meeting. So thank you for being here. I work for some extraordinary women leaders, among them California's own Nancy Pelosi. So it's my distinct honor to introduce another California native, Deputy Secretary Liz Sherwood-Randall, who has been a trail blazer of her own. She has been second in command at DOE since October 2014 and before that, she served in a number of positions in the Obama White House from day one. She was with the National Security Council from 2009 to 2013 and most recently was the White House Coordinator for Defense Policy, countering weapons of mass destruction and arms control. Which is a mouthful and you might wonder what that has to do with the Department of Energy, but our mission is in part is to steward the safety of nuclear materials. So she has a great portfolio for that. She's also worked at Stanford, Harvard and the Council on Foreign Relations and was a Rhodes Scholar. So with that, let me turn the podium over to the Deputy Secretary.

(Applause.)

ELIZABETH SHERWOOD-RANDALL: Good morning. Thank you, Karen, thank you, Deputy Mayor Romero, thank you, Chris, it's wonderful to be here. And it's true. This is my hometown. I grew up in Cold Water Canyon, and my father worked for his entire career just a few blocks from here. And so it's particularly meaningful for me to come here for a public stakeholder meeting for our QER 1.2. We appreciate very much that Barbara is with us, representing Mayor Garcetti, who has been a very significant partner in all that we do on the clean energy front. And most importantly I'd like to thank the members of the public who have taken their time to join us today to offer perspectives and insights as we undertake this important endeavor. Your contributions are extremely valuable to us, as we put together this second installment of our Quadrennial Energy Review. And I also want to thank the panelists who will participate in this dialogue with the public to inform our analysis. Your experience on the ground will help us to sharpen our focus on the challenges and the opportunities that are facing the electricity sector so that we can best support and promote economic competitiveness and energy security and environmental responsibility.

The Quadrennial Energy Review 1.2 process, like QER 1. includes significant stakeholder outreach to inform our recommendations. And this is the 6th of seven national stakeholder meetings. So we invite you to provide your comments, if you haven't already signed up to speak, please do so. And as Chris said, if you don't have a chance to make comments today, we also welcome you to contribute to our online comment portal at www.energy.GOV/QER. This will help us to draft the second installment of the QER that will make it as comprehensive and useful as the first. Today, to set the stage for the panel discussion and your comments, I'd like to talk to you a little bit about the overall QER process, how the first installment is already informing policy and about our focus for QER 1.2. I'll also spend a little bit of time talking about the clean energy innovation that is so important to modernizing our grids, diversifying our energy mix, and meeting both state and local emissions goals.

So first of all on the QER process. The review is a result of recommendations that were made to the President in two reports by his Council of Advisors on Science and Technology which is also known as PCAST. In case you don't know about PCAST, it's a group of scientists and engineers who advise the President on policy, where a greater understanding of science, technology and innovation than lay people

generally have, is important to informed decision-making. And in fact, Secretary of Energy Moniz was then a PCAST member and was one of the people who worked on the 2010 report that first recommended the steps that would lead to the first QER. This included quadrennial technology review, a report that examines energy technologies and research opportunities that DOE released in 2011 and then updated just last year. The PCAST repeated its recommendation that we should conduct a QER in its 2013 report to the President, looking at climate and energy issues specifically. And the President formally launched the QER process in June of 2015. The QER process comprises more than 20 agencies of the U.S. Government and is headed up by the White House Domestic Policy Council and the White House Office of Science and Technology Policy. I'm very pleased that Austin Brown from OSTP could be here with us today and he will be a part of the group that shepherds this project to completion. The Department of Energy is actually responsible for most of the analysis conducted in the QER based on the information that we receive and that work is carried out by the Office of Energy Policy and Systems analysis, which Karen is the Deputy Director and Melanie Kenderdine is the Director. In fact, QER 1.1 is proving to be a very useful document. Working with Congress we have actually been able to implement a number of its recommendations already and we have secured significant bipartisan support in doing so. So far, 14 of QER 1.1's recommendations have been used to inform federal laws and to push for much needed improvements. For example, one of the key findings of the first installment of the QER was that the infrastructure of our strategic petroleum reserve is at the end of its design life. We also found that its marine terminal required new distribution capabilities. So among the most QER related legislation is the authorization for us to raise two billion dollars to modernize these crucial facilities and infrastructure through sales of crude oil from the strategic petroleum reserve. The first installment of the QER also made very clear what our focus should be for the second installment. All of the critical infrastructure that we discussed in the first document was heavily dependent on electricity, and our electrical infrastructure is aging. At the same time, we are making enormous technological advances in generation, transmission and storage that need to be integrated into that aging system. As a result, the second installment of the QER will be an integrated study of the electricity system from generation to end use including transmission distribution, markets and grid operations. We will develop a set of findings and policy recommendations to help guide the modernization of our electric grid. This in turn will ensure its continued reliability, safety, security, affordability and environmental performance through 2040.

As you all know well, the United States is a very big country and each region has its own energy ecosystem and there are strong regional characteristics to the electricity system based on local conditions. As a result, we knew from the outset that a one size fits all approach would not work and that's why we have organized the seven regional stake hold meetings, all around the country. We need to hear the perspectives from a wide range of models, given the diversity of the energy systems across our country. We want to explore how markets and resource mixes, state and local policies, financing options and a host of other factors influence how the electricity system is managed and operated in different regions of the country. We want to hear from stakeholders about how federal policies can best address the challenges and opportunities of modernizing an electricity system with distinctly regional characteristics. And that is what brings us here today. California has a unique energy ecosystem and is home to many energy intensive industries. However, as a result of very strong state and local policies and efforts to improve energy efficiency, California has one of the lowest per capita energy consumption levels in the country, all while growing its economy. And I should add, of course, that the temperate climate helps in that regard. It's also one of the only states to produce more than 5% of utility scale electric generation from solar power, a true revolution taking place in our country today. And it's working toward the goal of meeting 50% of its energy needs from renewables by 2030. California has transformed its market with policies like decoupling, targeted renewable and storage goals and efficiency options. California's refrigerator standards in the mid-1970s, and its clean car laws that paved the way for the first increase in national vehicle fuel efficiency standards in 30 years, are exemplary of this kind of innovation. Indeed, following your lead, this month the Department of Energy moved to finalize the first ever efficiency standards for battery chargers, modeled on California's successful standard.

In addition, the state mandated recently that utilities expand storage by 1.3 gigawatts, this may have national implications for driving down the cost of storage and showing how it can be deployed for a variety of purposes including substituting for new transmission and helping smooth out the duck curve caused by variable renewables, I'm sure we'll hear more from you about the proposal to expand KISO and how a regional energy market across a number of western states might deliver economic and environmental benefits to the region. California is addressing a host of crucial issues confronting the electricity system at once, from regulatory issues like rate making to operational issues like integrating renewables into the grid and grid modernization, giving the nation potential lessons that we expect to be able to replicate elsewhere.

So this meeting and your thoughts are very important as we gather information and perspectives to support our work. You're ahead of the curve in deployment and integration of new sources, as you heard from Barbara. Management of demand response and growing citizen involvement, which, of course, is a hallmark of this state. Your experiences can serve as an example for other regions, looking to modernize their grid, bring on new services and technologies, and combat climate change. In fact, today's third panel will focus specifically on how the electricity sector has responded to the implementation of measures such as AB32 and others I just noted to reduce the state's greenhouse gas emissions. Currently the U.S. electric power sector is responsible for nearly a third of our total greenhouse gas emissions. We've been working to reduce these emissions for years with some positive results. Emissions have declined by 15% since the peak levels in 2007. This is due in part to a combination of energy and environmental policies, expanded use of cleaner fuels such as natural gas and clean energy innovation. Policies and remarkable innovations in clean energy technology combine with reduced prices, have driven increased deployment of zero emitting renewables. All of this is extraordinarily important as we are working across all sectors of our economy to reduce greenhouse gas emissions that are driving global climate change. At the same time, we are working to prepare our country, including our power sector, to be ready for and more resilient to the effects of climate change that can no longer be avoided such as more intense storms and extreme weather events, droughts and higher sea levels.

One of our goals with QER 1.2 is to make sure as we modernize our infrastructure that the U.S. electricity sector is reliable, secure, and resilient and can continue to lead the world in providing safe, affordable and environmentally clean power. All of these are again reasons why a regional approach to the QER is so important. And there are also reasons why we are in California, as I noted which is making such significant efforts to combat emissions and is a leader in clean energy innovation. I note that meeting our climate goals and modernize our electric some system will still require enormous technological innovation on a global scale from both the public and the private sectors. This is why on November 30th, the day of -- the first day of the Paris Climate Talks last winter, President Obama and 19 other world leaders launched something called Mission Innovation. The member countries of Mission Innovation have each committed to doubling their investments in clean energy research and development over the next five years. Collectively, Mission Innovation represents an extraordinary commitment and the mission innovation partners already account for more than 80% of global governmental support for clean energy research and development. Doubling the current U.S. Federal investment will take us to \$12.8 billion R&D by 2021. Implementation of mission innovation at the Department of Energy will be an all of the above initiative. And I want to underscore that; focused on low and no carbon technologies including renewables, nuclear, carbon capture and storage for fossil fuels and energy efficiency. It will also include system solutions that aid in the transformation of energy infrastructures such as IT management of energy. What all this means is that innovators such as those with the Los Angeles Clean Tech Incubator that I had a chance to visit last fall, will be creating a range of technologies to help us reduce emissions, modernize our energy infrastructure, grow our economy, and fight the effects of climate change. And we'll need to explore how to put those new technologies to work alongside the technologies that are already in use.

QER 1.2 will in part help us to understand how we can best apply all of these innovations to our electricity system so it can serve all of the American people better. Before I turn the podium over to Sam Rikkers, I'd like to conclude by suggesting a few framing questions for our panelists and other stakeholders to consider when you're making remarks this morning, and these certainly echo the questions that were suggested by Barbara. These include how the changing generation mix affects grid operations. And planning reliability and system performance, including the ability to provide affordable electricity. How we should address growing concerns about cyber and physical security, new challenges for us to meet. Whether our current market structures allow for adequate investment in grid modernization, and whether we will see future challenges from new technologies to the increasingly blurry line between Federal and State jurisdictions, and what the implications are of increasing customer connectedness to the grid.

So with that, I'd like to thank you once again for your participation today. I can't stress enough how important your perspectives are to us as we do this work to develop a comprehensive and useful second installment of the Quadrennial Energy Review before the end of the Obama Administration. Thanks again for being here.

(Applause.)

DR. KAREN WAYLAND: The Deputy Secretary mentioned that this is an interagency process led by the White House. It is, and there are over 20 agencies that have equities in some way in energy and energy infrastructure. There are a few agencies that have quite large equities, you know, the Environmental Protection Agency, the Department of Interior and the U.S. Department of Agriculture are three big ones that we work very closely with. And so it's my pleasure to be joined by Sam Rikkers who is the Administrator for Rural-Business and Cooperative Service. He was previously the Deputy Administrator and before that, served as the director of the Energy and Environmental Team and the White House Presidential Personnel team. The administrator is also an accomplished attorney and a former Peace Corps volunteer in Zambia. He grew up in rural Wisconsin where one of his first jobs was harvesting tobacco. So with that, Mr. Administrator.

SAM RIKKERS: Thank you. Good morning, and thank you, it is an honor to be here with you. At first let me say thanks, not just, on my behalf but also on Secretary Tom Vilsack, who would like to be here but sends his regards. He is now the only currently serving Cabinet Secretary who was initially appointed after President Obama's election and is still holding strong in that role. We're proud at the USDA, and one of his key, key priorities has really been energy in rural America. And so it's with that, that I come with his regards as well. I want to thank the DOE team broadly, Deputy Secretary Sherwood-Randall talked about the interagency process under President Obama's leadership. You've really seen in this administration I think some of the, as Secretary Vilsack likes to say, the silo, no pun intended, being from the Ag Department. The implosion of silos across the agencies, which is critical to making a lot of communication and policies come to bear. And then thanks, as well, to the Deputy Mayor. It's great to be in Los Angeles. It's particularly nice for me, I'm from a small town in Wisconsin as Karen talked about, but my two siblings now live in Marina Del Ray and the other one in San Francisco, so most of us are back in Wisconsin but a couple of us are in California. A lot of people are drawn to this amazing state.

I think I would, if I were in your shoes, be asking the question: Well, why the heck is USDA here? Particularly if you look out these windows and see this mass of urban landscape. I asked myself that when I flew in Friday evening, but then I headed on a plane yesterday morning real early up to Sacramento and spent the day in the central valley and was reminded why we're here. And so we'll talk a bit more about that. I think one of the things that folks here in this room should know is that as administrator of the Rural-Business Cooperative Service I am part of a team which is the missionary at

USDA which is rural development. And at that missionary we wake up every morning, I really do, and think about the type of towns that I grew up in, the small towns across the country, rural spaces, and certainly while we're sitting in the center of Los Angeles, California, and this whole region is no stranger to rural spaces. I learned that flying back and flying here from DC. To fit in and understand why USDA is at this table today, one way to understand it is looking back at the legacy of rural development, and then to look forward at what rural development is doing. So looking back, what we looked at when rural development was founded in its precursor was the vibrancy of rural America. And in 1936 when the precursor to Rural Development was founded, that is, the Rural Electrification Administration, what vibrancy in rural America meant, meant every little town, every little space had access to electricity. And so 80 years ago the REA was born under FDR, with the mission to finance the creation and expansion of member owned co-ops to bring electricity to rural spaces in this country. And today, while it's still challenging, a rural electricity bill is about \$400 on average per month than an urban electricity bill. The REA had a really strong history of bringing light, there the pun is intended, to a lot of corners of our country. And today it continues in its current form, which is a rural utility service, to do that. And what it does is it finances every part of bringing electricity to those rural spaces from generation to transmission, to distribution and energy efficiency. It finances renewables, and it finances all types of energy from fossil sources to coal to natural gas, nuclear energy as well as solar, wind, hydro, biomass, you name it. And we work with all different types of lenders. So we work with regular municipal utilities, rural Electric co-ops, we work with tribal utilities. We also work with nonprofit lenders, like co-bank and other entities who are helping extend power out to the corners of our huge country. It's really attractive, because it's -- really offers the cheapest rates that towns, rural communities can get to pay for the electricity. As we know it's a lot more expensive to string cable and wire and bring light to really far reach places of our country. And so after 80 years of doing this, we've seen a total of \$120 billion of investment through the rural utilities service which was once the REA. More than 40% of the U.S. electrical grid, much of the west grid, was financed through the REA. The current portfolio of the rural utilities service is \$46 billion in loans with 600 borrowers and it has a .4% delinquency rate. And so it's continuing to do that rural utilities service and rural development to succeed on its initial mission, but as we turn to today and tomorrow, and still committed to the vibrancy of rural spaces, the mission and what we look at also evolves. And so today what that means that vibrancy is not just that a rural community has power. It means that rural communities have jobs, rural communities have homes, part of the rural development does that. And there are new markets and new sources for people to get those jobs. And so at the rural-business cooperative service we have several programs, a couple, in particular, that really help rural communities make that transition from conventional energy use and creation to renewable and other creations that are going toward the future. And so we have a large program, the Rural Energy for America Program or REAP program. It helps rural businesses and Ag producers make critical investments in renewable energy or energy efficiency. We also have programs that say you can get great financing for big projects to create facilities that are taking -- the one thing that rural America really has a competitive advantage over, which is biomass, all of the biomass that is created across the country in rural spaces in California, in particular, that were able to take and help projects take that biomass and convert it to new forms of energy. It's tough though. I don't know if anyone here is from a small town. In talking to people, and in particular, I have a memory of one of the neatest parts about this role is once in a while getting called to Capitol Hill and being asked the questions by members of Congress. And there was a member, I believe, from this region, Senator Tester of Montana, who thanked the USDA's rural development for all its investments but then he lamented that despite those investments, that rural towns and places were either dying, and the way he described it is that well, we lost our grocery store and then we lost our hardware store and shoot, when we lost our tavern, you knew it was really tough in his hometown. And either the towns in certain places are struggling to stay alive or people -- people in towns are really struggling with the transition that's going on. You've heard so much excitement, that you heard this morning, but that's tough on individuals.

Yesterday, landed in Sacramento and drove, I think, south, if I have my bearings straight down to Madeira, California if pronouncing that correctly. There's a gentleman there, Case Van Stein, he must have been 60 years old, we went to his farm. He's a dairy farmer. Had 600 cows on his farm, one of nine kids, only two of them, the eldest and the youngest were farming and he had a couple kids and one of his kids was in DC. I said I'll head back to work for the USDA. I said when I'm back in DC I'll give your son a hard time and let him know you could use some help back here on the farm. He said he wouldn't do it. He wants his weekends and wants to knock off on the 5 o'clock and he went into that gloried way that farmers talked about, because this is a way of life he talked about, because when a cow is birthing a calf at 2:00 am, you don't have the luxury to say you're not going to work at that time. It's a really amazing man that I got to spend some time with yesterday, but when we spoke, he lamented, he said he had respect for the President who I get to work, for but lamented some of the policies and even talked about the state government and some things that were struggling there for him. And the same time that same farmer, I was there, because he just made an investment in bio digester sitting right there. Right? And so USDA, working with SMUD which is a -- just from what I understand is a tremendous utility based around Sacramento with about \$300,000 grant from USDA. He had the wherewithal and foresight to make that investment, but it's still tough. Even though he's making investment in a different type of energy. It's tough. And so we see our role at Rural Development to help with that transition, people want to make that change, but it's not easy, and particularly in rural places.

I'm excited to be here. It's exciting to hear what's happening in California. And I understand from working yesterday with leaders in and around the Sacramento area, leaders that I hear today, are that folks are aware, and we will keep working, and I urge folks here to also maintain their awareness of all of the pinches that that transition has on rural America. So thank you.

(Applause.)

CHRIS KELLEY: So with that, I think we can excuse our first speakers, so thank you for your time. Appreciate you kicking off the event here today. We're going to roll right into our first panel. And we're running a little bit ahead of schedule. So as we transition here if you're on the first panel, just make your way up to the stage here just to let me know you're here. If we have everybody, we'll get started a little bit early.

Just want to remind everyone that if you do want to provide comments there will be a period at the end of the day today where you can provide -- we are taking comments from the public. And so please sign up at the entrance, if you wish to do that. And you've heard it already three times today, but just to remind those of you who are joining via the live stream, if you'd like to provide your comments over the web, you're welcome to do that at the website -- www.energy.gov/QER.

So we're going to transition. Our first panel will be on the subject of bulk power generation and transmission. How can we plan, build, and operate the appropriate amount for future needs? We'll get started in just a moment.

(Pause.)

(Music.)

Panel 1

Bulk Power Generation and Transmission: How Can We Plan, Build, and Operate the Appropriate Amount for Future Needs?

CHRIS KELLEY: We are going to get started. We don't have our full complement of speakers, but since our last scheduled speaker is at the end of the table, we will turn to him as he shows up. So let me, without further ado, get us started here. It's my pleasure to introduce a distinguished panel here to get us started for the day. Again, the first panel is on the subject of bulk power generation transmission, how can we plan, build and operate the appropriate amount for future needs? So joining me up here are Dr. Keith Casey, the Vice President of Market and Infrastructure Development for California Independent System operator. Jan Smutny-Jones, Executive Director of the Independent Energy Producers Association. Marcie Edwards, General Manager of the Los Angeles Department of Water and Power, who already got props this morning. We have Rodney Cobos, Assistant Business Manager for Southern California Pipe Trades and hopefully shortly we will be seeing and hearing from Mike Florio, Commissioner for California Public Utilities Commission.

So just a reminder to our panelists, our plan for this morning is that you will each have five to seven minutes to provide your opening remarks. We will just start right down here with Keith and move our way down the table. Once you are done with your opening remarks, it will come back to me and I will have an opportunity to ask you some questions. There will be no questions from the public, the only questions you get will come from me. So with that, why don't we get started with you, Keith?

KEITH CASEY: Thank you, Chris. It's a pleasure to be here. I do have some slides that what I would like to do is kind of frame – I think we heard a lot of it in the previous panel's opening comments, but to give you the landscape of California's Energy Policy, we have a lot of them and we kind of try to provide some context on the challenges they present and how we are going about meeting those challenges. As you heard earlier today, there is no doubt California is a global leader in advancing policies for climate change, particular in the electricity sector. And as the grid operator for most of California, the California ISO is really at the focal point of enabling these policies and importantly, enabling them while maintaining the reliability of the bulk power system. Because the one constant in all of this change is that people out there expect the same level of grid reliability we enjoy today. So as we manage this very dramatic and challenging transaction, we always have to keep our eye on the ball that we are ensuring that we are maintaining a safe and reliable power grid as we go along.

If you could go to the next slide, please. So this slide really just kind of summarizes the major policies California has, environmental policies in the energy sector. And I really organized them in two tranches, there was the set of policies for 2020, the greenhouse gas reduction policy, to 1990 levels. You heard about the 33% RPS goal, and a goal we haven't discussed, but it's really promoting distributed generation of 12,000 megawatts of distributed generation, that was one of Governor Brown's goal. Another important policy is the ban and the use of once-through cooling in coastal power plants. That is a big environmental policy in California. It impacts a little over 12,000 megawatts of gas fired generation, predominantly along the coast. And another 5,000 megawatts of nuclear power. One of those plants obviously, the San Onofre nuclear generation station was shut down several years ago, but as we go through these environmental policy drivers, we have at the same time in terms of promoting renewables, we're also losing a significant amount of the gas fleet. The 2030 goals, these were signed into legislation last year, signed by the Governor. That's the 50% RPS goal, along with the doubling of energy efficiency in existing buildings, that was part of SB 350. The Governor also issued an Executive Order to further

reduce greenhouse gas levels, a goal of 40% below 1990 levels by 2030. So these are the major policies that we're advancing. At the same time, we're having a -- what I would call a revolution on the distribution system with the proliferation of distributed resources. California is adding rooftop solar in communities throughout the state at record levels every year. So we have that dynamic happening, as well. And I'll touch on a little bit some of the implications of that.

Next slide, please. This slide just highlights in terms of the transmission connected renewables to the California ISO system, what we're seeing and what we're projecting out through 2020. And what I would highlight for you is the portion of the column that you're seeing the growth in. That's the turquoise column which is solar PV. And I would say the most striking thing about California's renewable development, it's essentially over the next six years, one technology predominantly in one state, which is California. And when you focus on one technology, solar PV in this case, in one geographic location, it presents some challenging integration issues which I'll get to in the next slide, please.

So this is our infamous duck curve. I was pleased to hear Deputy Secretary Sherwood-Randall mention it. It's very well-known at this point. But it really highlights two integration challenges. So essentially what you're seeing in the duck curve is what we call our net load. So we're taking the total load on the system. We're subtracting off the wind and solar output, and that is essentially the net load profile that the grid operator, in this case, us, have to manage to. And what you're seeing is in progressive years as you go from 2012 to 2020, you see the duck start to fill out, what we call the belly of the duck filling out. And what that's reflecting is the additional solar PV, because it's very concentrated in the middle part of the day. It comes up very fast and goes away very quickly. And that's why you see that very deep sagged belly of the duck. The integration challenges it presents. The first is what we call an oversupply challenge. In the belly of the duck if you overlaid on that graph all the other resources we have on the grid, besides wind and solar, the -- those resources would exceed the line in the belly of the duck. Meaning we have too much supply in the grid. And we have to essentially curtail power, in many cases, renewables, to keep the system in balance. So that's the oversupply challenge. The neck of the duck is our ramping challenge. As that solar drops off quite dramatically, its coincidence with load increasing, this is later in the day, in the evening with people coming home, turning on their lights, appliances, so we have this huge ramping challenge that we have to have the right resource mix that can match that increase in demand over a very short period of time, three hours. There are a number of solutions that can get at the duck curve. Those are highlighted to the right. In the interest of time I won't get into them all, but I did want to comment on the last one that's listed there, deeper regional coordination. I won't be able to touch on all of the framework questions that Deputy Secretary Sherwood-Randall asked but I will talk about the role of regional markets and how they can help meet this challenge.

Next slide, please. So, from the ISO's perspective, there's a whole lot we're doing to manage this transition to clean carbon grid. And you can see the different categories there, from advanced forecasting, enhancing regional coordination, improving our tools on the operational floor, advancing our market and the like. And I will note that in the area of advancing market policies, there's a lot of challenges there. There's a lot of actors in that space. We have a very diverse group of stakeholders. We have Federal, state regulators, very hard to get everybody on the same page, pulling in the same direction. And I think that's a theme you'll probably hear from the other panelists, as well.

But I do want to talk a little bit about regional market, if we could transition to the next slide, please? So you may have heard about our energy imbalance market. This is a -- essentially a real-time market that the ISO has. We operate in addition to a day ahead market, we have a real-time market where we do 15-minute and 5-minute energy dispatches. Up until a year and a half ago, that was done just for resources in our footprint. With the advancement of the energy and balance market we extended it to Pacific Corp. Which is a utility in the Northwest. You can see them on the map there. They have essentially a western balancing area and then an eastern balancing area covering roughly five states.

And we started with them a year and a half ago. And essentially what we do in real time is instead of just optimizing the resources on our footprint, we're able to co-optimize as one system the resources in our footprint as well as Pacific Corp.'s and we saw enormous benefits from doing that. There's a lot of synergies and ability to really mitigate some of the variability in the system by operating it over a larger footprint. NB Energy joined the energy in balance market last year and we're seeing significant benefits through the end of 2015, over \$46 million in benefits. And a very dramatic up-tick the first quarter of this year where we saw between Pacific Corp, NB Energy and the ISO, roughly 19 million in benefits and on the renewable front, we saw this past quarter a significant reduction in curtailments. Last year it was avoiding roughly 18,000 megawatt hours of renewable curtailment. In this quarter alone we avoided over 113,000 megawatt hours of renewable energy curtailment, which translates to about 50,000 metric tons of CO₂ savings. So a lot of big benefits with this real-time market, but we believe that's just the tip of the iceberg, that the real benefits from regional market coordination come when you extend it into the day ahead because then you can start impacting how gas units -- whether a gas unit gets started or not. And just, you know, a lot more resources to move, and ultimately, you know, increased opportunities for finding sources for surplus renewable energy on the system. So that's something I can elaborate in the Q&A, but I did want to highlight the regional market opportunity that we have here in the west. Thank you.

CHRIS KELLEY: Jan.

JAN SMUTNY-JONES: Thank you very much. I'm Jan Smutny-Jones with the Independent Energy Producers and I appreciate the invitation to be here today. This is a beautiful building; growing up in Los Angeles, this at one point in time was the tallest building in town. I have fond memories of a science fiction movie; I think it was *The Day the Earth Stood Still* with a flying saucer crashing through this very room. So hopefully we get through the day without that occurring. At any rate, IEP is a trade association, we represent utility scale independent power producers, which includes a large chunk of the independently owned gas fleet here in California as well as most delivered RPS resources to California utilities. We have wind, solar, thermal, biomass and we are now getting involved in storage. So I operate one large dysfunctional family and we've got lots of opinions on things that are occurring today. We were established in 1982, back when we had mammoths in the La Brea tar pits. We've been around for that long a time. It will tell you this is -- this has been a long road to get to kind of where we are today and getting into 2050 goals which is another 35 years out, there's going to be a lot of changes, a lot of new technologies, and a lot of things to be developed.

Please. There we go, okay, we know who we are. All right. Progress today, and I think it's important to kind of know, you know, kind of where we are as we project kind of in the future. So we'll start with the gas fleet, as Keith indicated, we've done away with the once-through cooling units along the coast or they're being phased out. And in that period of time, about 16,000 megawatts of new generation was added since 2000. This is primarily combined cycle turbine technology and it's been very successful. It's very efficient. It's increased the efficiency of the gas fleet in California by 23%. And it's had a very significant reduction in GHG emissions associated with the operation of gas facilities in California. You've already heard a little bit about the 33% RPS. California has, since the days of PURPA been a leader in renewable energy, but this is an area that has really rapidly grown over the last few years. You know, prior to, you know, 2009, you had about 300 megawatts worth of utility scale solar. Today you have over 7200 megawatts will show up in any given day. That's in addition to the 4,000 megawatts of rooftop solar which we actually don't represent. There's a significant amount of increase. It's projected by 2015, we've had 14,300 megawatts of renewables here. And in-state wind has quadrupled. Solar has, as I indicated grew by 13. The sort of bad news or lack of growth has been seen in the geothermal and biomass industries. We have been very, very much focused on the cost of renewables and both geothermal and biomass are fairly capital-intensive and while they're base load we will get to that later. They are more expensive than the others have turned out to be. Last but not least is storage. We have a

policy of encouraging 1325 megawatts, the utilities and certainly Edison has been pretty active on that. You're going to hear from Susan Kennedy later who can – who is an entrepreneur that's moving into that market pretty rapidly. But there's a lot of interest in obviously storage moving forward. Challenges for the future - one of the key things is we talk about managing carbon while maintaining reliability and affordability. We need to reduce carbon by 80% by 1990 levels, by 2050. So these longer term aspirational goals are going to require, you can move the slide. There we go. All right. I forgot to do that. Intermediate infrastructure investments. These ultimate goals, I believe, will not be met by what we know today. There's technologies out there that will be developed over time. If you look back 35 years, you know, we didn't need to argue about iPhones versus Galaxies or whatever. They didn't exist. PCs didn't exist. All of those things have grown in that period of time. And likewise, I believe, in the energy area you're going to see a similar development. But in the meantime as Keith indicated we need to keep the lights on and people need to be able to pay their bills. So this is going to be a long road. And the other thing that keep in mind, I just thought about this a few months ago, that literally every single solar panel that's out there today is going to need to be replaced by 2050. There's millions of them. Up on the roof, out in the desert. Probably long before that but the point is all that technology is going to shift. The gas plants that we are currently building or that I talked about briefly, will be gone. So there's going to be a whole bunch of different things going on in 2050 that people other than me can worry about. I'm going to be a biomass problem by then.

I'm just throwing out some ideas of areas that I think there is some friction or some things that we need to think about. So one of these challenges going forward, as Keith indicated and you will have a whole panel on this next, is the concept of shifting in this distributive area and what does that mean. Historically we've looked at this as largely customer-driven, people put a solar panel up on the roof and they're swapping electrons with the utilities. There are a lot of advocates that are proposing a wide variety of different kinds of products that are -- it's changing that model. And you start wandering into an area where these begin to look like sale for resale which is -- brings in Federal jurisdiction. Now, that's not insurmountable, not necessarily a huge problem but it's a problem that needs to be thought through and figured out, because sort of the state -- the state versus Federal jurisdictional boundary is between distribution and wholesale, are blurry now and they're going to get blurrier. So this is an area to watch for. And as I -- just as I indicated, historically, the net energy metering for rooftop solar has been a pretty easy transaction conceptually, but when you start talking about bundling people together and selling ancillary services to Keith it gets complicated.

Utility scale renewables, this is a picture of my guys, it is the most equitable way to least cost and basically operational flexible way to pursue renewables. Next existing challenge is Keith talked about the duck curve. We have a number of power plants that are under contract. Those gas plants that are no longer under contract, these are normally ten-year deals, are kind of sitting out there, and we lack what is called a capacity market as the ability to generate when called. I don't want to use the word capacity market because people's hair catches fire. But the point being is, we need a way of being able to modernize or keep those plants available and moving up in flexibility that currently isn't being recovered in an energy only market. So the gas fleet obviously is needed to support the clean energy issue, to help address the duck curve. And while the sun never set over the English empire, it does do that on a regular basis here in California. So these resources are needed for night. This lack of transparencies in this capacity market and I use that word very loosely, presents challenges not only for the gas fleet, but to the extent that people want to pursue sort of merchant demand response or merchant storage, because there is no -- there's a lack of revenue from wholesale markets there. A multi-year resource adequacy program by the State could solve that problem.

Next slide, balanced portfolio. As I indicated earlier, the biomass and geothermal are higher cost technologies than what we've been focused on in terms of the intermittent lower cost technologies. They're base load, so that is a potential for as we displace coal and nuclear power elsewhere, they

obviously have some local economic benefits associated with it. But in addition, you have one of the issues that's coming up in California, is we have 29 million dead trees, we're going to take them out of the forest and then the question is what to do with them. So we see that as a great opportunity for biomass industry and are working along those lines.

So, real quick, and I'm going to sum up some opportunities, this -- next slide please. Yeah, this low cost midday energy presents real opportunities to address CO₂ and other sectors. The energy sector is doing quite a bit already. And transformation, for example, is a big one, but we're working on concepts of basically utilizing that midday -- a midday over supply for water processing, desalinization, recycling storm water. Electrical vehicle charging and that's just not solar. I saw a statistic where a combine cycle generator that's supplying electricity to an EV produces one quarter of the CO₂ than operating a car with gasoline. So it's significant. We've got hydrogen production. And then energy-intensive industries, California has a bad rap for driving energy intensive industries out-of-state. But if actually we're producing low cost energy in the middle of the day, why don't we reform our rates and then try to track them back.

And I'm going to close here with the next two slides. Opportunities in Western grid. I'm not going to over, are, you already heard from Keith, there are extensive resources in the west. My members own wind, for example, in the Columbia Gorge that they would like to sell here at a relatively low cost. I have solar developers here who are looking to be able to export their markets, so the concept of this broader market is something of interest to us. It's very complicated. It's very -- there's a political -- all kinds of issues that are arising around it. So it's not easily done, but it's obviously front and center, what a lot of people are talking about.

So in conclusion, that last slide, California electric grid is clean, reliable and flexible to match load. That's what we need to keep that up. We need timely investments to keep that going forward, and a portfolio of resources including a range of reliable base load facilities, and flexible thermal resources are going to be necessary for the future. With that, I'll wait for the rest of the panel. Thank you.

CHRIS KELLEY: Thank you, Jan. Marcie.

MARCIE EDWARDS: Thank you, Marcie Edwards, Los Angeles Department of Water and Power. First of all, I want to thank you all for being here today, your interest and commitment is not only critical but it's appreciated very much. Like the ISO, DWP is a balancing authority and one of their charges is to maintain system reliability. And that puts the bulk power grid really front and center. I wanted to start today with a bit more of a macro view and remind people of the value in the bulk power system over all. First of all, its diversity in fuel source and geographic diversity of where facilities are allowing for the dilution of risk across broader area business segments as opposed to concentrating it and placing a greater burden on the rate pair. I would offer as one example, Venezuela's dependence on hydropower and you know what happens when you are dependent on hydropower in the midst of a drought. They are anecdotally down to a two-day work week because they have insufficient energy to power their economy. I mean, that's a hugely impactful statement and it points to the criticality of diversity I think very clearly. And again as was mentioned earlier, look how the risk profiles in California have changed. We had been becoming increasingly gas dependent. We were expediting our withdrawal from the coal industry. And you need some type of fuel to provide grid integration services for renewables. The renewables trend line is going up very rapidly, but what it did then is it created a greater focus on gas, which immediately impacts that diversity equation. So it's important to understand now with the largest gas field west of the Mississippi out of service, it changes the entire real risk profile for large portions of Southern California. Bulk power facilities also act as a hedge. Many are fully depreciated but also due to economies of scale they help hold down costs to consumer in an era where technology is moving very rapidly, but it is not moving inexpensively. You have to find ways to manage the cost-equation. As you heard from Keith and

from Jan, bulk power facilities promote regional connectivity. And it creates opportunities to participate in broader markets. Bulk power also provides the flexibility and operations which promotes power system reliability. I've been in this business now for oh, I hate to say this number out loud, over 40 years. I've been a power plant operator. I've been a power grid operator. And ultimately a utility General Manager. So I have seen a lot in this time. And I will tell you the bulk power system is the backbone in this country for keeping the lights on. But planning and building new bulk power facilities, it's tricky. They're costly. They also rely on long-term predictable revenue streams in order to gain financing, and there's a notable lack of predictability in our industry that stems from a variety of factors, I think many in the room are familiar, I'm going to mention one or two examples. One aspect of the unpredictability surrounding bulk power investment is its technology solved the renewable integration issues, is clean power scalable? Is it economic? Is it such that it can replace larger centralized facilities. And as Jan mentioned, right now you get broader bang to your buck with utility scale, but technology is also coming down in price, and I think you'll see greater investment in diversified portfolios as well. I think the problem comes in that when you have this unpredictability with the technological curve straight up, you have a lot of variability of interest and in end game; it starts to make the investment in bulk power appear riskier, and that's one of the concerns and one of the reasons why I'm trying to underscore the value of those investments. So, the answers to those questions, particularly technological curves, et cetera, it's going to be different all across the country. And I'm happy that the policy framework continues to allow for those differences, because you have a wide variety of owners, operators, jurisdictions, very different philosophies in different parts of the country. And you always need to take into consideration the magnitude of sunk costs that are associated with previous investments, and so as was mentioned by the Deputy Secretary and it was very gratifying to hear, there is no one-size-fits-all approach to this.

Here in California we've been referred to as the living laboratory. And I prefer to think of it as the folks who are assigned to rebuild the plane while it's at 30,000 feet. We have multiple planning models, cost allocation models, utility operation models in California and they are all subject to shifting financial, regulatory, technological, market, legislative direction, all the time. In planning for new generation or new transmission is really not a simple engineering cost based exercise. It involves many, many stake-holders, and I'm not suggesting that including more interest isn't a good thing, but when you start to involve significantly the profit beneficiaries, the more rampant things, the issues and concern of rate payers, the environmental interests who may prefer other alternatives than what you're proposing. Regulatory and legislative bodies who want their specific policy platform realized, social environmental justice issues, and of course, as I keep mentioning, the speed of rapidly evolving technology. And here is my take away. These interests create broad differences in the development of a clear value proposition for bulk power investments. And that lack of clarity, which can also be interpreted as a lack of predictability, can lead to an underinvestment in bulk power right when we need it, as a hedge to maintain stability. To help hold costs down, create greater regional opportunity, and help our industry transition in whatever way the prevailing interests demand.

So, a few closing observations. Help at a Federal level, in my view would look like this, a broader empowering of local interests. They're one of the best reflections of the specific needs and interests of that community. And acceptance that unintended consequence can stem from Federal policy. I know. Who knew? And, therefore, adding risk management tools to that process would be prudent. As an example, policies that project the desired policy objective but aren't overly prescriptive or policies that include off-ramps or openers to address the unexpected. Recognition that some of the national energy markets are really far more complex administrative constructs than actual markets. We seem to add bureaucracy with more the appearance of competition than the reality. And I think there needs to be some sensitivity to that. We need help with developing research and development options and not by selecting specific technologies, companies, or fields. I would offer that energy policy should, to a greater extent facilitate the development of new technologies through independent institutes. I've noticed an increasing reliance on information gleaned from those who stand to make a substantial profit. And while that

information may be valid, that profit motive needs to be weighed against the outcome and interests of others. With that, I'm going to conclude my opening remarks. Chris better give me a duck curve question though at some point, because I took notes. Thank you very much.

CHRIS KELLEY: We'll see. We can bring the slide up I guess if we need to.

RODNEY COBOS: Good morning, my name is Rodney Cobos, I'm with the Southern California Pipe Trades based here in Los Angeles and this morning I arrived a little early, because I didn't want to be late. And then as I notice that the meeting started late, that was going to be one of my excuses for cutting my presentation short. But now that we start on time, I can't use that excuse, but I do appreciate the Department of Energy for welcoming me and sending me the invite to my organization. The Southern California Pipe Trades and its affiliated local unions are made up of members that help solve the state's energy problems by building, maintaining, and operating conventional and renewable energy power plants. Our organization is committed to building a strong economy and a healthier environment. We provide a workforce that delivers reliable energy and power plant jobs while protecting the state's air, land and water from pollution. The thing is with all this renewable energy is jobs, and that's one of the main reasons for me and my organization being here at the table. And I hate to use the term about if you're not at the table you're on the menu, but I do appreciate the invitation. So and I will use that as my closing, thank you.

CHRIS KELLEY: Thank you. Mike? Actually let me introduce Mike Florio since he joined us on time, but we started early. Mike Florio is the Commissioner for the California Public Utilities Commission. And Mike, everyone's just giving their opening remarks right now, 5 to 7 minutes. We will hear yours, sir.

MIKE FLORIO: Thank you, and welcome to not so sunny California. As I feared and anticipated, between the previous speakers, they've covered a lot of the things I would have liked to talk about, but I think there's still plenty of room to cover. As you know, the California energy scene is complex, but we soldier on. One of the things, I think, that has worked reasonably well is in the period since the energy crisis of 2000, 2001, we've restored a pretty robust, long-term planning process that involves resource procurement proceedings at the California Public Utilities Commission, and the municipal utilities, as well as sophisticated transmission planning process at the California ISO. We have worked, over the years, to the point where now, all of those processes use a common set of assumptions, which can often be a problem in these areas, but through great staff work involving the ISO, the State Energy Commission, and the PUC staff, we now have a uniform set of planning data that we work from. And that has served us well. The retirement of the once-through cooling plants along the coast was something that was anticipated well in advance. We have guided our utilities to procure ahead of time the new capacity to replace that which would be retired, and that has been quite successful. We have new gas plants, new renewables, new storage, and a wide variety of resources to replace those plants that either have closed or will very shortly. But in the middle of all that, we had a shock when the San Onofre nuclear plant that was the reliability heart of the Southern California electric system went down unexpectedly several years ago. And through a combination of advanced planning and, frankly, some good luck, we got through that without any reliability problems. Part of it was the serendipity that the sunrise power link that brings power into the San Diego area from the Imperial Valley came online right about the time San Onofre went down, and that enabled us to get through. As previous speakers have indicated, we're well on our way to meeting our 33% by 2020 renewable targets, and I think, given the highly competitive nature of the solicitations, we shouldn't have any problem meeting the 50% by 2030. From a supply standpoint. There was a lot of concern initially about cost. The costs were high in the early years, but now we have a thriving industry. Many of whom are members of Jan's association, that, you know, compete aggressively to provide new renewable as well as conventional resources to our fleet. The proliferation and incredible cost reductions of solar energy has led to some problems that Keith highlighted with the infamous duck

curve, but we have a lot of tools, as he mentioned, to address that. Regionalization is one that we're pursuing. Right now we're grappling with some tough issues of how a multi-state independent system operator would be governed, but a lot of goodwill and hard work going into hammering that out. We've pushed forward with a storage mandate that, again, there were concerns that it would be too expensive, but the initial results are pretty favorable there. Really, the solicitations that have happened to date have brought in a variety of different types of storage at surprisingly low cost. We're also aggressively expanding our demand response capabilities, not only the traditional, interruptible load programs, but advancing into auto DR and integrating those resources into the ISO market, so they show up when and where needed. One of the challenges is how to fill up the belly of the duck, which occurs particularly in the springtime. We're hoping that through time of use rates at the retail level, as well as advancement of electric vehicle charging and a number of the other potential technologies that were mentioned are going to serve that well. And cheap energy is not a problem that we shrink from. And I think there are going to be a lot of opportunities for taking strategic advantage of that excessive solar in the middle of the day.

At the same time, we've had a lot of success in developing fast start gas fired resources that can provide flexibility to the system. And we may need to invest in upgrades to lower the minimum load on some of the combined cycle plants that are now not running at the high capacity factors that were anticipated. Increasingly, we're moving toward a world where, instead of the traditional supply-following load, load will need to follow supply, because the supply is intermittent. It's abundant at some times and nonexistent at others and through our rate setting proceedings, we're trying to accommodate that and move away from our former time-sensitive retail rates to rates that are reflective of conditions on the system. One area of some concern to me as I look at the trends we're facing is that we may have a growing stranded cost problem. And that problem is not so much, you know, older resources that for the most part are well depreciated, but the early era renewable contracts that were more expensive, you know, ten, fifteen cents a kilowatt hour don't look so good now that solar and wind are available at five cents. And we have a program here in California called Community Choice Aggregation where local communities can essentially move away from the investor-owned utility that provides the transmission and distribution and buy their own power. In California, not surprisingly, that trend leads to a desire for more renewables than the utilities currently provide. Because the prices are so cheap now, it's very easy to start a new procurement entity and get cheap renewables. And then the question is: Who pays for those more expensive legacy resources that the utilities invested in to get the market moving prior to 2010 or 2011. This leads to some pretty spirited cost allocation disputes at the Public Utilities Commission. And those I suspect will continue and grow more intense. All not unlike the situation we faced in the early 1990's when combined cycle gas generation could undercut the prices of the existing resources and you know it created a push for industry restructuring not just over here but a lot of the country. But in the end those stranded costs don't go away. It's just a matter of who pays them.

Finally, despite our best attempts at looking forward and anticipating problems, the Aliso Canyon situation has, of course cast a pall over all of our planning in Southern California. It simply was not very well appreciated that while SoCal gas has four storage fields, only one of them, Aliso, is particularly situated in the right location and with sufficient pressure close to the load center to provide fuel for the power plants, the gas fired plants, that often have to start up very quickly. Unlike electricity, gas only moves at 20 or 30 miles an hour. So gas at the state border is not going to keep the lights on in Southern California. It's got to be where it's needed. We've developed a multi-agency action plan to address this. There is still some gas left in Aliso Canyon that hopefully we can use on peak demand days. The Commission is in the process of adopting some tighter balancing rules on the gas system to make sure the gas is there when we need it. And additional energy efficiency and demand response options are being pursued in the LA basin to try to cushion the blow. So there's a lot going onto try to address the problem, but unless and until Aliso Canyon can come back online, we are facing some real risks this summer.

It was one of those things, we used to worry about seams issues in the electric market. I think we had some seams issues in the regulatory structure. The PUC has been very focused on gas pipeline safety, in the wake of the San Bruno disaster a few years ago, but our jurisdiction stops at the wellhead. There's another State agency, the Department of Oil, Gas and Geothermal Resources, that regulates oil and gas wells, including storage wells, and this problem with Aliso Canyon fell through that crack. And that gives us a real challenge for the next several months and probably through next winter.

CHRIS KELLEY: So, Mike, if we could just reserve some time for questions, could you just turn to your closing remarks?

MIKE FLORIO: Yes. That was where I intended to finish.

CHRIS KELLEY: Good, good timing.

MIKE FLORIO: Thank you very much.

CHRIS KELLEY: Excellent. So with that, let's go ahead and dive right into it, shall we? So I'll start with -- I mean, I've heard solar mentioned by pretty much every one of you so let's just get started there. So the Deputy Mayor actually at the very beginning spoke about how even in Los Angeles alone distributed solar has increased by 20% just in the past year. And many of you did talk about managing the move to increase distributed energy resources. So I'd like to just maybe have you talk a little bit about how this might present additional challenges with the new DR coming online for your organizations or those that you interface with. Anyone want to take that? Yeah, Marcie?

MARCIE EDWARDS: It's an interesting confluence of events. You have the rapid development of additional solar and in fact utility built solar. I have 560 megawatts coming on the end of this year. So we're dramatically increasing those resources, and as you add solar, given its intermittency, you need to be able to use a fuel that's predictable to integrate those renewables, so when we talk about grid integration services for renewables, typically we're using gas plants. Now, you add the restrictions imposed by Aliso Canyon, and you can't replace the services that the current gas plants provide with renewables or energy efficiency or demand response solely. And this is because those generators are creating other elements that keep the power grid stable. They're providing voltage support and they're providing something called rotating mass. Those two things are very critical to keeping a power grid stabilized. So it's very important as we talk about the onset of renewables and energy efficiency and demand response, all good things to reduce our consumption of energy, we need to remember there are still elements that we need to provide the electric grid in order to keep the lights on.

CHRIS KELLEY: Thank you. Anyone else? Yeah.

KEITH CASEY: Yeah, I think this building on Marcie's comments, I think in the area just simply forecasting what the demand operators have to meet, when you have that magnitude of behind the meter solar, it just adds a whole exponential dimension to uncertainty around cloud cover and what your actual demand on the system will be. So, one of the areas we're really focused on is really ramping up our forecasting tools and getting better information of what is actually behind the meter, the distribution feeders in the way of rooftop solar, because it's really becoming a real challenge. Also, just operationally on -- I know that the next panel will talk about, you know, DER, in general, but the coordination between Transmission and Distribution Operation is really coming to a head where we really have to better understand our respective roles, not just in real-time operation but also how we coordinate in planning the system, because we're seeing interfaces with the transmission distribution system where the flows are going both ways, where historically they only went one way. And we're seeing voltage swings during certain parts of the day and certain times of the year. And the question is, well, who's going to manage

that voltage? Is it he going to be the transmission operator, the distribution operator or both. So there's a whole suite of planning and operational issues that comes about with that, that we have to get after.

CHRIS KELLEY: Thank you. Jan?

JAN SMUTNY-JONES: Yeah, let me see if I can -- as I indicated earlier, obviously I represent, you know, utility scale interests, and we're very proud of the fact that we've been able to drive the price down now below a nickel. How anybody makes money at that, I don't know, my job is just to help them make markets, how they lose money is their business, but there is this tension beginning to develop. There's a lot of DER advocates who are arguing that we need to completely radically change out the entire grid to go from kind of the integrated grid that we -- that this panel's talking about, to something that's, you know, ever everybody is going to live on a SmartGrid, and everybody is going to have solar panels, whatever. I really question that that's actually going to happen. I think there's real value in an integrated grid. I think there's real value, you know, in sharing resources over a broader area. And I don't think the -- certainly the programs we have there now are sustainable. That energy meter read program's sort of as a general rule and the way they have been rolled out, have been directed at customers but these are largely customers with high FICO scores with a home with a south facing roof and don't pay their income taxes with an EZ 1040 form. You run out of those people after some point in time. And the important piece of this and this is what I think is missing from the policy debate, as those folks are now -- they no longer contribute to the distribution or transmissions issues. So that the problem then is -- well, who is left to pay for that. Okay? We assume that the poor people are going to get taken care of, because that's part of the resource act. Who is left? And I'm afraid that's the assistant manager at Costco who lost their house in the last recession, and, you know, is -- doesn't have the ability to put solar panels up on their roof. Now, maybe there's other programs that will come up but certainly the programs that we see out there now, this is a significant problem. So while I think there's a great deal of things to be enthusiastic about, about new technologies and a way of integrating these resources into the bigger grid, the idea that somehow we were going to radically reform everything and the bulk power grids are going to go away, I think is way ahead of reality at this point in time.

CHRIS KELLEY: Thank you.

MIKE FLORIO: If I could pick up on that, I think, you know, Marcie addressed some of the technical and engineering challenges with heavy reliance on solar. It's also a big political challenge. Solar is incredibly popular in California. You know, it's mom, apple pie and solar energy, and sometimes it gets a little carried away, which I think Jan was alluding to. Today we can't run a grid on just solar energy. Maybe someday with the appropriate supporting technologies, we can do away with fossil fuels, but we're not there today, but a big segment of the public in California wants us to be there today. And it makes it very difficult. The Public Utilities Commission faced a decision recently where the net metering provisions had hit their cap and we were charged by the legislature with figuring out what to do next. And, you know, the first reaction of a regulator is: Well, let's look at the costs and benefits. The problem is, a lot of the costs and benefits of rooftop solar occur at the distribution level, where we don't have a very good understanding of the dynamics. We have a distribution resource planning proceeding ongoing, where we're attempting to quantify the local -- localized costs and benefits of solar, but those are still in their infancy. So we know that there are places where putting in solar would be extremely valuable, and there are other places where it's not helpful at all. It makes things worse. And we don't have a good handle on that yet. So, when confronted with, well, what is it worth to pay for rooftop solar, the Commission pretty much threw up its hands and said: We don't know yet. And we're going to kick the can down the road three years and cross our fingers that we'll have better data then. Some of us -- it was a 3 to 2 vote of the Commission. I was one of the dissenters who felt that the extension of the investment tax credit for solar would allow us to lower the compensation a little bit more than the majority did, but these issues are hitting Public Utilities Commissions all over the west, and unfortunately the issues

become extremely politicized and cast in black and white terms, that it just isn't. But that's something, you know, some states have moved aggressively to lower the compensation. Others, like California, have kept it essentially the same, but this is going to be a real challenge to confront in the next several years.

CHRIS KELLEY: Thank you, Mike. Rodney, anything to add?

RODNEY COBOS: No, like Mike had mentioned about hitting our goal by 2030 with 50% renewable, and I agree with him as far as we're not going to do it with just the solar and wind. So I agree with you on your comments.

CHRIS KELLEY: Thank you. So, I'd like to turn to markets at this point. So, Keith, you mentioned in one of your last slides, you touched on the value of regional markets and how well they cooperate. So I'm curious to hear more about markets in this region and perhaps maybe for the others, do you see any needs here? I heard the concept of capacity markets coming up. Energy and balance markets. Does anyone care to comment on that? We could start here with you, Keith, if you like.

DR. KEITH CASEY: Yeah, well, as I mentioned, you know, I think the energy imbalance market, which is just a real-time market that we've extended to a number of utilities in the west has shown a lot of significant benefits, and we think it will continue to do so. But, you know, as I mentioned, you're really, when you're talking about a real-time market you're dispatching on the margin, the big decisions around how are you going to use your resource fleet have been made in the day ahead time frame if not sooner. So, what we're exploring with Pacific Corp. At least initially, is a full participation where, as a utility outside of California, major utility outside of California, they would join the full participation in the ISO. Would essentially become a regional ISO. And you'd get the benefit of a day ahead market. You'd get the benefit of a consolidated balancing area. One of the things we, I think, are vexed with in the west is, we have 38 balancing areas over the entire Western region. And they range from, you know, very small to, you know, huge. But it really creates a lot of inefficiencies and seams issues, and the benefit of a full participation as you consolidate that balancing area function, you're able to manage your reserves, your resource commitments, much more efficiently. And then also consolidating transmission planning and resource planning, you know, we heard earlier in the panel, you know, that we have very different approaches to resource planning and transmission planning. And having a consolidated centralized planning over a larger geographic footprint, it means you're better positioned to get alignment around a resource plan and a transmission plan. And ideally you've worked out the cost sharing arrangements between all vanities in that regional market. So we're pushing ahead as Commissioner Florio mentioned it's a very complicated endeavor. It raises a lot of state, political, jurisdictional issues, both for California and the Western states considering this, and we're right in the midst of kind of grinding through all of that. And we'll -- we're going to continue to fight the good fight to see if we can make this happen. And it's too important not to try.

CHRIS KELLEY: Thank you, Keith. Marcie.

MARCIE EDWARDS: Just a brief slightly ironic observation. It's similar to, we have the Federal Government, we should, therefore, abolish all the state governments. It creates that same kind of complexity. In our industry, if you want to know where someone stands, you ask them where they sit. And that will inform you immediately what their position is going to be on any one interest. Now, that having been said, there are some real benefits in regionalization. And I think it's up to all of us to study and see to what extent they can be extracted. Though as an example, DDBP has taken that approach for years in conjunction with the large Southwest marketing agencies up in Washington, where we arbitrated the difference in season and availability of resources, so we know on its face, it's a good thing. It's the issue of how do you structure it in ways that past issues or investments are not simply abandoned and you can't just move to a brand new model.

CHRIS KELLEY: Thank you, yeah, Jan.

JAN SMUTNY-JONES: Follow up on that and two other points, first of all, I think what gets lost in all this, is people think that there's something radically new being proposed, and in part, there is, but to Marcie's point, we've been trading power all over the west for 40 or 50 years. So that piece of it isn't new at all. And those markets have basically evolved over time. So we will probably continue to see that, you know, what ends up happening with this, the melding of Pac. Corp. into the ISO, if that happens. We'll see, but as Keith indicated we're right in the middle. There's three things I want to say on the market though. Because it's important the DOE understands. In California we run largely on a bilateral market, so the renewable resources that have been added as Commissioner Florio indicated, come out of a long-term procurement proceeding and it's done by contract. So whether that is renewable, whether that is gas and now we're moving into storage and other types of demand response as well, that's largely been done through a bilateral market. And so that's good for as long as those contracts are there, but if you want to see things are more dynamic or what happens after the contract's over with, then it gets a little dicey. And as I mentioned in one of my slides I used the word "capacity", and that's a loaded word here. We're not going to have a capacity market in California, because the State is worried about losing jurisdiction to FERC. Okay, I spent four years of my life wasted on that, that's four years I could have been spending fly fishing, we're not going to go down that road, but -- just on costs, yeah, having said that, there are ways of creating resource adequacy markets that, you know, that duck curve, there should be a value associated with that. And it struck me, reading the document that the study that the ISO paid for about a year and a half ago, identified the lack of revenue coming out of the wholesale market is the number one thing that was holding back demand response and storage and some other things. Well, that's kind of silly. We ought to figure out how to remove that, and therefore, if people -- you know, trust me, if energy storage people figure out that there's a really high value in that four hours in the day, they're going to figure out a product to make that happen, just like the gas guys are going to figure out a way to make their gas plants hang around. So I think that's a very important piece that needs to get done. And, you know, so that -- that is something that I think largely is -- falls within the state jurisdiction, and it's a piece of work that needs to get done sooner rather than later.

CHRIS KELLEY: Thank you. Mike?

MIKE FLORIO: Yeah, I think, you know, we currently in the CAL ISO footprint have a very high reserve margin as a result of both bringing on the renewables, but also the fact that were developing generation to replace the once-through cooled plants, but many of them haven't retired yet. So we have this temporary surplus that means that prices are very low. I expect that once those retirements kick in over the next several years, you know, we're going to have more of an equilibrium in the market and we will see the compensation for the plants that are providing reliability services increase, that we've also just in the last few years added a flexibility component to our resource adequacy program. So we're looking not just for peak capacity, but capacity that is available to ramp, when needed. And that, for the moment, again, doesn't carry much of a price premium, because there's a lot of it. But, again, once the once-through cooling plants are retired, I think we're going to see an increase. And I'm sure Jan's members can't wait, because they are getting squeezed currently, but I don't see that as a long-term indicator of where the market is going. If you've got a set of capabilities that the system needs, that's going to be paid for, or we'll be in a world of hurt. On the regionalization issue, just wanted to point out one of the reasons it's so challenging setting aside the fact that we've had a bilateral tradition in the west and have not had the tight pools that exist in other parts of the country is, we're trying to combine some very different states. You have the coastal states of California, Oregon and Washington that largely embrace the Clean Power Plan, that are moving at varying speeds but generally in the same direction. And then you have the Rocky Mountain States, Utah, Wyoming, parts of Idaho that you know are -- at least some of them are suing to overturn the Clean Power Plan and who are not at all interested in becoming, you know, colonies of

California. So that is -- you know, a cultural and political divide that we've got to work very hard to cut through. I mean, I've been in any number of meetings, where I've said, you know, we got to leave the guns at the door here. We're talking about mutually beneficial exchanges that should have benefits for everybody. Let's not try to use this process to change the politics of another state. If you look at -- the population of the entire state of Wyoming would fit comfortably into the City of San Francisco, with room to spare. And much of their economy is dependent on extractive industries: coal, oil, gas, uranium, and now a growing wind market. But they're a seller state. They're -- and without those industries, even the few people that live there wouldn't be able to stay. So this is tough, but I think if we approach the issue with an understanding of where everybody is coming from and swear off the temptation to try to use regionalization as a cudgel to change someone else's policy to something we would like better, I think it can be done.

CHRIS KELLEY: Thank you. So, Rodney, I can give you a pass on this one if you like, but I do have another question I'd like to turn to. Marcie, briefly before we go to our next question.

MARCIE EDWARDS: I just want to mention along the lines of what the Commissioner just mentioned. L.A. is taking a good, hard look at the energy and balance market. There's no benefit to us in taking the, just say no approach, though historically we have been known for that periodically, but I think there are some true opportunities for us there and I just wanted to kind of go on the record with that.

CHRIS KELLEY: Excellent. Thank you. So I'd like to turn quickly to the subject of workforce. So in other panels in other cities we've heard about and even here we've heard about new technologies being deployed and these other panels, we have heard about the need for additional newly skilled workers. My question to you is, are you seeing new skilled workers entering into the workforce and the market to support these types of new technologies? Is there a gap here, what are you doing or what are your organizations that you work with, what are they doing to prepare? Did you want to -?

RODNEY COBOS: I'm not going to take a pass on this one, right.

CHRIS KELLEY: This is for you.

RODNEY COBOS: Like with all industries, we're - the baby-boomers are retiring, it is a big challenge for all industries. But we are definitely preparing and training that future workforce to take on the challenges that -- that we face. As far as the pipe trades and all the other building trades crafts, we invest millions in training our workforce to take on any challenges that come our way.

CHRIS KELLEY: Thank you. Other comments? Yeah, Marcie?

MARCIE EDWARDS: This is an area in Los Angeles where reform is really not moving quickly enough. We are an established Civil Service system. So there is a complex set of exams and how people move upward within the organization, and so it's very difficult for us when we see a need to be able to go out and fill it. We have to train and bring people up. We are looking for some flexibility in that area. As an example, I can go to a job fair and there can be journey level craft employees looking for work whom I need desperately, and I hand them a piece of paper and say, please take this test and maybe next year you can come work for us. That's not a sustainable strategy on the Human Resources side. One of the things we've been working on in conjunction with our labor partners, IBEW, Local 18, is something called Utility Precraft Training Program, where we actually bring people in. There's probably a thousand people now on the wait list, and we train them in the basics. We migrate them around the department for up to two years, and in the interim we teach them how to pass a Civil Service Exam and how to obtain those jobs and so we've been having a lot of good luck with that program. And were looking to expand it.

CHRIS KELLEY: Thank you. Other comments? Mike?

MIKE FLORIO: Yeah. I think there are some tensions in this area, as well, because, you know, our -- it was -- it's been widely stated recently that there are more people working in the solar industry in California than work for the three big investor owned utilities, and that may very well be true, but I think the quality of those jobs and the pay scales are not necessarily comparable. And by and large, our utilities and our construction trades are unionized. Some of the new entrants in the market are not. And when we look at expansion into -- of the ISO into other states in the west, you don't have the strong union base that we have here in California. That creates another set of challenges. Because what we hear from a lot of our disadvantaged communities is, we want green jobs, but we want good paying, stable, family-supporting jobs and not, you know, "Mc" jobs and that's a big challenge in this area and it's one we've got to address.

CHRIS KELLEY: Thank you, Jan, did you have a comment?

JAN SMUTNY-JONES: Why not? The industry I represent, obviously has people you are going to find in an operations room, a large percentage of them are trained by the United States Navy. That seems to be where a lot of plant operators come from. That's been true for a very long time. Obviously, a utility-scaled solar plants create a lot of jobs. Those have largely been union jobs but they are, again, these are construction jobs, they represent short periods of time, but they're very big. I've got friends who live in Blythe and the power plants that have been built out in the desert, really was a big deal for people out in those desert communities. I have a tendency to discount jobs figures because they seem somewhat to get inflated. When I start doing the math, if you go like, well, what are they doing, knitting the solar panels? Because you have 400,000 up on the roof and you've got 50 or 90,000 people working in the industry. The math doesn't work out. But a lot of people are working there, and obviously the skill-set of putting stuff up on the roof and you're quite right, there's these debates about level of training there. But I think in this -- and I assume that people are looking at this, as the industry moves from, you know, the installation of a solar panel which obviously people can be trained to do and if, in fact, I'm wrong, when I said earlier that we're going to have a bazillion microgrids and all this stuff is going to work out there. Who's running that, when all that stuff crashes, who's out there to deal with that, and you know we obviously have a model that's changing, but the question then is who's trained to do those things, what's the skill-set there and I'm frankly the wrong person to ask what the skill-set is that's needed to do it. I know it's not me. So ...

CHRIS KELLEY: Noted, Jan. Thank you.

JAN SMUTNY-JONES: Not be a light bulb, it's about me touching an electrical system even in my own house.

CHRIS KELLEY: Any comments? So we're running low on time here, but I do want to get one more question in and then we'll turn to your closing comments. Maybe I could just ask you to keep your response to a minute or under. So my last question here actually has to do with -- it's more of a blue sky question. Jan, you sort of touched on this a little bit. So you said that in your opening comments that California carbon goals, and you don't anticipate that this will be met by the current mix of resources and technology. You mentioned solar panels, will even need be to replaced by 2050. So my question to all of you is: Do you have a sense of what this new mix might look like? Do you see a role for, since we have DOE here, see a role for DOE in the R&D space for specific technologies or areas? Any suggestions? Yeah, Marcie?

MARCIE EDWARDS: I want to provide just one example, and I think it will serve to make the point. Right now due to the once-through cooling requirements DWP is also changing out its seaside plants. And we've been installing the fast-acting gas turbines, but we now are installing a variety that comes with

a clutch. We have three of the only four in the United States. And what that allows you when you pull that clutch is that unit continues to create elements that support the grid, but it's doing it without using gas. That's the kind of technology on a macro scale that I am looking for. I would like to follow on, not putting words in Jan's mouth, but I think we're talking about technologies that we're not even envisioning yet. I think it's the ultimate in hubris for us to think we know where we're going to be even in five and 10 years with the speed of the technological curve.

CHRIS KELLEY: Thank you. Other comments?

MIKE FLORIO: I'm reminded of a tour I took in New Mexico during a conference, and it was -- I believe a DOE funded project that was a set of solar panels, and a trailer full of batteries, I think they were lead acid, and what everybody on the tour wanted to look at was the cabinet that had all the controls in it, because it was autonomously operated. There was nobody onsite there most of the time. And the computerized systems that made that system work were impressive and mysterious to most of us over the age of 50. But I think that is, you know, Silicon Valley is eyeing the utility industry as a place where, you know, we have a long way to go. If you look at what's happened in Telecom, you know, we're just on the cusp of that in energy. And how that happens, and how it can be guided in a way that maintains the public benefits that the existing system provides, I think, is a real focus for the future.

CHRIS KELLEY: Thank you.

JAN SMUTNY-JONES: Well, when my teenaged daughter figures out how to Snap Chat on my Smart meter that work. The reason in my opening remarks I made that comment because I'm agreeing with what Michael just said. The fact of the matter is, a lot of the great advancements that have been made in all the industries that we've been talking about today, whether that's solar energy or storage or whatever else, there's a whole lot of our research and development that went into that. There's a whole lot of government money that went into, you know, field testing various things, in the military, for example. So, I think continued investment in that is very important. And you know I'm a big believer, I don't know what the hell -- how the system is going to operate in 2050. I mean, if you asked anybody in this room, would solar energy be below \$0.05 a kilowatt hour, you know, eight years ago or ten years ago, no, no one would have said that, but that's happened very, very quickly. It resulted in not only innovation from Silicon Valley and elsewhere and crossover from other technologies, but because of R&D. So I think that continues to be an important piece of this. And the U.S. needs to be ahead of this curve, we need to be on top of that.

CHRIS KELLEY: Thank you. Keith?

DR. KEITH CASEY: Yeah, just to pile on to the same thing here, as Yogi Berra said, the future ain't what it used to be. This automation and control theme, I think, is something by necessity we're going to have to rely more and more on, because this decentralized system of very different technologies, and managing all of that, at the end of the day it's going to require automation and controls that were nowhere near where we need to be. And I think at the end of the day, you know, looking out, you know, 2050 and beyond, I think the gas fleet at least for California is going to be a transitional resource, that as we get more flexibility in the system throughout automated demand response and storage, even, you know, more out of renewables, solar and wind themselves in providing assistance to the grid, you're going to see less reliance on the gas fleet. So, I think that's kind of the long-term, but clearly you can't get there overnight. And the gas fleet's going to play a critical role over the next couple of decades, in, you know, making sure we can reliably manage the system during that transformation. Thank you.

CHRIS KELLEY: Thank you. Any other comments? Okay. So at this point, why don't we stick to a minute a piece and I'll give you a chance to make your final comments. You can summarize what you've

said. You can bring up a new point if you like. I just want to remind you that as we heard from the Deputy Secretary this morning, that many of the recommendations that went into the first version of the QER actually did make their way to at least be considered under legislation, and some new laws that were put into place. So a good opportunity to kind of share your thoughts there. So we'll start here with you, Keith.

DR. KEITH CASEY: Okay, well, I guess, you know, you've heard a lot of discussion around, you know, the challenges and complexity and all of that. And that's all very true, but I think there's also, at least from our perspective at the ISO, a tone of optimism that we can figure this out. We have to. I think, you know, the climate change issue is imperative. It's going to take leadership from developed countries and innovative states like California to really figure this out. How are we going to, you know, address this very serious issue, and show the rest of the world how we can transition to a low carbon grid? So the moral imperative to keep on working through these issues, I think, is something that motivates a lot of us. And it won't be easy. We'll make mistakes along the way. But the other thing I'd stress is we got to keep our eye on erring on the side of reliability, too, I don't think anything would set these climate initiatives back further than if we let the reliability of the electric system degrade and start having people's lights go out. There will be no tolerance for that. So I think, you know, sometimes we're seen as the skunk at the party, because we raise these issues, but we do it with looking at the long game, that we've got to keep this ball rolling.

CHRIS KELLEY: Thank you, Jan?

JAN SMUTNY-JONES: Yeah, I think that, you have three of the 26 people that were in the stakeholder board at CAL ISO when the lights started to twinkle, actually there's a fourth one out there I see. So we almost have a quorum, but that was not a pleasant experience, and anybody who tells you that, gee, we will forgo a few brownouts if you don't build anymore gas plants, don't know what they're talking about. So it cuts across all socioeconomic lines that reliability is the critical component. And we can do all these things, it needs to be reliable, it needs to be affordable and it needs to be clean. So we need to keep those three things in balance. Just by way of sort of the Federal overview of this, we already talked about R&D, I think that that's very essential. I think what we saw happen during the recovery, the Recovery Act was a big deal in California. A lot of that solar got built through the hard work of a number of Federal Agencies that work with the State of California. Actually President Picker of the PUC actually was a Special Assistant to both Governor Schwarzenegger and Governor Brown in working with the Federal Government to get a lot of that done. So there was a great deal of progress made there. That always needs to be under review. There's too many hoops to jump through. So the Recovery Act was good. Tax policies obviously a lot of the energy business operates in a variety of tax policies and by the way, every technology out there has some sort of incentive or tax break or whatever, but those I think the Congress in particular needs to take a look at constantly in terms of are they incenting the right kinds of investments and they need to be updated? And then we talked earlier about training. As I said, we do have people, most are out of the military, that could be trained to do various things. There's Federal money that can go into local communities. Whether that's through trade unions, community colleges or whatever, I don't want to touch any hot rails that I don't belong on, but the fact of the matter is training for the next generation of people that actually operate a reliable set of resources would be critical.

CHRIS KELLEY: Thank you, Jan. Marcie?

MARCIE EDWARDS: In the interest of time I will basically echo the comments made by my colleagues. I would also ask for continued focus on, don't spend every dime at the top of the cost curve. Realize you need to have some funding for the next 2 or 3 or 4 iterations of these fabulous technologies that are happening. Focus on grid integration, solving those problems will do more to move us, more expeditiously into a green future. And I do want to underscore what Keith said about automation and

control technology. I built a combined battery-solar field in one of my last jobs. I got the batteries to work great. The solar field was fabulous, and I never could get the communications piece to where I could integrate it into the system. That's a small representation of the type of challenges we need to work through.

CHRIS KELLEY: Thank you, Rodney?

RODNEY COBOS: Yes, thank you, I just truly appreciate the Department of Labor and staff for inviting our organization here. And I agree with Jan on his comments regarding training, and veterans. We do have a program, it's called VIP, Veterans in Piping, where we actually take an active duty military and train them to become welders. So I totally agree with bringing veterans into our program. Marcie, I appreciate your comments between you and IBW Local 18 working together. We definitely, between southern California Pipe Trades and our industry partners, our management side, work similarly in bringing the, we call them the pre-apprentice into our program and putting them right to work.

CHRIS KELLEY: Thank you. Mike, you get the last one minute.

MIKE FLORIO: Okay. I think continued stronger than ever partnerships between DOE and the states is imperative. We're working more closely than ever with the National Labs. We need the research and development. We need the data analytics. I've heard in two different places in the last couple of months, at the western electricity coordinating council level, they have the synchro phasor program that is generating so much data they can barely store it. And they haven't figured out how to really use it and analyze it yet. We've got the same thing at the utility level with the smart meter data. Again, and enormous increase in the amount of data generated. And, you know, there are a few entrepreneurial outfits that are starting to figure out things you can do with that data. But help in that regard would be extremely valuable, as well. And just sharing information, you know, it's hard for us with what we -- the busywork we've got every day, to see what's going on in New York, in Hawaii, and to the extent that DOE can help disseminate that information, so that we get a sense of what's working and what's not working, that's incredibly valuable.

CHRIS KELLEY: Thank you. Well, I'd love to stay here all day and pick your brains. You're a wealth of information. Really appreciate your time. Please join me in thanking our panel.

(Applause.)

CHRIS KELLEY: So with that, we're actually on a lunch break. We're scheduled to go until 12:45 and we will start right up at 12:45 Pacific time this afternoon with our second panel. Electricity distribution and end use, how do we manage challenges and opportunities, and if you're here in the audience and want to provide a comment at the end of the day today now is a good time to go sign up and do that at the entrance and one last reminder if you're online and you'd like to submit comments you can do so at www.energy.gov/QER. So we'll get started at 12:45.

(Lunch.)

Panel 2

Electricity Distribution and End Use: How Do We Manage Challenges and Opportunities?

CHRIS KELLEY: So we'll get started with our afternoon session. We already have most of our panel assembled and then we'll have Susan join us momentarily. So, I hope everyone enjoyed their lunch. Welcome back. We start now with our second panel of the day and the focus of this panel is on electricity, distribution and end use. How do we manage challenges and opportunities? So once again, I'm joined up here by an illustrious panel. So thank you for taking time out of your day to chat with us. We have Michelle Bertolino, Electric Utility Director City of Roseville and President California Municipal Utilities Association. Lars Lee-Potreck, Vice President Product Management and Product Marketing Energy Management, Smart Grid Solutions and Services, Siemens AG. Ronald O. Nichols -- did you go by R.O.?

RON NICHOLS: When I'm at Edison, I go by R.O., because there is another Ron, another senior officer. Otherwise I'm known as Ron.

CHRIS KELLEY: I'll call you Ron here. Senior Vice President for Regulatory Affairs and Nuclear Southern California Edison. Michael Yaki, Senior Counsel for Market Expansion and Policy Renovate America. And David Geier, out of order, but I'll make sure I address you by your correct names. Vice President, Electric Transmission and System Engineering, San Diego Gas and Electric. I'm not sure if you were here for the previous session, but just a reminder the way this will happen is, I'll just have each of you speak for 5-7 minutes, provide your opening remarks. We'll go down the list and have you all provide your opening remarks and then it will come back to me for questions. Just reminder, we have a series of colored lights set up at the front. When that red light turns on it means five minutes is up. You still have another two minutes at that point. Ready to go? Okay. So we'll go ahead and get started with you Michelle.

MICHELLE BERTOLINO: Okay, well thank you. I want to thank the Department of Energy for the opportunity today to be part of the Quadrennial Energy Review and this panel discussion. I'm here today wearing two hats, one is as the General Manager of the City of Roseville, the electric utility in Roseville, California. Roseville is in Northern California just outside of Sacramento. We like to call ourselves a full-service city. We have about 135,000 residents. We also have one of the highest penetration of rooftop solar in the country for a utility. We are at about 5% today. And like many utilities in California and across the country, we are in the midst of changing our business model and positioning ourselves to adapt to technological advancements, legislative and regulatory changes that we are facing and evolving customer expectations. The second hat I'm wearing today is as President of California's largest coalition of publicly-owned water and electric utilities, the California Municipal Utilities Association. We represent 102 members that are across the state and we include cities and counties and public utility districts as well as irrigation districts. Just one note, many of our customers are also preference customers of the Western Area Power Administration both the Sierra, Nevada region and Desert Southwest region. We are very, very diverse as all of California is. Some of our

membership is in the California ISO and others have their own balancing authorities and others like Roseville and SMUD, Sacramento Municipal Utility District and are part of the balancing authority of Northern California.

So just briefly I'll talk about a little bit about the municipal model and as we address the challenges and opportunities regarding electricity distribution and customer end use, I wanted to share our perspective. First of all, we are community focused service providers. Our focus is all about the consumer. And we are the boots on the ground with the consumers of electricity across the state. For many, or for all the municipal utilities, our objective is to be responsive to the community's needs and through our local regulatory bodies, whether a City Council or a commission or a board. For customers this provides a venue of direct interaction and communication with the officials that govern their community. I receive phone calls on a weekly basis from customers and I speak to our customers every week about their concerns, whether it be their inability to pay their bill or their questions about what the charges on their bill mean. This has served Roseville and many other communities across California and the country well and it allows the decisions to be made at the local level and will make decisions as to what is best for our community. Our model is built upon cost-based rates. We are not for profit organizations. And it is important for this industry and our state regulatory bodies to realize that a lot of the policies are often focused on incentive based policies which motivate utilities to change structurally or invest in infrastructure and for us, it's a little bit different. And that we are looking for the lowest cost to provide service that is reliable to our community and meets our community's needs. We don't have financial incentive to build profit. But we again, manage our cost exposure. Four key points I wanted to just briefly touch, at the red light just went on, are that customers are embracing technology. And we have heard this morning about the proliferation of rooftop solar and our community and all throughout California. This has become a very, very popular form of energy as well as electric vehicles are going to change the face of what we are doing in California and energy storage is poised to do the same. We need to modernize and look at modernizing the distribution system. We heard this morning about the need for transparency within the distribution system. But, just as our customers are embracing the new technology, we have to look at new technologies for managing our distribution system. Things like advanced metering infrastructure, smart meters, as well as the electric vehicles that could really create new opportunities and challenges for the distribution system. Customer education and outreach is very, very important as our customers make decisions to invest and use new technology, we need to be there to make sure that they have the information they need to make the decision that is right for them. And fourthly, business model changes. All of us, all utilities, are looking at and need to look at business model changes that are necessary in order for us to continue to meet our customer demands and expectations. The business model changes that is we are looking at and that others are looking at, can include a range of items but specifically we need to look at rate structures that best reflect how our customers are using the grid and the electric distribution system in the future. I know somebody mentioned this morning that we really don't have any idea what our business is going to look like or what the grid might look like in the next 5-10 years and we are usually wrong when we try to predict those things. But we need to make sure we have a business model in place that can adapt to our best ability and we have to make sure that for the new technologies that are being used such as rooftop solar, that we don't have winners and losers in the system. And that we treat or have rates that are fair and equitable. So, in conclusion, I have a few items that I think should be taken into

consideration. Federal policies should encourage diversity of resources and we heard that this morning. And technology to address distribution system modernization and customer needs. Our Federal policies should avoid being overly prescriptive and should not attempt to create winners and losers in technology and resource types. The policies should provide flexibility and implementation and realize not all utilities and customers are the same. A one size fits all solution is not going to work. The policies should provide opportunities for regional collaboration all lessons learned in addressing opportunities and challenges. And as well as the policies should continue to provide access to public funding as utilities and customers begin to embrace technology on a larger scale. And finally, the policies should reflect a comprehensive and balanced approach to identifying solutions and considering implications on cost, reliability, customer impact and environmental goals.

CHRIS KELLEY: Thank you, Michelle.

LARS LEE-POTRECK: Good morning. Lars Lee-Potreck. Siemens AG is located in California. Siemens is a global company. We have 350,000 employees of which are 60,000 in the U.S. We have quite a significant base here in the U.S. in various locations. Siemens is one of the leading global partners in the energy business to provide energy equipment, electric equipment, software components to our customers and we are looking with some excitement and with concerns in the, like Michelle said, 5-10 years towards the opportunities and the challenges we will face with our industry partners. Siemens as a vendor is of course in the forefront of the business, we need to make some educated bets in order to understand research and develop technologies and products for this industry. We typically have a 2-5 year lead cycle towards anything that goes on in the global scale. What we see in the recent 12 months is a tremendous shift in industry starting in countries like California, states like California and also in Germany and Japan, where governments and regulators looking in how to deal with distributed energy resources which definitely drives one of the biggest shifts in the industry at the moment, at least it accelerates the transition. And we see at the same time, a shift in consumer behavior. We have to start with technologies coming in or new business models and products. So we see that as a forefront of the digitalization of this industry. It wasn't always like that. I think two years ago there was pretty much -- that wasn't the situation. So we definitely see a new pace in the industry which is exciting for many of us. As a product manager, what I'm here for today is of course I have the simple task to lead the global organization towards a long term goal. And ensure that of course technologies, the regulatory environment and the products line up and markets line up perfectly at the same time, which is a very simple task as you can imagine. So, we clearly see the future of the energy business and the customer centric model is part of what we call or the industry calls, a transactional grid, where the industry needs to collaborate out about in order to reach that endgame. It's a long term vision on a global scale for sure, in some states where we have increasing distribution of distributed energy resources. We see a record acceleration of that here in California of course and in New York we see some efforts and of course in Europe where these challenges for example in Germany was 25% coverage for renewables of the energy mixes is steadily increasing.

The industry sees a lot of changes; I think Michelle mentioned some of them already. Changing business model, I think, foremost. We are stuck in business models which don't really incentivize us to go forward in the right way. We need to look at them with a fresh look so the

business models incentive, actually innovation and the change embraces the transition in order to address the biggest challenge of CO2 reductions and others in the industry. It might be just reliability. We see new markets forming so we getting new markets players in the industry, so it's definitely exciting and to look at that and see what the capabilities out there needs to be. Siemens as a global player of course invests currently in the world. The way we address this, because also it was mentioned, that nobody knows where the journey goes, even if I say I invest towards a transaction grid, it's a bet on my side. It's a huge investment on my side, but the way we address it is by staying agile. We try to be flexible and adjust if needed. Standards, we are trying to embrace as much standards as there are which is a big hindering or a big roadblock I think, currently in investing in future technologies, we also need to stay critical. That we are doing the right thing and reviewing our technology on a daily basis, basically to make sure that we don't get off track and meet the customer demand and customer needs. And of course we welcome the industry to go together with the transition of the next 5-10 years. Thank you.

CHRIS KELLEY: Thank you. Lars. I'm going to turn back to the start of our panel here to Susan Kennedy. Let me introduce Susan. You get a pass right now for Ron. Susan is the founder and Chief Executive Officer for Advanced Microgrid Solutions. Susan, we are just giving our opening remarks now, so the floor is yours.

SUSAN KENNEDY: Great. Are you pulling up a slideshow, gonna run through some kind of quickly. While she is doing that, Advanced Microgrid Solutions is a project developer behind the meter energy resources and our projects are utility facing. So which means we design our projects for grid support and choose technologies and host customers based upon what the utility needs in a particular targeted area of the grid. We don't own or develop our own battery technology. We procure energy storage systems from leading technology providers and capture economies of scale by procuring energy storage systems in large volumes. Our first big projects are designed as capacity products for Southern California Edison. Each projects ranges in size from 3 megawatts to 10 megawatts. So these are pretty big projects. So I'm often asked, how we got to where we are with the grid today and where do I think the grid is going? And I think where we are today can be summed up in a couple of slides. First of all, ITC is single-handedly the most impactful measure that has driven the growth of distributed resources in the United States. Annular solar installations grew by over 6500% since the ITC was implemented in 2006. That's a compound annual growth rate of 48%, 72 billion dollars invested in solar installations nationwide. The Solar Institute, SEIA estimates that due to the directly to the ITC, multi-year extension, solar rooftop installations will increase by 8 fold between now and 2030. The growth is tied to the push and pull of market incentives that have been put in place. So the pull incentives of the ITC and net energy metering are one side of it and the push side of it is really like readable portfolio standards and carbon reduction policies. They created a significant driver towards utility scale solar and wind, while the investment tax credit and the net energy metering policies have created a significant driver towards rooftop solar or pulling it. A study done by E2 not long ago on the correlation between net energy metering policies and growth, showed astronomical correlation and one state case study, Delaware, the 10-year extension of energy metering will result in 75% increase in solar by 2030.

So these incentives are what created -- go to the next slide. What created what is now recognized as California's most famous duck. CAISO has between 13,000 and 15,000

megawatts of renewables on its system with the peak load of 50,000 megawatts, which is 40% or more of its power coming from renewable resources largely wind and solar. The problem is that most of the generation happens during its day especially from solar plants, when peak demand actually occurs in the evening. And utilities are spending literally hundreds of billions of dollars a year, chasing load curve that they can't catch. We spent 100 billion dollars in 2014 on the distribution system alone in the United States. 100 billion dollars. Go to the next slide. Hit twice, please. So this is a customer solar -- this is the most illustrative graph of where the problem comes in. So based upon the incentives we have given to put solar on roofs, this customer is a solar rooftop customer and you can see that in the middle of the day, when the red line goes below the line there, the numbers line, they are net metering on to the grid and then at the end of the day when the sun stops shining right about 5:00, their demand shoots back to the grid. This is a solar customer. The next two, please. So the blue line is the system load. So that is what the system operator has to prepare for and we have that is fossil fuel resources that is are on spinning reserve to be on call for when that customer's demand reaches the peak at the end of the day. So this customer believes they have done the right thing. They have invested in solar and getting off the grid and doing carbon reduction. For every ton of carbon reduction that customer is taking off the grid, there is probably two tons going on the grid from the resource that is have to be -- the redundant resource that is have to be on spinning reserve for that -- in order to be prepared when that sun stops shining. The new conditions on the grid - next one please. New conditions on the grid look like this. So this is -- you can see the outlines of duck in here but this is the grid we are dealing with today in almost any state that is a high penetration of renewables. Short steep ramps. 4:00 in the morning up until 11:00 in the morning of these massive steep ramp before the solar starts to kick in. The ISO has to bring on or shut down generation resources to meet increasing or decreasing electricity demand very quickly over a very short period of time. The over generation is in the belly of the duck. All of those resource that is have to be put somehow on spinning reserve or somehow on the turn down, they have to do something with the excess generation in the middle of the day and at the end of the day, at 4:00, they have to ramp up again and be ready for when the solar stops shining. So, grid operators are looking for nontraditional grid resources that is can respond to this new system reality, which is fast, flexible resources that specifically target ramping services. The CAISO Director in California said -- he coined a great phrase and said, capacity will no longer be the coin of the realm. Capability will be the coin of the realm. And I think that is a critical statement that tells the story of where we are. Energy storage from my perspective is the most promising technology and the only technology that is able to perform multiple fast, flexible, functions in order to be able to meet these challenges. But a battery is nothing but a battery. It's what you do -- it's very expensive vessel that holds energy that comes from someplace else. So it's not about the technology. It's about what you do with the battery that actually can perform these functions and the market for those functions out of a battery are not developed yet. Go to the next slide please. Click twice. So this is that same customer with solar. Click twice again. So that is the distribution system. Now click twice again. That is the same customer with battery storage on that system. So you can see that the battery storage takes some of the solar from the earlier part of the day when it is really not necessary. It minimizes the amount that is net metering back to the grid, and it actually reserves the solar for later in the day to stop the customer's load from shooting back up to the grid. So there are two major benefits here. One is, even though that customer is net metering and getting paid a retail rate in order to send back to the grid, they are actually saving more money by preventing their load from spiking back to the

grid at the most expensive part of the day. So this is actually good for the customer and the delta between the green line and the blue line is what the distribution operator now sees from that customer's load. That is empirical measurable load reduction. That is not -- with solar, you don't know if cloud cover comes over, you don't know -- you have to be prepared if it is going to spike. If you have battery installed in the right sizing, you are able to curtail that customer's load and you know empirically what load is going to be on that customer's meter. So, what does it take to put in storage at a customer like that? Next slide, please. Who pays for storage? Storage doesn't benefit from the ITC, it doesn't benefit from net energy metering, it doesn't benefit from any of the mandates in terms of putting storage in at a host customer site. It's either going to benefit the utilities or it's going to benefit the host customers, but somebody has to pay for it and today, without these same incentives and the same kind of market structure that you have for solar, you have customers that would put it in are dependent upon subsidies. It's never going to be cost effective to put a battery behind a solar at a customer site unless -- without subsidies. It's too expensive. The ROI of that customer will never pay for itself. On the utility side, if the utilities can't -- mandates don't help when you put in storage because it's a very, very expensive CapEx system and if they can't use it as part of the money they are going to spend on the distribution system anyway, then it's never going to be adopted at scale in a way that actually helps the grid. So the trick is figuring out how you can -- how the utilities can find distribution level benefits from storage. Next slide, please. These are the economics of storage. Sorry this is hard to see. I'm not very prolific with PowerPoints. On the left hand is today. You very heavy Capex for battery storage. You have financing costs because it's a new asset class or very expensive. You have got O&M costs and you got taxes. On the cost side, you got -- I'm sorry. On the revenue side you have the incentives basically covering most of the cost of it. You have got some money coming from the end user which is the savings, which is the value proposition for why they would put it in. You're taking that back, in order to help pay for the system and then there is a small market for grid services today. East coast, a lot of frequency regulation, west coast it's all about capacity. All about demand charge management which is a short-lived tariff sensitive subsidy. On the 20 years -- 5 years from now in 2020, you will see Capex come down somewhat. Battery costs will come down. The cells will come down. The engineering and construction costs not so much. Some will be fixed costs and always a very expensive proposition. Financing costs will come down and then O&M and taxes. The critical issue is to be able to get off of subsidies and use or be able to use the batteries for a distribution level resource you can tap into what the utilities need to spend anyway. If they are forced to buy it, it never will happen. If you can make it available as something that the utilities need in their distribution system and it can be cost effective with the other resources that they have available to them, then the economics of storage will actually be favorable for a large scale deployment.

A couple more pictures and I'm done. What we are doing in our large project with Southern California Edison, which is groundbreaking. Edison, when they were faced with San Onofre coming off line and cooling plants coming off line, they had a delta in their local capacity and they were the first utility to hold an all resource procurement which meant that storage had to compete with a peaker plant which had to compete with energy efficiency and demand response. And so our first project was 10 megawatt projects, Hybrid Electric Buildings, 25% reduction in peak demand. 26 buildings, 10 megawatts of firm, dispatchable resource, 8% production in energy cost.

CHRIS KELLEY: Can I ask you to conclude.

SUSAN KENNEDY: These are my conclusions. This is a picture and then we custom fit the buildings with energy storage. Next. Put in the software to manage the load with the building and the last one is we create full automated dispatchable load reduction for the utilities. And then aggregate it for utility scale. That's it.

CHRIS KELLEY: Thank you, Susan. Ron? Now it is your turn.

RON NICHOLS: Thank you. I like following Susan. So I think probably most of you are familiar with Southern California Edison. We have about 5 million customers, population that we serve, about 14 and a half million and about 23,000 megawatts peak load. People know we are trying to always work on managing, Susan is helping us with that. I want to take just a high-level quickly on dealing with the scope, the pace and the opportunities and channels associated with how we pull together a major shift towards much higher reliance on distributed energy resources for DER. In California there are major changes both underway and even more major changes that are contemplated for DER development and deployment, to get a lot more penetration than we have today. We have top solar, has been the leader. It begins there but it doesn't end there. Everything from customer solar to demand response, energy efficiency, battery storage, as Susan mentioned and electric vehicle charging are all pieces of the pie of distributed energy resources that we are active in all of those areas and in particular, in the solar area. We have today -- I shouldn't say today. Probably two months old. 130,000 more customers have rooftop solar. We are adding 5,000 a month to that. So the number is going up quickly. One of the things that I think has benefited that, going more quickly, is we now take 72 hours or less to interconnect our customers as opposed to the thirty days it took just a year ago. We are getting better and certainly trying to get more and more accommodating and friendly to accelerating solar. Susan made a mention of our battery solicitation. It was an all source solicitation and we ended up as a method to really push forward battery demonstration, see its performance, take a look at the cost, did a competitive solicitation of all sources through that process, awarded contracts for 260 megawatts of battery storage, 160 roughly megawatts of that being behind the meter. To our knowledge, it's the biggest such solicitation in the world, certainly in North America. Another major area that we pushed forward on is in transportation, electrification and our charge ready program. All three utilities in California have taken their own take at trying to come up with plans to accelerate the penetration of electric vehicles not just for their greenhouse gas reduction, but also for the strategic load they create, which is another piece. If you take a look back at -- thank you again for your figures up there, Susan. If you go back and take a look at those figures, clearly some opportunities for some load at the right time of the day when we have excess energy is important. But from an environmental perspective, California right now, utility supply to meet the requirements of our customers is probably about 20% of the GHG emissions in the state. Transportation is still double that. More like 40. Anything we can do to accelerate moving towards zero emission or lower emission vehicles is going to be a big contributor to that and it's going to have to make those kind of contributions if we are going to get anywhere close to our goal of getting to 80% below 1990 level carbon. It will have to take bold moves.

When you look at all of these types of DERs are needed to get to GHG reduction. And historically, somewhere in Michelle's comments, historically, a lot of our DERs have been individually mandated or individual incentives associated with them. And I see that changing. And I think the whole process that the Public Utilities Commission in California is doing right now, those are following the resource plan proceeding, the integrated distributed energy resources proceeding, are really more about from our perspective, Edison's perspective, more about integrating some of these solutions. And the goal here is not to rely totally on incentives. Incentives are necessary. Incentives have been important to get resources, new resources and technologies moving. The idea here is to not be selective in picking winners and losers but to get performance oriented. What did we need to have on our system to meet that duck curve issues, to meet reliability, to meet growth, to meet GHG reduction in a way that prescribes the performance that we need and then let's make the right resources fit that need and create a market to make that happen? Edison right now and the other investor-owned utilities are working on a handful of specifically prescribed demonstration projects that the Commission is proposing and we are also looking at some new ones as well to try to develop more quickly, what is the compensation models need to be? How do we competitively bid for these resources to get these things moving forward? So I think that the goal here, our goal is let's make these demonstration projects successful. Let's get the results as quickly as we can. Let's learn from that as quickly as we can. And move forward into expanding DERs on our system. I see Casey is here from the California ISO. They are taking an effort to jumpstart looking at their distributed energy resource program – not sure where they came up with the acronym DURP, but it's okay. To find a way to get DERs on the distribution system to play the wholesale market. And we are working with them on that. I think all the utilities are working with them. The key and details here will be how to meet the price signals necessary to meet what is necessary at the wholesale level to start displacing the amount of resources that is we are conditional or large-scale renewables we might need, and make sure at the same time those same resources on the distribution system are providing reliability on the individual circuits. I think we'll get there. Some things need to get worked out. It's an exciting time and we are excited to see these things come together. All-in-all, I see a huge shift for over a century we had a utility model, utility system, that has been predicated on large-scale generation, high voltage transmission, coming to serve the requirements of customers and then distributing it. It's not going to change overnight. But we are on the road to have that actually going in reverse. Take distributed energy resources, customer-centric, meeting customer needs first, is going to be something that will then have large scale generation and transmission filling in as necessary. It's a big change. I think that change is underway. Certainly here in California and probably in New York, other states probably not as quick to follow, but as we get or remain focused on the customer, and all parties, utilities, distributed energy resource providers, the financial service providers, clearly our customers, stakeholders, environmental groups and regulators work together to find a way to make this work in a competitively bid situation to keep the costs as low as we can, I think we'll make that change happen.

CHRIS KELLEY: Thank you, Ron. David?

DAVID GEIER: I like going after Ron also. So I'm going to try to -- basically as Ron alluded to, all the utilities in California are in the same boat with this. They are really no less than four active proceedings tied to distributed resources including the one -- so all very active and we are

trying to figure out this new world that Ron alluded to. First I'd like to thank DOE for inviting us today and having all the energy folks here in Southern California to really talk about this dynamic area and there is New York and Hawaii but here in Southern California, we are on the forefront of these renewable resources and DERs and we are trying to figure it out as we go forward. So hopefully, we can help a little bit with the nation, a little bit of roadmap where we are going with this whole new world we are going into.

So I'd like to start with a little bit about clean energy and how we are transitioning to sort of a cleaner fuels. We have a big goal here in California, reducing greenhouse gas. From an energy perspective, we have hit our 33% RPS goal. We are the first utility to do that. Well into 40% and then we'll be to 50% by 2030. I think we can get there. We can probably go beyond that. A lot of integration issues, but I think as we move forward, we are going to see that happen. And our customers are onboard, just like Ron talked about also. We have 90,000 customers as rooftop solar, about 580 megawatts were over - from a load perspective, we are a 5000 megawatt utility. We are more than 10% from a peak load perspective. And as Ron alluded to, we made big strides in California. We have a fast track process where with the use of technology and cell phones, the day they get their city permit to hook up their installation, they can take a few picks for us and send it in electronically and we can approve the installation that same day. So we are really trying to move the industry forward. We are doing work with older homes, trying to find adapters so they can hook up solar also.

The second area is electric vehicles. As Ron alluded to and Susan showed the duck curve, it was something when we started to talk to Keith 5-10 years ago about this, everybody said is this really going to happen? It has happened. And as we move forward, the duck just keeps getting fatter and fatter. We were feeding it well, actually. So, we really, the plug of the electric vehicles are a huge opportunity for us. They help to build base load in the way the regulation is in California here, the more kilowatt hours we can spread our fixed costs, the lower cost for customers. And I think keeping the customer-centric. We agree with Ron 100%. It's key in every decision we make. We have high priced energy in California and the goal is with all of our beautiful sunshine, use that to our advantage. Not only to decrease greenhouse gas, but also decrease cost of energy. We have a program that was approved by the California Public Utilities Commission also for electric vehicles. We are going to be installing 3500 EV chargers on 350 multifamily and condominiums. Two things that are innovative about this program. That's an area sector that really had not been penetrated at all. Really difficult to get charging systems in multifamily homes. And so what we are trying to do is get a vision where everybody can play in electric vehicles. Not just the single-family residents, but everybody across our service territory. The other interesting thing is we are using a day ahead pricing ISO for the pricing mechanisms for these electric vehicles. And everybody thinks that means charge at night. But from a duck curve we saw earlier from Susan's presentation, we have lots of energy in the middle of the day also. You think about that, during the middle of the day, we are not asking people to do anything in the middle of the night when they are sleeping. This is when our economy is booming. The middle of the day, everybody is at work and we have a great opportunity with excess energy. Ron already talked about the numbers. But, we really are trying to take a big piece out of that 40% of greenhouse gasses going forward. Now from a grid perspective, I start off that we serve 3.4 million customers safely and reliably. That is a fundamental for the utility. We don't believe that is going to change and as we integrate all the DERs, we have to make sure

we can maintain that safety and reliability. Just like your cell phone, your cell phone is the platform for every app you may want to do. We looked at the grid as being the platform for DERs. Whether it is PV rooftop, electric vehicles, batteries, whatever it is. We think the grid is the basis for that and throughout all the proceedings, STG&E's position has been, we want to provide universal service like 3G, 4G and going forward. We know that our grid will have to increase in capability as we move forward. One thing we learned a lot from was our Borrego Springs micro grid. Borrego Springs, if you are not familiar, is a community about 60 miles east of San Diego, up in the high desert, across the mountains, served by a single transmission line and probably one of the worst reliability areas in our service territory. With the help of DOE and an 8-million-dollar grant, we built a micro grid out there and I'm happy to say that we used it four or five times where that community would have been out of power because of storms or flash floods and we have been able to use that micro grid to keep the power on in Borrego. And I think it's just a sign of the partnerships that we can have with DOE and other folks that California Energy Commission partnerships will allow us to move forward. Ron alluded to some of the pilots we are doing. There is a pilot study sort of working with the Public Utilities Commission, but there are other demonstration projects that if we move forward with those, we can learn just like we did in Borrego Springs and do some of the really great things that Susan talked about. So in conclusion, I think we are in a brave new world. I think it is all about leadership and in Southern California we try to provide that leadership and it's about partnerships. And as we partner with DOE and California Energy Commission and the utilities, our partners and the DER world, all of us coming together and California ISO, we can make a better world for California. Thank you.

CHRIS KELLEY: Thank you. Michael?

MICHAEL YAKI: Thank you very much. My name is Michael Yaki, I'm the Senior Counsel for Market Expansion Policy, Renovate America. I want to thank DOE for inviting us today. One of the interesting questions you have when you talk about end user efficiency is you look at David's customers and Ron's and Michelle's when you look at the people who want to buy the technology, the question is how do you get them to that place? How do you get them to create someone who wants to use energy efficient products? How do you get them to buy solar? How do you get them to do the things we want Americans to do to reduce the demand on carbon fuels and reduce emissions? Well, that is where we come in. And I want to thank you for recognizing that because one of the things -- what we try to do is help the average homeowner of those 132 million housing units out there in the United States, about 66% of them having been built before 1980. How do we get them to a place where they say I want to do this? I want to replace my HVAC and put solar on my roof. The biggest challenge that is found in a lot of different studies, whether it's been McKenzie in 2009 or studies by PG&E 2013, the questions are, how do you deal with the upfront costs of products? Because they are not as cheap as say, just the regular ole' thing. And you look at the studies out there. I think that J.P. Morgan did a survey that showed 3 out of 4 HVAC systems in this country get replaced every year with the same or worse energy efficiency as they used to have. That's unacceptable in terms of what we want to do. In terms of what we as a country want to do. What the department is trying to encourage. And so, we have dived into this head deep with something called Property Assessed Clean Energy financing, PACE. In short, PACE is a government form of using the tax power to create financing for homeowners who will get 100% financing to buy energy efficient products, to buy

solar, and repay it through their property tax bill. It's secured by a lien on the property. A lot of technical which I won't get into, but it was innovative and it was thought up in the early 2000's. It started in little demonstrations in California. California is one of the few states that fully embrace today from the legislature to the Governor to the community and the utilities we work with out here, whether it is San Diego Gas, Southern California, PG&E up north. It's important because it helps interdict at a decision for many homeowners when something breaks. Say you have a HVAC system in the San Bernardino in the middle of July. Or if you're at your -- somewhere up north whether Tahoe or further north during the winter and your furnace breaks down. What do you do? Most of the time you call someone and you just basically try to find whatever is going to work. And what PACE does, if it's adopted in a community, it enables someone to basically take an energy efficient decision and finance something that will save energy, save them money, create jobs, and help the environment. So this is what we are trying to do. And we have done it in a way that I think is quite innovative. We are, not to brag, we are about 90% of the market in California. We have done over 60 of 70,000 homes in California. 1.4 billion dollars' worth of financing. 60% of that is energy efficiency. So, what people are buying products at LARS and Siemens and Trane and other people, manufacture, it is a great thing to do but it's not easy. It's not easy. It takes cooperation with local governments, it takes the support of the state government through the creation of the [unintelligible] for example, which Governor Brown put in the place after 2010. It takes also commitment to the consumer because all of this is about making sure the consumer believes in this product, wants this product and will tell their neighbor about it and it involves a lot of consumer protections, a lot of other forms of financing don't have. And make no mistake about it, this is entering a market where there has market failure for many, many years. There have been energy efficient mortgages out there. You see a lot of people offering deals on this product or whatever. But the question is again, how do you get someone to say I'm going buy a SEAR 16 or 18 HVAC system which may cost \$2000-\$5000 more than what they had before? That's what PACE enables us to do. We are very proud of what we are doing. We are going to continue doing it. We want to expand and take this model elsewhere. We are going to two other states right now, possibly 3-4 others. It's something where again we need the support and cooperation of government. We need the support and cooperation of the utilities where our customers connect to and work with. It's something that we think is innovative and we enjoy talking about it and thank you very much again for this opportunity.

CHRIS KELLEY: Thank you, Michael. So now we'll turn to the questions and you have already touched on a bit of this. But the topic I'd like to discuss is consumer engagement. So I heard from a few of you. Michelle, you mentioned customer engagement and involvement, Lars, you talked about customer-centric models. I'm curious to hear about the extent to which you're seeing customers in the region paying more attention to their electricity consumption. And do you see behavioral changes occurring at the customer level? Anyone care to take that?

MICHELLE BERTOLINO: Absolutely. We are seeing the community that we serve is a fairly conservative community and obviously the utilities throughout the state have very diverse communities. We are seeing folks who are willing to pay more for electricity, if it's green, if it's solar. They are willing to pay more for it. They want to feel good about it. The other piece of this is that utilities don't necessarily have a great reputation. We are kind of the big bad utility and so they want to get off of relying on utilities as much and it brings predictability if they enter

into a purchase power agreement for power for predictable amount over time. We have a program in Roseville and I know that a number of other utilities have it too, but it's called, your trusted solar advisor and anybody in our service territory who is thinking about investing in solar, they can come to us and we'll talk to them about what their options are and what to ask, what questions to ask, what they need to know and how to evaluate what is good for them. And the other piece of that is that we really try to encourage energy efficiency first, as a first choice in resources, but many times you can combine all of that. So we definitely see changes in what our customers are willing to do.

CHRIS KELLEY: Thank you. Other comments.

RON NICHOLS: At Edison we see similar patterns. We have a very diverse population; given that we serve across our 50,000 square miles. But everything we do either on surveys, or on individual outreach with customers, finds an extraordinarily strong interest in renewable energy, customer-driven renewable energy, rooftop solar increasingly and starting to hear more about storage and really large appetite to know more. But a lot of frustration also of trying to find out who do we trust? It isn't, quite frankly, interestingly enough, and this isn't just self-fulfilling here, we are finding that increasingly, they find that we understand you. We dealt with you. We had a relationship with you for many, many years. But we are or have been constrained by our commission in how we can advise our customers on some of these issues. I think some of those things will change. I think it is important to have the ability of the company that provides distribution and that customer relationship to be able to at least be available to advise on these types of opportunities. At least one of many that can provide that. At our larger customers, our CNI, our commercial and industrial customers, is something where they are more savvy. They have their own energy people typically. And we find abilities to very quickly find opportunities to seek out customized opportunities and similar to the types of circumstance that Susan and others found when we did this preferred resources pilot in southern part of our system when San Onofre was shut down. Coming up with a plan to make certain that 300 megawatts of new load doesn't happen through a combination of DERs. And we are finding that it's easiest to reach out to CNI customers who are very interested in seeing what the opportunities are. It's a little tougher to engage with residential customers, but working on that through our customer service and new apps we are putting together.

SUSAN KENNEDY: I want to dovetail on that. I want to echo what Ron just said. Our approach to being aligned with the utility providing a utility facing service is what gets us to even talk to their large customers. They want to see something. They want to see a relationship with their utility where they are helping to provide support to the grid and they are benefiting from reliability or cost reductions. But being aligned with the utility is the single most important aspect of become able to deploy.

CHRIS KELLEY: Thank you –

DAVID GEIER: From San Diego's perspective, very, very similar. Our customers want us to be the trusted energy advisor but we have all the sort of baggage that goes along with that, so we are trying to work through that. But it's been amazing how much they adapted to being on our website. The hits are phenomenal compared to where they used to be. We put up an energy

marketplace where we are selling energy efficient products and it really ties into the trusted advisor and sort of Amazon-type base. Customers have the ultimate choice, but we are giving them vetted products that we feel we could really help them. So, and things like, the paperless bill. We thought that was a big deal. We set goals around that. And then we just blew through that because that is what the customers want. They want easy and convenience. And we are doing a lot of looking outside of the utility industry to say, what really do the customers need and want how can we make that beneficial agreement between us?

CHRIS KELLEY: Michael?

MICHAEL YAKI: We are sort of at ground-zero when it comes to customer engagement because we are the ones through contractors quite frankly, local contractors, who work with their own people who they would normally call when something breaks down to try to talk to them about how they can move from what they had before to something much more energy efficient. What we found in our -- and our program has evolved over the last four years. We found that we need to be much more direct. We need to have adequate disclosures and make sure that the products that we have meet energy efficient needs whether is it DOE Energy Star or California Title 24 standards. We find that we have been able to work out an algorithm that for many products can cap, put a cap on what something should cost so something triggers an alarm bell in our system. If something doesn't look like it shouldn't cost all that much. These are all things that go towards trust and making a consumer want to do more. In fact, we have a lot of consumers who pay more than once on their property. They have such a good experience they decide we are going to go to the next step. But it's all about ensuring that you have right kind of message, the right kind of disclosures and the right kind of protections to -- because again, you're taking people who normally aren't going to make that decision. They have too many things going on in their lives. They have got the kids in school, they worry about this thing. Or that thing. And then, the darn HVAC breaks down in the middle of summer. We have to do a good job of making sure that they feel good about that transaction.

CHRIS KELLEY: Thank you. Lars? Any comments?

LARS LEE-POTRECK: Mostly has been said, but it's hard to echo. Maybe a few points in here. I think the role of the industry will change of selling a product to selling services. So I think that is the biggest point to make here. And that has a lot of consequences. What we see here in California and around the world is of course people who can afford to put solar on the roof and I think that as a second step drives the regulator ahead of them because the regulator now changes mind-set and says instead of subsidizing that or incentive that, in a way that the cost of the grid, which is a common cost of every consumer out there, is getting put on solar [unintelligible] I think in Germany, I'm German so if you don't recognize my accent. In Germany we are looking at 15% of what we call energy poverty. People can't pay energy bills anymore. In Germany it's not California weather. It's really cold. These are problems to deal with in order to make transition and consumer friendly throughout the population.

CHRIS KELLEY: Thank you. So now I'd like to turn this subject of cyber and physical security. So if you were here this morning, the Deputy Secretary tee'd up a framing question about cyber and physical security so again, given all the new technologies and systems being

placed on the grid, it strikes me that this potentially introduces new points of vulnerability. So can you speak to how your organizations are addressing those? Do you see challenges there? And also since we have the DOE and the Federal Government here, do you see a role for Federal Government in this space? Anyone care to take that?

LARS LEE-POTRECK: Security was always a difficult question. I didn't bring my lawyer. But we recognize in Europe and in U.S., components in the network getting placed -- for example the NERC in U.S. under special cyber security conditions and regulations. We respond informing and Siemens body for cybersecurity where we try to drive programmatically the cybersecurity. It is getting really critical. It's getting critical maybe to highlight two points here. First of all, we want to switch, as I said before, from selling a product into service. What that means is more and more services added to the network and have access to the network. These services need to be controlled, they need to be made cyber secure, which is a growing challenge for the industry. The second part is that these vertical access to the units are not all -- not all of them living under the control of the utility. So we are looking at a world where the utility loses more control or has more loosely control on the components in the grid. Maybe through aggregators or other roles in the market, which need to be cyber secure as well. So the growing ecosystem and less close control of these assets make it mandatory to have a consistent cyber security [unintelligible].

CHRIS KELLEY: Thank you.

RON NICHOLS: I'll just add briefly to that. There is a tension, as we are looking to rely increasingly on smaller and more devices. And our customer locations at third party providers, some of them aggregated and some of them provided directly and doing that and trying to make that all cyber secure at the same time. It is a challenge. We want to make sure that we don't have cybersecurity be something that slows down that process and that pace. So we need to -- there is a lot of grid modernization we need to do on our system in order to enable all of our customers, not just selective circuits to be able to get that. We need to expand our field area networks to do that. We need to make sure that we have protocols that is work, communication standards, if they can be accelerated, to know that they are safe, to the extent how can DOE or the Federal Government help? They probably perhaps not research but performance of technology working with us on these, to the extent that things are moving slowly if they can on standardization if they could accelerate those efforts, I think that would be helpful. And to work with us as we deploy this so they can get experience of what we are learning. And to help us test our systems for their security. Those are the types of things that are top of mind for us.

CHRIS KELLEY: Thank you. Other comments? David?

DAVID GEIER: Sort of adding on to what Ron said, I think there is going to be a tension here that -- there is a lot to be learned from all of the SIP work on the transmission system. Some very good standards out there. We are, every time we add a communication link to a DER, you're adding an access point, so it is probably going to add cost. And so I think they'll probably add frustration because it's probably things that people complying with substandards is not an easy task, but I think as we add more devices out there, we just need to make sure that we have the protocols in place and the security in place. And I agree with Ron. It would be a great area

to do pilot work and learn together. We really shouldn't start over though. I think that we have some good standards from the SIP transmission standards and we can base it on that and then see what is appropriate but as we integrate the different resources, we need to make sure it's secure.

CHRIS KELLEY: Thank you.

MICHELLE BERTOLINO: And I'll add to that and both David and Ron mentioned costs. We need to keep in mind that first of all, cyber security and physical security are top priorities for us, but it does add cost and all of us have added resources over the last decade for regulatory, cyber and physical security. And so we need to keep that in mind. Because that will be another cost that folks that are selling the PD panels on rooftops and installing them, aren't going to want to pick up that cost so we are stuck holding the bag there. We need to make sure that is understood, that is a cost of running the system to have the physical and cybersecurity in place.

CHRIS KELLEY: Thank you. So I'm glad you brought up cost and affordability because that is really where I want to turn next. So certainly, cyber would add some costs but a lot of the other technologies I heard you talk about, could also add cost too. So we heard from the panel this morning about desires from the administration and from the CPUC, from customers and utilities. To not only have reliable but affordable electricity and so with the added cost associated with these new systems and technologies, do you feel that this will change affordability for customers? Anyone want to address that?

RON NICHOLS: I'd be happy to. It's another area of tension. And I think, take a look at the technologies we are dealing with. Not everything is probably going to have the same path as solar in terms of how costs have come down, but all the costs are going to come down, as we get scale and more experience and innovate more on doing this. The challenges that we have when looking at trying to focus specifically on distributed energy resources is absent some incredibly new different technology that no one knows of right now, and that might happen. I don't think in my lifetime. I don't think anybody in this room's lifetime but something could happen that changes, but until that big monster change happens, we will rely on distribution system to serve our customers. Maybe not all their needs, but some of them. And maybe not every customer's needs. To do that, we do have to make certain we have broad access from customers and not pick winners and losers among our customers. You can have DERs on your system because our circuit happens to work. We have 4600 of them in our service territory. But you can't because it's an old 4KV system and it won't work. So there is investment that has to be made. I believe that we can make the reinforcement to our system, the modernization of our system, do it at a pace that will support the development as DERs grow and just like, just as we seen rooftop solar didn't have it overnight. This isn't going to instantaneous have every single customer have today's vintage of DERs. It will grow. I think that as long as we keep the notion that subsidies are necessary for new technologies, we get that. We have a lot of experience with that. As we keep our eye on the notion of trying to move towards, increasingly towards competitive markets and not relying on subsidies if they aren't necessary and monitoring that and making sure that we are looking at the total picture of our customers cost, I think we have time to have this be implemented on a path and a pace that will continue to be affordable. But it takes constant attention and looking down the pipeline.

SUSAN KENNEDY: Really an observation more than anything else. You know, as the new technologies are brought to the market, there is -- it is really a conversation with that utility about what their needs are and whether or not the technologies are responding to the question that is being asked. I mean, SCE stands out. I don't just do that when he is on the panel with me. I say that in my privacy of my own office, but SCE stood out because they asked for -- they asked for solutions and we were able to bring in solutions that competed on a least cost best fit it. We knew we had to step up and find something that was cost competitive and it forced us to do that. Now, and I have seen other utilities, they are looking at it. We want batteries. You get batteries and the way you ask for it is really expensive and it's not going to be cost effective, because they were asking for a solution in a box that they didn't understand how we could offer a different way. What is happening, crisis being the mother ever the best inventions, Southern California is again ground-zero with Aliso Canyon coming off line, gas field coming off line and the need for additional in basin resources so we are stepping up with looking at wherever we are putting in a battery, what technology can we add to that, to provide for not only the telemetry and the visibility and security into that resource, it is incumbent upon us to bring that. We understand that coming to the table. We have to bear that cost to provide that to the utility to make that resource more valuable. But also every place where we put every circuit where we put a battery, we have the capability of providing voltage regulation on that entire circuit, creating an exponential affect in terms of the amount of demand reduction on that circuit. So we are designing our system so we can provide that kind of resource all the way up the food chain. That is going to be what drives cost effective technology changes over time.

CHRIS KELLEY: Thank you. Michael?

MICHEAL YAKI: I want to take this from a slightly different point of view, and that is from the consumer point of view of affordability. Because the question is whether they can afford the technologies that we are trying to have them install in their homes, so they can save money, so they can take advantage of the ITC, so they can take advantage of these programs that are being offered. One of the things you should know about PACE is PACE has two faces. One is the public face which is traditional bond financing, government sales bonds, puts it in a pool and people apply from that pool. That's not what we do. We leverage -- we use private capital and it is basically a closed-loop system using a bonding authority or all the money injected into the system is essentially from us. And one of the ways that is we are able to keep things or make things more affordable is because we are able to securitize that into what we now have as the largest green bond platform in the United States right now. We created a new asset class called PACE, but bringing in institutional funds, private funds, keeps the cost of capital low and enables us to keep funding new projects going forward, but it's not easy. It's very complicated. But again, it's all about ensuring that you have a way to competitively finance for people who otherwise would not make that decision to buy that energy efficient product.

CHRIS KELLEY: Thank you. Other comments?

MICHELLE BERTOLINO: I'll add. I think that costs are part of this and there is a tension that when we were looking at 33% renewables, we all -- our hair was on fire and we said it will cost too much and we can't do it. We made it look easy. Now we are looking at 50%. No! At the

end of the day, people aren't marching in Sacramento to the Governor's office saying we are paying too much for electricity. Our people complain about bills in our service territory, but in our service territory and in other utilities in Northern California in the Central Valley, it's not unusual for someone to have a 600-dollar electric bill in the summer. So, I think it is important, but probably not as important as some of the other things that are happening.

CHRIS KELLEY: Other comments? Lars?

LARS LEE-POTRECK: There is a promise in that. At the end of the day, we do that in order to achieve greater good by reducing CO2 globally. Which means basically producing energy today at low cost. Since you don't calculate all the global impact of producing energy. And I think consumers are getting that. I think on a global scale, we see good customer awareness and acceptance of this need in order to move forward. There is great promise in that initial investigations show if you have distributed energy resources implemented in the grid to balance more transmission where this localized -- local production, there could be a 50% reduction in overall cost of the grid. So if you look for the grid component, there is a potentially a great savings as well to hold against the cost in order to modernize and advance the grid. So I would think at the end of the day like Michelle said, it's less dramatic than it seems. If you get to the end goal, to the end game in a way we can take everybody with us.

CHRIS KELLEY: Thank you. So, given the time, I think we should go ahead and turn to our closing remarks at this point. So what I'd like is for each of you to maybe give a minute summary. Any key points you want to share with the QER task force again? Just as we did with the last panel? I will just remind you that you have the QER task force in front of you. Really representing a number of bodies within the administration as mentioned earlier today for the first version of the QER resulted in legislative changes.

This is a good opportunity to share thoughts on policy decisions you think need to be made as well as summarize; so I'll start with Susan.

SUSAN KENNEDY: I would say the single most important tool that the government has is the tax incentive for both utilities and for individuals in terms of buying resources. You saw the impact of the ITC on solar and if storage a solution to many of the challenges, you need to align the incentives in order to create the market for storage to be part of the solution.

CHRIS KELLEY: Thank you. Michelle.

MICHELLE BERTOLINO: I'll just mention this and it's not something that hasn't already been said, but we have to remember that the electric grid is the backbone of what we do and we cannot compromise reliability whatever we do or the safety of our customers and consumers. Affordability is important. It may not be the most important but it is important. As well as there is not a one-size-fits-all. We really need to embrace the idea of implementing and using diverse resources and not favoring one technology over the other. I think the answer to this is going to be a combination and a portfolio of answers to the questions and the opportunities and challenges that we are facing today.

CHRIS KELLEY: Lars?

LARS LEE-POTRECK: So what we would or what we propose is to basically follow the initial signs which is we see in other countries of forming new markets for DERs to basically allow for investments to come in, but also having non-discriminatory access to the grid and build off our -- build a competitive landscape there and the issue which we had in some markets where the customer locked in and removed from accessing the market freely. That will contribute greatly to affordability of making that transition. Thank you.

CHRIS KELLEY: Ron?

RON NICHOLS: One brief point is that the Federal Government and only the Federal Government is in a position to be able to try to create and maintain or at least establish a more level playing field between states. The Clean Power Plan is one of those. To the extent that we can have more states taking on the types of efforts that California is doing, it expands, QER energy resources expands technologies and makes technologies cheaper quicker by getting to scale faster. And it's a great role for the DOE to do. I think DOE tried to do that to the extent there is legislative efforts in that regard. This is going to be legislative efforts in the energy area that affects resources and utilities, that is an area where I think would be helpful and also helping to share results. Sharing the results from the states that do some of this perhaps ahead of the other states, so that the fear of the unknown is reduced for those other states and those other utilities and we are certainly happy. We have always contributed to that smart grid program and others. I think those are great ways to help to advance opportunities even if you're not mandating other states to do the things we might be doing in California.

CHRIS KELLEY: Dave?

DAVID GEIER: I think it's important that we align goals at both the state and Federal level. We have a major goal here: reduce greenhouse gas. Part of the DOE Climate Resiliency Committee with the latest forest fires in northern California and it's a fear we have in Southern California every day. There are great opportunities there. It's not just the changing energy market we are talking about today, but it's the big picture as far as how we are going to operate our utilities with new partners in a safe and reliable manner. They think is really important. I think the continued financial funding of pilots, of technology, all the things that will allow us to move faster to this new energy future are key and I agree with Ron that we may be sort of at the forefront in California and New York and Hawaii and we need to share that nationwide so we can all benefit from those learnings.

CHRIS KELLEY: Thank you. Michael.

MICHAEL YAKI: I think Assistant Secretary Wayland knows what I'm about to say. There are 33 states in this country that have adopted PACE, but only a few have adopted and have a vibrant residential program. I think you can count them on less than one hand. The reason is that there is uncertainty still at the Federal Government level regarding the future of PACE because of uncertainty regarding housing agencies at the Federal Government level. We are hoping that they will understand and see, recognize that this is a tremendous benefit to homeowners, that it

provides value to their homes and creates energy efficient benefits that have impact nationwide and most importantly of all, this is something that enables homeowners to make the energy efficient decision in a way that helps them and helps all of us. So, we are looking forward to working continuing to work and expand PACE across the country and we are looking for help and assistance from the people in the room, from the Federal Government. So thank you.

CHRIS KELLEY: Thank you. With, that please join me in thanking our panel.

[Applause]

Panel 3

Generating and Delivering Electricity to Meet GHG Targets

We'll transition once again. We are going to move right into our third and final panel of the day. Just a reminder to folks here in the room that you will have an opportunity to provide public comments at the end. We will take comments. If you haven't already signed up at the front of the room, please do so. We'll get started in a moment. Our third and final panel is on the subject of generating and delivering electricity to meet greenhouse gas targets.

CHRIS KELLEY: In addition to the folks we have here in the room, we also have folks joining us via live streaming. We typically have a few that join over live stream, so you have quite an audience. So our third panel is focusing on the topic of generating and delivering electricity to meet greenhouse gas targets. At every one of these QER events, the first two panels are pretty similar in terms of the topic. The third is always a deep dive into in new and different and very suitable here in this region to focus on GHG targets. I'm very pleased to have a great panel up here with me and I'd like to introduce them now. So, we are joined by Arlen Orchard the Chief Executive Officer and General Manager from SMUD, Sacramento Municipal Utility District. A lot easier to say SMUD. Melissa Lavinson, Vice President Federal Affairs and Policy and Chief Sustainability Officer for Pacific Gas & Electric. Jana Ganion, Energy Director for Blue Lake Ranch Area and Sonia Aggarwal, Director of Strategy and Energy Innovation. So, just as we did with the last few panels, what we'll do is give each of you an opportunity to present. You'll have 5-7 minutes to give your presentation. We'll go right down the list and then it will come back to me for questions. All right? Let's get started.

ARLEN ORCHARD: I guess this is on. Thanks, Chris. Good afternoon everyone, I'm Arlen Orchard from SMUD and we are a community of not for profit utility, providing electricity to 1.5 million residents in the capital region of California, right adjacent to Michelle Bertolino's utility, who was on the last panel. I'm pleased to provide comments on this panel about meeting GHG targets because they have been a top priority for SMUD for more than two decades. California as you know, has been a leader in adopting policies to reduce GHG and as a community-owned utility we embraced these changes reflecting the values of our community and our elected board. More than that, we think it is simply the right thing to do to reduce our greenhouse gas footprint. Not only for our current, but also our future customers. Our utility

has developed an integrated generation portfolio that includes renewable energy resources such as wind, solar, and hydro as well as high efficiency natural gas fired plants. At present, more than half of SMUD's retail electricity sold comes from carbon-free resources. So my comments are going to touch on some of the policies that California has adopted to reduce carbon emissions and how we are meeting the challenges raised by these policy decisions and the changing energy landscape and a few suggestions on what the Federal Government might consider in the context of the QER to support continued greenhouse gas reductions. So as many of you know, California adopted long term carbon reduction goals through executive order and legislative action. These overarching policies are being accomplished through a variety of targeted policies encouraging rooftop solar, zero emission vehicles, low carbon fuels, cap and trade, energy efficiency and other efforts. One of the biggest drivers for the electricity sector is the renewable portfolio standard which will reach 50% by 2030. As more distributed and variable resources come online, and base load gas fired generation declines, we lose some of the collateral benefits associated with traditional resources such as the ability to quickly ramp up and down to meet demand and integrate the expansion of variable resources. We are going to need quick ramping and other resources to replace those more traditional services in order to meet renewable and sustainable energy goals in the future. To get a clearer understanding of potential impacts of the state RPS requirements on the grid, SMUD and the other large utilities in the state including PG&E funded modeling that predicted substantial amounts of over generation of solar energy totaling as much as 23% of the hours of the year, and we are seeing those modeling predictions bear out especially in the spring and fall in California. These findings indicate the need for flexible generation, demand response and energy storage to accommodate more variable generation without curtailing its output. Currently the majority of flexible generation including fast start up capability, rapid ramping and regulation services come from hydro and gas. These findings also indicate an opportunity to support the expansion of a transportation and building electrification. So SMUD owns a large hydroelectric system that can provide some of the necessary flexible grid services. Our upper American River Project is a 688 megawatt resource that plays a significant role in our energy management. Unfortunately, there have been regulatory barriers to bringing resources like our hydro project online. SMUD's experience relicensing our project took 13 years and cost approximately 24 million dollars due to a lack of coordination between agencies, duplicative reviews and studies and deferred decision-making. These factors ultimately delayed both the relicensing of the project and the associated environmental improvements. So we are very pleased to see Congress considering legislation to streamline this process and certainly support the effort. In addition to maintaining large generation resources, SMUD is focused on retail level solutions that contribute to GHG reduction. Over the past few years we made a significant investment in smart grid technology that is now paying dividends in many ways, including allowing us to segment and understand our customers and cost effectively market our efficiency in energy solution programs and implement rates which better reflect the cost of energy and influence customer behavior. Further we are currently engaged in a comprehensive examination as distributed energy including local solar, energy efficiency opportunities, DR pricing initiatives, support for electric vehicles and consideration of a variety of storage options. Our examination is informed by significant R&D efforts including distributed storage pilot projects partially funded by DOE. We are interested in distributed storage as an important solution not only to integrating variable resources like rooftop solar, but also to meet new challenges associated with electric vehicles, another area in which SMUD has made investments to reduce greenhouse gas emissions and

increase our net revenues through things like rebates and sponsoring charging stations. The promise of cost effective battery storage will allow customers to access storage to charge EDs during peak utility hours and use the storage to better manage their overall peak energy cost or demand charges as well as provide a backup during utility outages and provide SMUD with assistance in reducing our overall peak load. We are also examining regional developments such as the energy and balance market, which may allow renewables to reach a wider customer base and we are currently engaged in the study to determine whether the benefits of EIM participation outweigh the potential costs for us. Over all we are on track to meet an interim goal equivalent to 30% below our 1990 GHG emissions by 2020 and planning to meet our renewable and GHG reduction goals for 2030. We respect to recommendations for the DOE and the administration and I think this is a theme you heard. Our first priority should be to minimize cost impacts to customers and businesses. The efforts SMUD and, taken to reduce GHG emissions have real financial implications to our customers and we encourage DOE and the administration not to ignore such costs to consumers and businesses as you consider advancing climate policy. Our experience is that having the flexibility and a relatively long time horizon to accomplish our goals have allowed us to keep these costs lower than otherwise would be expected. An emphasis on regional flexibility with local decision making and accountability, will allow the most appropriate cost effective solutions to emerge based on the diversity of resources and tools available in each region. Further, a key opportunity lies in energy efficiency, obviously the dollar saved through energy efficiency represent dollars that need not be spent in the future for energy resources. Similarly, Federal action should not preempt or complicate existing state or regional emission reduction programs that provide compatible alternatives. Finally, utilities can and should play a key role in the electrification of transportation and our building stock and DOE and the administration should avoid any actions which would create barriers to utility participation in these efforts. In conclusion, we encourage Federal policymakers to ensure that utilities such as SMUD in states such as California, have the regulatory flexibility to find cost effective, innovative and environmentally sound solutions to meet the energy needs of our consumers. And I think I'll conclude with that and I look forward to any questions.

CHRIS KELLEY: Thank you. Melissa?

MELISSA LAVINSON: Thank you. And thank you all for being here today and for providing me the opportunity. Melissa Lavinson with PG&E and I'm pleased to be here to talk about operating in a high-greenhouse gas reduction environment as we have in California. I think as folks know, California has been a real leader in advancing policies to reduce greenhouse gas emissions to the levels necessary to effectively combat climate change. And PG&E and the other state's utilities have been very supportive of these efforts and we have all played a significant role in helping to achieve the reductions we gained to date. So the issues that have been explored here today both on this panel and on the previous pages are really fundamental as what we see as enabling an electric system that can seamlessly integrate the new power generation and end using technologies that will continue to facilitate both the deep greenhouse gas reductions that are necessary to address climate change, but also position us to weather the impacts of climate change going forward.

As one of the largest combined natural gas and electric utilities in the country with more than 23,000 employees, we provide gas and electric service to 16 million people throughout 70,000 square miles in northern and central California. And over the next three years, we plan to invest more than 8 billion to make our electric grid smarter, more resilient and better able to help California realize its vision for a low carbon future. And we are not alone at PG&E. Over the next decade, the electric industry is poised to invest nearly a trillion dollar to upgrade, expand and enhance the electric grid. As a result, this newer and smarter grid will benefit customers and the environment. And as the nation pursues additional greenhouse gas strategies more aggressively than in the past, particularly through the Clean Power Plan, we do expect the fundamental shift in generation and the underlying infrastructure that supports it. For example, the U.S. Energy Information Administration expects total renewables used in the electric power sector to increase by 10% in 2016 and 5.1% in 2017 and this is on top of a tripling of renewables over the last decade. So, given these increasing levels of intermittent renewable generation, we indicated there will be increased system need to make the system more flexible, to balance both the electric supply and demand. I think we heard a lot about that today, particularly in California with the infamous duck curve.

So a smarter, modernized grid that can successfully incorporate technologies like energy storage and other distributed energy resources. They can provide the grid with the tools necessary to address rapid changes in consumer demand as well as on the supply side. And PG&E has been very successful at integrating new clean energy technologies and reducing emissions, demonstrating we can achieve both the greenhouse gas reduction goals, keep the grid reliable and stable and also do it affordably for our customers and in fact, California has really been a proven leader in clean energy through the decades and the states utilities have played a really major role in that. Going back to the '70s for example, California became the first state to establish a utility business model that encouraged utilities for energy efficiency. And today, one could say California is a world leader in energy efficiency. In the early 2000's, the state put in place renewable portfolio standards and has increased it twice since then. Today, California's utilities are leaders in providing renewable energy to our customers and these purchases have helped to create a thriving renewable industry in the state of California and nationally and helped to drive down costs and again, in 2006, California implemented AB32 creating a cap and trade program which demonstrated if you create a flexible program, you could both drive down emissions and advance low emitting technologies and maintain affordability for customers. And the state has also taken important steps towards advancing a modern grid by encouraging its utilities to be some of the first to deploy automated meters. PG&E has deployed 10 million of these meters. So, as you can see throughout California's history, the partnership that policymakers had with utilities, both investor owned and municipal has been significant and really driven innovation and progress. In fact, today 30% of the electricity we provide to our customers comes from renewable resources and similar to SMUD, more than 50% of the electricity we provide is greenhouse gas-free when you include our hydro, and nuclear. So policymakers have really understood that there is an opportunity to leverage the scope and scale to really increase and accelerate the pace of change in the electric sector by working with the utilities. So going forward, we believe that it will be critical to recognize the vital role that utilities will continue to play and also particularly as it pertains to the electric grid.

The modern grid, I think as we heard, is a platform for connecting and integrating these newer, cleaner and more efficient technologies to work in concert and with each other and at a scale to maximize benefits. And we think this requires a few things. One, it requires rethinking the utility regulatory model and adopting it for the realities of the 21st century. It is going to be necessary to adopt approaches to rate making that create the right policies to ensure that adequate investment and equitable cost allocation continues to support the kinds of investments we will need to realize a low carbon future. Another is the focus on the primary goal of reducing greenhouse gas emissions as opposed to picking technology winners and losers. If you keep the focus on reducing carbon, which is the ultimate goal, and maximize flexibility, we believe that innovation will come and entrepreneurs will step up. To achieve goals, and I think we heard a little bit about that with Arlen, we do think that it will be important for states and Federal agencies to rethink how facilities get permitted and built. For example, we know that more transmission will be necessary and availability of flexible resources like hydroelectricity and pump storage will be needed going forward. So not only do we need to maintain and utilize the assets we have today, but the fundamental transformation of the infrastructure going forward is going to need to occur and we will need to do something about the permitting process in order to ensure that we can do that cost effectively and expeditiously.

And finally we heard a little bit about this on the first panel, but with regard to workforce development. We will need the highly skilled, well-trained workforce to make this transformation and to achieve the greenhouse gas reduction targets that we know we need to achieve. So, again, we believe that it is important for both state and Federal Government and private sector to step up to provide the resources necessary to train the workforce of the 21st century. So with that, thank you and I look forward to questions.

CHRIS KELLEY: Thank you. Jana?

JANA GANION: Good day everyone. It's an honor to be here in such accomplished company in terms of generating and delivering electricity to meet GHG targets. SMUD built the nation's first utility scale solar array and PG&E has more residential customers using solar, over 200,000 of them, than anywhere else in the U.S. and my sincere thanks to the Department of Energy for convening this planning effort. It's something that the Department of Energy does very well. My name is Jana Ganion, I'm the Energy Director for Blue Lake Rancheria. It is a Federally recognized Native-American tribal government. Our goals are to reduce greenhouse gas emissions eventually to zero, reduce and mobilize the cost of energy, create jobs, increase energy security and community resilience and reverse the causes of climate change. And I can tell from you firsthand experience, building green infrastructure successfully achieves all of these goals. Through energy efficiency alone, we are saving about 30,000-40,000 dollars a month on our power bills and we have increased employment in our energy operations by about 10%. The tribe is located in rural northwestern California in a little bit of an energy peninsula. We are connected to the larger energy grid by about a single 70 megawatt line. And so for us, energy and electricity generation is really a matter of resilience. There is an emergency power component to it. But it is also about driving down the causes of climate change and the impacts that come from climate change we are seeing already. The tribe sits on the Office of Indian Energy Indian Country Energy and Infrastructure Working Group, where we work with other tribal governments nationally on energy policy and due to the tribe's GHG reduction and

community resilience activities, it was selected as a 2015-2016 White House Climate Action Champion. One of the 16 communities in the United States to receive this honor.

We are fortunate to be in California. Both the tribe and the state of California have adopted aggressive GHG reduction targets and this alignment of goals has created a productive nexus for clean energy deployment. Our comprehensive energy efficiency distributed generation renewable energy, green fuels programs, and electric vehicle infrastructure, among other projects, have been achieved with the help of state funding and incentives. Our current project is a low carbon community scale micro grid and today I really am talking from a community scale perspective. It's wonderful to be here with my utility colleagues. But, we approach things from a community scale primarily. The micro grid includes a half megawatt solar array, one megawatt hour of battery storage and central management control system which will balance about one and a half megawatts of combined generation with about one megawatt in combined loads across the six building campus. We are working closely with PG&E and we have received an amazing amount of customer service and technical help from our local PG&E representatives to make this happen. This project will be online by the end of this year and will power the tribe's critical facilities including government offices, economic enterprises and an American Red Cross certified shelter in place. In the businesses as usual mode, the micro grid will reduce our fossil fuel use by about 40%, and increase our demand response capabilities. In an emergency, it will provide what we call life health and safety level power for as long as we need it. An island and moat.

As exciting as our projects have been, at least to us, they won't make really any difference in global climate health by themselves and so we are actively communicating lessons learned to hopefully ease and support replication. The QER calls for input and that's what we are here to do today. Ours primarily comes from our lessons learned around our clean energy activities and input from our local energy partners including the Shots Energy Research Center at Humboldt State University. Regarding technology and innovation and smart grid. The tribe has made significant investments in new energy technologies and with due respect to those who think that new tools are the only solution to climate mitigation, we would say that we already have the technology we need to reach GHG targets. We need fast tracked innovation in these sectors to make them work better. We need hardware and technology to easily allow bidirectional flow of power and to integrate and control the distributed generation and distributed energy storage as we heard many people talk about today. As a specific example, we need to work with inverter manufacturers to very safely, enable remote control and transitions between islanded and grid connected modes and admittedly these aren't as sexy as cold fusion but they will reverse climate change now. Regarding distributed generation, which is what we are heavily involved in, we need regulatory and pricing programs for streamlined and economical DG installations. We need more modeling of interconnection scenarios to inform utility and regulatory policy and incentives. And thresholds governing the size of DG systems should be eased through more study. And we need to standardize equipment and components so the costs of these technologies are readily understood by both utility and DG project teams. As an example, from our micro grid, exceeding is somewhat arbitrary, but regulated. One megawatt name plate limit added over \$400,000 to our project. We reduced generation by 38 kilowatts and virtually eliminated this line item. We also need more standardized and reliable information and telemetry and [unintelligible] that allow for real time load balancing with DG systems. And to

adjust the output of DG exports according to constraints and load conditions of the grid, and more policy support for net metering and virtual aggregated net metering would be immediately effective. This has been incredibly effective program for us. The good news is that most states already have a net metering policy. We just need to maintain and expand these programs and we think that is a role that the Department of Energy can play. We are fortunate again to be in California where Governor Brown, the CEC, California Energy Commission, the CPUC and leading edge utilities like PG&E and SMUD are all pulling towards an aligned set of low GHG goals. This has resulted in real investments in projects like our micro grid, heavily supported by state funding. We have also benefited from California's decoupling of energy efficiency measures from utility kilowatt hour sales structures. Vastly improving utilities ability to deliver cost effective services across a wide range of deployments. Investing in energy efficiency, reducing use, is often the most cost effective way to deliver the total electricity we need and we recommend the DOE support each state, creating a blueprint for low GHG strategies, as other people discussed here earlier today. It is something that the DOE does well and DOE can facilitate knowledge transfer from say California to other states. Building local capacity is key to implementing low GHG sources of energy. For example, the tribe is a very small government and has sourced engineering technical, financial and policy expertise by partnering with our local Humboldt State University, our local Shots Energy Research Center, the local Joint Powers Redwood Coast Energy Authority and of course our local PG&E customer service and engineers without whom we would be lost. To be clear, without these local partners our projects would not have been possible. And finally I'll talk a little bit about consumer choice. We need more policies and programs that give consumers the ability to choose clean energy sources, including utility-sponsored green powered programs such as PG&E's solar choice and many others. These programs allow millions of commercial and residential consumers to vote with their feet and to move their power bills to green power purchasing that in turn, helps meet GHG targets and creates widespread financial support for utilities increased investment in clean energy. Commercial scale customers in particular can move an avalanche of investment into green power with modest regulatory policy and incentive support. Thank you very much.

CHRIS KELLEY: Thank you, Jana. Sonia?

SONIA AGGARWAL: Thank you Chris. Is this on? Thank you for having me here today. It's great to be here with you all. So, I just wanted to talk a little bit about policy. I know that topic has been touched on in various different ways throughout the day. So, I will just try and zoom out a bit and then talk about what we see as the top policy priorities, as we move to a world where we have renewables and efficiency at the core or even the majority of the electricity system. So, you can go to the next slide.

My name is Sonia Aggarwal. And I work at Energy Innovation, as Chris mentioned, where I direct America's Power Plan. Which is a platform for innovative thinking about how to manage the transformation happening in the electric power sector today. We began back in 2012 by bringing together almost 200 electricity policy experts from around the country to curate information for decision-makers and their staffs, highlighting specific solutions to the most pressing policy regulatory planning and market design challenges. You can go to the next slide.

So first a few words on how the system changed and why we need to be thinking about fundamentally new policies. So last century we had the great challenge of meeting growing electricity demand by building new infrastructure. We wanted to deliver universal electric service to all Americans and to do that affordably, reliably and safely. That was a tall order which our nation and our utilities rose to meet. Utilities and their investors faced a limited set of options to make all this happen, including centralized power plants, transmission lines and a one-way distribution system to bring power into people's homes and businesses. Building all of this required a great deal of capital and getting it at low cost was a high priority. You can go to the next one. Now our goals have evolved. Instead of focus on building out the system, we are maintaining it. Resilience has grown in importance as we rely more on electricity for critical services and as extreme weather events become more frequent due to climate change and traditional grid hardening for reliability may not always be the most cost effective course of action. The cost of clean low carbon energy has also plummeted and we have an opportunity to make the right choices for the environment at the same or lower cost as the wrong ones. Customer satisfaction has grown in importance for utilities as they face increased competition from rooftop solar and other third party service providers and of course we still need an affordable, safe and secure system. So driven in large part by Research and Development support by the Department of Energy, our suite of options for meeting these new goals has vastly expanded. We have all the traditional stuff and it is more efficient now, plus innovative distributed energy resources like efficiency, demand response, solar, electric cars and huge advancements in information technology and cheap sensors that can enable us to optimize the system and take advantage of balancing demand against supply in real time. Given all these changes, it's our feeling that a new set of policy priorities is needed to run a highly efficient electricity system based primarily on zero carbon generation. We need a more flexible electric grid as others mentioned and we need to align the financial motivations of electric utilities and customers with outcomes we want from the system. Resilience, affordability, environmental performance, safety and security. So I'll highlight three of the items I consider to be the most important here and use the remaining minutes to sketch out a little bit more detail on those three items. So first, moving to performance-based regulation can harness the utility business model to deliver outcomes we need from the electricity system. Second, we must also ensure that wholesale markets appropriately value flexibility and create a level playing field for all resources to provide flexibility and other electricity services. And by flexibility here, it's been mentioned before, but I mean the ability to adjust supply and demand resources up and down, ramping in real time to keep the electric system in balance at least cost. And then third, we have to align customer facing rates with the pursuit of technologies and services that lower cost for everyone. And the Department of Energy has a big role to play in all three of these, I believe. So if you go to the next slide, performance-based regulation. So traditional utility regulation relies on cost of service plus a fair rate of return on capital investments and under this model, utility profits are linked to greater investments in capital recovery. This model made a lot of sense when our primary goals were building out the electric system to meet growing demand and provide universal service, but as we talked about, our goals have evolved a bit and we need to shift from rewarding undifferentiated capital deployment, to rewarding system optimization. Well-designed performance based regulation can change the central question asked by electric utility regulation from, did we pay the right amount for what we got? To, are we paying for what? This turn of phrase originated with Ron Lehr, a former of the Chair of the Colorado Public Service Commission.

So performance based regulation was the number one recommendation from America's Power Plan a few years ago because utilities are such important actors in our nation's electricity system and speaking here particularly about investor-owned utilities. If we can adjust the revenue of these regulated entities such as they are most profitable when they deliver outcomes customers and society want, we will have made this whole transition a lot easier and faster. Performance based regulation starts by determining what we want from the electricity system. Resilience, affordability, environmental performance, other goals. And then policymakers can choose quantitative metrics and performance targets in each of those categories. Finally, a portion of the utilities revenue can be tied to performance against these outcomes. Can we go to the next slide? So we are agnostic as to whether a region operates with wholesale power markets or properly incented vertically integrated utility, but the truth is that competition emerged across our nation. And in regions with wholesale markets, it's particularly important to understand future grid needs as the generation mix evolves and develop plan to meet those needs. So we are going to need more grid flexibility as renewables and demand side resources grow and the key to a low carbon grid is accessing the flexibility available in the existing electric system. Wholesale power markets can drive cost effectiveness of the overall system by clearly defining flexibility and allowing all kinds of resources to compete to provide it. This should happen on a day-to-day operational basis for example by creating tradeable flexibility products in the markets as well as on a long-term planning basis. For example, in coordination with state resource adequacy processes. Resources at the distribution scale represent a huge untapped reserve of flexibility particularly demand response and increasingly over time electric vehicles and batteries. And understanding the value of portfolios of distribution scale resources will be more and more important for wholesale markets to grapple with day-to-day as well as in long-term planning. Given the evolution of the power system needs and advancements in our understanding of those needs, it will be important to move away from undifferentiated rewards for capacity and instead focus on paying for the capabilities we need on the system. The Department of Energy and in particular, the National Labs have a huge role to play in advancing the state of the field on being able to model these complex evolutions in our system. Right now, I think we are far behind where we need to be on understanding how to compare distributed energy resources in the services they can provide with central large-scale more traditional energy resources. And there is a huge opportunity to push that whole field of knowledge forward.

And then last, customer facing rates. So, there is latent value in the existing electricity system and we have talked a lot about affordability today and this is one of the main ways we can make this transition affordably. So choosing smart times to use power can help unlock all of that latent value. It's time for us to finally apply our IT advancements to the electric sector. Cheap automation technologies can now optimize customer's electricity use around rates that vary throughout the day. Something really interesting happens when customers see a rate that varies according to system needs. Businesses can provide new services that enable customers to control their bills and deliver value to the electric system as a whole. The value of more efficient smart appliances increases. And opportunities abound in behind-the-scenes demand response and smart charging and more. Taking advantage of these opportunities to extract latent value in the existing system can lower cost for individual customers at the same time as it lowers the overall costs for customers by reducing need for new infrastructure.

So, with these top priorities in mind, we can make huge progress towards a modern electricity system that meets today's imperatives for clean and resilient grid that is also very affordable. Thank you again for allowing me to share this perspective and good luck with your important process and I'm looking forward to more conversation.

CHRIS KELLEY: Thank you, Sonia. So with that, comes back to me for a few questions for you guys. We'll start off with this one. So we heard from earlier panelists that the California customers do desire carbon reduction technologies potentially even if there is increased cost associated with that. When it comes to generation and transmission distribution. I want to validate that with you and make sure that we are accurate in hearing that correctly. Because it's not always the case in the rest of the country. Do you find that this is true for all customers for industrial and commercial customers and agricultural customers as well as residential customers? Anyone care to take that?

ARLEN ORCHARD: I don't think you can make a comment that is universally true of all customers. I think there is a fair amount of diversity among customers. And it probably is reflective of the community that you're serving or the service territory you're serving, but we certainly have seen a lot of customers who are willing to pay more for renewable energy. We have a green pricing program that has 73,000 customers and that includes business customers who are opting to pay more to have a greener energy portfolio. We also have an expanding community solar program. Our new 10 megawatt program was secured by two customers, two business customers who wanted a much greener portfolio. They each took 5 megawatts, one was the state of California, making it the largest green pricing customer in the country, I understand. And the other is our professional basketball team, the Kings, to fuel their new arena. We have seen a lot of interest in green pricing programs and we have seen an uptick in interest from businesses because it is an expectation that their customers are now having them to be having a more sustainable business practice. But we still have a lot of customers who are very, very concerned first and foremost about the lowest cost. So I think the challenge for utilities is to look at how do you create opportunities for customers who are most concerned about affordable cost to participate in this new renewable world and take advantage of those resources?

CHRIS KELLEY: Thank you.

MELISSA LAVINSON: Just to build on what Arlen said, I think he's absolutely right. It's difficult to generalize across all customer classes and customer types. That said, we have done focus groups throughout our service area of residential customers and essentially what we do get back, there is a willingness to pay more to get a cleaner product. But at the end of the day, customers still are very price sensitive with regard to both electricity and natural gas. And we see some of the sensitivity play out in terms of how it manifests itself in some of the energy efficiency programs we provide. So I think that there is also a need to take a step back and look at rates versus bills. While rates on average in California may be higher than elsewhere, bills tend to be below the national average. And that is because of the commitment that the state and states utilities and customers have made to energy efficiency. So it is really looking at the holistic way we can serve consumers, the kinds of products and packaging that we can put

together because every customer is unique. Their price sensitivity is unique and their environmental profile is unique. While there is a base desire to be as clean and green as they can at the end of the day, some are willing to take the next step and make those investments in technologies and that's where we are seeing some of the new products and services come to bear and that is where you're seeing a more customer-centric focus. Not just utilities in California but nationally.

CHRIS KELLEY: Other comments?

JANA GANION: I'll add to that. In our region, there is an investigation exploration of community choice aggregation and one of the reasons for that explanation or exploration is that businesses and residents want the ability to choose a greener mix. Now there is still pricing sensitivity around that mechanism but one of the main reasons for looking at it closely is to transition. So it won't happen tomorrow. But to transition and begin to move those dollars into sources of energy that are clean and more reflective of what the community wants. We had a long-range water planning effort and there is lots we could talk about around the nexus between water and electricity, but we had a long-range water planning exercise, planning effort, and we had probably 20 public meetings and there were maybe five comments around rate increases, the overwhelming amount of comments at these public meetings was concern for environment and concern for in-stream flows and water quality. So I think as we start to implement more and more of this messaging around GHG reduction, and reversing the causes of climate change, that those kinds of decisions, those kinds of holistic attitudes about power bills will come more and more into play.

CHRIS KELLEY: Thank you. 04:14:51

SONIA AGGARWAL: One thought. I think we are in a really interesting and very different time than we were even just a few years ago where I have seen some utility-scale solar plants coming in under four cents a kilowatt hour in different states across the country. And we also have some data showing that new wind projects in Colorado are coming in at lower cost than continuing to run old coal. So, it's kind of a new era also. I mean, I'm definitely not saying that this transition will be free or anything like that. But I think it is worth noting that a lot of the clean energy resources now we don't have to make the choice between more expensive option or a cleaner option.

CHRIS KELLEY: Thank you. So I'd like to turn to the topic of innovation. So even in the opening remarks that we heard from the Deputy Secretary, she mentioned mission innovation, investment in R&D. A few mentioned innovation in new technologies. Jana, I think you talked about we have a lot of technologies we need but we want to just make full use of them. So my question is, I wonder if you could maybe all of you, consider and then expand on where you see R&D or policy innovations and any support needs you might have in those spaces as it relates to GHG reductions? Anyone want to take it.

MELISSA LAVINSON: There has been a lot of innovation over the past decade and what we have really seen is the coming together of innovation on energy technologies with information technologies and that is really the nexus that we have seen and that is what I think has allowed

us to really jump to where we are today on a more automated and more digitized system and facilitating decarbonization. Innovation alone isn't going to get us there. The issues we heard earlier today, there is innovation and then there is integration. So all of these wonderful technologies in and of themselves aren't going to get the collective greenhouse gas reductions we need unless they are integrated and we are not going to be able to do it cost effectively unless they are integrated in a way that focuses on bringing the most benefits we can to the broadest number of people as quickly as we can and as affordably as we can. So I think that in order for the innovation to be sustainable and to really realize a promise, we do need to focus on some of the issues that we talked about earlier today and so the policy piece that does go with that is, we need to think about what is the utility business model going forward? We need to think about how can utilities have more and more partnerships with communities that they serve? And we also need to recognize that while there is a desire of some segment ever our customer base to actually take control of their energy future, there is also a large segment of our customer base that just wants the energy to be there when they want it. And they would like others to take care of it being cleaner, greener, and as affordable as possible. This is a balance in the consumer and we need to look at innovations across the spectrum and how to integrate all of that so we can have one seamless system that works for everyone.

CHRIS KELLEY: Thank you. Other comments? Sonia?

SONIA AGGARWAL: I'll give a shout out to the Energy Systems Integration Lab, I believe it's called. That is a really interesting development where people can actually bring technologies and plug them into a system and see how they work on an integrated basis and that is the type of stuff I think that could be really powerful for moving the stuff into market faster because we do have the technologies now and it's more about figuring out how to make them work with the system in a real world situation. There is one point around CRADAs, I believe. It's Cooperative Research and Development Agreements between private companies and often National Labs to test out some new technologies. These are really important tools and making them as easy to enter into as possible and with as many protections as are feasible, can really help move a lot of these things in through the labs and out into the field. And I would just mention not to forget in the mission innovation arena the R&D and D&D. All the demonstration and deployment, part of the research chain. I mean that is honestly the lab stuff is less expensive often than actually scaling something up, understanding what it takes to get it deployed and really working in the market and that can be a huge opportunity for increased funds in this area to support. That can make a big difference.

CHRIS KELLEY: Thank you.

ARLEN ORCHARD: I'll add quickly. I think there is a lot of innovation in a lot of new technologies and I think they will continue to be a lot of new innovations around those new DERs. I think the one challenge that we -- one thing I'm concerned about is that the behind-the-scenes that the utilities need to do with managing all of these DERs and creating the visualization and the ability to optimize it, requires some really pretty complicated and complex IT platforms. And those are tending to lag behind the amount of DERs being incorporated into our system. So things like demand management systems and distribution energy resource management systems. The promise of that are great to helping utilities manage that and ensure

reliability and also to help move towards a more trans active grid, but they are just not there yet. So innovation in that space for the next several years will be essential.

CHRIS KELLEY: Thank you. Jana, any comments?

JANA GANION: Just a couple of comments. One is that for our micro grid project, we are working with Idaho National Labs, they have a hardware loop testing lab there, so all the components, including the digital components and the software are going to be set in place and tested. That is a critical part of innovation, but again it's in many ways improving on technologies we already have, which is sensible given our timeline. And the other piece of innovation is that innovation around integration is just as ground shifting, I think, then a brand new technology that maybe none of us have heard here yet. And I think that the last piece that I'll say is that your comment about the deployment and demonstration. You learn so much and we had a couple of these projects from actually deploying leading edge technologies and seeing what it takes in the balance of system or the complete system train to make those things work. Especially on a distributed generation scale. Some are not going to work. Some are going to fail. But some are going to succeed. But in any situation, you're going to learn valuable lessons that either lead to replication or lead you away in a more knowledgeable direction. And I think it's important that we keep that in mind as a part of the innovation going forward.

CHRIS KELLEY: Thank you. So now I'd like to turn to energy efficiency. So it's interesting, there has been a lot of talk about DER in the previous panels and on the generation side of things, but I heard a few of you mention energy efficiency at the grid and the customer level. So, I'd like you to maybe talk a little bit about whether you see meeting greenhouse gas targets and being able to do that, is that more increased focus on the generation side and clean generation side? Is it more energy efficiency? Is it a combination of the two? Anyone care to take that?

ARLEN ORCHARD: I'll go ahead. I think it's a combination of everything. We are not going to meet those aggressive goals without doing part of everything. I think part of the challenge in California is we have a very siloed approach to meeting our greenhouse gas targets with very prescribed renewable targets we have to meet; very prescribed energy efficiency targets we have to meet. Now the storage requirements on the investor-end utilities. And I think that creates some challenges to look for the most cost effective way to reach the greenhouse reduction goals which I think everybody in California, certainly all the utilities agree is a very necessary outcome. So, energy efficiency to me, is always your cheapest way to achieve what you're trying to achieve. Folks tend to want to focus on the newest and greatest energy efficiency technologies. But the truth is, we have a huge housing and building stock in California that is very old and very inefficient and just bringing it up to our current Title 24 would provide a huge amount of greenhouse gas reduction and that isn't even installing the best and the greatest it's installing stuff that is really available on the market. So I would agree that is probably the most cost effective way it should be the first trench that we take in California.

CHRIS KELLEY: Thank you. Melissa?

MELISSA LAVINSON: Back to the integration theme. It's on both sides of it. We need to manage demand and reduce demand where we can as cost effectively as we can and Arlen is right. There is a wealth of technology that is out there, a wealth of programs, of initiatives. California is very good at developing utility partners with customers, have been very good at developing them and again with more of the information that we have from all the automated meter data we can tailor programs to really meet customers' needs and usage patterns. So the innovation has come in and now it's figuring out how best to integrate that and again, we need to do that on the demand side while looking at then optimizing supply side. So, as you have these siloed programs, I think sometimes you're not going to come to the most cost effective solution. I think from our perspective, if carbon is our North Star, which we think it should be, then we do need to provide flexibility and how to get there and while the renewable portfolio standards have been wonderful in driving technology and driving innovation, and we are fully supportive of 50% renewable and obviously there is room for that to grow. At the same time, we want to be able to figure out how do we optimize? Is it 54% renewable? A doubling of energy efficiency? Is it 60% renewable and 75% more energy efficiency? Whatever that might be, that might work best for our system versus Edison's system and we think for example at the national level, the Clean Power Plan actually provided a good example. They identified pathways to get to that greenhouse gas reduction goal, but it didn't say to a state, you have to hit these targets in these sectors. It said, we think that there is this amount of greenhouse gas reduction available in this area. Now you state, you come back with a plan and say how you're going to meet it and it has to be a rational plan and we think something like that, akin to that actually, given where we are from the technology perspective, at this point, is actually makes a lot of sense and is an interesting path to go down.

CHRIS KELLEY: Thank you. Other comments?

JANA GANION: I'll just add to that. You know, energy efficiency is often the thing you do first from a consumer's perspective. And the Clean Power Plan, the Clean Energy Incentive Program piece of the Clean Power Plan is an optional program that states can adopt, but it all ties into a national or a state carbon market. So you can earn credits or allowances and it provides for a lot of flexibility for early investment in energy efficiency projects and other qualifying projects. It's a wonderfully flexible program that wraps energy efficiency into a total approach in a fairly flexible way.

CHRIS KELLEY: Sonia? Any comments?

SONIA AGGARWAL: No thank you.

CHRIS KELLEY: So I think we'll just turn ahead to our closing remarks. So just as with the other panels, I'll give you a minute to provide a summary and just a reminder, we have the QER task force here representing various offices within the administration so, if you have policy recommendations, or any summary comments you would like to make, now is the time to do it. We'll start with Arlen.

ARLEN ORCHARD: Thank you. It's been a pleasure to be here this afternoon. I think I will echo themes you heard throughout the panels and that is the need to define what the ultimate

outcome is and agree it is greenhouse gas reduction and then provide the flexibility and the framework to allow states or utilities to chart the best path forward from a utility standpoint both for financial sustainability purpose, but also the best way to meet the needs of our consumers and it will vary depending on where you are across the country. Different resources, different advantages et cetera. So that flexibility I think will be paramount going forward. I also think that we need to develop a paradigm that encourages innovation, but does select winners and losers. I think we have seen a little bit of that in California in the past. Somewhat to the detriment of consumers. And so, going forward, I would say, create a level playing field acknowledging that with new technologies, for some period of time, you may need to incent their development, but once you have a robust market it is time to step back and let that market work. And then finally, I think it is very important to look at how do you provide benefits to those in our communities who can least afford the investments in things like energy efficiency and renewables and that is quite a challenge across California where you have a fair number of people who live in poverty. So, figuring out how to spread those benefited and make sure that everyone benefits from these new technologies is important.

CHRIS KELLEY: Thank you. Melissa?

MELISSA LAVINSON: Thank you. And thank you for having me here today. So, if you take a step back, we fundamentally believe that the investments that we make in the next three to five years, both in California and as a nation, are really going to form the basis of the magnitude of reduction that we are going to be able to achieve 20-30 years from now. We are in the industry with assets and so, with the decisions we make both as utilities, as consumers, but also as policymakers today, are really going to dictate what we are able to do and if we will be able to achieve the 80% reduction goals that we really need to achieve to avert the worst effects of climate change. And so as we heard many technologies are available today. Some are emerging that will enable to us to make those significant reductions. So the key is to figure out how can we effectively do it cost effectively, efficiently, and how can we get integrate the technologies to maximize our benefits. So we really look at it fundamentally much more as a systems challenge as opposed to a technology challenge. I think we all heard the technologies exist. So how do you make them work and how do you make them work for everybody and how do you make them work affordably? And we do believe the electric grid is an invaluable asset in that. We have all invested in it over the years. It has performed very well for the past 150 years. We believe it has the potential to perform well going forward. And a lot of the debates we are having on policy are all around how to use the grid and pay for the grid. If it wasn't a valuable asset, we wouldn't be having policy discussions that we are having today, because people do want to use it and they understand there is an importance to it. We need to figure out what are the policies we need to put in place to ensure we are making the investments we need to make to modernize it and make it more dynamic, to better integrate everything and make it work for everybody and make it affordable and sustainable over the long term.

CHRIS KELLEY: Thank you. Jana.

JANA GANION: So just a couple of points. First of all, we need a national energy and climate policy that moves forward from here. We need a national Energy Policy that moves us towards a renewable energy economy and this should include a national renewable energy portfolio

standard and national pricing for carbon emissions through trading markets. An example of how this has been rolled out in some detail is the Clean Power Plan and the Clean Energy Incentive Program that we mentioned earlier, which we enthusiastically support for its national trade in carbon market and early investment in zero emission power and energy efficiency components. And we really are in sort of a state of energy emergency. We need to move faster. We need Federal, state, tribal, local authorities and agencies to declare fast track to action to transition to low GHG sources of energy and do that as fast as possible. There are individuals, communities, governments, around the country that are standing by to invest and engage and get involved in this so we need to ease the way. I'll bring up one interesting story and then I'll conclude. The loan guarantee program that Solyndra was part of. We heard about Solyndra, right? What you didn't hear, what most people don't hear, is that that program went on to be one of the most profitable programs ever in the history of the United States government. Bringing in billions of dollars. So when we come up with policies that ease the way for people to invest both on the public and private side, people take advantage of it and they are successful at it. Thank you very much.

CHRIS KELLEY: Thank you. Sonia?

SONIA AGGARWAL: I just wanted to start by saying thank you so much to the QER task force and to the Department of Energy for the leadership on bringing these issues to the fore, synthesizing what is undoubtedly a really giant body of information that you are hearing across the country. So thank you very much for making the outreach effort and for doing all the work that you're doing. Also the focus of this panel on greenhouse gas emissions, I think is really very important and I'm extremely happy that is going to be a big piece of this QER. So, just a couple of thoughts on what DOE specifically could do. I mentioned briefly the girth of expertise in modeling distributed energy resources in a way that is comparable with more traditional energy resources. I think there is a lot of assistance that could be provided by the amazing research laboratories across the U.S. that DOE supports on that topic and also on the topic of the IT platforms for integrating all of these new resources. Also just continuing to analyze valuable transmission lines and providing that information to decision-makers at the state level. I think again from the analysis perspective, there is a great deal that could be offered. And then something that I didn't mention but could be interesting, is thinking about ways to demonstrate all of these types of policies and programs and integration through the Federal power marketing administrations and TBA. Those are institutions that have large systems that could be testing out some of these new innovative policies and technologies. So, thinking about that as a resource. Thank you very much again for having me.

CHRIS KELLEY: Thank you. Please join me in thanking our panel.

[Applause]

So we are going to make one last transition here as we move to the public comments portion of the meeting for today. Again just a reminder to those joining on the web, submit your comments at any time at www.energy.gov/QER. And we'll just get situated here and get started in a moment.

I'm joined up here at this time by colleagues from the Energy Policy and Systems Analysis Group. You met Karen earlier today. Dr. Karen Wayland. Also have John Richards, Matt McGovern and Larry Mansueti from Energy Policy and Systems Analysis Team. They'll be listening to your comments but as we get started here, let me turn it over to Karen to just get us kicked off for the public comments.

KAREN WAYLAND: Great thank you. This is our favorite parts of these meetings because we don't know what we'll hear on the panels, but we have literally no idea what we are going to get at the open mic session so it is very interesting for us. And I want to say that we think this open mic part is as important or more important than the panels. All of them get treated the same way. The entire meeting is transcribed and tagged for keywords in a sortable database that will be made available to the public. It will be made available to our analysts as soon as we are ready, so on a week by week basis, so that they can sort and really go through the things that we are hearing and make some sense and do ground truthing on how it leads into and matches with the analytical work we are doing. So again, this public comment period and the overall stakeholder engagement is a critical part of the QER and we thank you for sticking around and for sharing your insights with us.

CHRIS KELLEY: We need to get somebody to work the timer here. So the way this will work is I'm going to call folks up in the order in which they signed up for public comments. Each speaker will have five minutes to provide your comments. We are transcribing the comments here as Karen said, so we'll capture those and they will be incorporated into the analysis for the QER. So, just point out to the speakers that you can just step right up to the microphone and we have these colored lights just like we did for the panelists. So our first public commenter is Will McLinn.

AUDIENCE MEMBER: (Speaking native tongue) My name is Will McLinn, I'm Indian and Chief Executive Office Officer for the [unintelligible] Indians, which is a Federally recognized Indian tribe in East San Diego County. We have a 5,470-acre reservation into sections in the East County. I'm a member of the Department of Energy Office of Indian Energy and Infrastructure Work Group and when the task of my employment is we are a lessor to the wind energy project, which is a lessor of tribal or a portion of the tribal lands for 51 megawatts of the Truly Wind Energy Project, which is up to 186 megawatts on BLM public lands contiguous to the reservation. So, I just came here to make a couple of recommendations to the QER and I began by citing the Department of Energy Indian report on developing clean energy projects on tribal lands, and that report found that 2% of U.S. land contains an estimated 5% renewable energy resources, yet while developers have built 686 utility scale wind farms and 787 utility-scale solar arrays, on nine tribal lands since 2004, there has only been one significant commercial scale wind project on Indian lands, [unintelligible] just southeast of the [unintelligible] on the Campo reservation. And one in development which is 25 megawatts and in development the solar project, the CSP Project, with 200 megawatt name plate. So the BI has identified 25 renewable tribal renewable energy projects that could be completed within five years and produce up to 2200 megawatts of power. We are one of those projects. But what I wish to point out is that Federal agencies who are stewards of Federal public lands must reform their policies and decisions concerning renewable energy projects if the U.S. is to adapt a climate change and develop the megawatts of renewable energy sufficient to meet the GHG

reduction targets in Federal and State and Government Energy Policy. My recommendations pertain to U.S. Forest Service and U.S. Fish and Wildlife Service. This is truly low hanging fruit that requires neither legislation nor technological advances to realize. The Forest Service and NROL established a partnership where they determined the, what are the National Forest units and grassland units that have likely the highest potential for private sector development, solar and wind energy resources. It found 169,000 megawatts of potential for CSP, solar sites, 492,000 for affordable take and 171,000 megawatts for wind class 4 or better. The current production total on national Forest Service units is zero. Compare this to BLM public lands have a solar energy total maximum development potential of 2.9 million megawatts. And for wind potential is 206,000 megawatts. The current megawatts in production on BLM public lands is 12,000 megawatts. Public lands renewable energy development matters to tribes because most tribal lands share boundaries with public lands. And have impacts on public lands because of the need for transmission infrastructure connecting the project to the grid and often the need for renewable energy project to provide both tribal lands and public lands to achieve the scale necessary to make a project financeable and therefore feasible. The Forest Service policy on permitting makes renewable projects on Forest Service units unfinancable and unbankable for a number of reasons; one is that the Forest Service minimum area permit does not grant exclusivity, developer can spend many years collecting data and the analyzing the data to determine the feasibility and bankability of the resource and yet must hand over the proprietary data to the Forest Service and the Forest Service then makes the permit competitively bid to any number of developers.

CHRIS KELLEY: And that is five minutes, sir.

AUDIENCE MEMBER: So I just finish by saying that there is a number of solutions for Forest Service as well Fish and Wildlife Service on its eagle permit, is including on the May 4th solicitation in the Federal Register and addition to the standard for disturbing eagles, a regional impact, which is again a standard that is too high for regional development of the meeting Federal and State Energy Policy standards. We have extensive written remarks we will submit for the record.

KAREN WAYLAND: If you could, Will, perhaps you could share cards and e-mail your written statement right away that way we can match the transcript against what you said. Thank you.

CHRIS KELLEY: Thank you. Our next public commenter is Steve Zareti. Correct it for me when you step up.

AUDIENCE MEMBER: Good afternoon. Steve Zareti with Brookfield Renewable Energy Group. Owner and operator of 10,000 megawatts of renewable resources globally. Our portfolio is predominantly hydro in the U.S., we have over 3400 megawatts of hydro, alone. And that includes the 600 megawatt pump storage facility in Massachusetts. Appreciate the opportunity to provide feedback to this process. We specifically encourage is for this process to consider on a national basis the role for hydro, in the transition to a lower carbon economy and areas where the existing hydro fleet can be better leveraged and the services can offer be better valued. Hydro is particularly valuable among non-emitting resources, renewable resources, because of the ability to be dispatched. We believe that capability is a necessary component in

the modernization of the electric grid. In particular, the existing hydro fleet is well positioned for firming and shaping intermittent resources, such when the wind isn't blowing, or the sun isn't shining, these resources can be paired together to create a base load renewable energy product. And this approach to optimizing the use of existing hydro can play a key role in reducing costs, limiting over build of renewables and limiting over reliance on gas fire generation. Hydro technology we feel is especially valuable to address issues out here in the west, it's closed loop pump storage, which can be developed close to significant wind and solar resources to act as balancing resources and can help address over generation concerns. But leveraging and optimizing these resources for the future grid requires environmental markets to better recognize the role and value of existing hydro and its contributions to state and Federal low carbon targets, grid reliability and resource diversity. The lack of recognition of the potential for existing hydro resources to provide a low carbon hedge that can be contracted would also need to be addressed. A recent and still pending example of this gap can be found in the EPA's guidance on clean power plant compliance. Which offers very little in the role for hydro and focuses instead on the deployment of new intermittent resources. And then lastly, there is a lack of contracting mechanisms for new hydro infrastructure, which needs to account for the lifespan of the resource, as well as the high upfront capital investment required and that is particularly the case for development of pump storage here in California. So with that, we encouraged the QER process to consider recommendations that help define renewable energy to include existing hydro and promote the use of hydro for firming intermittent resources. Also to ensure appropriate recognition of the market value of hydro resources, including pump storage hydro, and established contracting mechanisms to align with benefits and life cycle of the asset. And lastly this process help ensure a role for existing new hydro resources and achievement of energy and climate policies through non-discriminatory, flexible, carbon and renewable markets. So, look forward to expanding on these comments through our written submittal. Thank you for the opportunity to do so.

CHRIS KELLEY: Thank you. Our next speaker is Dave Bryant.

AUDIENCE MEMBER: Good afternoon, my name is Dave Bryant, I am the Director of Technology at CTC Global Corporation, based in Irvine, California, about 40 miles south of here. Following the Western energy crisis of -

CHRIS KELLEY: Can you move closer to the microphone?

AUDIENCE MEMBER: Following Western energy crises of 2000, and the major east coast blackout of 2003, it was caused by excessive conductor sag. My company developed a high capacity low sag overhead conductor that could be used to double the capacity of existing transmission lines without the need to replace existing structures. Essentially, we replaced steel core wires used to strengthen overhead power lines with the higher strength, lighter weight carbon fiber composite core. While our initial goal was to increase line capacity, improve grid reliability, mitigate congestion costs and open up existing corners to new sources of cleaner generation, what we and more than 150 utilities in 40 countries realized, was that the technology could also be used to improve grid efficiency. As we all know, improving efficiency is the least expensive way to reach our energy and environmental objectives. For instance, it is far less expensive to improve the efficiency of demand side appliances such as refrigerators,

air-conditioners and lightbulbs, than it is to build new sources of generation that only produce energy when the wind is blowing or sun is shining. The lighter weight composite core utilized in the next generation conductor technology, commonly referred to as HLC, enables manufacturers to utilize 28% more and higher quality aluminum without a weight or diameter penalty.

The added aluminum content quality not only serves to increase line capacity, it also serves to reduce electrical resistance, which can reduce line losses by as much as 40%. Reduced line losses not only serves to reduce fuel consumption and associated emissions, which can have a profound impact in helping us reach our CO2 emission reduction objectives, it can also substantially help improve the economic viability of renewable generation resources. Case in point; last December American Electric Power completed the retro fit of an existing 345KV transmission line in Texas. They replaced 240 circuit miles of conventional steel reinforced conductor, known ACSR, with high performance ACCC conductor. Not only did they double the line's capacity to accommodate load growth, they also reduced line losses by 30%. The reduced line losses will not only save them over 250,000 megawatt hours of electricity per year and nearly 30 megawatts of generation, it will also help reduce CO2 emission by 160,000 metric tons a year.

That is the equivalent of removing nearly 34,000 cars off the road year after year. To ignore the importance of transmission line efficiency, is to turn our backs on one of the least expensive ways we have to reach our clean energy policies and environmental mandates. I encourage all of you to take a closer look at this. In closing, I'd like to commend all of you, the Department of Energy and Secretary Moniz for using the second installment of the QER to underscore the critical importance of our electric infrastructure and economic and environmental security challenges and growth. I believe this report can and should highlight for policymakers, the electric utility industry and the public, the benefits of high performance transmission conductors like ACCC with the aim of accelerating their broad deployment. Thank you.

CHRIS KELLEY: Thank you, Mr. Bryant. And he was the last person to sign up. Do we have anyone else who would like to provide comments? Okay. With that, I think we are done. Thank you. Meeting is adjourned.