STAFF WORKSHOP

BEFORE THE

CALIFORNIA ENERGY RESOURCES CONSERVATION

AND DEVELOPMENT COMMISSION

In the Matter of: Preparation of the 2009 Integrated Energy Policy Report and Energy Storage Technologies and Policies Needed to Support California's Renewable Portfolio Standard (RPS) Goals of 2020	Docket No. 09-IEP-1G

CALIFORNIA ENERGY COMMISSION

HEARING ROOM A

1516 NINTH STREET

SACRAMENTO, CALIFORNIA

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10:03 A.M.

Reported by:
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ALSO PRESENT

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I N D E X

I N D E X

P R O C E E D I N G S

10:03 a.m.

MR. GRAVELY: I want to thank everyone for coming today. I'm Mike Gravely from the Energy Commission, research and development division. Today's discussion is going to focus on energy storage.

We have a good crowd here. Today's agenda will include some brief, upfront discussions on technologies in general, just to give everybody kind of an idea of what technologies are out there.

And then we will go into several panel discussions. We have a large group of individuals that are on the WebEx calling in. And so just for a second, would you unmute everybody and see is anybody has any upfront questions of any challenges that we need to address before we start.

So, we're going to give everybody on the WebEx, if you have a problem that you're not able to hear the presentation, material is going to be presented on the WebEx. All the presentations today will be posted on the website within a day or two, as well as anything else that comes out of the meeting today. So, from that perspective we you be available to hear.

The meeting is being recorded both by a court reporter, and the statements will be put -- I mean a CEC recorder, and that transcript will be available at a later date on the website. And we're also recording it as a backup feature through WebEx, the audio.

For purposes of just a quick starting point, for those of you in this building here, just a couple of quick housekeeping details. We do have facilities, restrooms right outside to the left.

When you came in the center door right in front there there is a snack bar. They encourage not to bring anything but small cups or anything in the room here. Water and those type of things. So there is a sitting area out there if you want to take a break.

And if you want to have lunch there's an opportunity there, as well as several places within walking distance of the Commission.

We do have, as an facility like this, fire drills, and we have had incidences where we had to leave the facility. If you hear the large alarm and see everybody leaving, we'll go back out the center door, ideally, or the door on the left.

There's a large park area over here with ballparks and everything, and basketball courts. And so we all meet over there -- again, it's about a half a block away -- just to get away from the building. So I don't anticipate that happening, but it has happened.

If we have any other challenges, we've had the ceiling tiles fall a couple times. I think we've fixed all that, so I think we're done with those type of challenges. But we have had those in previous meetings, kind of provided some entertainment for the room here.

Anybody from the WebEx that's having a problem that we need to address before we start? Okay, if you'd go ahead and mute everybody.

For those of you on the WebEx there will be times for comments. If you have specific questions that you're not able to, I encourage you to type it into the chat session. And then we have an individual tracking that, and they will read your question or allow you to speak that the time it's appropriate. We do have a large crowd so we are going to have to manage the discussion from there.

Overall, the objective of today's workshop, this is an Integrated Energy Policy Report; this is a document that the Energy Commission, in conjunction with the PUC and the ISO, publishes every two years. It is policy for the state.

In the 08 IEPR, which is an update to the 07 IEPR, every two years we do a full IEPR, so 09 is what we call a full IEPR. And every off year we do an update.

Energy storage was identified in 07 and 08 as an area of interest. And we've had several technical presentations and workshops to go over the state of technology.

So, today we're not going to actually spend much time talking about the state of technology. We do have some vendors presenting in the afternoon. If they get too deep into their product I'm going to ask them to just talk about the policy side today.

I do encourage all vendors, all people interested, to send information to the docket. We do want to understand and report in the IEPR the state of technology. So if you're willing to share with us where your technology is, what you see as promising in the future in particular that will support California's needs that we'll discuss today, I would encourage you to provide me -- provide us that information to the docket so we can review that information and summarize that information, and to our Commissioners, and also for the IEPR for 2009. So, if you'd take the time to submit it, we will do that.

There's a possibility that we may cover some of this storage information again at the smart grid workshop in May; or we may have a follow-on workshop if enough issues or items come up that we think it's useful to have a second workshop.

The plan right now is not to have a second workshop before this IEPR is completed. But the smart grid does include energy storage in most of the discussions.

We also want to look at today, in particular, the integration of renewables in California, particularly the RPS on the schedule, the RPS of 2020 of 33 percent renewables in California by 2020.

And today we've set up, after we go

through the initial introduction, we have set up two panels. One from the utility grid management perspective as what they feel storage's value and also why there isn't more storage on the grid. What are the barriers and what are the institutional problems that we're having to get more storage on the grid.

One of the challenges that we have that we'll hear more about today is storage is not generation, it's not load, it's both and it's neither. And so for that reason it gets difficult in how you site it, how you pay for it, and how you collect revenue from it.

In the afternoon we have vendors and manufacturers and associations that represent those people talking about, from their perspective, what storage can provide. And also what we would like to find out from them why California doesn't have a larger percentage of storage in its mix. And what we can do.

And some of the previous research and development we've done, there's an indication that California needs a mixture of many energy sources. Demand response, spinning reserve, frequency of response, type of responses. And when you look at the uncertainty of renewables there's a belief that 10 to 15 to 20 percent of the renewable resources should be backed up with some type of storage to manage the grid effectively.

Now that's not a -- that's just a planning number; it's an education number, a research number. But it does seem to be fairly valid.

And if that's true, in 2020 we're looking at somewhere between 2000 and 4000 megawatts or more of storage that we need. And we don't have anywhere near that amount. And most of these things take a long time to get there.

So part of the discussion today is to understand what kind of barriers we can address to try to make that happen, if that's what we decide and the state decides is needed to manage the grid of the future.

And also we ultimately are looking for where we can invest our research and development time and efforts. I do come out of the research and development division. We do fund research in this area. So we're interested in prioritizing where we go.

I would be remiss if not mentioning the

stimulus package. Right now, under the smart grid stimulus package, which is in the process of being released from the Department of Energy, there is a large potential for funding for smart grid energy storage utility-level projects.

And so we won't discuss that in much detail today, other than to realize there is an opportunity if we come out of here with some actions to potentially respond to those actions with stimulus funding.

There was a series of questions that came through on the announcement. I won't cover all of these, but it's generally -- and what I've asked people to do is provide their responses to the questions in the writing today. We will cover all these questions throughout the discussions, but not necessary question-by-question. The intent is to cover these areas.

Basically they're asking the same types of questions of the value of storage and renewables. The challenges we have in doing a business plan for storage. And the challenges we have in getting the storage provider paid, and the cost of ownership issues. And then just understanding, from the perspective of the RPS, what we have. So today's discussions are really on those types of barrier issues.

Just to show you that we're talking about, in this case today, mostly grid-connected storage. We will hear from one provider that does residential, this supports the Million Solar Roofs. But most of the discussion today is going to focus on distribution and transmission level storage as opposed to customer site and residential storage.

The reason I'm having them speak, in particular, is they have had some incentives from the PUC. And they have had some other types of incentives. And they haven't had the success they anticipated. So I'm curious, you know, to hear a little bit. Sometimes the incentives seem to be the answer, but when the incentives are approved it isn't always the answer.

This just gives you a collage of the types of technologies we generally consider when we're looking here. I think everything is pretty much covered from the perspective of what technologies are on the table, even though, again, we will hear a brief presentation later this morning from EPRI where these technologies currently reside.

And in the announcement we asked for comments by the 9th, but I'm asking for an extra week, so we would give you two weeks after this workshop to provide written comments to us so we can incorporate what we learned from the workshop and incorporate the comments into the IEPR document we prepare for that.

So, any questions before we start forward from anybody here?

Okay, I'd like to introduce Kevin from the PUC, who also wants to provide a little bit of information from the PUC's perspective.

MR. DUDNEY: Good morning, everyone. As Mike mentioned, my name is Kevin Dudney; I'm from the CPUC, where I'm on the energy division staff. I work primarily on procurement and resource adequacy issues, so that's sort of the background that I'm coming from.

And really what I'm here to do today is to provide part of the regulatory background. Specifically I've got two goals. First and foremost, I'm here to listen. The PUC, at this point, doesn't have a clear policy in relation to storage.

Maybe you have some opinions on whether we should, whether we shouldn't, what it should like, you know, so come tell me how you think current PUC processes or policies help or hinder storage and what changes should be made there.

And then secondly I'm here to describe a little bit how the IOU and CPUC procurement processes work, you know, from the perspective of the storage developers in the room. This isn't the only way that you can paid for your product, but this is one way. So, you know, I just want to provide that perspective.

Talk a little bit about other CPUC-related storage issues. We're, I think, mostly focusing on integration of renewables today, but there are some other programs going on at the PUC that can be relevant.

And lastly, what questions does the CPUC have, you know. As I said, we don't have a clear policy framework here, so what questions are we thinking about as we maybe move in that direction.

So to jump right into the CA-ISO and CPUC procurement, every two years the three IOUs do ten-year-forward plans called long-term procurement plans that look at what does the system need to operate reliably over that ten-year timeframe. And then it's a plan to go out and make sure that those resources exist and are on the grid and available to the CA-ISO to reliably operate the system.

So, an important part of the long-term procurement plans is the energy action plan's loading order. And currently storage doesn't fall on that order. But there's a couple of places where it can be tied in. So that order is energy efficiency, demand response, the California Solar Initiative/distributed generation in general, renewables, and then lastly, clean fossil generation.

The current round of LTPP plans, the 2008 round, is not actually doing plans. They're doing, tackling policy issues right now. But it is expected that the 2010 plans, which will get kicked off probably later this year, will look forward from 2010 to 2020 and talk about what does the system need and how the IOUs will be involved in getting that generation, potentially storage technologies, to reliably operate the grid with ever-increasing renewables being the background.

So, the PUC favors competitive

procurement processes. Most procurement that the IOUs do goes through RFOs. And usually for new generation the IOUs do periodic RFOs, specifically focused on new generation. I guess I'm speaking about fossil generation there.

The renewables picture is a little different. Every year the three IOUs each do an RFO for new RPS contracts. And then the -- after the RFO, the utilities bring forward contracts to the PUC for approval. And that's either done by an application, in the case of fossil generation, or through an advice letter for RPS. I don't think we really want to get into the details of what those are right now, but certainly come ask me or any of the IOU staff if you have questions there.

Now, a few other notes about that. Right now, in the RPS RFOs, there's a placeholder value for integration costs, which is currently set to zero. But that could change in the future. So, the cost of integrating renewables could be affected by coordination with a storage project.

So the other CPUC programs that are relevant. There is a current demand response permanent load shifting pilot. Right now there is some money out there for the IOUs where they're authorized to spend the money. And some vendors are going forward and looking for customers to do some sort of thermal energy storage for peak load shifting.

Once the vendors come back with proposed contracts, again the PUC will make a decision. And possibly authorize those projects.

Secondly, there's the self-generation incentive program, SGIP, which provides an upfront incentive for distributed storage.

And thirdly, there's an ongoing smart grid rulemaking, which the rulemaking number is 0812009. And this is, to the extent that the PUC is formally looking at storage right now, I think this is the biggest umbrella right there.

And I would make an appeal to anyone who wants to get involved in the PUC process right now, this is a good place to start. There was a smart grid workshop hosted by the PUC on Friday. I think there were close to 150 people there. It was very well attended.

There's a lot of topics in that smart grid rulemaking. Storage is obviously closely connected. Is storage going to be addressed in the smart grid rulemaking? I don't know. It could be. Again, I would encourage you to get involved and make comments on that issue.

One possibility is that the smart grid rulemaking could recognize a need for the Commission to formally consider storage and kick off a new storage focused rulemaking. So that's a possibility. It is the right answer? I don't know. It's one answer.

Lastly, some unanswered questions from our perspective. The CPUC has a tendency to do things in sort of different boxes. I mentioned this with the energy action plan loading order.

What box does storage fit in? I think there's a lot of right answers to this question. It probably varies depending on the technology, the application, which box is appropriate. A lot of applications might fit within multiple of these boxes.

What I have in mind when I'm talking about these boxes are renewables, demand response, distributed generation, conventional generation, transmission and distribution, ancillary services. There's a lot of ways to conceptualize this.

Does there need to be one answer? I

don't really thing so. But does there need to be a clearer answer? Yes. I think there is a need for that. So, again, I would encourage you to, you know, come talk to me today and tell me what you think that answer should look like. I don't sit in the part of the organization where I can make policy promises, but I will listen to get ideas.

Second question, what is the capacity value of storage. I think this probably depends on a lot of characteristics of the specific projects. Particularly the location, you know. If the storage facility is on the site of a wind farm, then the storage might operate to smooth the production there. And there would be one capacity value associated with that.

Is that the optimal capacity value? I don't know. From a systems perspective it might be more optimal. I've seen studies that suggest this, to locate the storage elsewhere on the grid, and then have it match not just the intermittent profile, but also the profile of the load.

From a capacity valuation perspective in the RA program, resource adequacy I mean, RA, that second possibility is sort of harder to conceptualize. It doesn't fit within any of the existing protocols that we have for resource adequacy accounting rules.

So if there's a storage project that wants to go down that road, if it wants to tap into a potential resource adequacy value stream this is a question that the PUC needs to address in the future.

Lastly, the simple question of how to compare alternatives. I'm not sure that there's a clear answer here from the PUC's perspective on storage. For example, if there's a storage technology that can respond more rapidly than AGC -- control, is that more valuable? Some argue yes. Is there a market that values that higher response right now? Not that I'm aware of in California.

So, that's it for my remarks. So thank you all for your attention. There's a number of PUB Staff members in the room today besides myself, so that's a signal that this is an issue we're interested in. So if you have answers to some of the questions that I've posed. If you see problems or potential solutions out there in terms of the policies or processes that the PUC is involved in, let us know. We'll keep thinking about it. Thank you.

MR. NEFF: Next is a presentation from EPRI by Dan Rastler. I want to take this moment to remind you that if you're not speaking into the microphone the online audience is going to have a hard time hearing what you have to say. I'm pretty sure they're going to want to hear that.

MR. RASTLER: Thank you. Good morning, everyone. And thanks Mike and to the Energy Commission for the opportunity to provide a little bit of an overview of what's currently in play in the energy storage portfolio to sort of set the foundation for our follow-on discussions on barriers and opportunities for advancing storage within the electric enterprise.

So I've been asked today to sort of lay out, in a very short time, sort of what's currently in play. And I'm going to try to give a snapshot of some of the technologies we're currently looking at, and some of the technologies that we see are in the pipeline, which I think will be available in the next two or three years, certainly within the timeframe of California's RPS goals that we need to be thinking about, and how they fit in.

I also look forward to participating a little bit later on on the industry panel talking about barriers and constraints. I won't touch on these at this point.

Okay. This slide summarizes some of the drivers that we hear from our electric utility clients. And EPRI represents now about 90 percent of all the electric generation, or electricity sold in the U.S. And we're also getting a lot of input from our international clients or members in Europe and in Asia, who are also very keen on energy storage.

But these five bullets sort of summarize some of the key drivers, particularly here in the U.S., that we're hearing from our members. Time and time again it's coming up how do we manage this increasing amount of variable wind penetration.

You know, the electric sector emits about 30 percent of the nation's greenhouse gases. And so renewable, a full portfolio is going to really be needed to reduce that. And renewables are visioned to be a really important part of that. So how does storage really enable this, and how does storage really enable more renewable penetration?

Finally, another item is the ancillary services area, and I'm sure you're going to hear a little bit more about that later today, but currently these services are being met by the cycling of thermal power plants, which is really not a terribly efficient way to use a thermal power plant.

And so we're seeing a lot interest in exploring how storage can support that and avoid those cycling plants, as well as the values of improved greenhouse gas reduction.

Managing the grid peaks, managing peak demand and peak load is a huge problem for the electric sector. They spend billions of dollars for managing, for putting the infrastructure that's really only used for 400 or 500 hours a year.

And, of course, delivering power in a reliable way, and maintaining reliability. And having options for outage mitigation are really important.

The next wave of renewable penetration is expected to be photovoltaics, both in large-scale utility systems, as well as distributed systems. And the question of how to storage really support these new investments is of prime interest.

And finally, how does this all play out into the smart grid. And I'm not going to be talking about smart grid today, but certainly as a distributed asset within the grid infrastructure, storage is viewed to be one of the essential assets in really enabling this whole vision of smart grid and delivering robust lower cost power and reliable power to the end users.

This lays out the locational opportunities for storage throughout the electric value chain, both in the bulk storage area, regulation services. Looking at distributed systems, systems that would fit in the substation. And then down more into the commercial sector, either on the customer's side of the meter or the end-use side of the meter. And, of course, all the way down to the residential area.

So I'll be talking about a little of these today and trying to give you a snapshot of where some of these are, some of the applications we're seeing. And certainly not to -- you'll be hearing from some of the specific vendors in more detail on each of these. So I'll just try to cover these pretty quickly.

This is a chart that's been out there awhile, sort of a positioning chart of where storage fits in. And I know there's a lot of interest in this meeting about utility-scale storage. So we tend to think about bulk, bulk and grid support, as the heavy lifting both in power and in energy.

Utilities like hundreds of megawatts, you know, for hours. That's the kind of heavy lifting that's really needed. But there's a number of storage applications and a lot of different technologies and each fit into certain applications.

And I think you'll hear later on, it's the need to monetize a number of benefit streams here, different applications that really are really important.

In the bulk area we're particularly interested in pumped hydro and compressed air energy storage. And I'll talk a little bit about those particularly.

In the grid support area we're seeing

adoption, really, occurring within the utility sector. Starting to look at how megawatt class storage systems can start to support utility infrastructure. And that will also play into renewables.

And then I'm not going to talk too much about power quality and the smaller power ratings and the short duration. Those are also very important for ride-through power quality UPS. They could be technologies that will play into the frequency regulation market and applications.

And there's just another note here, there's still a lot of R&D needed to advance a lot of these technologies to get them to appropriate cost points. And there's a lot of technologies in the pipeline that I don't have on this chart that are emerging that are still in the R&D phase. And I'll touch on those in a little bit.

One area that we're particularly looking at is just the lithium ion batteries. These are the systems that are going to be in plug-in hybrid vehicles. And I'll show a little graphic later on that the electric vehicles and the PHEVs are coming. They're going to be coming in full force.

So the question is how might these

batteries play in, taking advantage of the large volumes of volume manufacturing that's going to be a place to support the transportation sector. And could there be a cross-application in the stationary power sector. So I'll touch on that a little bit.

Well, what do we have here today? It's primarily the largest storage technology we have that's in play in the U.S. is pumped hydro. And here we're showing PG&E's Helms facility, 1.2 gigawatts. And nice graphic picture of TVA's Raccoon Mountain.

And this really, you know, not really exotic technology, but it works. The challenges are the long lead time in permitting, getting the environmental compliance and finding the appropriate reservoirs and geology to really make this work. And it still is a technology that utilities are taking a serious look at, because it is a proven technology. It's just a long lead time technology.

We're not doing too much in pumped hydro, but we are going to be looking at it. It did come up in our last advisory meeting.

This slide shows what our current

portfolio looks like. Not to say that we're not interested in everything that's on the earlier charts, but with our resources we're looking at compressed air for the bulk storage areas. We're looking a variety of large battery systems for grid support. And looking at lithium ion for more of the distributed and the frequency regulation applications.

Just a little note on compressed air. This is a second generation cycle. This is one of the few new options we have in the bulk storage area that looks reasonably cost effective. Estimated to be about $800 a kilowatt; overnight in construction with some caveats that, you know, there may be other permitting owner's costs.

But there hasn't been a plant like this built yet, so we're moving forward with the collaborative to really demonstrate something on the scale of 400 megawatts ten hours. It's expected to have a much improved heat rate. This does still use natural gas, so it's not carbon free. But it's a high efficiency cycle, so it has a higher efficiency. And it's expected to have a lower capital cost than some of the earlier compressed air cycles that were done about 20 years ago.

There's also -- so let me just back up. This is, for those of you who don't know this, you take off-peak power, store air into the ground in a storage area, and then during the peak you take that air back out, heat it up, expand it, and put it right into a conventional gas turbine. So this is an underground storage.

There's also an above-ground version that we're looking at, sort of a mini version, 15 megawatts, two hours. Here the air is stored in pipes, so you need a little bit more of real estate.

So those are some of the options we're looking at with compressed air. And we are seeing a lot of interest, industry support in advancing demonstrations of these, which should happen within the next couple years.

And these, particularly the large case, will be one of the leading options that could support large amounts of wind penetration.

In terms of R&D on compressed air, this is a little bit more long term, looking how do we get away from the fuel, and their so-called adiabatic cycle that doesn't require natural gas as a fuel. Still probably about four or five years away in first demonstration.

So one of the other areas that is interest for storage is supporting large penetrations of photovoltaics. And, you know, solar's great until the clouds go over the panels. So here's a profile of what the variable power might look like at fairly large PV arrays. So we're looking for smaller storage systems that could mitigate these fluctuations.

Sort of quickly now, a snapshot of some of the technologies that are in play that can be deployed today, and then a look at some of the ones that are in the pipeline.

Sodium sulfur batteries being deployed significantly in Japan. Many installations in the U.S. Electric utilities are starting to adopt these. Very robust technology, long cycle life, heavy lifting. They come in modules of 1 megawatt, seven hours. So putting a number of these together you can start to get into significant utility applications.

We have a project on Long Island with New York Power Authority in a customer peak-shaving application. American Electric Power in

Ohio, and their ADP West in Texas have announced plans to put significant amount of these batteries in their territory.

Next in the pipeline and sort of gaining utility consideration is a family of flow batteries. This happens to be a zinc bromine flow system being designed and offered by Premium Power. It's half a megawatt, two megawatt hours. It's transportable, so it can be brought into urban load centers. It can be put out in different perhaps wind applications. And scalable through a number of regions.

So, we're seeing quite a bit of utility interest in the idea of having a transportable system that can be put out in the grid and moveable, particularly for T&D grid support applications.

ZBB has similar technology, more for distributed applications, but certainly capable of being scaled up. And the systems, again, here are positioned for early field demonstrations and deployment.

Vanadium redox is another flow system. There has been a large system, 250 kilowatt, two megawatt hour, installed up in Utah there at

Council Rock. It can also be deployed in wind and distributed applications.

There's been some restructuring going on with the company. We're still waiting to hear about product availability, but certainly this technology could be available within the next few years for both bulk storage and distributed applications.

There are also a number of flow battery systems in the R&D pipeline. So-called redox couples, zinc air, aluminum air, iron chlorine, even zinc chlorine. Zinc chlorine technology EPRI looked at about 25 years ago. Very low cost, but as you can imagine, dealing with chlorine.

Hydrogen bromine, and actually even hydrogen air. Just on a call yesterday with NREL who's looking at a hydrogen air system, sort of, making hydrogen offpeak and storing that in the ground instead of air. And trying to understand the economics of that.

So these are all going to continue to be vetted and assessed and evaluated and appropriately demonstrated to show their overall viability.

Got to come back to lead acid batteries.

Talking with some of my colleagues here. You know, EPRI did a, I think, a 20 megawatt, four hour, lead acid battery with Southern California Edison about 20 years ago.

Lead acid is still in play, and there's advanced lead acid technology that looks like it can address the cycling issues that have hindered lead acid systems from being deployed. So we're very interested in looking at technologies, for example, here by Xtreme Power, one megawatt, four hour system. And currently in discussions with several of the investor-owned utilities in California to see if we can position this type of system at some of the sites eligible for SGIP.

You're going to hear probably a little bit more about the frequency regulation opportunities. This has been identified and caught the eye of a lot of people. It's the low-hanging fruit. You can make money, I think we can make money with this application.

There have been some early trials by both AltariNano and A123. Here they're using lithium ion battery technology, packaged in megawatt modules. So it's megawatts for minutes of duration. Again, to serve this frequency regulation market.

I should mention a lot of the other lithium ion batteries are sort of -- companies are sort of catching an eye on this and wondering, is this a market we ought to go after as a way to kind of expand the production into the stationary area.

Flywheels. Certainly another of the options. Again, positioned primarily for high power, short duration. And looking at the frequency regulation market. Here's a Beacon Flywheel system, 100 kilowatts, 15 minutes; Pentadyne, a local California company, has got a 500 kilowatt power system, again around 15 minutes.

Beacon Power's business model is to own, operate and sell the services. So, they're building megawatt class facilities to participate in that market.

As I said, got to really look at also what's in the pipeline and what's in play. And particularly this lithium ion technology. Tremendous amount of factory production already in Asia, but quite a few U.S. companies positioning themselves in the U.S. to make these systems;

taking advantage of the stimulus package and need for jobs. And just a tremendous amount of work going on in this area.

So potential for cost reduction, I guess, is one message. And numerous applications. It's probably not going to be a 400 megawatt, ten hour system. But certainly could be multi-megawatt class. And perhaps cost effective enough to really fit more into the distributed areas.

One application we're looking at is the so-called community energy storage idea. Here depicted by American Electric Power. But of interest to a number of utilities. And this is putting maybe 50 kV storage systems out in the neighborhood to sort of support the local community. Could also support photovoltaics, obviously, in that community.

And, again, perhaps how storage might support distributed PV. A lot of what we hear from our western utility members is the need to have a load shift between 4:00 in the afternoon and 8:00 at night. So, storage positioned either on the customer side of the meter or the utility side of the meter could support that issue.

So the PATVs and electrics are coming.

Just another shot here of a lot of activity in play. And certainly not going to talk about things like vehicle-to-grid or things, but the battery technology in here may have a play in the stationary market applications.

And finally, superconducting magnetic storage. Again, a lot of power in a short duration. An area of R&D is looking at some of the new technology and materials that would make these perhaps a very large system that could be deployed as a bulk power option. Again, probably a few years away, but the technology is here today for very short duration power quality applications.

How are we doing on time? Few more minutes?

MR. NEFF: Yes.

MR. RASTLER: This is a little bit of an eye chart. We are trying to get our hands around the costs of these systems, and it's very difficult. It's a moving target, and it's very difficult to compare technologies on a consistent, objective basis.

But what I've provided here is sort of a snapshot of where we see projected systems. I would say that the current systems are probably a little bit more expensive than some of these numbers. Projected systems mean sort of a reasonable volume of deployment.

And I won't spend a lot of time on this. I'll have some remarks a little later in terms of barriers, but certainly we need to see capital costs lower. We need to see the technologies, the life cycle costs analyzed. And we need to see the value analyzed. And that, I think, will help address some of the barriers to more deployment of these systems.

Finally, just a list of the markets and applications that we're particularly interested in. Certainly wind integration is one of the keys. And I would say we really need to understand this a lot more. And I'll have some remarks a little bit later, how does storage enable more wind penetration.

And, again, who owns it, and is it a generator, does a third party? And how do we monetize a lot of the various value streams that can come to various stakeholders.

With that maybe I'll have a little time for questions, if we have, or look forward to further discussions on the industry panel.

Any questions? Yes, sir.

MR. LYONS: Thanks. Chet Lyons with Beacon Power. Dan, I saw you mentioned that Pentadyne had a flywheel 500 kW that lasts for 15 minutes. I think it's under one minute. Just a point of correction.

MR. RASTLER: Yeah, thank you. And it's still in the R&D phase. I think there's some things they can play around with that. So, thank you for that.

MR. LYONS: Yes.

MR. NEFF: Okay, thank you.

MR. MICHEL: Hi, I'm Dave Michel. Mike Gravely will be back in a few minutes. He's covering another meeting at the moment, but he should show up in a few minutes.

At this time we're going to move on to the panel discussion. And we'd like to go around that panel and have some introductions. Tom, do you want to start?

MR. BIALEK: Yes. Tom Bialek, San Diego Gas and Electric.

MR. MONTOYA: Mike Montoya, Southern California Edison.

MR. JOHNSON: Walt Johnson, California ISO.

MR. THALMAN: Jon Eric Thalman, Pacific Gas and Electric.

MR. RAWSON: Mark Rawson, Sacramento Municipal Utility District.

MR. FIORAVANTI: Rick Fioravanti, KEMA.

MR. CAZALET: Ed Cazalet, MegaWatt Storage Farms. We're an independent developer of storage technology.

MR. RASTLER: Dan Rastler of EPRI.

MR. MICHEL: So, our first speaker on the panel is Walt Johnson with the Cal ISO.

MR. JOHNSON: Thank you, Dave. I'm going to just briefly touch on a few sort of bullet points here with particular reference to how the storage systems are potentially of interest to the ISO and some of the failures that we see.

I should start by prefacing this that again, my name's Walt Johnson. I'm principal for technology strategies at the ISO. And we're primarily in smart grid and demand response, but I'm channeling for one of our storage experts today.

Of course, I expect that we're going to hear, and we've heard some already, regarding the value of storage for the system, as a whole. And I think it's going to be revolutionary potentially. It's not just a new kind of generation or a new kind of demand, if you will.

But the value of it for peak shifting or demand shaping, and potentially the value for renewables integration, or what we might call supply shaping, is a topic I know we're going to be hearing more about.

So I'm going to move on and address a couple of the market-related aspects that I think could be of interest. Starting with the ancillary services market, which was touched on.

The capacity payments from that market are potentially an interesting revenue stream for storage. Except that under the current system the use of storage, or in fact, any nongeneration asset is generally difficult in those markets.

Spinning reserve can only be provided under the WECC rules by unloaded generation. Nonspinning reserve can also be provided by interruptible load. But storage is not a resource which is explicitly in one of those categories.

The PUC's point that what box do we put it in.

We are currently working internally because on multiple occasions FERC has ordered the ISO to change its tariff so that it can enable comparable treatment of supply side demand resources for providing AS, and think that storage should also be allowed.

The difficulty is that at this point WECC has not taken any action and is not planning on action on that topic, although there had been some discussion awhile ago. But that seems to have died out.

Unless we have some new definitions or standards regarding the AS projects, and how they can be served by nongeneration assets, this is going to be a difficulty for us.

FERC, in fact, explicitly directed us that if we had an issue with WECC on this that we should file a complaint against WECC before FERC in order to try to move things along.

Short of doing that, we have been discussing internally whether we can file a tariff revision that would violate the existing WECC reliability standards. That causes our operational people a certain amount of grief as a concept.

It is possible, though, if you read the sort of fine print at the end of the standard, that we could be excused for noncompliance with the WECC criteria if that noncompliance stems from compliance with an action or applicable law or regulation that is imposed by a government authority.

So we could presumably operate, or change our tariff, and still not be subject to difficulties with WECC. But the right course, I think, is to actually have the WECC standards revised. And we'd love to see that happen.

We are working internally on a policy statement and activity to try to get that resurrected at the WECC. But I think until that happens we're going to have struggle with trying to get load or storage or any of these new technologies into the AS markets, and get those capacity payment streams available for those people.

The second topic I'd like to touch on briefly is on the value of locational pricing and the new market rules which we're currently 36, 35 hours into in California. Went live a little while ago.

And under those new rules generation is settled at the locational marginal price, at the pricing nodes. But load is settled at the load aggregation price. Meaning it has significantly less locational value.

The opportunities for arbitrage in the energy market that may be available to a storage vendor who's trying to balance or arbitrage high and low prices intra-day may be somewhat compromised by this asymmetry in the way the settlement process works.

I'm not really sure about the implications of this, but if the battery or the storage unit is acting as a generator, presumably it's going to be settled at the LMP when it's taking service from the grid to charge itself, it will be settled at the LAP, which may not be the most beneficial structure. But that's the way we've gone live with it, and that's the way the current rules are written.

Finally, I'd like to just indicate that there are a number of questions about the operation of a storage system within the grid that we do not have answers to. And we have a fairly extensive R&D program proposed that will answer -- and I'll read a list here of some of the topics that we believe we need to investigate before we'll be able to accommodate storage adequately.

First off, we aren't sure if our EMS system will support the sending of negative setpoint numbers to energy storage facility, if that makes sense. We have to look at that.

We want to look at how some other ISOs and RTOs, who are slightly ahead of us in terms of filing tariff with some of this, are actually doing that integration.

We aren't sure whether or not we can go -- how much pilot activity we're going to need to do it, if we can go direct to market strategies for integrating some storage. I know that we want to get this moving quickly.

We aren't sure of the communication mechanisms that are going to be required. If we're going to use the same ones that require for generation, like the rates in DPGs. Basically the DMP protocol stuff, or ICCP, or where these are going to be integrated or communicated with. What the interconnection procedures will be. Will be the same as the SChip or will be something different.

Certification procedures for storage to provide AS. Those are all written around generation, as it is now. Is the locational value of energy storage in the nodal market different? Is it not really a load or not really a generator, but something else?

For example, the topic of fast regulation was mentioned. We have no way of valuing that right now. That's not the structure -- or not one of the markets that we have.

I'm not going to touch -- our focus here is on the utility-scale stuff, so there are some questions we have about plug-in hybrids and other smaller scale stuff. But I'll leave that aside for the moment.

We do have some R&D projects in the works. We expect to report out some of those by this fall. But there's a lot more work that needs to be done before we understand how these systems can play, both technical and, of course, as I alluded to earlier, market or reliability issues that have to be settled.

I'll leave it at that for now and be interested in hearing the rest of the comments.

Thank you.

MR. NEFF: Thank you. Next, Jon Thalman.

MR. THALMAN: Hi. My name's Jon Eric Thalman, Manager of strategic and technical services at PG&E. I just want to provide an overview of the PG&E perspective on energy storage. And appreciate the CEC providing this opportunity and bringing together interested people today.

As has been touched on, energy storage has the potential to greatly increase the reliability, dispatchability of the energy supply we have in California.

In the pursuit of this there are several challenges; I'm sure I won't be the last one to touch on these today. With our push towards increased renewables we have this need to smooth out the intermittent characteristic of a lot of those renewable resources.

At the same time there's a need Walter talked about with ancillary services; managing peak demand, which was touched on, Dan; and there's also just relieving transmission and distribution congestion, which is a key interest for both ratepayers and utilities.

With all these varied interests there's opportunity and there are challenges. As was mentioned by Kevin, we tend to -- in this industry we tend to look at things in pockets and buckets. And here we have a technology or a fleet of technologies that cross all those buckets. There's a great advantage there, but then there's a challenge, right. Because we can't -- it doesn't fit into the way we do business as an industry. And Walt talked about some of those challenges, which are very real.

At the same time we're losing the technology that covers all the possible and potential functional capabilities and categories. And so from a utility perspective, and probably from an operator perspective, we look at portfolios of these, and what technologies match closely, and which ones cross over, cover a multitude of needs.

And that leaves the next point and that is with the high cost of current technology of energy storage. Of course, we're all very optimistic that it will come down as we go down this road. But the high cost today, when you're looking at implementing this, you have to look at a wide variety of values.

And you say, well, you know, if you have energy storage option and technology, well, let's try to fit this into our current construct of the utility role, this is transmission or this is distribution or this is generation. Okay, let's do that just to get going on this.

And if you do that, and you look at trying to evaluate the benefits, you end up looking -- we need to bring more value streams. And in doing that you're crossing back over, -- these buckets.

So these are the challenges we see from a utility perspective. You have to look at multiple benefits when you start doing your -- to make these things cost effective. And that goes back against the challenges with the way we do business today with buckets.

So, with that said, PG&E feels that the successful deployment of energy storage will depend on our meeting five main challenges versus technology readiness.

There's a lot of technologies that were reviewed by Dan that are very far along. There's a lot of other promising ones like -- towards lithium ion that are not as ready. But yet we would like to see them move along for obvious reasons. So technology readiness is a real challenge.

As I mentioned previously, improving the cost economics and understanding the benefits, this is a very real challenge when you're looking at making a utility level investment. Not to mention going to FERC or the PUC or to explain what you're doing with ratepayer revenues.

So, helping to understand those benefits. Walt talked about, you know, the markets are not set up. We look at benefits on the market side that might be helpful. But how can you really quantify those? How can you really say, okay, if you do this energy storage project, you will reap these benefits?

You can talk about potential benefits, but when it comes time to make an actual project go, you have to admit that, well, these are potential benefits. And that doesn't create as much for you then in your cost analysis, cost/ benefit analysis.

As a result we look at, okay, what are

some of the other funding options to help demonstration of emerging technologies? And I think that's why we're met here today, as we consider the IEPR and the statements that'll be in that, as Mike teed up.

There's a need for us to -- should look at alternative ways of funding. Have the ARRA, the stimulus package that's a very nice -- at this time in the economy that was -- this emerging technology needs some attention.

And at the same time that funding needs to find some priorities. Do you view the funding should be pointed towards established, long lead time technologies? We're not looking at a flash in the pan here. We're not looking for a quick. This is -- sometimes it hurts us, as an industry, that we're a little slower moving, really more conservative. But I think at the same time we need to, there's a part of that we need to stick with. And that is that the funding, and so want to make a point here that as we look towards the funding that's available for helping demonstration projects, we need to take an eye towards long lead time and proven technologies, more established technologies.

And then the final point, the fifth point, Walt said it better than I can, that the market rules and policies recognizing storage, benefit streams are very important. We have some rules with the way we run the grid today that seem prohibitive. And we need to address those, both at the CEC level, PUC level, ISO rules.

So those are -- plus that PG&E feels that our key is -- energy storage.

MR. NEFF: Thank you, Jon. Moving on down the line we have Michael Montoya from Southern California Edison.

MR. MONTOYA: Good morning, everybody. My name's Michael Montoya from Southern California Edison. I'm director of grid advancement and transmission and distribution business unit.

Today I'm going to talk a little bit about energy storage. First of all, we believe it's going to be critical for integration of intermittent resources. One of the issues with it, though, today that really hasn't been cost effective. There are also integration issues that we have in properly getting them connected to the electric system. There's a lack of proper system, lack of models so that we can properly integrate them to the system.

And there's really a lack of real world experience at the utilities, in particular us. We did have a very large battery project 20 years ago, but we have not done one since then.

And we also see that further system studies are going to be needed, you know, effects on ramping and regulation. You know, where's the optimal location for storage? What are the power quality issues going to be? You know, any time you have inverter technologies there are a possibility of power quality issues. I'm not saying that there is, but we need to look at that.

We need to look at, okay, where is the additional transmission in the state going to be needed to bring the renewable resources into this system. And where can storage help with stability in local issues?

And then also on generation, you know, I don't know this, but there's a possibility that we're going to have to operate our hydro and fossil generation differently maybe; maybe not. But if we do, what are the effects going to be on them? And how are we going to mitigate those effects?

And then optimally we're going to look at, from a wide area of monitoring and controls perspective, if you have all this storage technology deployed across the California systems, how are we going to make sure that we optimize the bulk power electric system along with all the storage technologies out there, and make sure that we don't compromise the operation of the electric grid.

Some of the efforts that we have going. We have electrical vehicle technical center that President Obama visited the last couple of weeks. We're looking at advanced battery technologies for EVs and PHEVs. Stationary batteries, PV solar integration and PEV testing. And we have over 300 vehicles in SCE's fleet that are electric. And I'll get into a little bit more about the electric vehicle center, technical center, in a minute.

We're also having discussions with the CEC and EPRI on the 15 megawatt aboveground compressed air storage project. And also talking about using the ARRA funds. The issue with the ARRA funds is that typically when the DOE gives money out to people that are applicants, there is a matching funds needed to win those funds. And so there is a gap there where we need, as a regulated utility, to have an ability to have those funds to match the ARRA funds.

We also have applications before the California Public Utilities Commission for renewables integration program so that we can study how we can interconnect storage technologies and gather data on planning and operational effects of the storage data. And really to gather real-world experience.

And, of course, we have our solar rooftop project that's proposed to have 250 megawatts of PV connected to the distribution system. And we also want to look at what are the effects down at the distribution level, and what are we going to have to do for planning and operations of that in the future.

The garage of the future. We've got one to three kilowatts of photovoltaic panels. We've got charging station for plug-in electric vehicle charging and discharging. So we're looking at how that will affect the batteries in the electric vehicle.

We got home energy storage device. And then a load bank that we can load all of these energy sources up to 9 kW.

The other efforts that we're working on is we're working with WECC load modeling task force on inverter models. We want to insure that, or we want to simulate dynamic response and system voltage at frequency transients on the system so that we can properly integrate those technologies.

We're working with a variety of other folks on wind machine models so that we can accurately look at both steady state and transient behavior of the wind generation facilities.

And we're deploying phasor measurement systems for other reasons. But we think that we can use this high-speed data to look, once we get storage technology deployed, to look at how it operates and get much better data than we're getting today on that.

And to also validate any modeling that we do to insure that the models are going to represent what's going on in the electric system.

The conclusions is to get real-world experience. You know, we're going to need funding in one way or another, because these things are very expensive. We need to study the integration issues and develop wide area controls. And look at the generation and the effects of integrating all of these different resources to make sure that the performance doesn't degrade on the electric system.

So, thank you.

MR. NEFF: Thank you. Next we have Mark Rawson from SMUD.

MR. RAWSON: Great, thank you. I want to touch on some of the points that have been mentioned here a little bit, maybe with a little more emphasis on why SMUD believes that storage is going to be absolutely imperative in how we operate our system going forward into the future.

But not just bulk storage, distributed storage, we touched a little bit on that earlier. So I want to show a little information that we've collected on how our PV systems have impacted our particular utility.

And talk about some of our plans going forward with both distributed and bulk storage. And kind of our approach to getting at a point that Dan brought up about location. And how to value the benefits of storage from a locational perspective.

I wanted to start, though, and just make a couple points about drivers. In December of 2008 SMUD's board modified a core value we have relative to resource planning about sustainable energy.

We redefined that to set a particular target for SMUD to get to about 10 percent of our 1990 CO2 emission levels by 2050. This is a very aggressive target for us to accomplish. And I think I'm a little bit relieved that it'll be after my career, if we're successful in getting there.

(Laughter.)

MR. RAWSON: But we need to figure out a way to do it that insures that we're going to have a reliable system, and that we're being good stewards of the environment. While, at the same time, you know, being competitive and keeping our prices low for our customers.

So this graphic, to me, is pretty daunting in showing kind of where we are here today on the left-hand side when we look at what AB-32 is going to look like for SMUD.

As part of that revision to our sustainable energy goal, SMUD has adopted a 33 percent RPS by 2020. We're happy to say that we'll meet the current, or just completed goal of 20 percent next year of delivered energy. So we're pretty proud of that.

And as we go forward, looking at a 33 percent RPS as being part of our sustainable energy strategy, it's becoming very clear to us that bulk storage, as well as distributed storage, is going to have to play a key role in helping us get here.

So what you can see here on the right-hand side, you know, we need to get down around 300,000 tons of CO2 emissions by 2050. And these bars in the middle represent our new 500 megawatt combined cycle power plant and our three big cogen power plants, gas-fired power plants.

And you can see, in order for us to get 2050 we're going to have to start addressing those power plants.

And so the portfolio of options that we're going to have to bring forward are going to rely heavily on renewables, as well as energy efficiency and storage plays a role in that.

But, as was alluded to by Walt in some of his discussion about the challenges that wind puts on our system, this is some data from our little-over-100-megawatt windfarm located to the west of us here in Solano. And what you can see is that there's not very good correlation between our wind generation source and our load.

Our load, as an inland utility, is driven by this hot summer HVAC load. And, you know, the wind is the weakest at those points. And so when you look at it either, you know, on an annual basis or down to hourly basis, we have to rely on other resources to date, predominately natural gas resources, to address this mismatch and insure that we're able to keep the system reliable.

And so storage in this instance is a great opportunity, we think, to address this particular issue of our renewable portfolio.

So the approach that we're talking is two-pronged, because I started by saying, you know, we think we need both. It's not going to be one or the other. We have a pretty robust photovoltaic program. That drives you to needing to look at distributed storage solutions.

As we move forward with this 33 percent RPS, we see a lot more hydro, small hydro and wind. That drives you to large bulk storage solutions.

So, we're working in partnership with EPRI, as some of the other utilities here are. Looking at opportunities around compressed air energy storage.

We're also in the planning phases of a new pump storage system that's part of our Upper American River hydro system. It's part of our FERC relicensing to be able to do about a 400 megawatt pump hydro storage system that will go a long ways to helping us address the increase in our wind resources, and help us to match this -- or address this mismatch between wind generation and our load.

But I wanted to also talk about the distributed aspects of storage. And this really touches on distributed generation as well as storage.

Mike spoke a little bit about optimal location. And I have to say, Edison's been doing some very interesting work, with funding from the Energy Commission, to use new modeling approaches to understand how you can look at your transmission and distribution system as an integrated model, and understand the best locations to put storage, generation or traditionally utility solutions.

And SMUD has done a little bit in that area, at least at the transmission and subtransmission level. Where we're going to go beginning this year is we're going to take the same approach, basically, that Edison has been out in front on. And we're going to actually do our whole system down to our 12 kV and start to identify really where the optimal locations are for storage, as well as distributed generation, that are going to provide the greatest value to the utility.

And this will help get at some of the points that were made earlier about, you know, how do you get to some of these other value propositions so that you can stack these things and make these expensive storage technologies cost effective today.

We do have some distributed storage demonstrations going on. I wasn't going to talk much about that. But we're working with our transmission and distribution operations folks to start to understand how they can incorporate storage into how they dispatch and operate our system.

Thank you.

MR. NEFF: Thank you. Next we have Dan, again, from EPRI.

MR. RASTLER: Okay, I'd like to just touch a little bit on the barriers and the RD&D needs that we see in this area. And I just may limit my remarks to this, most of this one slide, but I do have a few other supplemental slides.

It's complicated, it's a very complicated problem we're talking about. We're talking about both a macro understanding, as well as more of kind of bottoms up, something that Mark kind of alluded to. Where you find the best value at the more granular approach in the grid.

But we are trying to answer sort of the macro level right now with EPRI and some of the Merge and Prism analysis that maybe some of you are familiar about, which has been capped recently to say, well, we -- I think around 25 percent of the U.S. RPS. And we're trying to understand, but what if we had cost effective storage. Could we go beyond 25 percent RPS.

We're also trying to look at this a little bit closer right now in ERCOT, big plans for wind. And they're making some very huge transmission investments in ERCOT.

So we are going to be doing a little bit more of a robust analysis using the tool. We're not advocating any special tool, but ERCOT is using UPlan. And it's a supply side and transmission analysis tool. To get at and understand the nodal pricing and really understand particularly the value of bulk storage.

And we're going to be testing the hypothesis of the compressed air, cycle air, the second generation one I spoke about. And try to understand how that cycle can bring on more wind in ERCOT. And understand the underlying greenhouse gas impacts under a number of wind penetration scenarios.

We also think, as was mentioned earlier, -- so you're going to hear sort of a theme here from all of us, I think -- of really the need to understand the application-specific solutions and the costs and value in gap analysis. Also, an example here of that, of what we're trying to do.

Also, echo what you've heard, we need to resolve the risk of deployment of these systems. Our members, the industry wants fully integrated systems, almost turnkey delivery. They don't want to have to spec battery, find an inverter that controls. Turnkey integrated solution, application specific.

And as I mentioned, we need some cost reduction and standardization. So a lot could happen if we could standardize on a few high-value applications. Put those specifications out to the market and we'd have competition and we'd have, you know, an opportunity for cost reduction.

That would address the technology risks and also the vendor risk in bringing these systems forward.

And certainly we heard about the regulatory treatment. It's really important to understand. Really appreciated the comments here, try to understand this regulatory treatment, how we can basically talk about here's what technology can do; how do we get the policies and the treatment right to take advantage of these technologies.

We are looking at storage in the smart grid. And a number of utilities are planning pilots to demonstrate the business case for smart grid pilots.

In some of the restructured states they've had to go forward to their commission to get regulatory treatment for these pilots. So that's really important. Some utilities will do it with sort of existing authority under their R&D opportunities. But others really need to have that regulatory approval to kind of advance the deployment of new systems.

Again, we need market rules that encourage win/win. And this could be allowing a number of different stakeholders to participate. And, again, monetizing those various streams.

And then finally, I mean storage has finally, I think, gotten the attention at the federal level. There's going to be several billions of dollars in the basic sciences areas targeted toward storage and advancing new technology to bring, you know, the more promising technologies forward.

I think with that maybe I'll just conclude. The other slides will be in the public record for support. Thank you.

MR. NEFF: Thank you, Dan. Next we have Richard Fioravanti from KEMA.

MR. FIORAVANTI: Thank you for inviting

me and have the opportunity to speak. I wanted to first put up a slide a little bit about KEMA. Mainly for the main reasoning of the -- I'm involved in doing the research and modeling a lot of the storage applications, so KEMA is involved both in the U.S. and in Europe. And we do a lot of -- a great deal of testing.

A lot of the points I'm bringing up and the roadblocks they're running into are because we have actually been testing these technologies from small applications all the way up to very large. And we're running into these problems. And the issues that I'm raising here are really from things that we have been running in.

In fact, we are working with, as an example we're working with NATO on future solar battery back applications. We're doing safety testing on some very innovative lithium ion batteries that are being used for plug-in hybrids. And we're actually working with some of the new technologies as they're being applied to large renewable projects out in the field right now.

So the point that we're raising are, again, just things that we currently are running into.

The first slide, something old, something new, same challenges. There's a lot of technologies being applied in storage. And I like to use storage as a concept, more so as a discussion of different and various technologies.

We have some very traditional technologies, pumped hydro, what we're seeing, the discussion that's been around for awhile; and some very new technologies, what we're seeing emerging with both batteries and different types of technologies that are being applied to the batteries.

But each day we're getting a greater and greater understanding of what we can do with these. But those understanding is leading into some questions about how do we really apply it and where do we really apply it.

So the same challenges with any emerging technology is we need to really get our arms around what we're trying to do.

And the first step when I look at this is let's talk about some of the things that we can't do. We can't change the laws of physics, so when we start talking about all these technologies, we can't group them into one piece and expect one technology to apply everywhere. And I'll touch on this a little bit further in the discussion.

But also we can't predict innovation and we can't select technologies that we think are going to be winning because this is changing very fast. And we are, in a lot of these areas, still in a very emerging area.

And try as we may, and as hard as we can, we're still not going to predict which technologies are coming around the corner.

Part of that is because this concept is really being highlighted right now as having a lot of light shown on it. And just as we have seen, you know, PHV battery manufacturers, power tool battery manufacturers get excited about utility-scale application, we're seeing advanced military, we're seeing solar power manufacturers also getting excited about this area and coming in, as well.

And so it's not just some of the traditional players, but because we have such a high visibility area everybody is coming in. And I'm sure right now there's somebody in their garage who has come up with something that they think will top everything.

But we have to prepare for that and realize that we're not going to realize that we already know everything that's out there. So, let's again, focus on the concepts. And I like to even bucket-ize it when we start grouping some of these applications. And, again, start talking about the performance. When we start finding out what we need we're going to realize that there's a lot of people out there that are going to want to supply that.

But knowing this, and even, you know, we've, I think for a lot of us in this room, we've all seen this on DG and CHP applications over the last ten years, some of the same scenarios, same activities that have been going on.

And these are just common pieces that really fit together with emerging technologies. And that's when I was actually looking at some of these ideas, I was thinking, you know, these seem fairly obvious. But when we start getting the speed at which we're seeing a lot of this move forward, some of that is kind of falling by the wayside. And we may get hurt by that.

So, as we go forward, the concrete steps that I wanted to focus on are really education, the standards, the testing and the grants.

Has been done many times and we're witnessing the storage, to really outpace a lot of these traditional approaches. Because we're seeing this as a solution to a problem that we know is going to be on the grid. And we're rushing to that solution.

And on top of that we actually, in some of these cases, have the opportunity to make profits from them. And so there's a great rush to get this out and get this working. But at the same time, from a perspective of societal benefits that are going to be gained from this, there really is a need to kind of take a step back, understand it, provide the proper standards for it, get the testing that is required, and start focusing our grants in areas that are a little bit more concentrated and focused.

So, I just highlighted each of these areas and I can go through them quickly. The steps that increase the education and awareness. Again, storage encompasses a lot of different technologies. And they vary in capacity, they vary in duration.

The tendency for everybody is to tell me what the best technology is. And it's something that you just can't do. I often use the term one size doesn't fit all. And I really think it applies in this case.

For ancillary services we know that 15 minutes fast response really has a great niche there. For diurnal cycles with wind we know that we need large capacity, long duration.

For congestion and constraints with renewables also we need not as long as we're looking for diurnal, but we still need hours instead of minutes.

So creating a database that starts aligning these technologies and applications, it gives people a pretty good idea of what they have in the field as far as the natural technology. And where that probably has the best chance to be applied is an education point and a database. And I think some folks really need to start focusing on creating that and making that public to get everybody up to speed.

Again, I've seen this in the past where people like to mix applications and technologies. And when they do that they often put the wrong technologies together with applications.

Creating standards for developers. You know, this is both for the manufacturers and for the end users. And these are the cases that we are running into when we're testing right now.

For a lot of these emerging technology folks they have been working on behind-the-meter UPS systems that now they're looking to scale up. And as they do this, they're now realizing they're going to be connecting at the transmission level and not just behind the meter.

There's a whole host of different standards and requirements are involved in that. And they don't know those. And some of the questions that we are receiving from these folks is what are those, what do we need to do, how do we go through that.

Then when we start looking at these standards and these policies we're realizing that they're not written for these type of technologies. And so that's an area, I think, that we really do need to focus on.

And every time we start looking at standards, it's a long timeline before we really figure out what those should be. So it's something, I think, we really need to be moving for quickly.

For end-users we have the problem in reverse is what am I buying. And right now looking at some of these storage technologies, there isn't a label on them that tells me, you know, how, what its capacity is, what its duration is.

And right now it's really an end-user working with a developer in coming up with the performance characteristics that they think they need. But in the end that is something that really needs to be standardized. How do you actually take these technologies and put a stamp at the end of it much like you would with a fuel cell or an IC engine when you know what the kW is and you know, you know, what type of fuel it's using.

So those are areas that I think we need to focus on in coming up with a consensus standard on how we actually define that. I think it's important.

On the horizon, of course, is this question, you know, what is it. Is it a T&D, is it a merchant player. I mean I actually get comforted when I hear people other than consultants answering a question by saying, it depends, or it can be both.

But that is something on the horizon that's also going to have to be addressed. We do, we really do have a technology that kind of cuts across a lot of different areas. And looking for a definition of what it actually is.

The testing. This is something that I, you know, again, we have these rapidly increasing interest in storage. And mainly because we see these problems that we're going to be encountering with a large amount of variable generation that we're trying to put on the grid. And we see storage as a solution to this.

And we've also noted through work by folks in this room there's opportunities in ancillary services where you can actually, you may be able to perform better, you may be able to get rewarded for that.

And so there's a very high interest in getting these things out quickly. But typically when an emerging technology comes out, there is a long lifecycle testing that goes along with it.

We talk about, you know, doing this, as

I say, in a New York winter, in a Houston summer. Right now we have testing on these technologies, but they tend to be short duration. They tend to be in pilots of applications that people actually are already trying to utilize as a solution.

But the talk for storage right now is all about what we can do and how this is going to solve this problem. We need to start focusing on doing long-term testing to make sure that these technologies can actually do what they're going to be doing.

And, again, when we start looking at lifecycles, you know, testing is over a couple months versus two years, even though we have a very short timeline on when renewables are coming out with all these technologies that are being introduced. When we see these problems we still need to start focusing on what is going to happen with these units after one year, after two years, after three years. And trying to find a way to get that out to the public, as well.

So, I think this issue is taking on more importance. Again, as many of these technologies are being pencilled in right now as solutions to some of the problems that we're going to be seeing in the near future.

But we do need to make sure that we understand exactly what they're going to do and how they're going to perform. And we can say as to how they're going to perform with some confidence by some of the testing that we've done on these.

And I know EPRI is doing a lot of work in this. KEMA is doing a lot of work in this. But it's something, I think, you know, as we start going forward we need to see more folks, meaning agencies and federal agencies, understanding this, as well.

Grants and incentives. You know, this topic is -- I mean again, I tend to like this because I've seen a lot of these grants and incentives being applied to microturbines and fuel cells.

And with storage I think we have a technology that is more near commercialization. It actually has solving a problem. It's one of the key factors when you look at emerging technologies, is it going to solve a problem or is it just an alternative.

In this case there's actually real

problems that are being solved by storage. And in some cases, it's performing better than what the alternatives are.

And yet we are just now starting to see incentives being applied to it where some of these other technologies, which are really just alternatives have a lot of money already put into it.

So, but we do need to preface this on one point about the market question. That if a solution is better, if it's profitable the markets are going to find a way to implement it.

So that gets back to this question about who these players and how do we determine which are the best technologies. If there is a motive for a technology, you're going to be seeing a lot of players coming into it. And, again, that's exactly what's happening right now.

Some of the advanced military folks that we are working with are looking at these renewable sides and saying, why can't my technology fit in there. The answer is, well, there's no reason why it can't. And so they're getting just as excited as some of these other folks are.

So we're going to be seeing a lot of

people coming in here which would, again, this is R&D stuff that isn't, you know, published, they probably don't want to tell people about it. But it's happening, it's occurring right now. And so we, in some ways you almost want to just step aside from that.

We also have the stimulus package that's coming out. Language in there about storage in many different cases, but still it's viewed as a component to smart grid, it's viewed as a component to some type of tool that we're going to have.

And I think by some way we kind of dilute the effectiveness of storage or what we can really utilize it for.

So I think this is all leading to something that folks at the CEC have already realized, is that the roadmap around where we want to utilize it, how we want storage to go forward, I think is one of the pressing points that we have to have as we move forward.

And that really comes into defining, you know, storage is a concept. Defining what its performance requirements are going to need to be in specific areas. Letting the market respond to that.

But also putting some direction as to how we want to go forward. We look at all the money that's going to be put into the stimulus package right now. We want to make sure that it's applied to areas that are going to be the most effective.

And when we have a technology that is emerging, it has multiple uses and more uses by the day that we seem to be coming up with, you know, there's a very strong probability that some of this money and some of these incentive grants are going to be diluted by going to areas that may not be some of the most pressing issues right now.

So I really do believe that somehow getting an idea of a roadmap of where it's going, it's typically something we'd want to see from the federal agencies, but even within the state of California. I think it's also very important about how it fits with the state, itself.

So, finally, that's really what I wanted to talk about. If there's any questions I'd be glad to answer. Again, when we start looking at the standards and testing, the education and the grants that are out there, I really want to see a lot of this get directed and focused more so than what we've seen so far.

Thank you.

MR. NEFF: Thank you, Richard. Next we have Ed Cazalet from MegaWatt Storage Farms.

MR. CAZALET: Well, good morning and thank you for being here. We have a problem, not of kilowatts or megawatts, but of gigawatts here in California. Unless we think on that scale, I think we're going to miss the target.

And let me just draw a picture of California here and think about where we might put 4 gigawatts of storage. Now, 4 gigawatts of storage is only 5 percent of our 2020 peak. That's less than a third of our planning reserve margin.

Now I'm talking about 4 gigawatts of storage in addition to the storage such as pumped hydro that we have already on the grid.

And we have in California a lot of renewables going in, a lot of transmission being built to support those renewables. We have perhaps 20,000 megawatts, 20 gigawatts of once-through cooling fossil fuel units, I guess nuclear is probably included in that number, but fossil fuel, 20,000 megawatts at risk. 70,000 megawatt perhaps peak load by that point in time, 33 percent of that being renewables. This is a significant challenge.

We may not be able to -- if we try to meet that target, and with the restrictions on the fossil fuels, we may not make it. Four gigawatts of storage is a tiny fraction of that. But I think it's achievable for 2020.

Now, where would you put that? Well, just roughly speaking, let's put a gigawatt in the Bay Area, two gigawatts in the L.A. Basin and a gigawatt in the San Diego area.

Now, this is perfect to put in the local areas because storage with the right technology has no emissions, no water, no noise.

Now, try to put fossil fuel plants in those areas today. You basically can't do it. Edison struggled to get its four 50-megawatt turbines in there, and the fifth one I don't think has been approved yet.

In the Bay Area I'm not aware of any recent approvals for new fossil fuel plants. And certainly the local residents are going to fight like crazy to have any put there. Similar struggles down in San Diego. So, we really don't have generation alternatives in these basins.

So perhaps we build transmission. Well, transmission faces many of the same problems. The Palo Verde-Devers line, on the existing line, was approved when I was on the board of governors four years ago. It's still yet to be under construction. The Sunrise line struggles and challenges getting that in there. Be a similar challenge to get new major transmission into the Bay Area.

Additionally, we're putting -- there's a major move to put photovoltaic on rooftops, parking lots, in those areas.

So a lot of the generation for renewables is going in there. The wind is remote. Wind blows mainly at night. And some of that can be brought in, to some extent, over existing transmission lines. Especially if you put the storage in the load basins.

So if we had four gigawatts of storage that theoretically could replace four gigawatts of transmission and four gigawatts of distribution capabilities you put it in the right places on the distribution grid.

If it's gotten a long enough duration it will provide four gigawatts of CPUC resource adequacy capacity to meet your resource adequacy requirement.

Now, storage is two-way, roughly speaking. Four gigawatts of storage will provide you with eight gigawatts of dispatchability. Dispatchability for providing frequency regulation, reserves, load following and ramping.

So when the wind up at Tehachapi, this is the picture that we're all using now, it shows the wind blowing at 6:00 in the morning like crazy. And in some cases it drops off in two hours to essentially nothing. Not all the time.

What does that mean? I have to have at least some fossil fuel, perhaps quite a bit, standing there, running at idle or running at 50 percent, waiting to absorb that capability. That's spewing out emissions; it's operating ineffectively.

If you put storage on the grid at least it can absorb a big chunk of that. And if we got a longer outage, we bring up the most efficient and cleanest fossil fuel plants to back it up, or use our stored hydro for the longer duration. Or perhaps remotely located compressed air.

With wind we will have over-generation problems at night. This will provide four gigawatts of over-generation protection at night. Locating it in the right grid with the right power electronics and operating properly provides four gigawatts of voltage support.

Now, today when we plan a system we don't think of four gigawatts of storage being in the basin. We plan the system now with the necessary transmission to get there.

And that's fine, but then if we come along and add storage on top of that, you say, well, we don't need -- we're not deferring any transmission because we already planned the transmission.

So we have to refocus California's transmission planning to say, let's think in terms of where we're going to put the storage and the generation, et cetera. And on top of that figure out where the transmission grid. Not assume the generation is going to go out and -- be imported from outside. And we have to build enough transmission to get into the local areas to backup all the solar, and backup all the -- and provide local use. So, take a different perspective at it. All this is very complicated planning.

Now there's some general feeling, okay, that storage is expensive. Well, compared to what? Okay. Storage is a different animal.

So let's say I got a gigawatt of storage and a gigawatt of fossil. Well, right off the bat you see, if I'm after dispatchability a gigawatt of storage provides me two gigawatts of dispatchability versus one gigawatt from a fossil fuel plant. So on a per-megawatt basis, for that application I can already afford to pay twice as much.

Now, it's really better than that. Because in order to get reasonably, you know, dispatchability for spinning or for ramping, that sort of thing, the unit's got to be online.

So let's take a fossil unit. It's got to be operating, say, reasonably at 50 percent. And then I can, in order to be able to move it quickly. So that means I only get a half a gigawatt of dispatchability out of that one gigawatt of fossil fuel.

So now we got two times two, four times more dispatchability for those applications than I do for fossil plants.

Let me take one more step. If we're looking at fast response applications such as frequency regulation or fast frequency regulation, okay, in some cases that may be worth more, up to twice as much to the system operator because he can buy less of that and provide the same grid stability service, frequency regulation, because it can move faster, you can get more control.

So in theory, for some applications you could have storage worth eight times on a per-gigawatt basis what fossil fuel is.

But even that's not the answer to the question because if we look at our L.A., San Diego, Bay Area and perhaps even, you know, SMUD, we really don't have any transmission or generation alternatives. We have no alternative but to put local photovoltaic and that won't be enough, than to put storage in there. It's the only clean, green alternative you can put in.

And so really it comes down to, from an economic point of view, is storage-on-storage competition to meet those needs in those areas, and not storage versus fossil fuel, because fossil fuel and transmission is not a viable alternative, I believe.

So, how do we get there? Well, we can do studies from here -- I've spent 40 years doing studies, we can study this and study it. And I can tell you the models aren't good enough to compare storage to fossil fuels. Okay.

If you're buying fossil fuels in a procurement you might be looking on/off-peak pricing or something. If you're going to look at storage you got to look at five-minute or five-second operation. You got to look at comparing transmission location. Very complex problem.

It's the same complexity to say what is the value of a wind machine at the grid, what is the value of solar PV. As a policy in this state and in the country, we've set RPS standards. And say we think we look at this technology, or this class of technologies, and we want to move that correction from a policy point of view.

I think the case could be made that given we've made those decisions, and they're the essential ingredient of getting there in a clean way and a reliable way, to have a significant chunk of storage on the grid, we should set a storage portfolio standard to provide the direction and the incentives to put the right amount of storage on the grid.

So I propose for California a storage portfolio standard of 5 percent by 2020. That's about four gigawatts, okay. And we've got to define what that is, because that needs to be clean, no greenhouse gas emissions. Because if we're just adding greenhouse gas emissions back in we're not attaining the goals of the renewable portfolio standard.

It needs to be fast, I would say less than a second response, with full charge to discharge. It needs to be deep. Now, let me explain this. I think if we're going to go to four gigawatts we got to be fairly deep, four to six hours, perhaps more on average. Set a role for storage that might be 15 minutes for a significant chunk of that.

But the overall, there's not a need for four gigawatts of frequency regulation on the grid.

So in terms of this standard I think somewhere in the range of four to six hours for the average composition of the storage. Some of it might be ten, some of it might be 15 minutes, et cetera.

And that it be located close to the load. We already have storage in some cases out, you know, for Helms and Big Creek and that sort of thing. But this would be a standard for storage located essentially on the distribution grid.

Now, once you have that in place, then just like the RPS standard, it's a straightforward procurement process for the IOUs to issue solicitations and competitively procure storage. I would propose under storage service PPAs, not unlike what you do today for fossil generation and for renewables.

So, that's my proposal. I hope that can help focus our attention. I would suggest that if this is of interest, the utilities in California, the regulators, we have an opportunity with the Recovery Act to propose to Washington a program that would take the initial steps towards this goal.

So if we go in there and say, our plan is four gigawatts of storage, and we're going to get 50 million, 100 million, whatever it might be, to start along this program. I think we have a big vision we can take to Washington. And something that would really energize the industry.

If we put this in place people will say, well, how are we going to manufacture 500 megawatts a year of storage. That's what we want people to begin thinking about.

Not -- we want to continue the research, but if we got to put 500 megawatts here on the grid, we have manufacturing plants to be built, jobs to be provided manufacturing. It's got to be installed and maintained.

It's a real program I think the political side of our country can get behind. And this will drive new initiatives. Will drive research where people say, gee, this particular storage you're putting in now costs X dollars a megawatt, I can do it cheaper.

And that's exactly the kind of incentives we want to move the industry forward. Thank you.

MR. NEFF: Thank you, Ed. I think we're moving on to the last one, Tom from San Diego Gas and Electric.

MR. BIALEK: Thank you for letting me come and give this presentation. And I'm standing between you and lunch. You've also heard a lot of the things I'm going to say, so, you know, I'm not going to take all that long.

I think what I want to try to do here is hopefully take a little bit different spin on some of this storage stuff. But I think, in general, what you're going to see is that SDG&E, like all the other IOUs in California, recognized that ultimately storage is going to be a key element as we move forward in the future.

It's going to be something that's going to be necessary for us as we look to try to integrate renewables particularly. But also as we look at some of the features, sort of smart grid applications, where customer side storage may be a viable option for us to use and integrate into our systems to actually be able to help out with some response.

With that, what I'm trying to do here is talk about a little bit different perspective. And when you think about, you know, and talk a little bit about planning, planning, to a large degree, really just sort of, you look at resource planning, sort of what do you need when.

The question becomes, with regard to storage, if I look at large wind penetrations coming on at night, and now I'm looking at how can I integrate that. Will I have to back off my fossil generation or nuclear plants because I got so much wind coming on at night that without storage that would be the alternative.

For T&D planning what's available at system peak, that's a key issue. That's one of the things that drives planning for transmission distribution system.

And so you sit there and say, okay, what can I do with storage. And if I now look at renewables, the question sort of becomes how do I know that I can be able to guarantee certain levels of performance such that I can count on them, such that I could have the right generation mix up and running and available to me.

And so also you throw now storage into the mix and say, storage helps me to, from the perspective of both looking at modifying load profiles, as well as looking at guaranteeing certain levels of performance with regards to renewables.

From a smart grid perspective, one of the things that I would throw out, as I think really becomes important as we move down the road, is optimization of a load profile that the IOUs see, that we see in the state of California.

What do you really want to see here in the end? Do you want to see it to be totally flat? You know, arguably you could do that. Do you want to see average efficiency or average load factors at 80 percent, 90 percent? What do you really want that to look like on a yearly basis, as well as sort of a daily basis?

When you think about that, starting thinking about the concepts that were raised about what bucket do we put it in, I think the real question is what are you really trying to get at. What sort of load profile do you really want?

There's a variety of ways to do that. You could do it with demand response, as well as with storage, if you can get enough people to actually respond. So, there are those kinds of questions that need to be answered.

And then lastly, centralized versus distributed. Certainly from a utility perspective we're used to big central facilities. Those are easier; there's less of them; they're easy to maintain.

But the reality may be very different

down the road, as we look at, you know, customers getting price signals, responding to pricing signals, looking at how -- what technologies they can employ, whether they be electric vehicles or others, to manage their energy use.

And so now you get into -- you can do it both ways. The question certainly distributed might be a little more complicated, but the question becomes train off those two, looking at those two perspectives.

So obviously you've heard about this. I mean this came out of the -- Power Engineering magazine. Here you're seeing a typical wind turbine power curve, relatively fast ramp and then ultimately cut off. Isn't a surprise to anybody, really fast ramping rates causing additional problems to conventional fossil machines, large fossil machines, because they can't ramp that fast.

So to Dan's point, I could be sitting here with a fossil generator sitting out there at a certain loading level to try to accommodate these types of ramps. And when I do that it's going to be operating at lower efficiencies than might otherwise do in an optimum perspective. And producing more emissions, more greenhouse gases.

And I've got to apologize for the next couple slides because I pulled them from a SunPower presentation. But this little mess here is actually the output of a PV system. The orange is actually the power output and the green is actually the ramp rates.

And we're talking ramp rates in kilowatts per second. Again, really quick ramp rates. And so now from a big fossil generator perspective, how are you going to follow this? Forget it. You're not going to do it. You're going to pull it out of the stored field in the system. And then you'll send signals to your large units to ramp up, rev down. They'll produce more than they need or less than they need.

Here's another example; here's a larger scale. This is actually a Nellis Air Force Base tracking. Same kind of thing we saw.

So you can just see some of the changes. Significant changes in output in very short duration of time. So that has to be accommodated.

So now let's change slightly. Let's talk a little bit about some of the, you know, microgrid, which we say is really an alternative service delivery model.

We're looking at flows going in a multitude of directions. We look at isolating from the substations. And ultimately down sort of just above the residential loads, as energy storage, whatever that happens to be, to help us both transition from a parallel operation mode with the grid to an islanded mode when needed.

You're really looking at probably, you know, it's been said here before, there's really sort of two components that we believe is going to be needed. It's going to need a fast storage capability, something that's going to be able to respond, react quickly. Doesn't necessarily have to have a long duration capability. But then as we want to try to sustain that island, and perhaps move some loads around, then we look at a longer term storage, as well.

And then again, here's an example of some, a voltage sag in one of our distribution systems. The top graph shows the basic lead, the RMS values as a function of time. And the bottom is actually the three phases.

You can see here, here's another application for storage. But, again note the relatively short duration kind of event, needing something that can respond very quickly.

Obviously, we've got EV program as well. We've been doing some stuff with plug-in hybrid electric vehicles. We've announced a partnership with Nissan to be one of, a regional partner as they roll out their EV programming in San Diego County.

And then lastly, so I can get you out so you can go to lunch, from our perspective there's really a couple of, you know, there's not -- any barriers, and you can call the regulatory challenges barriers, as well. But to the point of the energy policy goals. Thirty-three percent, you know, ultimately has committed our company to 33 percent renewables by 2020.

As we look at that and look at how do we do that, plus AB-32, how are we actually going to hit those in the timeframe 2020. It's really only ten years down the road now. And you think about that, that's not really that far away.

The cost recovery of these technologies. The point being that there's these bins. Storage doesn't fit in the bins. Somehow it needs to become a bin of its own, or there has to be some redefinition of what those bins are.

Do you care, do you really care whether you're reducing load via energy efficiency, demand response or storage or DG? Or do you really care about I want to reduce load?

And then the cost allocation. Who's going to really pick up these costs? Obviously, you know, people could argue, one could argue that these intermittent renewables are imposing additional integration costs on the system. Should those be borne by the developers of those systems? Or is it a societal cost that needs to be borne by all ratepayers because our state of California, from the perspective of we want renewables, we want a greener future? And therefore it's something that some dollars to be shared across the board.

So, from a perspective of barriers, you've heard this before, technology cost. Clearly the technologies today are expensive. Technology maturity. What you've got is some technologies that arguably we can go out today and buy off the shelf and install. But there's lots of other ones that are in the development phase. Or even in the R&D phase.

Another barrier to a certain degree is just this whole sort of technology tradeoffs. It's not quite as straightforward as perhaps you might like to think. Short- versus long-term duty issues. Which one do you need? Where do you need it?

Lifetime issues. Not only am I looking at -- when I start looking at how I'm going to discharge this storage device, you now impact the lifetime of the device. So while I'm able to get a cheaper, lower cost installation to get me through two or three years, then I'm going to have to go back out and replace the batteries. And that comes back to the operating regime, as well.

One of the other big things that is out there, another issue, is just the whole system integration. Batteries only versus complete systems. As a utility we want a complete system, we just don't really want batteries. It's great, but the reality is somebody has to integrate them. There's really not a lot of people out there doing that in a, you know, really streamlined fashion, or really in a lot of competitive fashion, that we see.

So if we go out and place an order we're going to place an order for a battery system. Or whatever energy system that we want AC in and we want AC out.

Use cases, multiple value streams. I think it's been mentioned again. Can you, while you have this energy storage device sitting there, apply it to more than one kind of service? Can you actually do the load shifting? Can you do the energy arbitrage? Can you do the -- which things do you want to do? As you add those up and you create more value and you, from your benefit/cost perspective, which is typically, you know, the -- we go to the CPUC and ask for recovery of any particular technologies that we're moving forward with, we have to provide business cases, demonstrate those business cases. Benefits have to exceed the costs.

Clearly the issue with regards to trying to evaluate and allow multiple value streams in those cases becomes important.

And then lastly, siting issues. Recognize that when you talk a megawatt battery you're talking, depending upon the technologies, you're talking a semi-trailer. Or a, you know, sea-container.

You've got environmental issues with some of the technologies, space issues. To get to Ed's point, if you think about 4 gigawatts, and if you think about a megawatt being, you know, from a utility perspective, being a semi-trailer, you're going to be having a lot of semi-trailers being needed to be parked somewhere.

So those are just some of the things to think about as we move forward with this. We believe that it's something that we are going to have to address, and sooner rather than later, given the challenges I think we're going to meet when we try at the 2020 goals.

Thank you.

MR. GRAVELY: Thank you, Tom.

MR. BIALEK: You're welcome.

MR. GRAVELY: I will make one little adjustment. We're not going to go to lunch quite yet. I apologize for that, but I do think some of our panel members will not be here for the afternoon and I do want to take 15 or 20 or no more 30 minutes to discuss some issues now that we've had a chance to cover a broad perspective.

So what I wanted to do is ask the panel some questions now and give a chance for the different experts who spoke about some of the issues we've addressed.

The first one I'd like to ask in general is we've talked around it quite a bit, but is there a unanimous or general agreement that storage is critical in our mix for 2020. Ultimately we're here to discuss about what do we need to meet the RPS in 2020. What does California need.

Because currently we don't have any specific directions addressing that. So I'd like to throw it out to the panel and have anybody just speak, as you have a chance. And we'll cover it for a few minutes.

And your thoughts, from the perspective of providers, is storage something we're going to have to have a substantial more? I mean, we've heard from Ed's perspective of what he thinks is a goal to shoot for. I'd like to hear from somebody else that's in this market to see what they think it's going to take for us to successfully operate the California grid in 2020 with 30 percent renewables.

I'll start with you, Walt, since you represent the ISO.

MR. JOHNSON: Yeah, that's the big question, isn't it? What will it take to operate that? What will the grid look like? What will the resource mix look like?

I mean we've given some pretty clear direction with regard to renewables making up a significant portion of the supply in that system. And as the bulk of the renewables are going to be suffering from the kinds of variability that we've seen some charts of. We're going to need some way to deal with that.

We are not always looked upon favorably with regard to how much we move around thermal generators, as it is, with the system. We'd like to see more stability, more predictability and the ability to do that. Which means we need some other faster responding systems to follow those what I call supply shaping, do something to firm up the intermittency or the variability of that large portion of the generation portfolio.

So I think there's no way that we can avoid having some form of -- a combination, I think, of the load side, some demand management of some form and storage. There's probably not enough demand on the system to be able to make up the difference.

We would like to see, and from a system operator standpoint I think we'd like to see the variable resources come to the grid with less variability. So I'm particularly interested in schemes that couple some form of storage as a leveler, as a buffer between the variable resource and the grade mix would make our life somewhat simpler.

And also it avoids the problem with respect to having to figure out exactly how to dispatch four gigawatts of storage, which is something we've never tried to do.

But I think you saw from the list of research projects that we're looking at, there's just a whole lot of questions we need to answer that we don't have good handles on right now, before we can get to the final answer to that question, like what will it take to operate the grid.

But we know it's going to involve a fair amount of storage, and it's going to involve a number of other resources. And we're looking to both the technology evolution, as well as the regulatory or sort of reliability standards relief in things that we need to make the mix of resources that we have at our disposal just a flexible and as useful to us as possible.

MR. GRAVELY: Someone else?

MR. RAWSON: I think from SMUD's perspective, yeah, we do think it's absolutely critical. That's why, you know, in our FERC relicensing we've included a 400 megawatt pumped hydro system. We expect when we get that license later this year or next year that we'll start designing activities to have that storage in place before 2020, for that very reason.

And as we look at, you know, our portion of SB-1 PV deployment, we're now starting to look at how we're going to address intermittency issues down at the distribution level. And we think that storage is going to play a key role there, as well.

MR. GRAVELY: When you considered that large of a system is pumped hydro the only source you considered, or were there other choices you considered?

MR. RAWSON: That was considered as part of a broader objective with our relicensing and our hydro system. It made sense to do it at that same time.

But today we are looking at other bulk storage systems. We're a member of EPRI storage activities looking at compressed air energy storage. I will say that, you know, the chart that I put up there showing where we need to be by 2050 with respect to greenhouse gas emissions we think puts a challenge on compressed air energy storage because that's, you know, a large enough system to handle the full buildout of our windfarm in Solano.

It's going to consume a large part of our CO2 budget by 2050 if we were to use compressed air energy storage.

So, you know, that technology has its challenges. Dan talked a little bit about adiabatic case that might be an opportunity to help us get around that issue. Those really are the two bulk storage technologies that we've looked at.

And we're doing demonstrations down in the distributed scale with flow technology, as well as advanced battery technologies.

MR. FIORAVANTI: I think it's also important to ask the question of how much better can the grid operate with storage there. And increasing in reliability and maintaining the grid.

Sometimes when you focus it on one specific component or one area you may get pushback from those folks, if it's their component that people are targeting or saying that that is what is going to cause you to require storage. They may push back and say that there's other ways to mitigate that.

But I think when you look at the system as a whole, you know, two questions: Is it needed, and then also how much better can it operate with it, as reasons to have storage on the system.

MR. GRAVELY: Okay.

MR. RAWSON: Well, I think just to add to that comment, I mean, you know, both Tom and Mike spoke to the point about, you know, experience. And I think there's going to be operational benefits from storage that we don't see today.

Until we actually get the opportunity to demonstrate these technologies and let the operator see really what it can provide to their system, there's going to be other values that are going to be unlocked from storage that we don't know about today.

MR. MONTOYA: Yeah, and from Edison's perspective we think that storage is going to be a piece of going forward. To use one of Ed's examples on the basin, one of the things that we're thinking about is if you use storage where should it be. Just like Walt's point.

Because if you look at the Los Angeles Basin, you have about five or six plants in the basin that could go away because they're once-through. Most of the intermittent resources are going to be outside of the basin.

And so if you have the energy storage in the basin you're going to need transmission to be able to utilize that intermittent resource.

So I think the question will be is where can we optimize the storage, where should it be. So that we have, you know, proper system operations.

MR. GRAVELY: Let me augment this question a little bit. And that is given what we've heard today from the utilities and different operators, about everybody has got some type of storage project that they're looking at and increased their awareness.

If there isn't any kind of policy change where to you think we'll be in five years, you know, or ten years if we say, I mean, take the goal that Ed brought up of four megawatts, which works out to 5 percent of the estimated load. What I'm mentioning was 10 to 15 percent of the renewable load, which is a third of that.

So, those numbers are in the same ballpark; they're not radically different. And it's not a huge number like I've heard from other areas, where 50, 60, 70 percent of the renewable load.

But the question would be if we don't have policy in the next few years, do you see a substantial different in where we are today. Or there'll just be a few more demonstration projects in the field and we'll still be discussing this as to what we need for 2020, Any comment from anybody on that one?

MR. BIALEK: We look at, just looked at sort of where do we think some of the smart grid vision is going; where do we see ourselves going down the road.

We recognize that if you really do expect to meet the AB-32 goals, as well as expect to meet 33 percent renewables by 2020, that we have to start sooner rather than later. It is a fairly daunting task. It's going to take time; it's going to take policy changes. None of that happens quickly.

And therefore, we believe that you are going to have to start -- we are going to have to start down the path as a state. And that policy changes are necessary.

MR. GRAVELY: Any other comments?

MR. CAZALET: I just think it's essential to get it into the utility procurement cycle just as soon as possible. Otherwise we'll be building, you know, they have to build to meet the load. And they'll be building more fossil plants to back it up. We're just digging ourselves in a deeper hole.

MR. MONTOYA: I guess, Mike, I would add that it depends on what you're utilizing the technology for. If it's for transmission, you know, to relieve the transmission or to upgrade the transmission, then it would be a grid asset versus a generation asset. So it just depends on what you're using it for, I think.

MR. RAWSON: That's an important point because, you know, when you start to have portfolio requirements around storage, for example, I mean the needs of the utilities across the state are very different. And I think it's more important to specify what the end objective is that needs to be met. And leave the utilities the flexibility to apply those technologies that help them get to that end point.

Whether it's a transmission and distribution issue that they need to address, that could be one technology solution versus something that's helping them firm renewables. Whether it's, you know, utility-scale renewable plants or customer-sited distributed renewable technology.

But if it's too prescriptive in terms of like a portfolio requirement that may not necessarily lead to the best technology being selected for the best application that's going to be the most cost effective in the interim -- in the end, to the ratepayers of each respective utility.

MR. JOHNSON: I think that's an interesting point. The philosophy behind, for instance, the choice that we have in looking at the constraints on the AS from the WECC rules, do we simply add other resource types to the list that can provide AS? Is it now become generation and load and storage and whatever?

Or do we take a different approach, which I think is where we're headed. And that's to step back and say, what's the functional requirement that we want. You know, we want this much energy on these kinds of ramp rates for this duration, you know.

And so that's why the characteristic, the electrical behavior of the resource, and leave it wide open what the technology is. That way it could be fit by a variety of different alternatives.

And I think that that -- our focus is on removing barriers. We're not in the business of incentivizing one technology over another, or one type of solution over another. But just leveling the playing field.

And I think that going back to sort of the principles that are the reason for why we're specifying these kinds of capabilities. And what we want from the resource, rather than what the resource type has to be, or anything more specific than that, is a philosophical position that I think we're likely to be moving forward with in our barrier-removal kind of initiatives.

MR. GRAVELY: Okay.

MR. FIORAVANTI: I also think some of the roadmapping is important because when you start looking at this being applied to an issue, a particular issue. We're also talking about there's multiple revenue streams and multiple benefits to get out of that.

It's hard to get a developer that's assigning it to one task to fully utilize that. To get that holistic point of view, when he's just really trying to solve a problem. He or she is just trying to get them to solve a problem.

So in some ways, I think that overall guidance of how we can utilize that more generally, as well, to tap into that resource. I think it's important that, you know, that's why I think the roadmap could come in and lay on top of that. Because you just may get components out there that may not be fully utilized or taken advantage of to its fullest.

MR. GRAVELY: One last question. I will

take a chance and throw it out for about ten minutes for the audience if they want to have questions, again because some of this panel won't be here in the afternoon.

And that is we have a rare opportunity right now, and that is with $4.5 billion for smart grid, the state of California's taken a very aggressive approach under the direction of our Governor, and we're trying to coordinate opportunities.

So the question I would have is if we were successful and able to attain a fair share or more of smart grid funding in according to the early announcement, energy storage is a big part of that. One of the areas they're looking to fund is energy storage utility-level projects.

And they're looking at demonstrations in the two- to five-year period. So, it's in line with what we've been talking about today.

So, is it possible that we have a substantial amount of success in the energy storage area from the stimulus package? And if it's so, what will we need to focus on to be able to do that?

So, is there a way to use this

opportunity we have in the next 90 days to bring this technology to a point where it's more involved in the 2020, more at the goals that Ed mentioned earlier. Are we still talking about maybe a poor kind of science project, not making that large leap into changing the mixture of 2020.

Anybody.

MR. RASTLER: Well, Mike, I just started to start this. I think there's a great opportunity to kick start some activities in this area. There's a number of technologies that can be applied, as I showed, both in the bulk area and in the distributed smart grid area.

And I think it would be a great opportunity, if the stakeholders in California could get alignment on a go-forward strategy here, to take advantage of this opportunity.

It's also, you know, -- I'm trying to figure out how to take advantage of the SGIP incentive right now. That's also a great opportunity. Because many of the IOUs in the state have end-users that are eligible. And $2 a watt is a pretty significant incentive for that.

So, anyone interested in that I'd be happy to talk to them later, but 5 million, that is much more attractive to go after.

MR. GRAVELY: Right, I would agree. Any other comments?

MR. MONTOYA: Yes, I think, you know, I mentioned it earlier. I think, you know, getting real-world experience on this technology is very important. And I think we'd be ready to do that.

A couple of things that would need to be changed. One is either the way the DOE allows money to be spent versus, you know, having the 50/50 allocation between their money and your other money. Or have some way to recover the costs in these projects. It would be an important factor to get.

MR. CAZALET: One thought along those lines. We could go to the Cal-ISO and to FERC and say, we want to put 50 percent of this demonstration project in the transmission ratebase.

You know, it's been a struggle to get LEAPS into that ratebase. But there's a change in attitude there. You have the leader of the demand response movement now the Chair at FERC. And that would spread the money all the way across California.

Alternatively you go to the PUC and say, okay, each of the utilities create a project for the appropriate percentage and we'll go through in the load-serving entities ratebase, or perhaps, you know, a distribution ratebase.

But, or you could split it. But I think you got to keep it simple. Probably the fastest one is to work through FERC and the ISO, because you're going to get a lot of federal support.

MR. GRAVELY: Okay, well, of course, one of the challenges is we haven't gotten firm guidance from DOE as what qualifies and how. It's possible --

MR. CAZALET: Sure.

MR. GRAVELY: -- I would agree with you it's possible with the accelerated interest you get potentially some type of special cases or pilot cases approved for these types of demos. So it's certainly worth considering.

MR. CAZALET: Yeah. And I think it's important not to think of this as a demo. But, you know, the first step to commercialization. Everybody's done demos. We want it -- it's really critical that the manufacturers see a path that they can invest in manufacturing capability, ramp up power electronics manufacturers, et cetera.

And if it's just a one-of demo, they lose money on every one of those. So, we need to have a plan that California signs up to and let the stimulus funds get it going.

MR. GRAVELY: Well, I would agree with, in certain scales. But I would say a utility scale, or a lot of companies that are interested in that market, that have not performed in that market, I think most people would like to see how well they perform before they would say they were ready for commercialization. I think most of them see it as a stepping stone.

So, for a few minutes here, go ahead -- mike doesn't work, so just come to the mike right here in the corner, if you don't mind, just so the people online can hear you, also. And then we'll try to answer a couple of questions. And then we'll break for lunch.

MR. WASHOM: Thank you, Mike. I'm Byron Washom from UC San Diego. I would just like to bring out a point that you raised, and Dan, as well, and that is DOE is talking about utility-scale projects. And we have interchangeably used that word with bulk.

And I think if you are interested in expanding the California opportunities under the stimulus package, we would look at utility-scale to include not only bulk, but also wholesale DG that has been discussed here this morning.

So, how low do you go with the definition of utility-scale will have a large impact on the amount of technologies, applications, demonstrations and projects that you could potentially have under the stimulus package.

MR. GRAVELY: I would agree with that. And, of course, again we don't have specific guidance, but there is also a smart grid demo that could include smaller scale storage. But, again, that's up to DOE.

And we have two of the California Commissioners are in Washington this week discussing with DOE those types of things, and encouraging them to come out with a definition that's broad enough for us to have this type of opportunity. Thank you.

Other questions from the field? Anybody have a question they want to ask? Go ahead, either mike. You can go to either mike here. Thank you, Byron.

MR. DUDNEY: I wanted to ask the group here about IOU procurement processes. In particular, I'm interested in the procurement policies and how they interact with the possibility of storage coming online. And is there anything in the current IOU RFOs that prevents storage? Are there -- if there was further detail about utility needs in terms of, as Walt mentioned, electrical characteristics, would that be a sufficient incentive to get storage bidding into those RFOs?

MR. GRAVELY: Could you identify yourself, just for the people in the audience and those online?

MR. DUDNEY: Sure, Kevin Dudney from the CPUC energy efficient.

MR. GRAVELY: And you want to address that?

MR. CAZALET: I'll speak from a party that's attempted to participate in RFOs with storage. And it's a major challenge. The whole, if you look at the PPA, they've got heat rates and gas prices and everything else under the sun. Their whole process is set up, at least for the all-source procurement, to work with fossil fuel plants.

Their models typically will look at on/off peak prices. You don't see any of the five-minutes. The ancillary services come bundled with the generation resource. In other words, if you sell a fossil fuel plant in there, they expect to get the ancillary services capability there. But it's never been separately evaluated.

So, if, for instance, you wanted a PPA for a lithium ion storage battery or flywheel to sell to a utility, there's nothing in that procurement process that would enable that at this time.

So, in the same way we break out renewables, I think we need to break out storage as a distinct procurement, because it is so very different.

And the same people, the people who know how to do the renewables or know how to do the analysis of the fossil plants, have to rethink how they do storage.

MR. JOHNSON: And that reminds me, one of the things we're doing with the next generation of the system is to shift from -- or to expand the resources that we can model from generation resources to demand resources, where you've mapped ramp rates to ability to get off the system, things like that.

In some sense, wouldn't the storage procurement be more analogous to a DR resource, in a sense?

MR. CAZALET: Well, you're right, --

MR. JOHNSON: And fit into those kinds of procurements more than the power procurements?

MR. CAZALET: Yeah, and we separately procure DR by quite a different process, yes.

And at a high level you say how much DR do we think we need, and can we afford it, is it cost effective when they go about procuring competitively. The whole industry's developed to provide DR with a lot of competition in that industry.

MR. JOHNSON: Right.

MR. CAZALET: I think the same thing can happen with storage.

MR. GRAVELY: Thank you. There are a couple of questions, just to wrap up, from the line I'll answer. One of them was addressing carbon footprints, which I think we'll discuss this afternoon in some of the discussions.

The other two were specific issues, more to the ISO and to EPRI. So I'll ask those before you leave in case you're not here.

So, Walt, the question is, is the WECC's reluctance to act on nongeneration asset policies affecting the implementation of the CA-ISO's energy storage pilot. If you don't want to answer that's up to you, but at least that's the question.

MR. JOHNSON: I can't say, to be precise. I'm not aware that it is, but I'm not particularly close to that. As I mentioned, we have another individual at the ISO, Dave Hawkins, who is really our lead on the storage and renewables integration activities and these pilots. And he would have to address that. So we're going to have to take that offline, I think.

MR. GRAVELY: Okay. And then the last question before we break for lunch is actually to EPRI. And it says: With regard to the stimulus dollars, aren't the EPRI compressed energy storage pilot projects ready to go currently looking for dollars?

So I guess the question is are you shovel-ready, I guess.

MR. RASTLER: Yes. Those compressed air projects are shovel-ready, they're ready to go. It would be great to have additional stimulus dollars to go with them. We do have at least ten utility organizations forming a collaborative to move those demonstrations forward.

So, with or without stimulus funding. But obviously stimulus funding would be great.

MR. GRAVELY: Okay, thank you.

So we're going to break for lunch from now till 1:30, for an hour. And in the afternoon we'll talk with some of the vendor manufacturer representatives.

And then we'll summarize and address what we think we can do from the policy side and the Commission side and the state side to help move forward.

Thank you all very much.

(Whereupon, at 12:29 p.m., the workshop was adjourned, to reconvene at 1:30 p.m., this same day.)

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AFTERNOON SESSION

1:35 p.m.

MR. GRAVELY: What I'll do is, would you just unmute everybody just for a second. We'll meet everybody real quick and see if there's any --

(Pause.)

MR. GRAVELY: Okay, we're going to start back in the afternoon. Again, we will have open public comment after this panel is over with. The panel will stick around to answer questions. And then we'll be also allowing everybody on the WebEx to participate.

In the interim if you have a question that comes up, I would encourage you to type it into the chat session. We have someone monitoring that. And then we'll bring that question up as we go.

And so we're going to start the afternoon session. In the morning session we focused primarily on the customers or the end-users or the utility requirement.

And so we all know and have discussed, there are many challenges to storage on meeting the needs of the future. And we're trying to understand that.

We're also trying to understand what we can do from policies and procedures and research programs to encourage more storage to be applied in California.

So we have a panel this afternoon of manufacturers and integrators and individuals that represent a series of storage manufacturers or companies.

And so we want to hear, I guess, the vendor manufacturing side. What does it take for them to be interested in California? What does it take for one of these systems to be put in?

And, again, we're focusing primarily on utility-scale systems today, as opposed to residential and home systems, even though we have hear later from ICE Energy, as I mentioned earlier, because they have received some incentives and they have received some legislative help. But, I -- maybe I'm wrong, but my perspective they haven't received the market acceptance that they anticipated on some incentives going.

So one of the questions we talk about this afternoon is what types of incentives would be productive in encouraging a larger penetration of storage to support us for the renewable portfolio standard of 2020.

Our first presenter today is going to be Charles Toca representing vanadium redox technology. This is obviously, there's some sense here that the presenters will give you a little bit of their technology overview and we will tolerate a little bit of that, but I'm trying to avoid too much of a sales pitch.

So, understanding the differences in the technologies, I think, is important. But also we want to get into the issue that's common to all technologies. And they all have a similar problem, and that is how to get paid for their system. How to do the business case to make it work. And how to value what they provide the grid and what they provide a utility and what the provide the customers.

So, Charles, I'll let you start us off here. I'll get your presentation here.

MR. TOCA: Mike, thanks for the chance to participate in this meeting. I won't do a sales pitch, but I think it is important to talk about the context in which I'm looking at this problem, which is, you know, how do we remove some of the barriers and get this into the system.

I don't know how you picked me to be first. There's people here that are much smarter than I am in explaining this, but I appreciate the opportunity.

If you listened in to this morning's session I think a lot of the issues were surfaced. I was very encouraged to hear about the buckets, bins and boxes that were discussed; the different advantages and uses of energy storage, and some of the barriers there.

I would like to touch shortly on the vanadium redox battery system, the current status of that technology. There's no point in talking about barriers to technology if we don't know what some of the technologies are. And then what I see as one of the issues that we could resolve.

Prudent Energy is the owner and vendor for the vanadium redox battery system. They are based in China and they are the global leader of this advanced energy storage system. This information here you have already in your handouts, as well.

It's well capitalized. The company is

very deep in terms of their technology and the staff they have available.

They purchased the VRB technology developed by VRB Power Systems in Canada. And that is a follow-on to all the work that was done by Sumitomo in Japan.

One of the real advantages now with this particular system and orientation is that we're able to bring low-cost manufacturing to the technology; it's fairly well developed.

Again, since merged companies, merged technologies, we have Regenesys, VRB Power, Sumitomo, 15 years of work on this particular technology. With low-cost manufacturing we think we'll be able to provide this technology in bulk. And some of the prices that we keep hearing are needed for this kind of technology.

A little background on the system. It's been around for a long time. The vanadium redox battery patent goes back to 1986. Been a lot of study done on this. We have systems already in place, including in the United States.

I think some of you have already seen this graph. In just a quick overview, the flow battery technology is different from your -- acid kind of technology. The electrolyte is stored in tanks. The tanks maintain the energy. If you want more energy storage you get bigger tanks for the electrolyte. The electrolyte in this system is a sulfuric acid with vanadium as the secret sauce, the magic ingredient. Provides you with electrolyte that never wears out. Has high residual value, very low maintenance, deep cycles.

The formula for this is shown at the bottom. You basically have identical tanks of electrolyte which just simply share electrons through a proton exchange membrane.

The key factors of this particular technology for looking at the barriers are the fact that you have two parts to this, which is the capacity and the storage, itself.

We have power cells through which the electrolyte flows. The more cells you put into your system, the greater capacity you have. The electrolyte in stored in tanks. The more electrolyte you have in tanks, the more storage you have.

So you got a 5 kilowatt system to a 10 megawatt system. You could have 15 minutes of energy storage to six, eight, ten hours of storage, depending upon how much electrolyte you have.

The original concept was to build it onsite using very large energy cells, 50 kilowatt energy cells, which are developed by Sumitomo. The last five or six years it's been a change. Now they're built in a modular fashion using small energy cells; 5 kilowatt systems that are mounted into racks, can be loaded into a container and delivered to the site.

The original application, the biggest application for the system was at windfarms. You can take a look at this picture here. This is a four megawatt system at a windfarm in Japan. It's over three years old, in operation. They've had 270,000 cycles in the last three years of balancing the wind.

If you want bulk storage in the range of 20 megawatts just picture four of those buildings at your site, at your windfarm site. It's easy to see how that could be accomplished.

And it's been used there for wind output smoothing. This is a day in the life of a windfarm. The blue line is the charging and discharging of the battery to match the generation and lack of generation from the wind turbine at the top, which is the green line.

Again, the purpose of this particular application was not peak shifting, but simply smoothing out of the power. The sizing of this was about 20 percent of the wind farm's capacity, which keeps the cost down for this particular application.

You can see during the course of the day the battery matches, kind of in mirror image, the generation of the turbine providing you with a nice smooth output at the very top.

So that's the information about the system. Happy to explain more of that if anybody has any more questions about the system.

But I want to talk about, from my viewpoint, how bulk storage is like an elephant. This goes back to the boxes, bins and buckets we've been talking about today.

Energy storage is a lot of things. What I keep hearing from, I think, many of the companies that would be interesting in taking on the technology, is they seem to look at it in one dimension. Sort of like the proverbial blind man coming across the elephant.

They see it as either, an elephant's either a rope or it's a tree, or it's a shield, it's a spear. They see energy storage the same way, you know. It's transmission, it's VAR support; no, it's a peaking generator; no, it's demand response.

How can we, you know, can we push this energy storage in. And, in fact, it's a very very large neat system that does a lot of neat things.

So, my challenge in being able to present this and to find places to put this system in is finding the value stream that would pay for the system. You're going to hear this again from other folks here on the panel. You heard it all this morning.

You know, we've looked at the Cal-ISO ancillary services markets, -- regulation, spinning reserve, energy markets, capacity benefits

Utilities, it can be used for demand response. You know, it's great for TOU rates for price arbitrage. Could be used as a peaker plant, you know, on and on and on.

The problem is that f you want to put the energy storage in one of these applications it's pretty much a merchant plant operation. You have to say, well, yeah, there's value there; and, yeah, we can make money doing this energy storage plant, but, you know, you really can't count on that in terms of a string of revenue that you can monetize and take to your investors.

So, we've always felt -- I've always felt that a contracted service would be easier to finance than a merchant plant. If you want to deploy these systems we need to be able to show an investor a return for their money. A merchant plant is tough to finance.

So, here's an idea. We've already talked about this this morning. We'll talk about it some more as the day goes on, but you know, why don't we have a system or opportunity for the utilities to contract for power and services.

Now, we have contracts for biomass plants; we have contracts for energy from renewables. You know, why not a contract some of the services that an energy storage plant can provide. And pick one of these items. Pick peaking, you know; pick ancillary services, I don't care. Leave it technology neutral.

If the utility would say, look, I don't

care if it's a biomass plant, I don't care if it's a wind turbine, I don't care if it's an energy storage plant, we are already paying costs for peaking, we're already paying costs for ancillary services.

Let's have someone respond to an RFP; give us their best price for ancillary services within the next five to ten years; and sign a contract with that resource.

If the resource happens to be energy storage, great. The advantage to that is if you monetize one part of the elephant, say the ancillary services part, you're going to get more elephants.

Now you can actually go out there and get financing for a large plant, which means you can get financing for a second plant and a third plant. And once you've got more of those elephants out there, now you get more of the elephant benefits.

Just one quick example here. Frequency regulation, Cal-ISO makes the information on frequency regulation public, it's not a secret. The utilities are all incurring costs for frequency regulation ancillary services.

If you would do a long-term contract with bulk storage you have now contained your cost, because almost all the cost of bulk storage is capital expense.

Now the storage facility, like a generator, can go to the markets. And with this agreement they get financed and installed. And quickly. We don't have to worry about all the studies and this sort of thing. The entrepreneur can take the risk; do the creative thinking; go out there and find the investment and get the energy storage installed.

Now, once it's installed and providing services to the utility that contracted for it, it's also able to do all the other things that we know energy storage can do. For example, providing fast ramps, wind smoothing.

If we put one of these at a windfarm for ancillary services we could also provide smoothing, as well.

Reactive power; voltage support; peaking power when needed; emergency power; black start. We can build these things, -- the only builder that can do this. We can build these in 5 to 20 megawatt distributed systems. Be easy to get 120 megawatts out of our particular application in two to three years.

So this is just an idea. It's one of those we've floated before. I appreciate Ed Cazalet's suggestion which I think really crystallized the idea of having an RPS goal. The technology is there; the technology is available. We just need to find a way to monetize some of the benefits so the investors can pay for it.

And let the utilities keep working on their projects, but leave this as an opportunity also for fairly rapid installation of these kinds of technologies.

So, where do you want to start? Which part of the elephant do you want to take on first?

Thanks.

MR. GRAVELY: Since we're having a panel there will be time for questions as we go through. So we'll go ahead and cover the presentations.

I will point out that we have two individuals already who have requested, during the public session, to make a short presentation and provide information.

So, if anybody in the audience wants to present during the public session, other than just a question-and-answer period, please bring your blue card.

There are blue cards in the back there. If you'll fill one of those out and bring them here to Brian, we will get you at the podium here. And then later in the afternoon we'll be just using the mike, or using one of the speakerphones for questions and answers from them.

I'd now like to go to our next speaker. I think most people in the industry understand that sodium sulfur batteries have the largest concentration in the world of systems, and the largest systems operating.

And so Harold is going to come talk to us today about his involvement from the U.S. side with that, and then some experiences they've had, which are very relevant, I think, in both installing and operating utility-level systems.

And then also some of the ones that they thought would be installed and operating already that are still in the design or install phase. Harold.

MR. GOTSCHALL: Thank you, Mike. As Mike said, my name's Harold Gotschall, Technology Insights, here on behalf of NGK Insulators. And

I've been encouraged by all parties to move through this crisply.

I'm going to take you briefly through an overview here. Some 300 megawatts of NaS batteries have been deployed to date, nominally six to seven hours, yielding that output of about 2000 megawatt hours in the field.

In this country we've got nine megawatts operating. That would be four systems for American Electric Power, one each for eXcel and New York Power Authority.

The real focus of my comments today, though, as a fact that last year we had ten megawatts in queue that have been delayed from six months to a year. We would attribute to the U.S. regulatory issues.

And we're going to get to it in some detail, but it comes back to the vision of combining functions versus the reality in the regulatory world.

We also believe that this is not unique to sodium sulfur. This is an issue that would confront any, we believe, distributed energy storage system. And the candidates include our colleagues here at VRB, the other flow batteries and so forth. And possibly Case.

To that extent we believe these are barriers that deserve policy action in order to move toward California's RPS goals and smart grid -- excuse my voice.

Very briefly, so we're communicating about units here. The configuration on the top left is a one megawatt system, nominally rated at six megawatt hours per cycle, 300 cycles a year, 15 years. Footprint of three-by-ten meters, and about five meters high. So when I say a megawatt that's what I mean.

Quick timeline. Significant point on the origins. This technology is an outgrowth of a utility, Tokyo Electricity Power, who chose the electrochemistry 20-odd years ago. The initial target at that time was distributed energy storage.

By the late '90s a six megawatt unit had been installed in a substation for Tevco. Ten years later almost the first one megawatt unit was deployed in this country.

Part of the agony of this business is the very slow sales cycle. Very slow progress for market development, not only in the United States but also in Japan.

I'm going to now move forward to what I'm calling the barriers and issues component of this presentation. And I've coined some terminology here that I think is understood by everybody here.

It's the delineation between market services, those services which can be traded through an organized ISO market such as energy, ancillary services and so forth, and those services that I've called grid services. It relates to functions pertaining to feed reliability, upgrade and deferral and so forth.

What we found in these case studies I'm about to summarize was that the owners were prevented by regulations, if you will, from combining -- from accruing the benefits of the combined functions. And as I noted before, this would apply to other technologies of a similar type. That is megawatt scale, multi-hour.

In the spirit of political correctness I've now moved from NaS to DES for the benefit of, I think, communication here. Went through very quickly three case studies.

The first was a six megawatt unit

purchased by a California IOU. That has been delayed for about a year.

The second is a four megawatt unit that is in the process of procurement by a Texas utility. It has been delayed about six months.

And the third is an experience by an independent storage developer. In which case the developer found that the IOU that was evaluating the RFO, request for offer, was not prepared to consider the combination of benefits.

Now, this slide gets a bit tedious, so very briefly, about a year ago, first of February, the California IOU purchased a NaS system. Weeks, actually less than two, before they were scheduled to be shipped from Japan we received the advice that the California utility was facing the challenge of establishing the precedent for battery energy storage system as a transmission asset recoverable in the transmission access charge.

Now, understand, as a vendor we're kind of looking through a foggy keyhole here to understand what that meant. The closest we could come is the second statement attributed to a FERC ruling on another storage technology which held that that asset may not be operated and/or managed by the California Independent System Operator Corporation. That means they can't participate in the market, I think. Or functionalized as transmission for rate recovery purposes. That means they can't take advantage of the asset from the standpoint of reliability or of -- deferral, I think.

That has led to a delay of that project. And right now it's still in planning as far as what the next step may be.

Second case. A Texas IOU T&D company received ERCOT approval for a four megawatt installation for the purposes of reliability. The point here is that there was never a part of the application that was looking for market services.

Nonetheless, the ERCOT review process resulted in a situation where the market participants, that's IPPs in the ERCOT world, filed objections. And the underlying part of that statement held that they thought it was inappropriate for the IOU T&D company to effectively take ownership while it is stored in the battery.

So we're back to this separation of

generation and transmission, and whether that control of energy is appropriate for the T&D company. Same as the previous point, I think.

Now, the policy part of that is we have very recently learned that the, after being referred to the PUC, the Texas PUC, that they have agreed that the initial project can proceed, after a six-month delay, for the purposes of grid functions.

The third case pertains to an independent storage developer. This is the storage counterpart of an IPP in our frame of reference.

In this case the developer was responding to a California IOU RFO; based the proposal on combined market and grid services. Went through an extensive evaluation process basically to learn at the end of it that the IOU was really only in a position equipped, if you will, to allow for values on the market side.

In other words, the grid services, the increased bid -- reliability, or T&D deferral, were not accepted.

So, in summary, what we're taking out of this is that in case one, FERC appears to be denying both market and grid services to a T utility owner.

In case two, the reviewers, in this case Texas PUC, agreed to the use of the storage asset for the purposes of reliability. The market question was not addressed.

And in case three, we found, again, where storage could be accepted from the standpoint of the market side, but the grid side was ignored.

I think I'll pause here just to make an observation gained this morning. And I'll attribute it to Ed Cazalet. His points on the need for a change of way of doing business, RPS, is the mechanism that you all heard him describe.

It's a way that may be necessary, if you will, to change the culture for the consideration of storage. And I put that out as a personal commendation to Ed on one hand, and on the insight I think I've come to here today.

The following chart I've tried to represent here first the three cases illustrated in the boxes that we have explored market channels; and the obstacles that we encountered in each of those cases.

In other words, we've been in the top left, case one with a T utility in California. Case two, a T&D utility in Texas. And case three, an IPP equivalent. In other words, an unregulated market participant.

Now, the question of where does all of this take us as far as RPS goals in California. The implementation of the smart grid is a very real need to open these market channels so that the owner, whoever it is, can accrue combined functions from the asset.

The point here is, I think, obvious to us all. We are talking about new tools and new markets, and we're dealing with a regulatory structure that's firmly rooted in generation. And firmly rooted in a distinct separation between generation and T&D functions.

So the appeal here is for groups like this to initiate policy action. And we really don't have the capability to give much advice in that area. But as an opinion, I think doing business as usual you're going to get the same answers.

We have to get to the point where planners can routinely evaluate the benefits of those combined functions.

Real quickly, responding again to some of the questions that were in the CEC notice, the locational benefits, we believe, for a distributed energy storage technology like NaS is proximate to load, equipped to deal with the renewables time shifts, particularly wind. Doesn't matter where you are on the grid. Offpeak wind generation can be stored and discharged during peak demand period.

The other key point in terms of locating proximate to the load is we gain the benefit of charging the battery during the offpeak period, of taking load off of the T&D assets.

And the third point of locating it proximate to the critical load and the customer is his enhanced reliability. And accruing those benefits is essential for most of these technologies to make economic sense.

Final slide. Most of the timelines that envision smart grid include storage. And I've circled here the ones that to me are obvious applications. And they all appear early.

From our experience, both here and in Japan, if you want storage to be deployed in four or five years you'd better start now. Because there is this institutional learning process of what can it do, and how does it fit into the system.

Second point is none of us started in this business to sell one megawatt or two megawatt units. We need to be working in networks of tens and hundreds of megawatts.

So part of this scale-up has got to take that next step before this will become a meaningful option for T&D planners.

Any questions? Take them now or take them later.

MR. GRAVELY: I'm going to take questions when the panel is done. Thank you very much. It was a very good job of helping us understand the issues that you're facing.

And I will mention for those that aren't aware, that the Energy Commission, through the Public Interest Energy Research program has been involved in many of these technologies. And there is information, for those that are interested, on our website. And also through contacting our office on some of those projects that we're doing.

One of the reasons we're so active is

we've been involved for the last five years in these technologies, and we are seeing firsthand some of the challenges, even though most of our focus in the past has been technical challenges.

Next speaker today will be Rob Parry representing the technology zinc bromine batteries.

MR. PARRY: Thank you very much, Mike, for the opportunity to be here and address this forum this afternoon. And I think we're starting to hear a similar message emerging from other energy storage developers.

ZBB is also a flow battery manufacturer. We are a U.S. corporation; we're based in Wisconsin. Our technology is a zinc bromine flow battery. We circulate electrolyte from two tanks through cell stacks. And our chemical reaction is a process of electrode plating. It's a zinc bromine electrolyte.

We have a building block of a 50 kilowatt hour module. We then package that into either a 50 kilowatt hour storage system, or a 500 kilowatt hour storage system. But structuring numbers of modules in series and parallel configuration. It is a modular transportable system for rapid deployment. And our market focus is on transmission and distribution network support, and primarily on the distribution side. We're down in the network distributed.

A couple of fellows that haven't come up there, renewable energy optimization, smart grid and electric vehicles. And I've got some slides that'll just elaborate on those.

For the transmission and distribution network support, the ability to mitigate congestion, deferring substation capex, expanditure when you've got a substation nearing its maximum capacity. Typically that the load at maximum capacity only occurs usually summertime here in California when everyone's got air conditioning on. But somewhere between 2 or 3 percent of the total asset utilization causes a hundred percent of that problem. It's a distributed -- a distributed resource out on the network, a peak shaving device, if you will.

For renewable energy it's really the ability to try and balance out the time differential between that period of generation to the period of maximum demand. I think everyone realizes 3:00 a.m. wind energy is really lost in terms of its value.

If we could use that energy at 2:00 p.m., 3:00 p.m., 4:00 p.m. in the afternoon that would be wonderful. We'd get much better value out of that wind energy. The problem being when it is hot is usually when the wind's not blowing.

And also the ability to smooth the delivery into the network by utilization of storage systems. A more levelized approach to taking out some of the spikes that we saw in the earlier graph. Use the energy storage system as a bank or a sink to absorb spikes and to fill in dips.

Smart grid is really going to require the use of an energy storage system to optimize all of these information devices and meters and opportunities that will arise through pricing policies. So we believe that the evolution of smart grid will depend on cost effective energy storage.

I mentioned electric vehicles. We don't see ourselves as being a drive mechanism for electric vehicles. What we do believe, however, is that these vehicles will require recharging at both ends of the journey, either at home or at work. Wherever that vehicle finishes, it will require some form of recharging.

When we go to an electric transportation system, which I believe we will in the future -- where that point might be, I'm not sure, but I think it's coming -- we're going to see some unique problems arising for our utilities when thousands upon thousands of electric and hybrid electric vehicles plug to the grid to recharge.

We believe a storage system, typically coupled with solar or other renewable assets, or even charged from the grid during offpeak hours will provide a recharge station at a domestic level, and also at a commercial/industrial level. And ZBB seeks to play into that market, as well.

So, coming to really the nexus of this discussion today is what are the challenges and what are the barriers that we see facing energy storage, and particularly ZBB's products.

Well, I think the words are different but the message is going to be the same as what we've just heard. We need to be able to recognize the complete value or the true value of the energy storage system to all of the beneficiaries in the chain from generation through transmission and distribution to the end-user.

We don't have an ability to aggregate the total benefit from the storage system. And when we come to looking at a return on investment for the person that's ultimately trying to put this storage device online, his benefit may only be part of the true story of storage. So we've got to find a way to be able to aggregate the benefits and get that benefit to the ultimate owner of the equipment.

Another challenge that we see is actually the acceptance of new technology solutions to replace existing and traditional methods. You know, we've got an infrastructure for our energy delivery, a transmission and distribution system that's being filled up over, you know, a hundred-odd years.

And it's still, today, operating like it was a hundred years ago, albeit that it's grown in size and the problem has compounded because of that. Until we actually get our utilities thinking about new solutions to existing problems I believe that, you know, that barrier is still going to be there.

Predictability. You know, one of the

things we've got with renewable energy is unpredictability as to its generating capabilities. Storage actually provides a predictability of being able to give energy when we need it. We need to be able to value that so that the cost of the equipment going in can earn its return. The investor can be repaid for the investment that he makes.

That predictability, if we can solve that, will go a long way to helping grid stability. Being able to make sure that renewable energy, at the time that it's generated, can be fed to the grid; or it can be held and fed to the grid when it's needed. So predictability and grid stability we see going hand in hand. They need to be recognized.

Regulatory measures. California is very proactive, and we're certainly aware of legislative measures that are going through the House at the moment. These sorts of measures are required. I don't think anyone sets out to build a business around rebates, but the rebates help defray the costs when we've got new technologies and new solutions coming to the market.

And, you know, we've seen it with solar, we've seen it with wind, and I think storage is on the same pathway. But still several years behind, where those renewable energies were in their development stream. So we do need some support along the line.

We also need what I call cultural change in our thinking and our acceptance. And we need to introduce this into our education systems. And we need to have this bold legislation that recognizes that these challenges exist.

In the area of smart grid, in the area of distributed energy storage, distributed resources versus the centralized platform, awareness programs to highlight the strengths and weaknesses of renewable energy and the possible solutions. And, again, from this panel's perspective, how energy storage fits into that marketplace.

We have RPS targets. You know, we hope to achieve 30 percent or 33 percent by 2020. But installed capacity, just installing renewable energy doesn't achieve those targets. We need to recognize the efficient use of that energy and the measure of when we've achieved that target really is are we using the energy that those assets can generate, or are we actually spilling it and losing it. So, storage really does create an efficiency for renewable energy. And we'll get our RPS targets, but it will take storage to help us along that way.

This final bullet point. Acceptance leads to volume. Acceptance of new solutions, the ability for utilities to invest in storage, or independent operators to invest in storage and earn a return, will also help to develop and sell more product. So, acceptance of the technology will lead to volume for manufacturers. Volume leads to cost reduction. Cost reduction benefits all.

In conclusion, I would like to acknowledge that ZBB has projects running in California. We are supported by the California Energy Commission. We've got a megawatt hour of system that's owned by the CEC. And we've run a program with PG&E over the previous summers.

We see this marketplace as being absolutely vital in our development. We think that California provides a great opportunity for job creation and education and penetration of this market with energy storage.

We are a member, a foundation member of a small group called the California Energy Storage Alliance. And we will hear from Janice Lin later in this presentation. So, Mike, thank you very much.

MR. GRAVELY: Thank you. Our next speaker today is coming --

(Pause.)

MR. GRAVELY: So while we're doing that we'll hear from the next two speakers, and like we had before I want to have a discussion period with the panel members primarily, and then a chance for the audience to ask questions of panel members in a general discussion.

And then we'll go into the open presentation, open discussion session. So we will -- that'll be pretty much the way we'll flow the afternoon discussions.

(Pause.)

MR. LYONS: Well, Mike, while that's loading I can --

MR. GRAVELY: Yeah, go ahead and make some introductory comments. We'll get that started.

MR. LYONS: Tell a short story. Mike,

he threatened me; he said, you absolutely cannot make a sales pitch at this thing. So I took him very literally and I expunged any reference at all to flywheels in my presentation.

And now I'm beginning to feel a little cheated in that. So I thought it was --

MR. GRAVELY: Bring out some pictures of our projects we did with --

MR. LYONS: There we go. I thought I might start off by at least telling you, you probably know what a flywheel is, but just in case, it's a type of mechanical battery that stores energy inertially in a rotating mass.

And in our case the flywheels are very big. They're about seven feet tall and about three feet wide. They operate on a speed range between 8000 and 16,000 rpm.

The spinning part is made out of high tensile strength carbon composites, and glass, oddly enough. It's all kind of glued together with epoxy. And the whole thing is levitated on an electromagnetic bearing. And it's in a vacuum, a very high vacuum.

So it's a very interesting piece of technology. It kind of brings out anybody's inner geek, you know, for sure. So that's what a flywheel is.

MR. GRAVELY: Could you check, because that mike is a little -- try and get closer to the mike, or bring it up higher.

MR. LYONS: Okay, I'll try to get closer.

In our case we put -- not working --

(Pause.)

MR. GRAVELY: It should work now; let's try it again. There you go.

MR. LYONS: Not only did Mike threaten me, now he's sabotaged my presentation.

(Laughter.)

MR. LYONS: So, thank you, Mike. Again, I took a very literal interpretation so actually kind of wrote the questions down that Mike sent.

And I guess -- I've got 14 slides, but this kind of summarizes all 14. And the most important constraint for us in terms of going to scale in California is that California ISO needs to go ahead and comply with FERC order 890.

FERC has basically ordered all the ISOs to allow so-called nongenerating resources into the regulation market. A number have complied.

And, you know, just say that after a really brilliant start of the California ISO and also the Commission and the Department of Energy and NYSERTA (phonetic), all participated in a couple of live demonstrations of the technology.

In this case one was on PG&E. Operated for a year and a half. Worked tremendously well. California ISO actually went so far as to certify that the technology was ready to go.

And they weren't wrong in that. It's now operating commercially in ISO New England. And just a little jump ahead, you know, again if these other ISOs can do it, certainly California ISO can finish what it helped to start.

But New York ISO has filed its tariff which specifically is built around energy storage. And this includes fast regulation, batteries and flywheels.

ISO has its pilot working. What am I missing here -- and Midwest ISO actually filed the world's first energy storage tariff for frequency regulation.

So, at this point it's time for California ISO to catch up. Just kind of throw that challenge out there.

Certainly we hear about software is also a constraint. You know, it's not like searching for perpetual life. You just kind of rewrite it and it works. So that's a constraint that I kind of think we can get done.

Someone mentioned earlier lack of long-term contracts. That certainly would help any of this technology get paid for. Charlie, I think it was you that mentioned that. It's a very very good point.

Because we have kind of chopped up the utility industry, this is harder to do now. But maybe we should be rethinking about this whole thing. It is very capital intensive, but it has almost no variable costs.

Lack of project financing, either limited or nonrecourse. In case anybody hasn't noticed, the capital markets have pretty much collapsed globally. So not only is there no project financing, there's basically no equity financing.

So in our case we're able to build this year another five or six megawatts off of our balance sheet, but that's pretty much going to be it until we hopefully get the DOE loan guarantee.

So something that addresses that, you know, we could talk about all these other things till the cows come home, but unless we get the basic capital markets fixed or find some other device to capitalize this capital-intensive gear, not going to happen.

If you're a practitioner, you know, when you really get into building it you try to figure out what kind of tax treatment it's going to get. It's a labyrinth out there. There are more "Catch-22s" in the tax code than you can possibly imagine.

I'd like to just say that storage should get basically the same stuff that wind and solar is getting. Wind and solar has a five-year makers depreciation. Storage should certainly get that, because it enables both of those. It doesn't, it gets seven year, because it's undefined in the tax code.

And probably everybody's going to sleep already, but you'd be amazed at how important this is.

Also in the stimulus bill there's a 30 percent investment tax credit for, again, our friends wind and solar. There's no such thing for energy storage. Why not? You know, we're trying -- on a federal level we're trying to really promote this stuff. Is it really that hard to convert national policy into the tax code? Apparently it is. Okay, but this is something that even the Commission could perhaps help out on.

And then again, lack of subsidies for initial large-scale commercial projects. A lot of incredible technologies, nuclear being one, had some subsidies in the beginning to help get it going. That would help here, too.

We know that storage reduces systemwide regulation capacity, or at least a study has been done that talks about that happening. We know that it can double as a ramping resource and we know that it uses a lot less fuel. When you burn fuel you make CO2, so it's a much lower CO2 kind of thing.

The study that I'm referring to in terms of regulation effectiveness, you've heard several presenters talk about the 2X effect; how fast-response energy storage, on average it's like two times as effective as slower fossil.

In fact, it depends upon the technology

that you're talking about. If you're talking about combined cycle versus fast-response storage, or steam turbine, it's 17 to 15 times better. This 2X effect is actually the average portfolio, regulation portfolio, in California, which includes fast hydro.

So it's even more -- it's even much better, you know, than it's being represented. And I recommend this study to you. You can go to the slide, and at the footnote you can see it. It's all there in black and white.

So what else can storage do? Fast-response storage can certainly do frequency response reserve. So, if there's a contingency event, the squirrel gets vaporized and a whole transmission line goes down, fast-response storage can immediately throw everything it's got within a second or so to help support the grid. Doesn't need any additional technology development.

It can also do VAR control since it's inverter-based. And it can do something called angular stability control. It's a very nice application. It has the potential to help prevent a wide area blackout.

So, mentioned that it can lower the

capacity requirement for regulation by 40 percent. And obviously costs.

I'm going to kind of jump through this to this important slide. This is the CO2 reduction. And compared to gas caseload, fast response included, again, batteries and flywheels, would only have about half of the CO2 footprint. Compared to coal, it would only have about one-fifth. In other words, 80 percent reduction in CO2. You know, why aren't we doing this? I mean it just makes sense.

It doesn't really make sense to throttle these big thermal plants up and down like they were little toy cars. You know, that's not what they are. And when you do that you really hurt the heat rate; it's much less efficient. We should be doing it in a different way.

You know, the question was posed do intermittent resources actually increase the need for regulation in ramping. This is California ISO's own study that says that it does. In fact, there were two studies, one in the blue, the smaller bars to the left of each of the kind of yellow gold bars. That's an old study. And then they updated it and said, you know what, we're going to need a whole lot more regulation. And this is just part way to RPS goals.

So, gosh, this is a very tedious slide, all kinds of things. Where should you put this stuff? It's probably a good idea to put it near wind, because then you could reduce some of the local variability. And you wouldn't have to send power over the transmission lines.

Probably makes a lot of sense to put most of the resources instate. That way it helps keep the grid from becoming unzipped, you know, during local constraints.

If you put a good part of it out of state, and actually that's the case today, the grid is much more susceptible to that kind of disruption.

So a little bit about the costs. I saw some costs that Dan had up earlier. They're actually too high for this technology. All of our stuff is pretty public because we've gotten a lot of help from the Commission and DOE and others.

So today our costs are on the order of $2500 to $3000 per kilowatt capital costs. And that's just not the stuff, the gear, it's the transformers to hook it into 110 or 115 line; it's the land; it's everything, you know, on that.

In terms of revenues, it'll make $8- to $10 million a year in regulation. Low variable costs, 20 to 25 percent.

Again, there's the reference to the effectiveness and the CO2 reduction.

So, challenges. We've heard a number of people talk about figuring out how do you monetize these different effects, these different benefits.

First, with respect to fast regulation, you don't need to monetize two or three. You can make it all on the back of one. However, there are these other macro benefits.

And I agree that what we should really do is just put some social policy into place that recognizes the complexity of figuring out what the costs and benefits are, and just deploy some of this. It just makes sense to do that.

Specific incentive ideas. First at the state level, it would be great if the Commission could help us, at least for awhile, not have to pay sales tax on components that are used to build up these projects.

Again, there's a state income tax, so why not have a state depreciation schedule that's five-year makers. And why not go all the way and have a 20 percent investment tax credit? That would be a good thing. It's certainly been done before.

At the federal level, let's get parity with wind and solar. You know, it just makes sense. So here are the details on that.

Wind, right now, can convert its production tax credit into a check at its option just by applying to the Treasury. So that's a kind of a nice gimmick. We'd like to have the same thing.

And again, five-year makers depreciation. It's only fair that we get the same thing.

Some type of national facility for financing would be awfully good. Allowing utilities to ratebase it, as Harold said. He took us through some, a labyrinth of roadblocks there. Makes a great deal of sense.

And then making sure that the actual IRS tax code provides clear and unambiguous beneficial tax treatment. Storage should be identified in the tax code, not just for vehicle-to-grid, but for what it is that we're all doing.

This is very very important. You know, everybody likes to work on the problems that are kind of fun and sexy. Tax code is not fun and sexy. But, by gosh, it's awfully important when you're getting ready to build this stuff, as we are; it makes a real difference in terms of the economics.

In terms of additional research. I guess the first dash point here reinforces my attention to that one. Some study of the tax code. And specific legislative and regulatory language changes. Not blarney. Not, you know, cumbaya, everybody get together, yeah, we need to do this.

The way it's done is you come up with specific language that then drops into legislation. It's expensive to do, frankly. So, it would be helpful if we could get some help on that.

A summary of the existing studies. I've showed you some results that talk about 40 percent reduction of regulation, that talk about the 2X effect, the 17X effect. Let's do a summary of these things so that everybody believes. And if we need to, a new definitive study. That needs to convert so that when California ISO does finally complete its work, and it is, I believe it's going to do that, that it provides payments in proportion to the system benefits.

You know, if we provide something, and it has a 2X effect, what in the world is the rationale for getting paid 1X? It's much more capital intensive. And that 2X, we're maybe 1.5X, maybe we leave a little bit on the table. That is really a necessary ingredient to the whole thing.

And that's it. Thank you so much.

MR. GRAVELY: Thank you, Chet.

So as you've heard earlier, several of the storage organizations have gotten together and have formed an alliance. Janice has been working with it also. Janice, if you don't mind, since you're pretty familiar with it, you might cover, as we've brought up a couple times, what's in AB-44, and how it's supposed to help storage and what it could do.

Because one of the topics we're talking about is how we can help. So, legislations like that, that potentially could be modified or updated to be more helpful, would be useful in having those kind of discussions. Thank you.

So, Janice will be talking to us now.
MS. LIN: Thank you, Mike. Can everybody hear me?
MR. GRAVELY: Just speak close to the mike.
MS. LIN: Always have to adjust the podium for a short person in the crew here.
I'd like to thank the CEC and Mike specifically for allowing us to make some comments today. My name's Janice Lin and I'm the managing partner of Strategy and Consulting. We're a strategy advisory firm that focuses on clean energy. And we've been doing work in storage, largely VRB, over the last three years.
And most recently I cofounded with our attorney, Don Lidell, I think it's one of the first-ever advocacy groups for energy storage in this country. It's called the California Energy Storage Alliance.
We chose the name carefully and we focused on California particularly because of all the exciting things that are going on here. But the ultimate vision is to turn this Alliance into a real nonprofit that has legs in a lot of states all over the country, as well as a federal arm.

Organized not too differently from SEIA, Solar Energy Industries Association.

CESA, as I mentioned earlier, we're this advocacy group. We're representing a number of different energy storage stakeholders. These are the members today, which about everybody here is present except for Extreme Power who is based in Texas.

And our goal is to expand the role of energy storage technology, to promote the growth of renewable energy, and create a stable, more secure electric system.

We are initially focused on distributed systems, distributed applications. And I'll explain why in a second. And in particular, storage coupled with renewable energy and integrated into the smart grid.

And some of our current priorities and activities, as Mike mentioned, we're very heavily focused on legislation. There's a bill, AB-44, which was introduced in December of last year by Assemblymember Blakeslee. It's often referred to as storage omnibus legislation.

It does wonderful things. Assemblymember Blakeslee extremely familiar with this area. It provides incentives for utilities to deploy storage technologies at beneficial rate of return, much like how California treats renewable energy here.

It provides and encourages tariff design that recognizes the true generation and delivery cost of delivering energy onpeak. And it is exploring, amongst other things, incentives for storage through the California Public Utilities Commission. If anybody wants to talk to me after the fact, I'm happy to do so offline. We could probably spend an hour just on that.

Other activities that we're involved with at the PUC include the implementation of existing incentives for storage. There's a $2 per watt incentive available today through the self-generation incentive program for storage coupled with eligible technologies, namely wind and fuel cells.

We are an active party to the DG cost/benefit methodology. And we're advocating that storage be included as part of that. And rather than looking at DG, consider distributed energy resources.

And we're also a party to the smart grid

OIR.

The last thing I wanted to mention about CESA is that we are technology neutral. There's a number of manufacturers represented here, and systems integrator, Chevron Energy Solutions. But we don't endorse or promote any one particular kind of technology.

Okay. So why distributed applications? I'm sure you've heard again and again from many speakers today the various benefits of storage. And one thing that I wanted to emphasize here is that distributed applications offer the potential to capture the greatest number of value streams, and are well suited for commercially available technologies today.

There's a whole plethora of different technologies. And many of the new entrants are entering in a small scale. I say small scale, sub 5 megawatts. Some of them are actually quite large.

And the other advantage of distributed applications that can be sited close to the load or even behind the meter is for their deployment you can leverage the customers' investment. So it's not just purely a rate-based solution, you're leveraging the investment of a particular customer who values some of these other value streams here on the customer side emergency backup, the ability to have greater reliability and so forth.

The other benefit of storage that I just wanted to emphasize here is that storage really does accelerate a whole bunch of benefits for society at large. It will definitely help accelerate the deployment of renewables. It can do so with fewer emissions. Create a healthier climate, create tons of jobs because we all know these things needed to be sited right here in California.

And energy storage, one of the reasons you see storage in all of the smart grid visions, as part of different state and national energy policy, is that it's a really key component to improving grid reliability and security.

One of their -- couple other points about distributed storage is that the smaller systems open up the potential for many different business models and ownership models. That's something else that was covered in AB-44. It's an explicit acknowledgement that this technology can be deployed as part of a utility system, owned by customers or third parties.

And was mentioned earlier, storage has the ability, when combined with renewables, to create dispatchable renewables.

Okay. So, if there's one thing that I hope everybody might take home from -- take away from our comments today is that small distributed systems can have a grid scale impact.

You know, utility scale doesn't necessarily mean big. And we've tried to show that here. This is a diagram that just shows conceptually storage can be sited at a substation, or it can be sited at the residential level, commercial and industrial.

In either of these scenarios the storage could be utility owned, it could be customer owned, or it could be third-party owned.

For example, I think some of the concepts that were presented by Charles and others was that, hey, there could be a third-party-owned system that sells services sited on utility land, and the services are sold back to the utility. So there's lots of degrees of freedom and lots of room for innovation.

The other point of this slide, and I'll

credit Dan Rastler back there at EPRI, this is a chart that EPRI put together a couple of years ago. This is what we call a day in the life of Cal-ISO.

A summer day. This black dotted line is the peak demand of the entire system. This blue line is what would result after the full implementation of the California Solar Initiative. So 3000 megawatts.

One thing you may notice here is that about 5:00 in the evening there's still quite a hefty peak. So what Dan's group did, they said, hmm, let's do a what-if. What would the load shape look like if we installed five kilowatt hours of storage for each kW of installed solar.

What it would do, it would raise your demand at night, so you'd have a higher, better load factor at night. And would completely clip the peak. And, you know, you could almost imagine lots of little batteries being installed with solar all over the state. And that would be the impact. So, once again, small distributed systems can have a grid scale impact.

One of the questions of this workshop was what happens, how can storage accelerate or help out the achievement of the 2020 33 percent RPS target.

And these are just some of the quotes. I think that a lot of really smart scientists have done research on what are the consequences of high degree of renewable penetration, and high penetration means anything greater than 20 percent. And according to NREL and the Department of Energy and EPRI, the grid will experience some issues once we get into those kinds of penetration levels. I won't read the quotes here; you'll have that in your handout.

And so what we're advocating is that there is these issues. There's lots of different ways to integrate these renewables. A portfolio approach. Storage necessarily needs to be one of those solutions.

It'll probably be a mix, including load management and other solutions, but storage can and should be part of this.

So, final slide today. What's stopping storage today? Our barriers and recommendations. And many of these recommendations are some of the policies that we're advocating through CESA.

The punchline is that energy policy that supports energy storage will also, by definition, support California's RPS, will reduce peak load and also support national smart grid policy.

So, some of the barriers, cost or economics. There are, as you've heard today, this is just a small cross-section of some of the storage technologies that are deployed today.

Many systems have not achieved scale economies. NGK has made huge progress, but we only have nine megawatts installed in this country. Many more megawatts elsewhere. And I think California has been famous for adopting and commercializing and putting on the map a number of new technologies among renewables. I think it should be no different for storage.

In terms of the technologies there are many solutions, and we believe there's a role for just about all of these technologies in different applications.

Storage is one of those interesting technologies that has the potential to serve multiple different functions. You know, potentially you could have a battery that also provides emergency backup power and shaves peak, or participates in a dispatchable DR program.

And any time there's a technology that's tapping into different programs and different markets that haven't necessarily been so connected historically, that's really hard. It's super difficult to implement.

And then finally, on the regulatory and policy front, you've heard it again and again, a broken record, but it's really hard to aggregate the complete, all the value streams provided by storage.

I think there's an incorrect perception that storage is just a utility solution. It is a utility solution, but it can also be a solution that enters the market through other ownership models.

We have tariffs that don't reflect the true cost of producing and delivering power onpeak.

And then finally, storage, as I mentioned earlier, is one of those interesting technologies that has a role in a lot of different areas. In energy efficiency, demand response, renewables, smart grid. And I think now, with workshops like this, and some of the discussion at the PUC on the smart grid proceeding, that's all starting to come together, which is very exciting.

So, to address these barriers, some of our recommendations are, first of all, incentives. Incentives are a great way, in the near-term, and very quickly realigning those benefit streams in such a way so that it encourages adoption. So the entity that buys the equipment gets to enjoy some of the benefits that accrue to various other stakeholders in the system.

And on that note we're advocating that the self-generation incentive program be fully implemented. Right now it's limited to wind and solar. Wouldn't it be great if the self-generation incentive program could incentivize stand-alone applications of storage, as well as storage coupled with solar.

Secondly, AB-44 recommended for an increased rate of return for utility-owned storage. That would be a great way to encourage adoption from the utility set.

Next big group are, in general, policies that encourage the integration of storage with all the other energy policy priorities in the state under different ownership and business models. So all the things that we mentioned earlier.

And some of the ideas that are being tossed around, so we talked about tariff design. As storage becomes more and more prevalent with renewables we will need clarification on how net metering is to be treated. Or systems that are integrated with storage.

Any time there's distributed renewables, as will be incentivized through the feed-in tariff, there's a role for storage. And for storage to increase the value of those renewables. So increasing a cap on the feed-in tariff, and the potential for, again, hitting that 33 percent.

I think that it's pretty widely known that peak electricity, the generation and delivery of it consumes most of the cost of our electric system. So any incentives such as a multiplier, a three-to-one RPS multiplier for example, for renewable energy that's delivered onpeak, there's precedent for doing that for distributed renewables in other locations.

And finally, the name of the game is peak reduction. Wouldn't it be interesting to have a peak reduction standard say for state agency procurement.

Finally, this has been touched before,

but particularly through the support of PIER, there's a wonderful opportunity here for California to support PIER and California to support proposals for projects that are going for funding under the stimulus program here in California, to accelerate and increase the number of integrated demonstration projects that are out in the ground.

These are the first demonstrations for customers once you have the beach-head, then you have something to point to. And then you get volume. And as Rob said, with volume comes greater cost reduction and greater market penetration.

And then finally, wouldn't it be cool if California had an energy storage center of excellence. We have centers of excellence for energy efficiency, for lighting, for demand response. I think it would be pretty neat if California had that center for storage, because it is so central to many of our policies.

Thank you very much, and I'll take questions.

MR. GRAVELY: I will take a few seconds now for the room here. And I would request you just come to the mike up here, or up to here and talk.

If anybody has any questions for any of the panel members before we start, come forward and ask your question. And I have some questions for them to address, but I want to give a chance to the attendees to do it.

I think that mic works, but I'm not sure.

MR. JOHNSON: Just a question. This is Walt Johnson, Cal-ISO. It's a question related to the locational value question that you spoke to a little bit.

It would seem to me that depending fairly strongly on the service that you envision the storage providing whether or not, first, if you're firming wind, as was shown in the VRB installation, you put it right there at the windfarm; trying to act as some kind of a load-shifting resource, you put it, as was pointed out here, near the load.

Does this mean we have to have it on wheels? Or is there a compromise or, you know, just wondering how we might resolve that, or -- in terms of, different value depending on the actual function the storage is providing.

MR. LYONS: How about if I start and then I'll turn it over. Walt, you're absolutely right. That depends on the application whether or not there's a locational benefit.

For frequency regulation the practice is that there is no location benefit. If you're anywhere in the so-called balancing area and you inject or absorb energy, it impacts the frequency of the grid.

On a physics level there probably is a minor effect in that if you are close to certain perturbations you can kind of eliminate those at the source, and in effect, it's maybe in theory a little bit more efficient. But for the most part, it's location independent.

MR. GOTSCHALL: I'll offer a few comments from a distributed energy storage model that is nominally six hours. You're very correct from the stabilization of wind point of view.

In Japan JWD and NGK have a hybrid product for that purpose. And in that case the battery is located proximate to the wind.

In Japan the requirements that the utility impose on the generator is to stabilize wind before it is put on the grid. And that's because it is a long island nation. There's much less integration of other resources for stabilization.

Very different in this country. The so-called stabilization would be market procurement services, regulation control, load following, et cetera.

For the most part it doesn't matter where. The storage asset is on the grid. For that reason we recommend to NGK for the U.S. market that the location should be targeted proximate to the critical load or substation. That lets us capture the benefit of time shift, capture the benefit of T&D, if you will, load shaving, peak shaving.

In other words, you're saving investment on the grid system as well as the benefit of renewables time shifting.

MR. TOCA: I would just add, in terms of the location, that here again it goes to the application. The VRB system was established at a windfarm in Japan. It seems to make just total sense to do that. Because now instead of having this choppy wind going out in the system, you've got a very very smooth wind going out. It seems to make a lot of sense.

However, depending upon the application if you used it at a load center, as we're talking about just a second ago, if that's where the value is, you can place it there, as well.

One of the neat advantages of the energy storage technologies you see in front of you now is they can be placed either in very very large bulk systems or smaller distributed systems.

So, to me, it's a question of what it is you're trying to accomplish and where the value is. As a vendor, I will go wherever you want to determine the value is.

I've talked to engineers, of course, who believe in doing things logically and rationally, and they say you should put it here where the wind is. You should put it here where the load is.

The regulatory folks sometimes think a little differently. The political folks think differently, too. So, I think location makes a lot of sense. And we just have to see how it all plays out.

MR. PARRY: I'd actually concur with those comments. Really, from the system developer's point of view, we're guided by the end use of the customer. And if he wants it at his windfarm, that's where it's going to go.

MR. GOTSCHALL: I would add one other comment to your point on should we put it on wheels. And the answer would be ideally, yes. For the model I described, where we're trying to capture both the time shifting of generation, as well as the T&D reliability, we all know the grid is a dynamic machine. The points of critical reliability move with the changes of customers' load generation on the grid.

So it would be a very desirable quality for that storage system to be relocatable at three- to five-year increments or something like that.

MR. GRAVELY: Any other questions from the audience?

I just have a couple quick questions here. I'll bring up one of them here for the panel, in general. And that is there's been lots of discussion on carbon markets and carbon credits and carbon penalties.

Does the panel feel that if the carbon market matures that it will have a substantial impact on lowering the barrier for storage? Or will it impact the storage market at all? Anybody?

MR. LYONS: Maybe I could start. To the degree that it increases the cost of our more fossil fuel intensive competitors it'll increase our profit margin.

But it's a small effect. We've looked at it. It might help out by, say, a 5 percent factor.

You know, it's not going to really break down any doors --

MR. GRAVELY: It's not going to be game-changing like it is in other areas?

MR. LYONS: I don't think so.

MR. GRAVELY: Anybody else? Charles.

MR. TOCA: Yeah, I would just add one thing. I think Beacon and KEMA did some great research on how frequency regulation by fast responding storage can really reduce emissions.

I'd also point out some other points that were made, that Rob made with regard to spilling wind. It just seems to make sense, again, to integrate storage with renewable energy.

If you've got a solar field that's got

this crazy spiking going on, and you've got energy storage along with that, you now have a capacity, integrated storage at the solar field, integrated storage in wind, you've got a generating system that's just as good as a fossil fuel plant.

So instead of building all these turbines out there to backup or to replace -- I can't use the right word here -- to provide the capacity, you can provide that capacity with storage and a renewable energy system. And you don't have to then fire up these things to go.

So I think there's a multitude of areas where storage can really help reduce carbon.

MR. GOTSCHALL: I'd like to second Charles' comment, and again commend Beacon for their work on regulation control, which was a clear offset of fossil generation with storage.

Further to that, though, and more conceptually, any time storage can displace part-load operation on gas turbines, it will have an impact. It's roughly equivalent to the hybrid vehicle. Your engine turns off when you come to the stop sign.

And without any analysis, don't know how significant that might be, or what the storage might be worth.

MR. GRAVELY: Okay. One question I have for the panel here, as we get ready to shift to the public comments, would be we've discussed many different options. And there was a little variety by technology, what helps the most.

But if we could take away from this workshop three areas in your mind where you think we should summarize what the Commission could do, what the state could do, the policies that might make a difference, what would be your top three ways for this workshop to be most effective in bringing more storage to support the RPS?

So, from a perspective of policy or direction, -- we have a diverse group -- what would be the priority in your mind that would make the most difference.

Any one of you.

MR. LYONS: I'll start on that. First thing I would say, tariffs. It does no good unless the tariff allows you into the market.

And a process has been started. Again, California-ISO has been terrific on the front end. They've gotten a little bit lost in the middle. If you could help them kind of find their way through the woods. That's number one.

Number two is taxes. The tax incentives that solar and wind are getting, very very materially help the capital cost component. It's huge. And it's also a real pain to kind of try to figure it out. It does not happen automatically in any way, and there's no reason why we shouldn't have parity with that.

And I would say number three is going to be some form of project financing. Again, these things have almost no variable cost because they don't burn fuel. That's a terrific thing. That's where the carbon savings comes from, a tremendous goodness.

But they're very costly on the front end. So any kind of a facility that we could put in to frankly replace the missing private market, because make no mistake if you fixed everything else, but we don't fix the access to capital, we are on hold.

So those three things.

MR. GRAVELY: Thank you very much. Rob.

MR. PARRY: Mike, I've got three bullet points and two of them are probably close to being the same thing, being regulation and legislation.

Although regulation from the utility or the users' perspective, Legislation for the benefits that it can create in helping us put these technologies into the marketplace.

Education. I'm a firm believer that it's not this generation, it's the next generation and the generation after that that are going to make the biggest significant changes to our energy policies, to the way that we actually handle energy; create it, transmit it, distribute it and use it.

So we've really got to educate those people that are coming through behind us, and the generation that will follow them, and the one after that. But it's got to start somewhere. So it starts now, I think.

MR. GRAVELY: Good. Janice?

MS. LIN: My vote would be for more support for demonstration projects, near term. Having actual projects in the ground that you can go visit will do a lot to demonstrate that the technology works, that the value is achieved. You can view it, touch it.

Concurrently, the demonstration projects alone aren't enough. And incentive programs such as the self-generation incentive program, where it's sort of a first-come/first-served commercialization program; that was the original genesis of the solar market here in California. And that would be a great vehicle for storage. Build up the volume.

I think some of the credit market issues and the tax policy, we'll need to take care of that, too. I would agree with Chet. Some of the stimulus money going towards the commercialization and new technologies can help bridge some of that gap.

But you're still going to need to be able to point to a project that capture different value streams and PIER can go a long way to helping to insure those projects get in the ground.

And then, in terms of the policies, we listed several that we would recommend, but policies in particular that are appealing not only for the storage industry, but also utilities and all the other stakeholders, large energy users that we can build a coalition and really make them happen quickly.

MR. GRAVELY: Okay.

MR. GOTSCHALL: I'd take on the ownership issue first. The interim rules, perhaps. Perhaps flexibility that would enable the owner --

MR. GRAVELY: Would you speak to the mic, because this is being recorded. I don't think we can capture your notes in the transcript.

MR. GOTSCHALL: Certainly. As I said, I would take on the ownership issue first. There's the underlying principle that the owner, whoever it is, distribution, utility, IPP, or transmission utility should be able to accrue the benefits, combined benefits of the asset.

This might be an interim thing, but I think from a practical point of view of evolving regulations appropriate for the technology, you need to know that the tool does what you expect it to do. And then you build the roots.

The other important aspect of such a model is that it should be deployed in 50 to 100 megawatts. These one-of transitions where each one of them has to take on a set of regulatory barriers and find its way through it can't be done. It has to be done at a scale that can be incorporated into planning. And evolve in a way that that gets transferred into the education of the forward planning people. The next smart grid, or the next distribution system. So you're not re-inventing it on each transaction.

MR. TOCA: Charles Toca here. I would just echo everything that the panel's been saying in terms of the tariffs and the studies and these sorts of issues needing resolved.

I will say, add one more flavor to this, though. One advantage of storage is, because of all these buckets and benefits we have, is that, you know, creative clever people can find ways to fit into the buckets that exist right now.

I'll give an example of that with the Cal-ISO. We went to Cal-ISO and said, you know, look, our technology can act like a generator. If we can do all the things a generator can do, can we play in your game.

And we talked about demand response. And Cal-ISO said, well, yeah, if you can act like a generator then there's no reason why you can't play in the new market we're developing for demand response.

I think A123 and lithium ion batteries, too, are looking at partnering with generators and providing services, you know, from the generator side of things.

So I think there's areas where we could begin to expand and to deploy now. The number one problem that I see today is being able to monetize these benefits. If we can get a guaranteed or dependable stream of income for the services we provide, I think you would see deployment of these, as Chet was saying, you know, much faster.

Then as we're deploying those I would say yes, let's keep working on the tariffs, make sure there's no barriers there, make sure the regulatory issues are taken care of, also.

But, you know, for goodness sakes, you know, why can't we go ahead today and enter into contracts for the services of a storage system, services that we can provide today in different kinds of boxes. And just say, you know, let's do that.

MR. GRAVELY: Go ahead, Janice.

MS. LIN: I just had one more thought that relates to this. In particular, and there's a lot of talk about cost/benefit. And when it comes to storage I think it would be helpful to have guidance from the CEC that insures that the cost/benefit methodology that's used to evaluate storage looks at the full cost of peakers and, you know, the related T&D cost, so we're not only -- we're drawing the box sufficiently large. And that cost/benefit analysis is the foundation for further policy development.

MR. GRAVELY: Okay. One final question before we go to the other public discussion here then, and that would be in AB-44 there is a requirement for the CEC, the PUC -- or the PUC, with our help, to come up with a cost/benefit methodology. All of you have done business plans; all of you have done cost/benefit methodology.

I'm curious if you think that given where we are today that is a step that we can come up with? A good methodology? Or is it one that's going to require some pretty serious discussion to come up with a methodology that's, as Janice says, captures everything and represents everything.

We've mentioned already how difficult it is. It will be interesting from those of you that have spent time doing business cases for customers to say how close are we to coming to a cost/ benefit methodology that will help storage move forward.

Anybody.

MR. LYONS: I'll start, if I can. You know, when you start to talk about wide system impacts like reducing the amount of regulation capacity across the entire balancing areas by 40 percent, those are big models.

I know Pacific Northwest National Labs has something called grid lab D that they just completed, in an effort to be able to quickly model what's going on at a macro-grid level.

So, you know, are talking about the sophisticated end of cost/benefit analysis, no question. But that doesn't mean that we shouldn't engage, and it doesn't mean that we shouldn't come up with the best answers and take action on those, even though they are not as precise as they're going to be two years from now.

I think we know enough today, based upon the studies that have been done, to say, yeah, you know, the amount of goodness is terrific; let's deploy a certain amount.

And then we can empirically begin to calibrate on what all this stuff is. You know, this is one of these problems where if you have to define the location of every electron in the molecule, you're going to be here for a long time, you know, and we shouldn't do that. Okay.

In particular now when the country is facing all these challenges, we need to move forward on a lot of fronts expeditiously. And there's no reason why we shouldn't be doing our part, you know, to kind of stay locked up in bureaucracy and inaction, you know, year over year over year.

You know, it's not good. It's not patriotic.

(Laughter.)

MS. LIN: I don't know if you've seen the cost/benefit -- the proposed decision on the DG cost/benefit methodology. That's an impressive document. I mean there's a lot of really smart people that spent a lot of time thinking there's four different tests that go through, you know, vectors -- I mean literally everything.

And so in terms of advanced thinking and raw horsepower to do that, I think we have those abilities here in California, and then some. It's just a matter of framing the discussion appropriately for storage.

MR. GOTSCHALL: I may be on the other

end of this debate, more of an empiricist than a modeling proponent.

I would observe, though, we have worked with two major utilities. Each of those utilities, given the opportunity to spend some time modeling the benefit of storage on their grids, assuming that they could accrue the benefits, and a business case.

My point is it's there.

MR. GRAVELY: Okay. Very good. Okay, we have a few other speakers in the same area that have turned in cards and asked to speak. So I'll start off with Lon House if he's here. And he will give us a presentation on storage from using water for storage.

And then we have two other speakers that have already given us information. If you want to join us feel free to bring a blue card up here. And when we're done with these we'll have some open discussion.

MR. HOUSE: Well, good afternoon. I'm going to talk about something that we haven't talked about thus far, but I'm going to talk about water storage. And it's a little bit different than what you talked about, what you're thinking about.

Let me talk about the big projects that you're familiar with, the big pump storage facilities. And I'm not going to talk about some of the other big ones that are being planned, like the Lake Elsinore or the Livenhaven (phonetic) project.

What I'm going to talk about today is the smaller projects which, as you'll see, there's a tremendous amount of them. And generally they're under 10 megawatts.

All water agencies have some sort of storage in their system. And the storage is added to integrate with their system. It's not for electrical demand or demand reduction. And it is what -- you see them everywhere. They're these beige tanks that are sitting on the top of the hills in every city and every town throughout California.

They were built to optimize the operation of the water system. They are used to meet water demand, and smooth out water treatment. But they can be used to store energy. Anytime you have water and elevation, it's stored energy.

And there are several examples of these.

You can have them with hydroelectric generation. This is fairly rare. Calleguas has one that has pumps and generators, but those are vintages left over from the old QF contracts.

What's more common is water storage with just pumps, like treatment. I have an example of Eldorado. And then anytime they have groundwater storage, too. Remember, you're putting water in and then you're pumping it back out.

What I want to do is I want to go through, this is an example, this is Eldorado Hills, for you that are familiar with California, this is their fresh water system. It's not their wastewater system; it's not any other part. It's just one small isolated part.

And this was the heat storm we had several years ago. And I wanted to show you the operation. This starts on Saturday. But you can see this is the water treatment plant and this is the well water pumping out of Lake Folsom.

So, the first week what we did is we bid it as typical demand response, right. Shut everything off at noon and turn everything back on at 6:00 in the evening. And you can see, this is six hours grid, it's 2.5 megawatts, what happened every day during that week.

The next week has actually turned out to be a little more -- and you can see it's starting to deteriorate at the very end. But the next week actually turns out to be a lot more interesting because then what the ISO was concerned with is they were getting these drops and they were having additional problems.

So, look at what's happening here. So you can see that what we're doing is we're running not on these big blocks, but we're going in and out of water treatment and our pumping facilities. Okay.

Now, remember, these are only pumps; these are only energy users. If they were reversible pump turbines, what you would have down here in this area, is you would have generation coming out. But that's not the way of that.

So, what this is, this is one isolated system in one town in California and it's 2.5 megawatts. And you can see what's happening with the way this system is being operated.

Right now the water agencies in California dropped about 400 megawatts onpeak. Exiting facility reoperation such as what I was talking about in Eldorado, there's about 250 megawatts.

And the reason that this is so low is because there has not been the stability in demand response programs because we got to figure out, the water system, remember, these are integral to the water system, and if you want to use them in some other way rather than just using them to meet your water supply, you have to do a lot of figuring out how to, going in and coming out of your treatment facilities and your water supplies.

So that's why this number's about 250 megawatts. But this estimate's about -- there's another 500 to 750 megawatts of either adding new storage for energy production, which we have not added because it never would pay for itself; or taking what we're doing now, which is running -- we're taking pumps, pumping water up to a storage facility, and then having a pressure-reducing valve coming down as a generator.

If you change those and allow reversible pump turbines, you would get about 750 more megawatts.

I just put this up. This is the largest facility in California. This is 40 million gallon storage facility down in -- by Encinas. The advantage of this, this is a technology we all know about. We're very familiar with it; we've used it; we're working with it.

It's much less expensive than the other storage technologies that you're talking about. Particularly if you can take some of the cost of converting this from just a simple water storage facility to an energy responding facility, and allocate some of that money or some of the cost of that for the water system. Because it actually is helping out the water system.

These are located close to the load centers. All the water systems in California have storage. And these are right in the load centers. And it also will improve the water and the energy infrastructure.

The disadvantages is it's small. These are generally two, to the largest potential that I've seen, is a ten megawatt system.

For the existing systems, they are integral to the water system operations, so for most of the existing systems the energy guys can't have free rein on them, because they're receiving water from the water treatment facility, and they're sending water back out into the system.

And so the existing systems need changes in their operating protocols.

And the current economics are discouraging because, particularly because of the changes in demand response programs that have not made it worthwhile to change the operation of the system.

And the reason that reversible pump turbines are not put in is because they never pay for themselves. The generation never pays for itself because you're only using it for a few hours a day.

Okay, so there's some additional information. One of the things that I would like to see, one of the things I'd recommend the Energy Commission do, is look at what would happen, what changes are necessary in the operation of a water system if that storage facility is dedicated to ISO or some sort of energy control.

How quickly can the water storage respond? We've talked today about from full discharge to full load in a second. It's not going to happen with a water system. You've got a huge amount of inertia. You've got a huge amount of water that's going one direction. And stopping it, and sending it back the other direction has implications for the entire part of your system.

The economics of how to change your operational protocols. The water systems will need to know that if they're going to participate in something like this.

The economics of operation for energy rather than for water use. These were built for water. They're not built for energy.

And the economics of new construction. One thing that has not been done is none of these systems have been put in for energy production, alone. Because there's no -- just like everybody else was talking today, there's no opportunity to recover that money.

Okay, the conclusions. All these storage technologies are nice, but this is a simple, readily available energy storage technology that no money from the Energy Commission or from PIER funding has been dedicated to, to determine how, what the potential is and what needs to be done in order to get this operational.

We could 1000 megawatts. Generally

these could be added within a year. Almost all water systems have the existing land held in reserve for future storage facilities. They haven't built them because they're not warranted based upon the current operations of their system.

It's a proven technology. The locations are readily available. Locations are located next to the load centers. But there are some additional information that the water systems will need. You need to know what changes are necessary in the operation of your system to maintain the integrity of your system if you have part of it. Or an adjunct to it that's producing energy, it's used primarily for energy.

The economics of replacing pumps with reversible pump turbines. And the economics of a new construction for just completely for energy use.

Thank you.

MR. GRAVELY: Questions? Any questions at all? Okay, we'll take questions of the speaker while the speaker's at the podium.

MR. GRAY: Bill Gray from Velkess. When you say reversible pump turbines, are you referring to -- is the costs that you're referring to there associated with the pump, the mechanical pump? Or with the electric motor generator pump?

MR. HOUSE: It's with the electric motor generator. These systems currently have pumps available to them, because that's what we're using to pump up the hill to get the water into the storage.

What is lacking is the generating side on the other side. And as I said, with the once exception of Calleguas that I'm aware of, those dual-function motors would never pay for themselves because if you're only operating them three, five, six hours a day, you never can get enough energy out of that small hydro facility to warrant the capital investment.

MR. GRAVELY: Thank you, Lon. Our next speaker is Charles Vartanian from A123. And I believe he can share a little bit with us some of their challenges of providing ancillary services to the ISO, as a storage device.

MR. VARTANIAN: Thank you, Mike; and appreciate the chance to be added to today's dialogue. Came to last minute. Much appreciated.

A couple comments. I'm here to represent a proven technology, and I want to riff off of my colleagues here who have established a beach-head. Our flagship client is, basically they throw themselves on the barbed wire. They've leapt and are holding the first inland city.

We are connected, two megawatts today, our equipment is connected. Two megawatts today is able to go under ISO AGC control. There is no technical hurdle. It's a resource hurdle, it's not -- as soon as they dedicate the resources to do simple software changes, in my opinion, our client can get paid. Paid, that's the key thing, paid.

So, let me spin through this quick. But then I've got some comments on how the CEC can help.

There's storage that's been around for awhile. Tons of megawatts in Berlin. This is what's gone in in California. Once again, able to go under AGC control. My colleagues proved that they can go under ACE control. We can, as well.

When you're ready to pay for performance we'll go under ACE control, as soon as you're ready to pay.

We've got a real opportunity. The renewables issue, and this actually ties back to meeting the RPS, believe it or not. Today frequency regulation is really built around meeting a variable load.

That's utilities and the operators don't control the load. The load controls the load. Consumers do.

Now you got another variable out there, the supply side, the variable intermittence. It's really an opportunity for storage to shine.

So our flagship has had us develop this solution. And we worked with them to integrate it to the ISO grid for frequency regulation. Sixteen megawatts has been built to deploy to Chile to do frequency regulation and spinning reserves.

Here's another issue. I don't need new markets, I don't need new services. Now markets, now services.

Here's where we're getting to what the CEC can do. The functionality, what's nice, the Beacons, the specialty, you know, solving the frequency regulation puzzle, that is not a low technical hurdle. Once you get into frequency regulation you could extend that to numerous services. If all we were doing was diurnal shift, which has its place, and once again that's a now market, now service, just pay them now.

But frequency regulation takes a much more dynamic control technical capability. That extends to a number of other more dynamic controlling capabilities.

And here's a nice, pretty slide. Here's what we do. And there's the efficiencies gained.

Ultimate impact. All of these are the value of solving a very simple bureaucratic puzzle.

And here's our path -- another message I want to put out. All of our companies are too small and fragile, number one, to be fighting each other. Number two, alone we aren't going to be heard. This is a legacy industry, very large, very vested. And make big investments that they have to recover. We're not here to mess with that. But I think even to be heard we need to join together and maybe the CEC can be a clearinghouse for getting the right information to the right people.

Smart grid ready. I call this the smart green vision. We have the functionality, just point us at the right problem. Once again, there's a lot of focus on what can I do. I'd like to turn around that and you tell me what you need in performance metrics. Don't tell me that you need a generator to do ancillary services. That doesn't do either of us any good. Tell me what providing ancillary services mean in terms of a performance spec. Leave it to me to figure out. Leave it to my client to figure out how to get paid.

But, meeting these characteristics will facilitate higher renewable penetration success. And the stimulus bill, by pointing to the smart grid programs in the EISA 07, what more do we want.

It accelerates getting the solutions in the field. And the center of excellence, great idea. I would just recommend build it around equipment connected to the grid operating.

So a call to action. You know, use the stimulus to fund this development. And this is the key, existing advanced technology, that the advances are an application. And that doesn't need any technical breakthrough. You could use SCADA, you know, off-the-shelf command-and-control to do, quote, smart grid applications.

I do agree, modeling qualified impacts.

I've worked as a planner on the utility side. Unless it's simulated, they aren't going to connect it unless they've seen it proven in a simulation run, in the models and languages they understand. That isn't happening. Once again, it's collaboration.

Lower barriers. Two specific California opportunities on the policy side. You know, if you can make a policy statement that compensating bundled values, you know, bundling value for discrete services from a single project or a single source. Even if there was a policy statement that that was desirable. Maybe to give someone the impetus to allow resources to work on that, you know, CPUC Staff level.

State as a policy, that California has proven that frequency regulation capacity actually is critical to delivering renewable resources, critical to the grid delivering renewable resources.

I believe the stimulus launching just does allow ITC for the manufacture of energy storage if that energy storage is facilitating the grid's ability to deliver renewable energy. If anyone questions that, please, I will cut-andpaste right out of the stimulus language that passage.

So it would help us if California established it through studies, frequency regulation capacity facilitates the grid's ability to deliver renewables. And that should qualify me. You saying that would be a lot more impressive than A123, or any of us individually. CESA might have a little bit more weight than any one of us.

So those are two items in identifying the value or the need to compensate for bundled services. And in particular, in California, in the market you can do frequency regulation. But you can't sell VARs. Unique to the ISOs.

Well, since there's such a bright line, why not allow the VARs to be sold to the TND? So I think that's even a test case that some staff people could dig into. Maybe the CEC can call the PUC, is there rate recovery if someone bought the VAR capacity that's not necessarily a market product? While that same project at the same interfaces doing frequency regulation in an open market. I think that would be a nice staff project.

Thank you.

MR. GRAVELY: Any questions for Charles?

(Pause.)

MR. GRAVELY: Okay, Bill Gray.

MR. GRAY: Hi. I'm Bill Gray from Velkess Energy Storage. We have --

MR. GRAVELY: Just pull the mic closer to you.

MR. GRAY: Closer to me.

MR. GRAVELY: Yes, it doesn't pick up much.

MR. GRAY: Yeah. I'm Bill Gray. Is this good?

MR. GRAVELY: Yes.

MR. GRAY: I'm Bill Gray from Velkess Energy Storage. And we have a energy storage technology solution.

And I have a question for the CEC. It seems as though particularly in this morning's panel, there was a very real recognition that the cost of energy storage is a real impediment to larger scale rollouts.

And then this afternoon a lot of people talked about how getting the benefits monetized successfully was very important.

And fundamentally the cost/benefit analysis seems to be just barely breaking even on a lot of these technologies.

At the same time there's a strong preference for tried and true, well understood energy storage technologies to be used. In general, those well understood technologies are well understood to cost a lot of money.

And so I have noticed in my work that there's very very little funding, perhaps no funding at all currently, from government agencies for the development of new technologies that would be lower cost to provide these functionalities.

And I was wondering if the CEC, particularly in the light of the recent stimulus bill, might help to rectify that situation.

MR. GRAVELY: I can address that in a couple ways. So the general question is in technologies in general there's a startup phase and a demonstration phase, or other areas.

The Commission, since I've been involved, and the direction we have under SB-1250 for the Public Interest Energy Research funding is specifically addressing the demonstration phase and closer to the commercial market.

So when we have, we have had solicitations in the past, we typically look for projects that already have one or more pilots in the field.

Now, we do have a small grant program, but it's limited to 95,000. And in many cases we have encouraged new startup technologies to go from a small grant, demonstrate their capability. In some cases they can take that to a venture capitalist; they can take that to other areas. And we can sometimes even in PIER we're able to do a follow-on presentation.

But you're right, the Department of Energy does fund some area here. And this is an area where there isn't a lot of funding right now. The stimulus package is specifically looking for shovel-ready projects. They're looking for technology demonstrations.

So, we are interested at our office. You can certainly -- my contact information is available on my presentation in the handout. So, our office, and I'll introduce Pedro Gomez here. Stand up just a second, Pedro. He's a team lead for energy systems integration and energy storage falls under his team. So he works for me and his team does. And so we look at storage all the time.

So those that have new technologies, yourself included, I would encourage you to come talk with us. Sometimes we can share what we've learned publicly with you about some of the other success stories, and how to go get things, how to make yourself more acceptable to venture capitalists, things like that. You know, price markets to shoot for and things.

So I share that a lot with new venture capitalists. I have -- new companies -- I have venture capitalists that call me all the time because they realize the Commission, it's a public agency and everything I do is for free, but we get exposed to a lot. And so I do -- there are -- I have in the last few years spent a lot of time with venture capitalists that are interested in storage companies. And I always try and mix the two up that are interested, so.

But the direct answer is the direction we have from the Commission right now, from the Legislature, is to focus on the later end of technologies, as opposed to an early end. So you would have to go to the National Science

Foundation for the government, Department of Energy, Department of Defense to fund some of the startup technologies.

I don't have -- other than small grant program, if it works for you I would encourage you to look on our website, the PIER website. It gives all the directions to apply for small grants.

We have had several storage technologies obtain funding; and some of those have actually gone into a more detailed scale of development. Okay? Thank you.

Questions on that? Anyone? Okay. Next speaker. Is it Praveen?

MR. KATHPAL: Yes. Hi. I'm Praveen Kathpal with AES. I'm on the grid stability and efficiency team.

And to tell you about some of the work that we've done so far. We have already bought and deployed four megawatts of advanced energy storage technology. Some of that is the work that Charlie from A123 referenced. Two megawatts of that is connected to the grid at one of our power plants in California.

And before I get to some of the barriers to us deploying more, including obviously an ability to get paid for the services we provide from that, I want to address the topic of systemwide variability.

We've been talking a lot about supporting the RPS targets. And I just want to clarify facts from noise about the location of storage and the benefits of different locations.

Variability is a systemwide attribute. It exists in load, and it exists in supply in increasing amounts.

To my knowledge there's no benefit of a smooth kilowatt hour of wind or solar from a specific site in the United States today. So the flexibility that storage provides should be thought of on a systemwide basis, not specifically with co-location at a renewable site.

I know a lot of incentives are being talked about and thought about where storage is storing renewable energy. But storage stores energy, whether or not it's at a renewable site.

Other benefits, such as voltage support and transmission utilization, can be gained from locating the storage at a renewable site. But in terms of the smoothing effects, the variability is mixed in with the entire set of resources, both supply and demand, and storages in other resource that can help provide flexibility to that.

Moving on to barriers. We have teed up commercial scale projects that we are ready to deploy. If you like the term shovel-ready, you might use that to describe them.

And as far as identifying barriers in California, the number one barrier preventing us from realizing the value in preventing the system and the state from realizing the value of a 20 megawatt scale project is access to the California ISO's regulation market.

And we understand that work is underway. The faster it can happen the better. A couple other speakers have talked about that already.

Another issue is the issue of contracting to the extent that a storage developer can contract with a utility for specific services, to the extent that a utility might self-supply ancillary services rather than buying them off the California ISO market, they could do so via contract with an independent source developer.

And our belief is that the technology cost points are in place where that can be done competitive and probably at a cost savings from the market rate. And I believe as Charles mentioned, as a hedge to what might happen in the regulation market as the need for regulation increases and fuel prices change through contracting that can provide a hedge. And a cost savings to benefit the ratepayers.

By using a structure like that, rather than deploying storage as a rate-based asset, the risk is not on the backs of the ratepayers, the technology risk.

I know in a relatively conservative industry people want long operating histories for technologies. Some of them have that, some of them don't. But a firm like ours has confidence in the abilities of these technologies and is ready to deploy them.

Furthermore, by doing so with a company like AES, we own over 40,000 -- own and operate over 40,000 megawatts of generation worldwide, including over 4000 of traditional and wind generation in California.

So the skill set of owning and operating a grid asset is in safe hands done by us.

Thank you.

MR. GRAVELY: So, I don't have any other blue cards. Anybody else want to speak? Walt? By all means, come join us.

MR. JOHNSON: With regard to the question of co-location of storage. Certainly it's an intra-hour variability of wind, or other renewable resources, can be addressed by putting storage anywhere. And I take that point.

I want to talk for a minute, though, about the impact on the transmission grid and some of the practicalities we face.

It may have come to your notice that most of the renewable resources, the wind and solar, at least concentrated solar, are located at places which are difficult to access with regard to the current transmission infrastructure.

To the extent that that transmission buildout is a longer process than the construction of the renewable resources, which is usually the case, we are finding ourselves constrained on the transmission side in accessing those resources.

One way of mitigating that -- there are a couple of strategies that we're addressing at the ISO to try to mitigate that, besides, of course, trying to construct more transmission.

On the one hand there's the question of rating those transmission lines. And you can always argue that if the wind is blowing and turning the turbines, it's probably also cooling the lines. So if we have a dynamic rating on that line, we'd be able to carry more over it. That's not currently how this operates, though.

So a lot of the time we're going to be constrained with regard to how much generation we can interconnect because of the transmission line ratings. We'd like to overcome that, and we have some experiments, some test work that's being done right now to try to deal with that.

Another strategy for mitigating that, though, would be placing storage co-located with the renewable resource so that it can level the demand on the transmission line for accessing that resource.

So I would argue that, in fact, there is some locational benefit for at least intra-day shifting of resources to be able to allow more of that energy to be stored, and then delivered, given the constraints of the transmission system that we currently have and will have for some number of years.

Thank you.

MR. GRAVELY: Yes. Would you walk up to the mike.

MR. TROPSA: Hi. My name is Greg Tropsa with ICE Energy. And I have a question about, to follow up on the comments from Beacon.

I think it's all about project finance. These projects are cost effective and they would fall into the bottomline and very easily adopted if we had access to low interest financing, the California Alternative Energy Financing Authority, if you would support accelerated depreciation and tax credits.

And we have a lot of projects that we've quoted recently, and it is a high fixed-cost asset with low variable costs. And solving the finance and ownership issue, I think, solves the ability for storage to go into the market.

And the question to the CEC, and to you, Mike, is do you get involved with California politics in Washington, to work on federal tax matters? Or is that outside the scope of where the state's willing to go with storage?

MR. GRAVELY: Actually, Suzanne's not here, but I'll answer two ways. In the research and development side we clearly do not. And the area of my role is managing the Integrated Energy Policy Report section on storage.

What I was going to throw out later, I'll bring up now, is that it was clear to me there's some areas that the Integrated Energy Policy Report is just that, a policy report.

As a result of this workshop and other workshops, we will be preparing policy recommendations for our Commission and for the other Commissions to consider as part of the 2009 report.

So I'm offering to form a smaller committee than the 100 we have today to work up with some of those recommendations. For all people online, once we've got the draft submitted, it goes out in draft form to the public comments. It's incorporated into the policy report, which is shared publicly for public comment. There are workshops on the whole item.

So it seems like one valuable outcome of this meeting would be to take some of these policy recommendations, and we had prioritized them and consolidate them into a finite number of actions that we could recommend.

At that time I can determine whether those actions are appropriate or not. But there certainly are some that would be appropriate.

So what I'm willing to do and what I'm willing to volunteer Pedro and his team to help me with, is to have a couple of WebEx's between now and the June timeframe when we have to prepare the written draft for the IEPR. And come out of this with some recommendations of what we can do to move this technology to a point where there will be more, given the assumption that most people concur that there should be more energy storage in California in 2020 than there is now. And we need to figure out what we can do to work that.

The closer we get to politics, the further it gets from me. But I think here --

MR. TROPSA: So, okay, that's fair.

MR. GRAVELY: -- technically, as well as mostly summarizing what we've learned. And we will take what we've learned today.

But even when I ask the top three questions I got some consistency, but there was still maybe eight or nine options, when you add them all together. And so we have to bring that down to something that's executable from there.

So I think there is some opportunity for us to do it. The recommendations we give to the Legislature, to the Governor, to other people, it does make a difference. So we can influence it indirectly. But we will take an action.

For those that are interested I would encourage you to either send information to the docket or email. My email address for now, we'll use it for the record to get started, is in the handout here in the presentation material.

We will do a WebEx, a publicly available WebEx, and we'll discuss it with the ultimate goal of trying to take what we've learned today and put it into something useful for the Integrated Energy Policy Report.

I will be providing information to our Commissioners, both in informal presentations and the results of this conference. We very likely may have another technology summary conference a month or two down the road where we'll cover several workshops. And that will be a topic for discussion there potentially, as one of the outcomes from this workshop.

So I will leave that as an option. Those that respond I will set up a WebEx through the Commission and we'll talk about it with the ultimate goal of trying to keep the discussion down to what can we do and how can we summarize it, and what is appropriate to go into the 2009 IEPR.

MR. TROPSA: Okay. If --

MR. GRAVELY: In addition to that, we're interested in lessons learned for the research side. So there is some opportunity, but there's also limitations on what we can do when it comes to the advocating of certain politics, for example.

MR. TROPSA: And then the last comment I would have is consideration of the loading order, where does it fit with efficiency and demand response and transmission distribution, conventional fossil fuel, you know, including storage in the loading order would be. Send a clear signal to the PUC and --

MR. GRAVELY: The loading order is clearly a part that involves in the Energy Action Plan, does evolve from the research in the IEPR. So that's the same organizations.

So a vehicle to get there is to go through the IEPR to the loading order as a clear vehicle to get there. But there's some work to go from there.

But I think now the key would be to summarize what we've learned today, and that information. And one way of doing that is to have a few more meetings and try and get something that people agree with. And then bring it back as a proposed draft at one of the workshops.

The other thing I will mention --

MR. TROPSA: I just want to thank you for putting it together. That's -- it's a great --

MR. GRAVELY: -- to everybody here, before you all leave, and those online, is that where I did encourage our vendors not to give sales pitches or presentation, I am encouraging everybody to send information to my office and to the docket so we have the record of your technology, for field success, information you want to share publicly. It is a public document, and it will be, so we can share with our Commissioners and with the individual parties what we consider the state of technology today, and where promising technologies are coming up.

So that's one of the other objectives of this workshop is to get that feedback in so we can assess for people who want to know. We get calls a lot from the Legislature and other areas to let them know what is the state of technology, and how can they help.

And so we want that information if you'll share it with us. Realizing what you share is public, I don't want anything confidential, because I can't protect it. I'll send it back to you.

But I am interested in getting the information from the emerging technologies and successful technologies so we can us that information to help convince the policymakers in the state that storage is progressing quite rapidly in the last few years.

Questions in the room? Any more questions in the room?

Would you un-mute real quick? So what we'll do now, hopefully there won't be too much background noise, we're going to unmute the lines.

So those of you on the WebEx, if Rich Mettling is still there? Are you still online, Rich? Rich Mettling, are you still online?

MR. SPEAKER: Not that I can see.

MR. GRAVELY: Okay, well, he had one question I'll throw out that we didn't get a chance to address earlier. And his question was: Rather than blur the line between T&D and generation, why not a storage capacity payment?

So, Chet, you work in the ISO market, has that ever been discussed at all?

MR. LYONS: I'm sure it has, but I think there are others that are better equipped to tackle that one.

MR. GRAVELY: Any comments from anybody? Walt, any comments on a capacity payment for storage? Is that something that just isn't --

MR. JOHNSON: Since we've never considered it a separate resource there's no discussion of that as a storage capacity.

MR. GRAVELY: All right, so I just want to answer the question since it was here. I got the perception it may be a little bit outside the box from where we are. Given stuff that's inside the box can't get any quicker than that.

Any questions from anybody online? We're about ready to wrap up today. Anybody on the WebEx who has a question they want to bring to the group? Everybody's phone has now been unmuted.

Okay, you can mute them back again.

MR. LENOX: This is Carl Lenox, can you hear me?

MR. GRAVELY: We can, go ahead.

MR. LENOX: Okay, I was typing away, but I think I'll make my comments verbally. I wanted to just make a couple of comments from the standpoint of T&D developer now.

And the first is, you know, I want to make sure that we're clear that when we talk about (inaudible) output, and the question of ramp rates with (inaudible) or not, so there's a quandary the way you deal with it.

I wanted to make a comment about the value of firm generation onto the grid at the point of interconnection. If there's a value there, that will be interesting to capture it. So, again, -- market. If there isn't a value there, then, yeah, there isn't.

Long term (inaudible) energy. When you talk about 5 to 20 percent, -- on energy. There's a lot more on capacity. Clearly we need storage. The idea of firming variability, not requiring (inaudible), clearly there's a value there. And so on.

So, I think the money message is (inaudible) what is and is not an issue with regards to having renewables on the grid, and where storage can play a role there. I think actually (inaudible), depending on application, where it can be useful.

Those are my comments.

MR. GRAVELY: Thank you very much. Would you repeat your name again for our recorder, just slowly?

MR. LENOX: Sure. This is Carl Lenox from Sun Power.

MR. GRAVELY: Thank you very much. Anybody else online?

MS. WAY: Yes. This is Julie Way with Solar Reserve. And I would just like to make a few comments.

MR. GRAVELY: Sure, go ahead.

MS. WAY: Thank you. Good afternoon. Solar Reserve is a renewable energy company developing large, utility-scale solar energy projects. Our technology is both renewable technology and the technology for the thermal storage.

The technology of concentrating solar power technology built around a central receiver tower with molten salt thermal storage system. And what distinguishes this technology from other power tower technologies is the heat transfer medium in the receiver, which is the molten salt.

The salt is a very efficient heat transfer medium and storage medium. And so we are able to provide the benefits of thermal storage very efficiently and cost effectively.

We view the following issues barriers to rapid development of projects like ours in the United States, in California: Lack of transmission to remote locations. Market structure, which we believe places an over-emphasis on projects at the expense of other value drivers, including storage. The lengthy development timelines. And also some of the development uncertainties over things such as mitigation costs.

I know that that list will probably surprise no one, and we know that there are efforts underway to address some of these issues, such as the RETI study.

The only other comment I would make is

that we would point to Spain as an example of where market structures and governmental policies have been deployed effectively to incent both renewables growth and achieve rapid market growth.

Thank you.

MR. GRAVELY: Okay, thank you very much. We have one more speaker in the room here that wants to talk for one second. Come up and just introduce yourself and then make your comments.

You can use this mic here.

MR. ZAININGER: Yeah, Hank Zaininger, Zaininger Engineering Company. I wanted to make one little comment about the capacity value of storage.

Before deregulation storage did have capacity value, in particular like Helms pump storage. There was a capacity value. There was always some kind of capacity value assigned to like in the Northwest.

So I think, as far as your capacity value, that certainly isn't out the window. I know for awhile there was no capacity value when they first started things up. And they did bring it back for generation, I believe it was 15 percent. So there is a value.

However, if you have a flywheel and you only have a few seconds of storage --

MR. LYONS: Well, 15 minutes.

MR. ZAININGER: Fifteen minutes -- you're probably not going to get much capacity value out of it.

Thank you.

MR. GRAVELY: Thank you. Anybody else online or anybody else in the room with comments? Okay.

I want to thank everybody very much for attending today, and participating. I would like to introduce, in the back, Pramod Kulkarni from the Energy Commission. He's been a champion of storage for over a decade. And we wouldn't be here, I don't think, without his early-on efforts. And I think more people are realizing the value of what we're doing.

So there are several areas within the Commission that have supported this technology for quite awhile. And we're trying to get, as you said, the cost of ownership and the value and the ability to pay worked out. We're not there yet, but we'll keep trying.

I would encourage everybody that hasn't

had a chance to make comments, or has specific comments, or has recommendations for us and things they would like to see as policy recommendations, to send those to the docket address that's on the announcement.

We've extended that for two weeks instead of one week. So, the comments are due on the 16th of April.

And as I said, if nothing else, those of you who are interested, there will be a draft Integrated Energy Policy Report in the July/August timeframe that will be published on the web. There will be workshops for that.

And then so you will be able to see what we're doing. And those that have interest in helping us develop some of those policy recommendations, send an email to myself, or send information to the docket email address so we can set up -- it won't be a meeting like this, it'll just be a WebEx.

And we'll work out a time as best is possible. I can't coordinate for 50 people, but I'll do my best to pick a time that's useful for everybody. And try and take the best we can from summaries from this workshop.

So, in closing, thank you all very much. I appreciate your time and all your efforts. Thanks to the panel members for their effort and participation, and all the staff we have supporting us. And you guys have a safe trip back. And thank you very much.

(Whereupon, at 3:55 p.m., the workshop was adjourned.)

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CERTIFICATE OF REPORTER

I, PETER PETTY, an Electronic Reporter, do hereby certify that I am a disinterested person herein; that I recorded the foregoing California Energy Commission Staff Workshop; that it was thereafter transcribed into typewriting.

I further certify that I am not of counsel or attorney for any of the parties to said workshop, nor in any way interested in outcome of said workshop.

IN WITNESS WHEREOF, I have hereunto set my hand this 21st day of April, 2009.