STATE OF CALIFORNIA – THE RESOURCES AGENCY
BEFORE THE
CALIFORNIA ENERGY COMMISSION (CEC)

In the matter of,	)
	) Docket No. 11-IEP-1N
	)
Preparation of the 2011	)
Integrated Energy Policy Report	)
(2011 IEPR)	)

Energy Research and Development Division

IEPR Staff Workshop on

PIER Benefits Assessment

CALIFORNIA ENERGY COMMISSION
HEARING ROOM A
1516 NINTH STREET
SACRAMENTO, CALIFORNIA

THURSDAY, MAY 19, 2011
9:30 A.M.

Reported by:
Kent Odell

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Vanessa Kritlow, PIER

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Also Present (* Via WebEx)

Panelists

Rick Tidball, Senior Consultant, ICF International

Tara Rainstrom, Benefits Analyst, New York State Energy Research and Development Authority (NYSERDA)

Pete Whitman, Policy Analyst, U.S. Department of Energy (DOE)

Mike Holland, Senior Advisor and Staff Director, U.S. Department of Energy (DOE)

Linda Cohen, Professor of Economics and Law, UC Irvine

Jeff Roark, Senior Project Manager, Electric Power Research Institute (EPRI)

Audrey Lee, Kennedy School of Government, Harvard

Laura Diaz Anadon, Kennedy School of Government, Harvard

Gretchen Jordan, Principal Member of Technical Staff, U.S. DOE Sandia National Laboratory

APPEARANCES

Public Comment

Tom Conlon

Ed Vine

Carol Yin

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P R O C E E D I N G S

MAY 19, 2011 9:31 A.M.

MS. BARONAS: Good morning. Thank you for attending today's session. My name is Jean Baronas, I work for California Energy Commission, Public Interest Energy Research, the PIER program.

This is a staff IEPR workshop, docket number 11-IEP-1N.

We're starting off today with Suzanne Korosec, of the Integrated Energy Policy Report Unit, Assistant Executive Director. Suzanne.

MS. KOROSEC: Good morning. As Jean said, I'm Suzanne Korosec, I manage the Energy Commission's Integrated Energy Policy Report Unit. Welcome to today's workshop on Assessing the Benefits of Public Interest Energy Research.

This workshop is being held under the 2011 IEPR proceeding. The Energy Commission produces and IEPR every two years that assesses all aspects of energy supply, demand, production, transport, delivery and distribution for all of the State's energy sectors.

And these assessments help to form the basis for analyzing the success of and developing policy recommendations for public interest research strategies, such as research development demonstration and commercialization to advance science and technology to produce public benefits.

The 2011 IEPR this year will be based on a number of underlying documents that were identified in the scope for the IEPR, which was released in March of this year.

The information and discussions from today's workshops will be used as input for a supporting document that focuses on the strategic value of RD&D in helping California to meet its energy and environmental policy goals. And it will also inform energy policy recommendations made throughout the IEPR for future R&D directions and strategies.

I just need to cover a few housekeeping items before we get started. There are rest rooms in the atrium, out the double doors and to your left.

We have a snack room on the second floor, at the top of the stairs, under the white awning.

And if there's an emergency and we need to evacuate the building, please follow the staff out the doors to the park that's kiddy corner to the building and wait there until we're told that it's safe to return.

Today's workshop's being broadcast through our WebEx conferencing system and parties need to be aware that you are being recorded. We'll make an audio recording available on our website within a couple of days and then there will also be a transcript available within about two weeks.

For the public comment period today we ask that you fill out blue comment cards, with your name and affiliation. You can give those to either Tiffany, here, or to Cody.

It's helpful during the public comment period, when you come up to speak you'll need to come to a microphone, so if there's a free spot up here at the table, use that.

And it's also good if you can give our court reporter a business card so we make sure that your name is spelled correctly.

WebEx participants can use either the chat or raise-hand function to let our coordinator know that you have a question and they'll either convey your question or open your line at the appropriate time.

We're accepting written comments on today's topics until close of business on June 1. And the notice for today's workshop, which is available on the table in the foyer, and also on our website, describes the process for submitting those comments.

So, with that I'll turn it over to Laurie ten

Hope.

MS. TEN HOPE: Good morning. I'm Laurie ten Hope, I'm the Deputy Director for the Research and Development Division.

I want to thank all of you who are here in person and those who are participating on WebEx, and I particularly want to thank our panelists.

This is a really important workshop for the Public Interest Energy Research Program. As I'm sure most of you know, this is a research program that's funded by the citizen's of California and it's really important that the benefits accrue back to the citizens of California.

And we are here today to assess how we currently assess the benefits of our research portfolio and to solicit input from others on how they assess the benefits of their research programs, and finalize our own internal recommendations for changes that we may make to our methodologies going forward.

Historically, the PIER program has really focused on picking the right projects. And so our research assessment has been based on what's the technical potential of the potential projects, and what is the -- how strong is the connection to our priority barriers, and we try to pick the projects that we think have the best chance of solving our critical research problems.

We've also done portfolio assessments at various stages of the program.

Now, we're at a point where we -- we want to systematize the methodology to make sure that we're collecting the right information at the beginning of a project, throughout a project, and then follow up to a project.

We have dedicated an internal staff of three individuals that are here at the table, Jean Baronas, Vanessa Kritlow, and Adrienne Kandel.

We thought it was really important that we have a standing staff that's focused on benefits assessment, and that are not the contract managers for the specific technology so they have independence and they have the focus to really look at how -- what's the right methodology and assist our contract managers in the collection and assessment of the individual projects.

So, today we are providing, basically, a forum to share the benefits assessment that we have used historically and are planning to use going forward. And, as I said, to hear from other research programs around the country on how their benefits assessment is done and then obtain feedback from our public members.

We have a really full day and a lot of great presenters here. We're going to start with our Benefits Team, as I said Adrienne, Jean and Vanessa will do an overview of the benefits assessment activities.

And then we have a panel, led off by Rick Tidball, with ICF, who will share experiences from Oregon and Iowa's benefit assessment.

Tara Rainstrom, who's here from the New York Energy Research and Development Authority. Thank you, Tara, for coming in person from so far.

We have two participants from DEO, participating remotely, Pete Whitman and Mike Holland. Thank you for your participation.

Linda Cohen, from UC Irvine, will be sharing the work that she's done with NRC.

And Jeff Roark -- I don't think I said his name quite right, sorry, Jeff -- from EPRI.

And Gretchen Jordan from Sandia National Lab.

Mike Gravely will do an assessment of what we heard in the morning.

And then in the afternoon we'll move from an overview to talk more about methodologies in some of the questions -- some of the assessments that are little more complicated in terms of how you assess the benefits to the -- of a research portfolio on the economy, in reliability, on jobs, on electricity customer costs. We'll be sharing some approaches and examples of our benefits assessment and asking for your feedback.

In the afternoon Linda Cohen, Dr. Cohen will be sharing her research on attribution, how much of the research results can the research program claim credit for, what other factors may -- you know, may be responsible for the savings that we're seeing in the marketplace.

We will be joined by Audrey Lee and Laura Diaz Anadon from the Kennedy School of Government, at Harvard, to discuss uncertainty in research results.

And then Vanessa Kritlow, from the Energy Commission, will be sharing the proposed PIER Benefits approach.

Our panel will stay with us for the afternoon for a discussion, and we will look for comments from the public and try to do our best to summarize what we heard during the day and what -- you know, what messages we're going to take forward for our future benefits assessment work.

With this, I want to turn it over to our staff team, lead by Vanessa, Adrienne and Jean. Thank you.

MS. BARONAS: Thank you, Laurie.

MS. KRITLOW: Thank you, Laurie, the Benefits

Team really appreciates all the support you've given us to develop this workshop.

Good morning, my name is Vanessa Kritlow and I work in the Energy Research and Development Division here, at the Energy Commission, doing PIER Benefits analysis work.

The PIER program staff are really excited to see today's presentations on ongoing benefits assessments in other State and Federal agencies, as well as research organizations.

I would now like to present to you a short presentation on past and present PIER Benefits activities, with a glimpse of what we hope to improve in the future. Slide, please.

First, we'll take a look at a timeline of PIER Benefits analysis activities up to the present day.

Looking at 2002 to 2004, an evaluation of the benefits resulting from the PIER program from its beginning through the end of calendar year 2002 was completed in early 2003.

The conclusion of that evaluation was that products then beginning to enter the market would generate benefits of two to five times the cumulative cost of the PIER program through 2002, based on applications of RD&D results projected over the five-year period 2003 to 2007.

That evaluation was then updated in early 2004, with the prior years' analysis of benefits estimation remaining about the same.

In 2008 PIER benefits estimation methods were developed further and were applied to seven individual projects. For energy efficiency projects, realized and project sales and savings were looked at.

For energy system optimizing work, the energy system with and without the projects was simulated.

For attribution, knowledgeable parties were questioned using the Delphi process.

The analyses summarized and quantified the physical, and financial benefits, and costs associated with the development and deployment of these technologies under review.

The results of the individual case studies strongly suggested that California ratepayers have reaped benefits from the program that significantly exceeded its costs.

More recently, in 2010, the PIER program continued to develop its benefits methods and also began research on the conceptual difficulties in evaluating benefits of public energy RD&D programs, including attribution and the role of market failures, with the goal of understanding the contributions of public energy RD&D and it's role in innovation in California.

Today PIER's continually studying past and present projects for benefits estimation, while noting desired areas of improvement, with the hope to establish a formal, transparent policy with protocols that would be flexible enough to be able to encompass the diverse energy research areas PIER invests in.

The next slide, please. I will now present a very high-level overview of PIER's current benefits approach.

PIER project data is collected from our database, called PINS, and other sources such as final reports, phone surveys, when these things are needed. They are generally energy and cost savings reporting by contractors for research and demonstration projects.

These projects are then categorized according to the types of savings they produce. If necessary, and if enough information is available, savings projections are estimated for the energy and/or cost savings.

We then apply these projected energy savings to estimate environmental benefits, such as GHG emissions or electrical generation criteria pollutants.

Finally, we vet our results with our contract agreement managers, or CAMs, and we report our findings to PIER management.

Slide, please. Here in PIER, staff are consistently looking to improve processes when the opportunities present itself, we do so all the time.

So, while we're evaluating present projects or we're following up on past projects for benefits, we've discovered avenues for improved and refined data collection. And we've included some of these process improvement suggestions in our afternoon presentation, later today.

We continually evaluate the effectiveness of the methods used in past and present assessments and we're developing training modules to help our staff better identify benefits of projects.

We perform quality checks on our summations, we go over our work to make sure it has great quality. And we try to improve the way we communicate our benefits to the public.

We have developed recommendations for input to work plans, solicitations and agreements and, again, this will be mentioned in the later afternoon presentation, in order to further -- gather further data and more improved data to get better benefits analysis.

Slide, please. Presently, PIER identifies four general types of benefit categories; economic, environmental, grid reliability, and knowledge benefits. In addition, PIER feels that other various projects also include benefits that are more qualitative in nature, such as improved quality of life, improved land use efficiency, water use efficiency, company and job growth that results out of PIER projects.

But I'm going to go ahead and now turn it over to Adrienne Kandel, who will explain what we have been able to look at this far.

MS. KANDEL: Hi, I'm Adrienne Kandel, I'm an economist at PIER.

So, here are some ways that we've looked at benefits. Slide, please.

So, first in our loading order is energy efficiency and I'll talk about that first. Let me define for you technical potential, it's how much could a technology save if everybody adopted it?

Now, we've always used technical potential to choose research directions and projects, of course.

In this example I give you we have ten energy efficiency projects, that's a sample of convenience, it's projects for which we have enough information to get technical potential, and not enough to get some of the more specialized estimates.

The technical potential on these projects totals

$990 million a year worth of reduced electricity use, reduced peak demand, and reduced natural gas use. That is counting full attribution to PIER and excluding many incremental costs. Obviously, at the beginning of research you don't know them, always.

And the cost to PIER of that -- those were just under $7 million.

So, the question, the first question I asked people for a comment later is what does one do when the only data are technical potential?

Would you reasonably take a small percent?

I would feel comfortable saying this; if only one percent of the technical potential is realized, the California ratepayers will save $10 million a year on these ten out of over 700 PIER projects.

And when we're funding them, we're expecting a higher realization than that, anyhow.

There are other ways to look at it. You could, again using the one percent, look at the net present value. If you have straight line growth from nothing the year it started until full implementation, full penetration in 2020, these ten examples would give you a $21 million net present value, or a benefit cost ratio of 4.5, for example.

Next, please. More specific than technical potential is how much do you actually expect to see in savings, where can you do projections?

So, we look at 2020 because it presents challenges to the grid, as you folks know, with the renewable electricity standard of 33 percent, as well as the need to accept electric vehicles into the grid and keep costs down.

I have another convenience sample, it's nine projects that are costing PIER a total of $2.1 million. The projected savings for those is $16 million a year by 2020, more or less. I say more or less because any projection is inherently uncertain.

Which brings my next question for comment is how do you deal with big uncertainty, how do you deal especially with the big uncertainty in game changers?

We have, for example, a project with radiant heating venting and air conditioning that costs us $2 million in expenditure.

Now, the Gas Technology Institute predicts that will cause a six percent drop in HVAC usage, which turns into $234 million a year.

But what if it fails to catch on? Do we look at a one percent drop? That would be $40 million worth of savings a year.

We could do a simple range, one to 40 percent.

We could do simulations throughout the range, we could do simulations with various parameters that went into that calculation changing.

And when we're adding up things altogether, we could do ranges or we could do simulations.

On this, as well, your comments are welcome.

Also, how do we attribute these and what do we do with the uncertain technology costs?

Next, please. For some technologies we already have realized savings ready to measure, you don't have to make projections.

Consider automated demand response, which we've funded from the conception. It was promoted by the Energy Commission's own Art Rosenfeld from the start.

And the idea was to get demand to drop instantly when it was needed without utilities having to remotely control unhappy customers' equipment, or cut off their electricity.

In this technology, the customer tells energy-using equipment how to respond instantly to real-time price signals. The equipment reads the prices from the server.

For instance, an industrial thermostat might adjust exactly when it's cooling or a commercial building might say if there's a critical peak pricing period, we will turn off every other laser printer.

This technology is already dropping peak demand 123 megawatts by the end of this year. When you analyze that, that's $13 million a year savings in foregone power plant construction. That is net of the installation costs, that it net of the utility incentives to the ratepayer, which we're counting as a cost here because most of the ratepayers pay for it.

We do have three to four more million dollars a year savings to the participants who are getting the benefit of the reduced peak, as well as the incentives.

In addition, there's a qualitative benefit, which is customer choice, that we can have the grid respond instantly and reduce demand without having to go and control other people's electricity use choices.

Next, please. But how do you progress from realized savings to future projections? Do you extrapolate?

If you look at the graph, it's growing pretty fast. We have the auto DR hardware technology in over 50 vendors' equipment, and the software protocol open ADR is a candidate for a National Institute of Standards and Technology standard, and it's used internationally now.

Do you set a reasonable ceiling? We do have one, good commercial and industrial candidates could save 1.5 to 2 billion dollars a year by 2020 if they all used that.

How about ten percent penetration among these? That would be 150 to 200 million dollars a year savings. This is not expensive to use and it saves people a lot of money.

How would you make a projection? Would you say ten percent's reasonable? Let's assume it or do something different.

Another use of automated demand response is more complicated to model the effects of, it's load balancing.

PIER has funded grid optimization modeling, which shows that the potential for automated demand response to replace some storage as a way to help the grid adjust quickly to changes is great, and this saves money.

The idea is that there is load balancing services, called ancillary services, that have to be provided when intermittent renewables go up and down, or as demand goes up and down.

That some portion of this the modeling has already showed will be best and most cost effectively implemented using storage, and some portion of the storage can be replaced by automated demand response, which is already being tested successfully for this purpose.

While storage is expensive, demand response is cheap, the preliminary estimate of value is 70 to 280 million dollars a year savings expected from using this, by 2020.

The afternoon sessions we'll talk about how we get some of these estimates.

Next, please. the calculation of automated demand response for load balancing was based on modeling and individual estimation.

We also need an individual approach for synchrophasor work. Synchrophasors are synchronized measurement devices disbursed throughout the grid to give operators a clear picture of where the grid is strained and at risk of outage, and to do so quickly.

PIER has funded the road map for California-tailored research. It has funded the platform that operators can visualize grid operations on and the applications to help them visualize it faster and more cost effectively.

And it's working on improved features, including automatic responses for features that go too fast for human immediate intervention.

There are two types of benefits that we will be looking at the value of reliability and electricity cost savings.

The main motivation for this research is that in 2020 we will have 33 percent renewables on the grid, we will have electric vehicles appearing, each one drawing the load of a house suddenly, somewhere, that we need to make sure we have a grid operating securely for and we're avoiding outages.

To estimate the benefit of that reliability you look at the cost of the outage and the reduced probability of the outage.

We've gathered different expert estimates for components of cost of outage and reduced probability. And these estimates for improved reliability range from, when we put them together in the whole equation, with the various possible assumptions, seven to 166 million dollars a year, averaging about $85 million a year, and most of them are closer to the center than those extremes.

The electricity supply cost savings come from two avenues that we're estimating. The first is transmission lines. If transmission lines can reliably carry more electricity, we're not obliged to have as costly safety margins.

Example is given for the California/Oregon inter-tie. If that could be re-rated to carry another 200 megawatt hours, as is being discussed by some, that would be worth eight to 18 million dollars a year in savings for that transmission line use.

Another possibility is renewable integration. Right now -- did I -- I apologize, but could you go back one, I think I missed a picture. No, I'm sorry, go forward.

Right now wind turbines are often unconnected from the grid because they have to -- they're posing some risk to the grid at some moment. We don't know, if certain conditions arise with phase measurement, angles being too different at different places, you would have -- phases, you would have to disconnect the renewables to be sure that their gusty wind features or they're going on and off won't make the grid collapse into some kind of outage at that point.

We have to be conservative with that because as long as we don't have exact measurements, we better be really -- we better give a big margin of error -- of safety.

When we can do it more precisely, measure more precisely, people have spoken about considerable savings we could have by not turning off as much.

And a simulation suggests that if you can have wind hours one to five percent more a year being allowed into the grid, you're saving 26 to 150 million dollars a year.

I now like to pass this on to my colleague, Jean Baronas.

MS. BARONAS: Okay, thank you, Adrienne. Just following the presentations of Vanessa and Adrienne, my name is Jean Baronas, I work in the PIER program at the California Energy Commission.

So, in the area of environmental RD&D, the PIER funded the integrated forecasting and reservoir management model known as INFORM.

The goals of the model are to provide probabilistic forecasts of water runoff in four major California reservoirs. And those are Trinity, Shasta, Oroville and Folsom.

The model provides a decision support tool to assist with balancing water supply, hydropower generation and other demands.

INFORM was designed to help water reservoirs to identify release schedules so that contracts can be fulfilled for the water supply, flood control can be managed, and water can be provided to dams for power generation.

Also, maintaining healthy ecological conditions for plant and wildlife in the rivers and deltas, this is another goal of INFORM.

And depending on the INFORM implementation, a three-year simulation estimates potential annual electric and water savings of $15 million to $82 million.

PIER funded 31 percent of INFORM 1. This was a contract for $300,000 that began in 2007. And INFORM 2 was started in May 2009. The goal of INFORM 2 is to focus on implementation and is planned to reach completion in August 2012.

PIER and the National Oceanic and Atmospheric Administration, known as NOAA, will jointly fund INFORM 2.

The next slide, please. What about jobs? Do people here measure jobs created by research and how? How do you measure jobs created by public research?

Turn your mike on. This is Tara Rainstrom, from NYSERDA.

MS. RAINSTROM: Hi. I mean that's something that we've been arguing about for years so I'll talk a little bit about that in my presentation. But right now we're using a macro economic input/output model to determine jobs.

But in looking at your slides, this is how we used to try to calculate jobs is based on, you know, dollar impacts of our saving -- or of our programs and then, you know, some sort of assumption about how much that -- you know, how much carries one job. Very similar.

MS. BARONAS: Okay. Well, thank you.

Here's an example of follow-on funding from the PIER program that results in jobs. The California Energy Commission's PIER program creates jobs through several different channels and they have different time horizons.

Sometimes new companies or lines of business are created which lead to private sector jobs.

Private sector investment in these new activities often greatly exceeds the initial PIER funding.

For example, the PIER Energy Innovation Small Grants Program, which regularly surveys grant recipients for follow-on funding, has led to about $35 of follow-on investment, mostly private, for $1 of PIER funding.

The Energy Innovation Small Grants Program is only about five percent of PIER funding. For this program the $29 million PIER expenditure, since 1999, has led to products attracting at least $806 million to

$841 million worth of private investment, plus $201 million of public and utility money.

The Small Grants Program has attracted over $1.2 billion in private follow-on funding and follow-on utility investments.

The follow-on funding is expected to grow over time. And this chart shows the rapid growth of cumulative Small Grant follow-on funding as mature products attract more funds, most likely even if the new funding for Small Grants remains constant.

We anticipate this growth in cumulative follow-on funding will continue for many years as successful companies expand.

We estimate that 94,000 to $100,000 investment -- that's $94,000 to $100,000 investment creates one job and that the Energy Innovation Small Grants Program has caused approximately 10,000 direct jobs and 20,000 induced jobs.

This leads to the question of what type of economic analyses do you perform to assess follow-on funding and jobs creation?

The next slide, please? This is a summary of our first presentation. The benefits assessment activities and processes we briefly described apply to a broad range of energy-related RD&D projects.

We are interested in your ideas for improvement and refinement. We look forward to considering all ideas.

The benefits assessment process encompass various types of benefits. We are interested in how you assess benefits.

Thank you for your attention and we will now move on to the panel presentations.

My name is Jean Baronas, I work in the California Energy Commission PIER program.

Next slide, please. I'd like to introduce the panel. This is 03 morning panel introductions.

Next slide, please. We have a number of people on WebEx this morning, many of them are panelists.

Let me just take a roll call, please.

Rick Tidball, from ICF International is sitting on my left. Rick, you're here.

MR. TIDBALL: Good morning.

MS. BARONAS: And we have Tara Rainstrom, from New York State Energy Research and Development Authority, NYSERDA.

MS. RAINSTROM: Good morning.

MS. BARONAS: Thank you, Tara.

And on WebEx, Pete Whitman, from United States Department of Energy. Pete, are you with the WebEx system?

Is anyone on mute, maybe, they need some time to go off mute for WebEx?

Okay, would you please identify yourself?

From USDOE, do we have a representative calling in for Pete Whitman?

MR. WHITMAN: Hello?

MS. BARONAS: Hello.

MR. WHITMAN: Hello.

MS. BARONAS: Hello, who is calling, please?

MR. WHITMAN: This is Pete Whitman, can you hear me?

MS. BARONAS: Yes, hi, Pete, thank you for joining us.

MR. WHITMAN: Great, thank you.

MS. BARONAS: Thank you. Please hold tight, we're going to start our panel soon.

And Dr. Mike Holland, from the Office of Science, U.S. Department of Energy.

Can I see a list of the WebEx participants, please?

Mike, are you on the WebEx? We have two columns worth of WebEx participants.

Mike Holland?

Okay, I'm going to move on to the next panel participant. Linda Cohen is here in person, at UC Irvine. Hi, Linda.

MS. COHEN: Good morning.

MS. BARONAS: And Jeff Roark, from Electric Power Research Institute, EPRI.

MR. ROARK: If everything's working, you should hear me. Hello.

MS. BARONAS: Hi, Jeff, we hear you.

MR. ROARK: Great.

MS. BARONAS: Thank you.

Dr. Gretchen Jordan, Sandia National Laboratory?

MS. JORDAN: Can you hear me?

MS. BARONAS: Yes. Hi, Gretchen, how are you?

MS. JORDAN: I'm fine, thank you.

MS. BARONAS: Great. So, one more call for Mike Holland, is Mike on the phone.

I do not see Mike on the list of participants, so I recommend that we start off with Rick, and move on to Tara, move to Pete, Linda Cohen, Jeff Roark, and then Gretchen Jordan. And then we can leave the questions for Mike Holland when he calls in.

All right. So, we have Rick's slides up. So, Rick, please talk to us as a panelist. Thank you.

MR. TIDBALL: Thanks for the introduction. We can move on to the next slide. Next slide, please.

MS. BARONAS: By the way, we're nine minutes ahead of schedule, so I'm feeling all right about this hesitation.

MR. TIDBALL: If you can back up just one slide?

As Laurie mentioned in the introduction, I'll be talking about two organizations, the Energy Trust of Oregon, and then within Iowa I'm going to speak about just one -- one program, the Iowa Power Fund.

The types of questions that I -- or the way my discussion is organized is I'm going to try to present information along the lines of to try to answer or address four questions.

And the first one is, you know, what type of benefit assessment activities do these organizations undertake; what have they measured; how do they look at or try to handle attribution dividing up benefits when there are multiple agencies participating? And then any comments we might get from how these organizations might be moving forward in terms of how they evaluate benefits.

Next slide, please. I'll start with the Energy Trust of Oregon. They're a nonprofit organization. They do fall under the jurisdiction of the Oregon Public Utility Commission.

They receive funding from a public purpose charge that is paid by the customers of four utilities; two electric utilities, Pacific Power and Portland General Electric; two gas utilities, Northwest Natural and Cascade Natural Gas.

The Energy Trust of Oregon started operation in 2002 and they really focus on two areas. First, saving energy, both natural gas and electricity, and then also producing, generating energy from renewable resources.

It’s not -- the numbers aren’t on this slide, but for reference, to put things in perspective, in 2010 the Energy Trust budget was about $120 million, about 80 percent of that funding went towards energy efficiency related projects.

And a lot of that funding was coordinated with utility programs that provide incentives for energy efficiency measures.

I’m going to -- I know one of the first questions I mentioned was talking about benefit assessment activities. I’m actually going to skip that and move right into talking about the sorts of things that the Energy Trust has measured.

So, if we can move on to the next slide, please?

And at a high level it’s pretty simple at the Energy Trust of Oregon in terms of what they measure. Again, how they go about making these measurements can be quite complicated. And I think you're going to hear from speakers in this panel, and particularly this afternoon, a lot of the challenges. You've already heard many of these challenges from the speakers already today, in terms of how you go about making these measurements.

But in terms of what is measured at the Energy Trust of Oregon, they look at energy savings. In the Northwest, the metric for energy savings that's used by a number of organizations, the Bonneville Power Administration, and others, is the metric of average megawatts, which is one megawatt operating for a year. So, one average megawatt is 8,760 megawatt hours.

So, the Energy Trust looks at energy savings, both from electricity as well as natural gas. And then they -- and then they, you know, turn those into, you know, measurements that can be in terms of dollars and other benefits associated with their program.

And again, I have some numbers which aren't on the slide but, again, just to kind of put some things in perspective, since 2002 through 2010, so over a nine-year time span, the economic impacts that the Energy Trust has estimated that they've created -- you know, they claim $780 million in savings of energy costs.

And these are savings in addition to what would have happened. So, the baseline is what would have happened without Energy Trust participation, and then they look at the incremental benefit. And those are the benefits that they attribute to their program.

So, $780 million in energy savings. But they also look at -- they extend those benefits to other areas as well. They estimate that they've, through job creation, they've created 2,400 jobs over that nine-year period. Those jobs translate to $80 million in wages.

And they also look at impacts on small businesses, they claim that they've contributed to about $12 million in small business income.

And these sorts of numbers and the background behind them are explained, discussed in a lot more detail in their 2010 annual report. I'm not going to go into a lot of details today.

Let's go on to the next slide, which talks a bit about attribution. And I mentioned that the Energy Trust, when they look at their benefits, they look at the benefits in the context of what would happen, you know, what did the Energy Trust create or cause that is in a -- that resulted if the Energy Trust activities did not occur.

Now, in terms of attribution I've got some words on this slide, but the -- in 2006 Fred Gordon, from the

Energy Trust of Oregon, co-authored a paper, it was presented at an ACEEE meeting. And he went into a lot of details about all of the challenges that they have at the Energy Trust in terms of attributing the benefits.

And they have, they do spend -- I think the conclusion from this slide and the message I'd like to leave you with is they do spend a lot of time trying to attribute the benefits and make sure that double counting doesn't occur with other agencies.

There are about a dozen major agencies, so the utilities, obviously, that they coordinate with. The Bonneville Power Administration is a big player in the Northwest, the Northwest Energy Efficiency Alliance.

And so they do work closely with these other organizations and they do, you know, try to make sure or make a good effort that they do not double count the benefit or how they're divided between these organizations.

So, let's move on to -- well, the next slide is talking a little bit about future plans.

At the Energy Trust of Oregon, in conversations, discussions with the Energy Trust, they don't -- they aren't anticipating making any major sort of fundamental changes to the way they go about measuring benefits. Although, they do want to do a better job of how they measure energy savings, really.

You know, right now, I think I mentioned earlier, that a lot of their funding goes towards incentives for energy efficiency measures. And right now they rely a great deal on billing analysis to evaluate the impacts of those energy efficiency measures.

And they would like to have a more robust approach for the billing analysis assessment, or at least that's -- they see that as one area where they could perhaps make some improvements.

And that sort of gets to this question of uncertainty, which I think you're going to hear from speakers, later today, talking about uncertainty and, again, a lot of other challenges.

So, we can move on to Iowa, please. So, within or for Iowa, I'm really speaking, my comments are focused just on one program, it's the Iowa Power Fund.

The Iowa Power Fund is administered within a state agency, it's within the Iowa Office of Energy Independence.

The Iowa Power Fund was started in 2007 and their focus is really to stimulate renewable energy and renewable fuel, so they focus on renewable energy, renewable fuels.

And since 2007 the Iowa Power Fund has invested in 40 projects and they've invested about $60 million in those 40 projects.

They tend to be very much of a minority participant, so they're looking at projects where they can either get those projects started more quickly or allow those projects to perhaps move along at a quicker pace with their funding.

A few example projects they've invested in, it's Iowa, we're talking about the Midwest, so they've invested in cellulosic ethanol bio-refineries, they've made an investment in an algae plant for renewable fuels production.

And they've provided funding to academic organizations, like the Iowa State University for PD research.

Let me -- we can move on to the next slide, talking a bit about benefits assessments for the Iowa Power Fund.

I mentioned that they've -- to date they've funded 40 projects. On this slide, though, or in terms of the assessments they've actually done, they did conduct a study last year, in 2010, where they looked at 31 of their 40 projects. The funding amount for 31 of the 40 projects accounted for just under $40 million.

So, you know, they looked at three-quarters of their projects that represented about two-thirds of their funding that they've invested to date.

They commissioned a third-party company, it was -- I believe it's Impact Data Source, in Texas, to actually conduct this economic study for them. And they looked at, really, sort of three types of benefits.

The way they categorized them were direct benefits, so these are -- this is economic activity that occurs right, again, in a lot of cases they're building plants. So, what was the construction activity, what was that economic impact?

And then they look at indirect activity so, you know, what about suppliers, fabricators that are providing services or goods to the project?

And then they look at induced activity, so these are things like, you know, lodging, hotels, restaurants, you know, other associated or induced activity that was created by their investment.

They looked at the -- they did a forecast analysis in terms of trying to figure out what these benefits look like, and they looked, you know -- you know, for a few decades into the future, they actually conducted their assessment out to 2033. And they did it in two time blocks, they did a shorter time block, 2007 to 2014, and then they did a second time block which was 2014 to 2033. So, obviously, there's more uncertainty in that larger time block.

We can move on to the next slide, which talks about what was measured. And that, you know, they -- you know, I indicated on the previous slide that they looked at sort of three types of activities, direct, indirect and induced.

When they started sort of, you know, focusing what those activities -- you know, what they actually translated to in terms of an economic or a dollar impact, they divided things into really four categories. It's not exactly the way it's presented on this slide, but the way they really boiled it down to is they looked at the economic output for the State of Iowa, they looked at the wages they created, they looked at the number of jobs that were created, and they looked at the state tax revenues.

And again, they did this projection out to 2033, it's over a few decades. But just to put these -- put it in perspective and, again, these numbers aren't on the slide, but the economic output that they estimates from these 31 projects, $40 million, they said, well, you know, if we go all the way out to 2033 that $40 million investment really created, in terms of economic output, $40 billion for the State of Iowa. They estimated just under $4 billion in wages, which was derived from the 8,500 jobs.

And state tax revenues from these plants selling fuels, whatever, they estimated that at $475 million.

We can move on to the next slide, which is the combination of attribution and future plans. The attribution analysis was, I think, pretty -- done at a really pretty simple level for the Iowa Power Fund.

I mentioned earlier that they're typically a minority participant in these projects. And typical for most of these projects or for their entire portfolio of 40 projects, they have invested about ten percent of the total project cost. And so when the benefit analysis study that I mentioned on the previous page was done, they took -- they took credit for about ten percent of the benefits out of that -- out of that economic activity. So, they matched their funding level to the funds, the total project costs that they participate in.

In terms of future plans for the Iowa Power Fund we didn't get -- get a lot of feedback from them. The feedback we did get from the folks we talked to at the Iowa -- within the State of Iowa is that there's some discussion going on, probably associated with, you know, reduced state budgets and reducing expenses, but there's some discussion about merging the Iowa Office of Energy Independence into the Iowa Department of Economic Development. And I think that's overshadowing, you know, some of their -- you know, some of their thinking about what they would do in the future, they really need to understand what kind of an organizational framework they'll have.

That concludes my comments.

MS. BARONAS: Okay, thank you, Rick, for your contribution today.

We'll move on to Tara Rainstrom, from New York State Energy Research and Development Authority, NYSERDA. Tara.

MS. RAINSTROM: Good morning. As Jean said, I'm from NYSERDA. And for those of you that don't know what NYSERDA is, we are a public benefit corporation, very similar to PIER.

We are -- our mission is to advance innovative energy solutions and ways that help the New York State economy and the environment.

I represent the Research and Development Program, which manages currently around $400 million in funds annually. NYSERDA as a whole manages around $800 million, just to give you a sense of the scope of what we're doing.

Our current portfolio is around a thousand active projects, so it's a lot to evaluate.

To give you a sense, as well, of the sort of activities that we're researching, we have six different programs right now. We have our buildings research, we have transportation and power systems, we have our manufacturing innovation and on-site power applications, energy resources and environmental research, clean energy business development, and then energy markets and power delivery.

The nature of our work ranges in scope as well and I think, again, very similar to the PIER program where we fund product development activities, as well as demonstration of commercially available technologies, renewable power and cogen incentives. We're focusing a lot more on business development and as well as environmental monitoring and research.

The next slide, please. I'm going to jump right into the work that we've done in benefits assessment. Hopefully, we'll get there.

Really, the question that we've been trying to ask ourselves is how do we quantify innovation? We're all trying to get at the quantification of research and development, and it's not an easy task.

One of the basic things that we've been trying to do is just to simply justify our existence. So, one of the first activities that I did around five years ago was try to understand a very simple cost benefit analysis based on our product development activities.

We did that because we have a large portfolio of product development activities and we know, we have a sort of a royalty obligation. So, one of the known quantities are the sales of these products.

So, we said all right, a simple way to start this is just to say, okay, what are sales in total and how much money did we put against that? And the impact was huge.

We knew that was a very rough way of doing that, so we started meeting with people, meeting with some economists, meeting with our analysis department, and we decided that we wanted to use this input/output model.

Another aspect that we were really interested in learning about is the jobs impact. As Jean mentioned earlier, everyone wants to know about jobs. And we know it wasn't, again, as simple as just taking our sales dollars and assuming that, you know, X number of sales equals X number of jobs. I mean that's the way we had been doing it, but we wanted to have a methodology that was sound and that people bought into.

So, we started using this macro economic model and what we did is we just fed in our sales numbers, and we've been doing this for three years. So, what we've seen is that our leverage ratio, or change for every dollar spent in product development can increase the gross rate of the state product by 5.2.

Additionally, we have seen over 750 net jobs, or 5,400 job years. The job year idea is that for X number of sales in a given year it will support X number of jobs. We're not assuming any kind of cumulative impact. There's, you know, the sales related to the jobs.

And then, you know, the cumulative impact of GSP is, you know, $785 million.

The next slide, please. So, here's an output of that macro economic model. So, one of the things that we first started doing, now at this point about four years ago, is just feeding the sales numbers in. We knew that that wasn't necessarily fair because we can't assume that our dollars were the only dollars that were contributing to those products developed.

So over the past couple of years we've been trying to get an understanding of what the outside, private funds go into develop those products, as well as any other program costs charged to ratepayers, like what was the opportunity cost, as well as any kind of evaluation and measurement verification.

And so, I mean what I simply want you to see is that even that we added those things into the model trying to get an attribution and there was still a large ratio of benefits to the cost supplied to the product development program.

The next slide, please. Okay, so one of the things that also we're trying to understand for the product development impacts is there are a lot of assumptions that went into the macro economic model. One of the things that we assumed was that our dollars weren't necessarily the only influence in getting these products to market, but we realized that we are providing funding in a critical time of development. We're working with a lot of start-up companies and without our dollars the probability of failure was pretty high.

The additional thing that we're trying to understand is how our dollars impacted the time that it took to get those products to market.

So, what we learned from that is that on average it took about four years, so we had to apply that to the model as well in terms of applying the -- when the costs incurred to when the benefits were realized.

The other thing that we were -- you know, we wanted to try to understand is we used a very conservative approach to the sales dollars, we used it based solely on the dollars that we were receiving in the royalties, but we knew that there wasn't necessarily high compliance in reporting. So, what we try to understand is what is that relative level of sales?

And what we learned from our product development survey is that realized sales were actually much higher than reported.

So, essentially, what we did with the product development survey is that we proved the majority of our assumptions and through that we felt very confident in the assumptions that we -- the outcome of the macro economic model. We also had a much better understanding of what our impacts were and the people that we are working with.

The next slide, please. So, we wanted to sort of take this a step further. One of the next things that we were hoping to do is look at our demonstration type projects. And so those are, you know, demonstration of commercially available products in the market, as well as on-site power, and then we also have an industrial process improvement.

And the idea behind these types of projects is that especially for the on-site power, renewables, as well as, you know, the technologies that are commercially available is that we -- we fund these projects in order to increase market awareness, as well as increase market adoption.

We knew that there were on-site benefits, but what we didn’t have a sense of is the scale of the relative impact, or the spillover effect, or what we’re calling replication. So, we wanted to understand what the true impacts of these programs were as well as understand what -- you know, we had a basic understanding of the on-site benefits, but we didn’t have a full understanding.

So, we looked at demonstration projects that were completed within a certain time period, we knew that we need to give them a couple of years in order for them to be completed, in order to see benefits or spillover effects. So, we chose at this time period, you know, a couple of years after the projects have been completed.

We also were trying to understand what the free ridership aspects were, so how much -- how many of these projects would have gone forward without our help. So, one of the things that we realized through the survey is about 20 percent of the projects would have gone forward without NYSERDA’s dollars.

So, what we found were about, you know, around 74 percent of the respondents reported they had replicated the technology, mostly in a similar market or application.

And then, 49 percent of them reported replicating it within New York State.

So, we are seeing some impacts both within and outside of the state.

The exciting part of the demonstration survey, as we saw, that there was potentially around 60 percent of increase to benefits. So, we knew that there was some level of replication. You know, we only surveyed about 50 projects so, you know, the impact is potentially much larger than what we had previously measured.

One of the things that going forward for our evaluation activities is that we hope to capture replication for a larger number of our projects and understand what that total benefit is.

One of the, I guess, hardest challenges of understanding spill over effects is really where to draw the line. So, do we talk to -- you know, we talk to our technology vendors, the people that are going out there, and then we talk to the other people that they're working with and then, you know, do we talk to the people that they've worked with? And, you know, really where -- the possibilities are endless, so where do we draw that line of how do we understand what those benefits are?

The next slide, please. So, one of our other evaluation activities was to take a handful of our large winners, as we called them, or products that we've paid for the development of. Again, one of the things that we're trying to understand is what are the realized savings and what are the projected sales for these large winners, or products that have had, you know, over $50 million in sales?

So, we've done about four to date. And, I apologize, I should have brought some more key findings for these specific projects. But, essentially, what we're trying to understand is that the benefits, again, far outweigh the program costs.

We're not -- we're trying to decide if whether or not we're going to continue to do this. This is a different scale and very specific. What our traditional evaluation activities have done is looked at full program impacts rather than individual products, but it was an interesting, I guess, endeavor to understand what the total projected benefits were for these projects.

The next slide, please. Okay. So, one of our biggest challenges in all of these evaluation activities we've done in the last few years is actually getting the data to understand what the impacts were.

So, we realized even just having the contact information or understanding the baseline information it was very difficult to do after the fact. You know, we had, you know, some retirements. We have people in these start-up companies moving around, it was very difficult to get at that baseline data.

So, what we decided to do was to create a database that would capture all that information to allow us to evaluate our programs better.

So, we started around three years ago to design a database that could track the progress and outcomes, and we would be able to accurately produce reports. And our ultimate goal is to provide a full benefit cost ratio for all of our programs.

The next slide, please. Okay, so one of -- again, another one of our challenges was having a common language across all of our programs so that we could look at them in the same way, aggregate benefits and be able to manage our portfolio better.

So, one of our first -- or first orders of business was to come up with our technology taxonomy, so making sure that all of the different programs were speaking the same language and talking about the same level of technologies. But that also allows us to understand, okay, well, what are we doing in product development for like a power supply, or what are our total energy savings for discrete building technologies?

The next slide. A couple of other key concepts is grouping our projects so that we would make sure that we collected metrics, the same metrics for the same types of projects. So, you know, for instance product development projects we'd collect all of the same types of metrics.

As well as having a sector list across all of our programs that was the same. The important part of that is, you know, in order to feed into our macro economic model, we needed to have the sectors that we were working with.

And another, you know, part of our new language was the key words, so being able to get at sort of buzz words so that we could be able to identify certain aspects of our research.

The next slide, please. One of the most important things and certainly took one of -- some of the longest time, is making sure that we were using all of the same -- measuring all of the same resources across all of our programs for energy, non-energy, and air emissions resources.

The next slide. Okay, so one of the things, again, product development is a really important area of our research and we wanted to understand what our total development costs were for our product, as well as following that product through its development cycle and understanding some of the outcomes of that product.

The nature of our work is that we, you know, we have -- could potentially have multiple contracts with a single contractor to develop a single product, so we wanted to be able to make sure that we weren't double counting. So, we created a way to sort of track a single product in our system and follow it all the way through.

The next slide. So, looking at our products and this is sort of short list but, you know, a key metric, again, is looking at the product sales, looking at any kind of follow-on investment, including the private, as well as federal funds, you know, any other kind of outside investment.

What kind of patents were procured as a result of this product development?

Where the product is in its development stage?

And sort of the Holy Grail of product development is what are the resources savings? One of the things that we're trying to get at is the total impact of these products on the New York State market when they're sold in the market and what the total savings would be for that, for all of our products, as well as understanding, you know, where they're landing, what sectors they're landing in.

And in addition we have, you know, sort of interim metrics of, you know, any kind of licenses, certifications, ULS things, et cetera.

The next slide, please. And our demonstration type projects, so we're trying to understand, again, the resource savings, and a lot of this is the on-site resource savings. So, as well as when we're talking about fuel switching what kind of resources are being used when we're talking about fuels.

And again, we've always measured our power production.

This is, I think as well, not a total list, but I think just to give you a sense of what we're looking at. You know, your standard energy, air emissions, and non-energy savings.

As I stated earlier, we have a lot of industrial process improvement projects that see a lot of large-scale, non-energy savings in the state.

The next slide, please. Okay, so looking at our demonstration projects, as I just said, we have our energy, non-energy and emission savings. We're trying to also understand fuel switching for our transportation projects.

One of the things that we're trying to get at is job retention or creation. We haven't fed our demonstration projects into our macro economic model, yet, so we're still trying to measure it on a project level basis.

As I mentioned before, with our demonstration survey we're trying to understand replications or the spillover effect of these demonstration projects. Again, trying to get at interim metrics of understanding the status and the scale, where these are in development so at any point we can understand what our portfolio looks like.

And for our power production projects we're measuring the output as well as the system size and capacity factor.

And as well as, I forgot to include here, is peak KW reduction.

The next slide, please. So, then we have, also, our information type projects. So, these are pure research studies. A lot of them are used to inform policy, so we're trying to understand what kind of publications are developed, where are they landing, who is siting them, what kind of policy influence they have, as well as any other vehicles where we're trying to get the information out to the public.

The next slide, please. As I stated earlier, we're doing a lot more in business development. Again, we're trying to understand what the sales are from these business development projects, keeping in mind that a lot of our product development partners wind up with -- in our business development program. So, it's really important, again, for us to track, on the product level, what the impact of the metrics are.

We're also trying to understand the jobs, very important, so working within our programs, our incubator programs, our training programs where are these jobs being created and how are they being retained?

We are working with I believe, now, six incubators within the state, trying to grow clean energy businesses. So, understanding who those clients are, how many there are, how many of them are successfully transforming their businesses into viable businesses in the state.

And then we also do some manufacturing incentive programs where we're trying to increase capacity of clean energy technologies within the state, as well as transitioning executives that are currently working within certain industries in the state and want to transition into clean energy businesses, so we're trying to work with them to make that leap so that we can continue to grow the clean energy technology business in the state.

The next slide. Okay, so just to give you a sense of the sort of things that we're looking at in our database, and I should add a little caveat, is that we're still in the process of populating our database and these are not -- some of these numbers have not been QC, so keep that in mind.

So, one of the things, again, we're trying to look at, it's not enough for us to just do these one-off benefit assessments, we want to try to do a better job at managing our portfolio.

So, we're looking at trying to understand what our expenditures are, where we're focusing our money based on the project type.

The next slide, please. And then looking at, okay, when we're doing product development activities what technology areas are we focusing on?

The next slide. And then we can even drill down to another level if we want to look at building systems products, you know, where is the focus in our building systems?

Again, a lot of this information we kind of knew, but we didn't have a way to really analyze it before.

The next slide. Again, looking at our on-site power projects, understanding, you know, how many there are, which discrete technologies we're working within? And if we wanted to, we could drill down and look at, you know, the size of each of those technologies, what they're output is, where they are in the development process, et cetera.

So, next slide, please. Again, trying to understand our portfolio, you know, trying to get a better sense of where products are in their development, being able to speak to how many products are in development, when we can expect them to be commercialized. So, this just gives you a sense of some of the product development aspects we're looking at.

The next slide. And we're trying to focus a lot more on business development, so a lot of it has to do with understanding that the companies that we work with, so again, this proves our assumption that most of the people that we're working with are either research organizations or, you know, in an early stage of their development. So, again, it helps us to try to understand how -- the nature of the companies that we're working with and how we can help them advance their clean energy technologies.

The next slide. Again, another way of looking at who we're working with, so looking at a specific research program and, you know, the sectors that we're working with within that program. Again, it's something that we assumed, but it's good to know that our assumptions are correct.

The next slide, please. Like I said before, sales are a really important aspect of our metric, so being able to have annualized sales numbers, being able to look at trends, this is really important for us to track in our database. It's something that we have been tracking but now we can be able to slice and dice that based on different technology areas, or different programs.

The next slide. You know, I believe leveraging was mentioned earlier, so trying to understand our leveraged dollars. Again, this is looking at just simply business development projects.

This is looking at simply just what are companies -- the cost share that the companies that we're working with are contributing to the projects?

One thing we're still trying to get out is the level of outside investment that we're stimulating.

The next slide. And again, you know, the energy power production is something that has always been important to us and that we've been tracking. So, again, being able to look at that by technology, or look at in a time-based period. You know, our database is allowing us to slice and dice the information however we want to or need to look at it.

The next slide. Okay. So, looking at the bigger picture, one of the things that NYSERDA's been trying to do across the board is look at our key performance indicators. So, it's not enough for our deployment programs to be measuring the energy efficiency impacts, or research and development just looking at their sales.

We're trying to come up with a common language across all of our programs so that we can understand what the impact is, you know, and how we're meeting our targets across the organizations.

So, there's a lot here, I'll just kind of touch on each one, briefly.

You know, the efficient use of energy. This is, you know, traditionally our deployment programs that are incentivizing equipment to go into the market.

We're trying to get at, you know, how our demonstration programs contribute to efficient use of energy.

The renewable and diverse energy supply so, again, across the board for all of NYSERDA, looking at the number of operating systems, the electricity output, looking at our cogen, and then for our transportation projects looking at the petroleum displacement.

The clean energy economy so, again, this is something that's really important to NYSERDA in understanding the economic impacts, especially in this time of financial trouble that we're having across the world.

So, how are we impacting the New York State economy? So, we're looking at the number of products that we've gotten to the market, what are annual product sales? What are some sort of interim outcomes, as I've mentioned before, the patents, the licenses, the other knowledge certifications?

The jobs is a really important metric as well, and I mentioned that with our macro economic input/output model, we're trying to understand that, as well as the change in GSP.

We also want to know how many clean energy businesses that we're working with and how those numbers change through the years, and how much we're investing in business development.

And from there we look at the cleaner environment. So, looking at those energy savings, what is the CO2 impacts, what are the NOx and Sox impacts in New York State?

And again, looking at our key performance indicators, we want to make sure that our customers are satisfied, so we are trying to show how we're efficiently doing our job at meeting these goals.

The next slide. Okay, so some challenges that we're having in our transformation to try to do a better job at evaluating our program. So, our number one challenge is getting the data from our contractors. So, I'm hoping, you know, to maybe hear about that throughout the course of the day, how people are getting their data. But we're struggling to do a better job at that and try to see if there's any kind of incentives we can give or, you know, maybe work with some outside parties to do -- to help us get this data.

One of the hardest things about quantifying research and development is a lot of these impacts occur outside of the time that we're working with these companies. So, we pay for products to be developed, but it takes four years to be developed. At that time our contract is over.

You know, we continue to see savings for our demonstration programs and usually, you know, the project is over after the equipment is installed, so trying to understand the continuation of those savings.

You know, one of the things that we're trying to do with the database is really understand our whole program analysis. In the past we've done sort of sub-program analysis, so we feel like we're in a better place to be able to do that and really look at the entire program as a whole and see if we're, you know, spending our money in the right places.

One of our challenges, we're doing a lot more by way of smart grid and energy storage, electric vehicles, so understanding how to evaluate those type of programs.

Another thing we're trying to look at is a measurement of environmental impacts and how that can translate to economic development potential.

So, I'll give you an example of our biomass research program, which is a joint program with our building systems and environmental research program.

So, of course, the environmental researcher in that program is very concerned with burning of, you know, wood combustion and the impacts, particulates and that sort of thing in rural areas, as well as in schools.

Well, the person in our buildings research program has been working with manufacturers in New York State to develop better and cleaner wood-burning technology.

So, having that key partnership and understanding the environmental benefits really can lead to increased economic benefits if we play our cards right and really try to work with the manufacturers, assuming that they're willing to work with us.

And then the last thing is really understanding the relationship between the technology and business development. So, we've been doing technology development for over 20 years and we know that it's not enough for us to just give money for product development. We want to be able to grow clean energy businesses within the state, so we're really trying to do a better job in helping them making that leap, and crossing the valley of death.

And, you know, making, you know, getting key partnerships, understanding how to better commercialize their products. Helping them try to find venture capital, additional investment that they need to make their business stand on its own.

Okay, the next slide. So, future evaluation, as I showed before, we're looking at key performance indicators. We’ve done a couple of dry runs across the organization, but we’re trying to do that consistently and come up with a good methodology for how we can continue to show progress towards our goals throughout the organization.

We’ve made a promise to track our applications of our demonstration projects across all of our new programs. So, that’s one of the things that were going to try to do continuous surveys on and try to reach our partners that we’re working with, and understand that spillover effect.

Our next step of the macro economic model is adding energy savings and as well as renewable energy production so, again, trying to expand our benefit cost analysis.

And we will continue to conduct surveys and try to understand the full benefits of our programs and product development, as well as demonstration.

The next slide. That’s all I have, thank you.

MS. BARONAS: Tara, thank you so much. And if we could hold the questions, okay.

So, I’ve been informed that Mike Holland has joined us, so if it’s okay with the remaining panelists if we go to the original order of the agenda, any objections?

Okay, hearing none, moving on to Dr. Pete Whitman of U.S. Department of Energy, Policy Analyst. Pete, your slides are projected.

MR. WHITMAN: Hello?

MS. BARONAS: Hello, we hear you.

MR. WHITMAN: Great, thank you. Good morning, my name is Pete Whitman, I'm a Policy Analyst in the Office of Policy and International Affairs, in the Department of Energy.

This morning I'm going to talk about a project that we have been involved with, which is doing benefit analysis for the Energy Efficiency and Renewable Energy Office of the Department of Energy.

Using two models, one is NEMS, which is the National Energy Modeling System, which is the primary model which is used for the annual energy outlook from the Energy Information Administration.

And the second is a MARKAL model, one of the family of MARKAL models called -- our version is the DEO MARKAL.

Next slide, please.

MS. BARONAS: You can control your slides, if that's okay, Pete. Or we can, however you want to do it.

MR. WHITMAN: I have no idea, sorry.

MS. BARONAS: Why don't you go ahead, Cody, if we can stay in charge of the slides. Okay, your next charge is projected.

MR. WHITMAN: The order of my presentation is I was going to run through our four questions and then talk more specifically about the analysis that we've been doing.

Question one, the DOE, the Energy Efficiency and Renewable Energy is, of course, in charge with RD&D, research, development and deployment of technologies associated with both energy efficiency vehicles and renewable energy.

This particular project used those two models in order to evaluate the benefits, primarily, as we know, energy benefits and economic benefits of the various portfolio of the research and development projects within EERE.

In general, we look at oil dependence or oil independence, the percentage of petroleum usage coming from imported sources.

Secondly, and also equally important is greenhouse gas reductions through the development of these programs.

And in addition to that, the models are -- allow us to be informed about the economic benefits, including the consumer, reductions to the consumer, and expenditures for energy, and various imbalance of trade issues.

The next slide. There we go, thank you. In general, the way this analysis is done is the individual program offices establish goals and research funding requirements. And the models allow an integrated assessment of the performance given the goals and the research funding that is approached.

So, in the modeling, our modeling in particular, learning by doing; in other words as technologies come in and technology penetration are an important part of the evaluation of new technologies.

The purposes of looking at this RR&D is taken into account in the assumptions going into our modeling of private -- both public and private effects.

So, part of what the modeling illustrates is that we attempt to illustrate the impact of program goals when the funding is reached. And part of that is just the idea that public and private funding would be necessary in order to reach the program goals.

And this particular form of the analysis was accomplished last year. The department has also added an uncertainty analysis using elucidation through experts on the field to understand the probabilities of and uncertainties of new technologies. And those are added in to either these models or other models to attempt to understand the value of the research and development.

Next slide, please. Under our systems, the general purpose of the benefits analysis, we're trying to look at, through these models, the interactions between the technologies and the various programs because they could have differing effects. As one program comes into place there's a price impact on the fuel, which could have a deleterious impact on some of the other programs.

Secondly, there's competition for resources and implications on stock turnover, and the physical constraints in changing the system, all of which these models use so we can evaluate the programs and integrated portfolio of the programs within EERE.

The purpose of this exercise is to allow us to evaluate the portfolio of technologies that are associated with the Energy Efficiency and Renewable Energy office and align it with our public needs.

The value also, of course, is that it allows us to support the GPRA, the Government Performance and Management Initiative, analysis that we're required by law to do.

The next slide. In general, the way we evaluate it is that the models have a base case, which assumes a certain level of technological improvement. And from there the scenarios attempt to add in the program goals, which is the value of the technologies assuming the funding comes through.

And these are based on the stated goals that each program office provides, which are input into the model.

The benefits, of course, are for the future program be given up the budget up to this point, rather than any addition -- additional funding.

And the value the, of course, is current laws and regulations including such things as CAFE standards, which influence the light-duty vehicles, and other policies are incorporated within the base case of the model.

The next slide, please. Both of these models, the NEMS, which is the National Energy Modeling System, and MARKAL are consistent economic frameworks. They have differing time frames, they have slightly different ways of handling technology. But in particular they allow a similar, but two different takes upon the value or the evaluation of these programs.

In particular, what these models allow us to do is to see the interaction, both direct and indirect, through the price of energy, which may or may not change the deployment of the various technologies.

In addition to just the straight technologies and the scenarios, we also include various additional scenarios under alternative energy, high-oil, low-oil price case and various environmental policies; for instance, a tax on carbon.

The next slide, please. In general, we have a no program, a base case which is very similar to the Annual Energy Outlook's reference case. And from there, there are a set of single programs; for instance we have energy efficiency, there's certain renewables, wind, hydropower, geothermal, et cetera. We put in individual cases and then from there we look at subsets where there's an interaction between the program goals, the valuation of the program goals.

And in addition to that we add alternatives, as we said, with high- and low-energy prices, with carbon mitigation policies, additional -- additional scenarios with, say, CAFE standards, those kinds of things

The next slide, please. Here, I'm just going to describe some of the current results of the last year's evaluation of the EERE's energy research and development portfolio.

In particular we're looking at the PV, the photovoltaic case. The program office helps decide what the base case would be. We show here the annual energy outlook base case, reference case, the base case associated with the program office and, in this particular case, the assumption based on what the research development goals would be on the PV.

And in this particular case we show commercial and residential PV systems. As you can see, that given the program goals there's an immediate drop in cost. And from there the rest of the modeling illustrates what the cost would be taking into account market penetration and learning by doing it, and the other factors.

The next slide, please. In general, here's the complete list. We have the efficiency program, such as buildings, and weatherization, industrial technology and, of course, FEMP; the renewable energies, solar, wind, geothermal; and alternative fuels which in particular are biofuels, such as advanced -- advanced ethanol and cellulosic biofuels, hydrogen fuel sides and the vehicle technologies which includes battery costs, and battery -- the advanced battery program.

The next slide, please. In general, this is the list of the types of benefits the integrated energy models can report to us. In particular, from the economic side, the energy expenditures, the change in residential or a change in person consumption price of the energy, total consumption of energy, carbon dioxide emissions, or CO2, or greenhouse, full greenhouse gas emissions.

Security benefits, in particular. We value reduction in oil imports. And, of course, the various metrics associated with the power sector, including renewable energy, percentage of renewable energy.

And, also, within the vehicle technology the percentage of advanced vehicles, which would include fuel cell electric vehicle and, of course, hybrids.

The next slide, please. This is an illustration from the fiscal year 2011. As we can see, this is the oil imports, in other words in millions of barrels per day, the reduction associated with the EERA programs, without EERA programs.

In particular, the programs that influence oil consumption would be the light-duty vehicle and heavy-duty vehicle research and development; this includes hydrogen, and fuel cells, and batteries for advanced plug-in hybrid and electric vehicles.

The next slide, please. Here’s an example of the analysis for CO2 emissions reductions. We can the EERA portfolio is the dotted line and we can show the contribution of each of the individual programs. The point behind this is that the total contribution is less than the individual contribution as assumed of the different portfolios because you get interactions between the various programs, program offices, which change the price of different fuels, among other things, and cause certain programs to be more or less effective.

Similarly, there's competition for resources which would restrict one program relative to another.

The next slide, please. The current regulatory policies are included within the base case. As we pointed out, in particular we examined, because we have a large renewable fuels portfolio, then the power sector, the state RPS's and the current set of incentives are already fairly advanced, so there's relatively small improvement or additional renewable capacity even with our programs.

Secondly, the CAFE standards in the light-duty vehicles are relatively strict, so there's a limited amount of additional improvement that could be seen at least over the next 20 years or so on adoption of new vehicles and advanced technologies.

However, R&D improvements could definitely influence the ability of the new future policies that could be more restrictive than current.

The next slide, please. In particular, the various types of current regulatory policies change the benefits of R&D because we would have to meet those goals anyways.

Two examples, in the CO2 emissions it's because we already have environmental restrictions on various types of power plants.

Secondly, from this perspective, we also have on the light-duty vehicle side, as we've said, a very relatively extensive CAFE standards for light-duty vehicles, and we have upcoming greenhouse gas regulations for heavy-duty vehicles going forward, so those are already relatively restrictive.

Therefore, the ability of the R&D to actually improve against or above the current laws and regulations is somewhat lower.

The next slide, please. For instance, this illustrates in the total renewable generation. For instance, biomass is limited or in competition between various kinds of -- between power generation and use of a biofuel. So, you could get competition between the various technologies, which would reduce the ability or the affect of any particular portion of the R&D portfolio.

MS. BARONAS: Pardon me, Pete. This is Jean

Baronas, with the California Energy Commission. Would you please conclude your remarks in five minutes?

MR. WHITMAN: No problem. Thank you. The next slide, please.

Variously, the -- something like a carbon cap would also have a significant impact because it would have the same kind of result in that one would have to meet the particular CO2 restrictions, anyways.

This is an example showing the technology improvement with and without a Waxman-Markey type.

The next slide, please. And, very briefly, electricity generation showing under a cap, of course. The magnitude of how the R&D program is affected when you have a cap of course is much different. You can see, obviously, that conventional coal drops and we get a significant -- or a significant increase in renewable and other energy.

The next slide, please. In general the problem, as you can see, the problematic goals that are input into the model may or may not be consistent across the various program offices. In general, the interaction of those goals and, in particular, the mixture with private money and getting to a learning by doing may or may not -- it's difficult to model within this energy framework.

Therefore, there is a wide range of technologies, as we said, and so there's a great deal -- and, in particular, there's uncertainly on the efficiency side because the consumers are much more difficult to predict than in the supply side.

The next slide. Thank you very much, that's our presentation and these are the two primary workers for on location, and Chip Riley, from Brookhaven National Laboratory. Thank you.

MS. BARONAS: Okay, thank you very, very much.

Next speaker, Mike Holland, United States Department of Energy.

MR. HOLLAND: So what do I -- how do I advance my slides?

MS. BARONAS: We'll take care of that over here.

MR. HOLLAND: Okay. You can --

MS. BARONAS: This would be 07?

MR. HOLLAND: Yes. Okay, you can -- actually, you can skip ahead one.

MS. BARONAS: We have your four questions and now we've got your graphic.

MR. HOLLAND: Okay. Before I start talking to the slides I just want to sort of probably explain the difference between how I look at this and probably some of the other people.

I've always worked in oversight bodies and so am more a consumer of evaluation information and measurement information, than a producer of it. And so I have been at the Office of Management and Budget, the Office of Science and Technology Policy, and the Health Science Committee. And now I'm working for an undersecretary here in the department.

And so I'm always trying to figure out how to use the information, the performance information, the data that the programs are providing to me to explain something about the programs to my bosses, who are trying to make decisions.

And so the thing I want to emphasize, you know, over, and over, and over again is it's about context. If you're doing the evaluations, a lot of times the incentive is to really focus on the rigor, the methodology, the generalizability of the answer, the correctness of it, something like that and at times lose sight of the policy context in which they'll be used.

And so the thing to keep in mind on this slide is if you're down -- you know, if you're a program evaluator in a program, you are closest to the program managers and the performers.

And I have spent most of my time dealing with a basic research program, the $4.8 billion Office of

Science. And in that program things are aligned along -- along the sort of disciplinary lines, high energy physics, nuclear physics, material science, so on and so forth, and the people in the program are most comfortable in talking and thinking about things in terms of scientific opportunities. The, you know, nano science, atomic, molecular, optical physics, elementary particle physics, something like that.

The thing is that the decision makers, whether they're in the White House, in Congress, at the head of an agency are trying to reconcile the programmatic wants and needs, and opportunities with the societal demands, and those are not organized along opportunity -- you know, the disciplinary lines or the technological lines. Those are, you know, these broad things, defense, energy security, or energy reliability, economic security, health, you know, a clean environment, secure food, or an abundance -- you know, a clean water supply, abundant food, something like that.

And so any time you're using these metrics there's this enormous tension between the logic of the program and the logic of how you derive that metric and the policy context in which it will be used.

And at every stage, whether you're the program manager, the program leadership, whether you are an executive within an agency, whether you're, you know, within a White House office, or a member of Congress, or a chairman of a subcommittee, or a chairman of a full committee in Congress the balance between what's policy -- or, you know, what the policy driver, the policy interest is and the specifics, that the specific detail varies widely.

And so if you -- you want to be able to think through how that metric and how that measure will be used in the debate, and make sure it's well linked to the policy drivers.

Okay, next slide, please. So, the thing that I want to do is not focus so much on the particulars of how the Office of Science does its evaluation, and the easiest thing to think about the Office of Science is it has four big pieces of its portfolio. It builds and operates big, scientific facilities. These are light sources, neutron sources, super computers, colliders, all sorts of things like that.

And then it has research programs that it supports, very fundamental research. And it spends money at the DOE National Labs, Argon, Brookhaven, Berkeley, places like that, and then it has a big university research program at some 300 universities across the country.

And trying -- and it has techniques for evaluating the performance of each one of those types of spending. But I want to walk you through the simplest case and how I think you -- that you most -- or at least for somebody who used program performance information, I'll show you what I think is the most effective use that I was able to make of it.

And it's the -- the clearest case I have is one that was -- that built out a suite of big facilities, something in excess of -- I think the recapitalization cost would be on the order of $6 to $8 billion for these facilities.

And that's because there's a stable research policy in the United States for basic research and that is the government R&D programs should be looking to the research, the relevant research community for -- to articulate priorities and then the government program responds in helping that community realize those goals.

So, in 1984 the material science community got together, they put -- the National Academy had them grapple with where the scientific opportunities were and what their big asks were.

They came out with this report, Major Facilities for Materials Research, referred to as the Seitz-Eastman Report. And that study called for four things, a hard x-ray light source, that's the 6 GEV synchrotron. It asked for a advanced steady state neutron source, that's a reactor. It asked for a soft x-ray light source, that's one GEV synchrotron, and it asked for a pulse neutron source.

So, there was a -- there's a policy that says, you know, ask the community, the community gave us the answer, so that's the first part of the story. A stable ask and very good policy clarity.

On to the next slide. Then the next component of this is understanding how the politics is resolved. And so the Director of the Office of Science, at that time it was called the Office of Energy Research, in 1986, crafts a solution where he takes three things off of the Seitz-Eastman list, that's the 1 to 2 GEV synchrotron light source and he sort of says, gives that to Berkeley. That's now the advanced light source.

He takes the 6 GEV synchrotron light source, gives it to Argon National Lab, that's the advanced photon source.

Takes the advanced neutron source and gives that to Oakridge National Lab and that's the -- it would have been the advanced neutron source. But in the process of this plan being build out, Three Mile Island happened and so there was no way we were going to build a nuclear reactor for neutron scattering.

So, they went back to the original report, the Seitz-Eastman report, and pulled of that pulsed neutron source. That's the Spallation Neutron Source that was built at Oakridge National Lab.

You notice that, you know, there's a light source in the east -- or, I mean, a light source on the West Coast, a light source in the Midwest, a neutron facility in the Southeast. And the political compromise was, you know, the Northeast needed its thing, and so Trivelpiece pulls off of a totally different report, but equivalent, the relativistic heavy ion collider, that's now built at Brookhaven and is operating.

So, it takes from 1984, the Spallation Neutron Source was the last one of those built. It turned on in 2006, so it essentially takes 22 years to execute the plan but, you know, we have -- again, we have a clear ask, we have a stable political arrangement that everybody can understand.

Go to the next slide, please. And then here's where the performance measurement and the performance metrics come in. And that is the purpose of these facilities was to deliver something to the science community.

And if you look -- you know, this is --

everybody's been talking about much, much more sophisticated measures, performance measures before this, but the point is that a strong, clear linkage of a metric to the policy purpose is better, in my opinion, than a very complicated, very detailed model or analysis that isn't, you know, absolutely obvious sort of on first sight.

So in this case, since we designed and built these, and the policy purpose of it is to provide something to the science community, if you look at that, if you look at the chart it's showing the number of users, by year. And so the line is showing that, you know, in 1990 you've got 2,000 or so users. This is an old chart. In 2004 it was approaching 8,000 users, and this is just for this suite of four light sources.

But the interesting thing is if you look at the bar charts, the purple and blue, kind of, and beige colors are the academic disciplines and those -- or the bar chart's about disciplines.

And the darker colors are the people who asked for the machine, that's the material science community at that point.

And over time, as we see this enormous growth in the number of users, we're actually seeing entry of a new class of users, and that's the green bar. Those are the life sciences users. Structural biologists, they're overwhelmingly funded by NIH and they're using these DOE material science facilities.

And what's great about this graph is it allows me, as an oversight staffer, arguing on behalf of, at the time, actually, a replacement for the national synchrotron light source, that NSLS machine that's in sort of quadrant one of the four pictures. The replacement machine for that NSLS-2 was a billion dollar class facility and it was coming up for a decision. And the question was going to be, you know, do we in tight budget times build this machine? Do we retrofit something else or do we just shrink down to three light sources and let that be enough for the country.

MS. BARONAS: Pardon me, Mike, this is Jean.

MR. HOLLAND: The fact that I was able to use this year plot --

MS. BARONAS: Hold on, please.

MR. HOLLAND: -- to show that, you know, the suite of facilities is performing better than expected and is providing greater service than initially intended, that's what allowed me to make the case.

And then the last slide.

MS. BARONAS: Okay.

MR. HOLLAND: And the thing is it's -- you know, then you want to also come up with systematic evaluation to back up that story to show that the facilities are being managed.

And if you look into these two studies, I'm not going to go through them in any detail, but Birgeneau-Shen and the Petroff report, both of these are available on the website for the Basic Energy Sciences Advisory Committee.

In this they developed a methodology for looking at scientific impact, they applied it to the four light sources all at the same time. One of them wasn't performing well, that was the advanced light source. They took some management corrective actions.

They go back with the Petroff report, apply the exact same methodology again, what is that three years later, and show that the management and the performance of that under-performing light source had been turned around.

This is the kind of thing, from a programmatic, from a budgetary perspective, from a management perspective this is like the best story I have.

But it allowed me to sprinkle the story with the relevant performance metrics, not any performance metric.

And with that I'll conclude.

MS. BARONAS: Mike, thank you. Thank you very, very much.

Moving on to Dr. Linda Cohen, from UC Irvine.

MS. COHEN: Jean, I see where we started early and we're ending late, what kind of --

MS. BARONAS: You have 15 minutes.

MS. COHEN: Okay, thank you.

My name is Linda Cohen, I'm a professor of economics and law at the University of California at Irvine.

And I was fortunate enough to be on a number of National Research Council Committees over the past ten years, I guess, and Jean asked me to report on the way that we decided to do these methodologies.

Can I have the next slide, please. So, the NRC did a series of studies trying to think about and actually assess benefits of the programs at the Department of Energy in EERE, and the energy efficiency and renewables area and in fossil energy.

And I thought it really interesting listening to the previous two discussions because I see that a lot of what we did really fits very well into what the Department of Energy is doing now, which is really nice.

So, the first study that we did, we started this one in 2000, and the job that the NRC had been given at that time was to go back and evaluate the benefits from the Department of Energy's work in these two areas, their R&D in these areas between 1978 and 2000.

And we came up with a book called "Was It Worth It?" and I'll answer that in a minute.

Considered 39 different case studies, nearly all of the fossil energy work was included in our evaluation. The fossil energy are these big, huge projects in coal, nuclear, and so on, so it was easy to sort of pull them all together.

In energy efficiency there are hundreds of small projects and we tried to take some of the more important and some of the more representative.

And I'm going to get back to those numbers again in a minute. This project was then -- then the NRC was asked to do a follow-on study to think about how to measure the prospective benefits of programs and projects that were then underway at the Department of Energy.

And we worked hard trying to develop a methodology and I'll talk a little about that.

The next slide, please. The retrospective methodology was built around what we called the benefits matrix. One of the things that clearly distinguishes DOE from this discussion in New York is it sounds like the NYSERDA program is very involved as an economic development program, that that's a really important component.

At the Department of Energy they cared about the economics, but the goals of the program really weren't economic development. The goals of the program were -- we wanted to be -- the goals really had more to do with energy efficiency and environmental benefits, and trying to do this in a way that wasn't going to bankrupt the country.

So, the economics was we want to do all this stuff that is pretty expensive and is there some way to do it that isn't so expensive? But, basically, we were trying to -- I guess it -- I think it's fair to say that if we can break even, we're doing well, so they really weren't looking at economic development.

Even thinking about this as a retrospective study we had to consider benefits kind of in different categories. One was what had happened so far.

So, this was, you know, we were looking at 22 years worth of outcomes, but it was still the case that a lot of -- that only some of the benefits that were important we could actually observe and measure.

So, we separated it into three categories, one were realized benefits, one was the so-called option benefits. And what this really had to do with was we've developed -- the Department of Energy has developed some methodology and in the event that, say, oil prices go up this might become a really valuable technology, but it isn't being used, yet, or it hasn't penetrated, yet. So, that was the idea of the option benefits.

And then some of the programs that they were doing really weren't product oriented and a lot of the outcome that they were interested in had to do with this idea of knowledge.

Could I have the next slide, please? So, since we were a small committee and had to come up with some numbers, we imposed some assumptions on it to make the problem doable, as it were.

One of the ones that infuriated the Department of Energy, and if you guys are still on the line, I hope maybe you've forgotten by now, was we insisted that you can only count benefits for five years into the future, under the assumption that more technology is going to be developed, somebody else would have done it by then.

Five years, obviously, isn't the right answer for every project, but it was something that we just insisted on because forever also, obviously, isn't the right number, so we sort of had to come up with something

We were -- as all of the other speakers pretty much this morning have said, what we tried to do was focus on the change in the value of goods and services, or the change in the quality of the environment thanks to the technology. And we'll get back to it. I think that is one of the critical issues that one has to think of when talking about, you know, who deserves the credit, as well.

And then this, again, at the federal level one of their goals is security benefits which, at the time, really was focused on the possibility of avoiding macro economic or large shocks due to change, due to the price of oil. So, if you could save in imported petroleum, that was going to give us some benefits.

The next slide, please. And I've kind of gone through this already, different kinds of benefits. This turned out to -- the reason that we then put it in as a matrix was it turned out that we had a lot of discussions about this that it was really going to be -- it wouldn't be a good portrayal of what was going on in these projects if one tried to aggregate them all into a single number.

That what we knew for sure were these -- the first category of actual realized benefits. The options, these are much more speculative. If you try putting them together in one number, you're probably doing a disservice for trying to characterize the program, and that was why we came up with this matrix.

Next slide, please. Broad summary of conclusions, so this was, again, the retrospective analysis, it turned out -- the energy efficiency programs and we looked, like I said, at a bunch of them, and then we looked at the whole budget for energy efficiency, and it turned out of that a few of them were just staggeringly fabulous and characterized the entire program.

And this is -- when you're trying to do assessment this means that you really have to think about this as a portfolio because a lot of the projects were duds, but a few of them were just absolute home runs. And we wound up -- and that is another thing about this is it's another good thing to say about how the Department of Energy was choosing things because, in fact, what that implies is that they're choosing a high-risk portfolio.

And that, actually, is one of the things that as an economist I was arguing that they ought to be doing.

So, that came up with a few. Fossil energy didn't look so great, the benefits and the costs were kind of along the same category in terms of realized benefits.

But in the environmental area the fossil energy program was paying back big time. So, it wasn't just carbon dioxide at the time, there was sulfur, there were a lot of things that were going on there.

Security benefits pretty much, no, the Department of Energy really didn't do much when it came down to saving on imported oil, this category of stuff. We weren't looking at the transportation programs. But there could have been something.

Okay, let me go on because we're talking, really, about assessment methods here, and not really what happened to DOE.

So, could I have the next slide, please? So, we came up with these matrices. Okay, there's some numbers. And then for each of the technologies we had very elaborate -- one way to think about this is it's just footnote after footnote.

And one of the -- in terms of who deserves the credit, we did two things in this retrospective study. We talked to people in the industry and said how important was the Department of Energy Contribution? So, it was not very sophisticated, but that was the basic idea.

And if they said, ah, we would have done it all without them, then we would ask a few more people. And it was -- we didn't try to do anything sophisticated, but the various matrices we come up with -- that we came up with at least have some notes in it about what different people were claiming, so that was pretty much as far as we went with that.

Let me get the next slide. If you have copies of these, I guess it's an even smaller print. Anyway, you can still find these on the NRC website.

The next one, keep going, more, more. Okay, this one is kind of interesting because under benefits it says "none" if you can read that small.

Next one. Okay, so moving on to the prospective study. So, we did this study and then the Department of Energy came back and said but what about the programs going forward?

And this relates to what you were talking about earlier, Adrienne. This is really complicated because of the interactions of things, these were -- what the DOE was doing was complex technologies, dynamics, things are changing, regulations are changing, there's a lot of interactions.

And at the time we were looking at it, the DOE had not yet started using NEMS, the way we just heard it described, which really goes a long ways towards dealing with a lot of the problems we were talking about, actually.

And then we were worried about attribution. And going forward it's even more complicated thinking about this because then you can't look and see what happened, you have go guess what would have happened or what -- well, going backward, even, you have to think what would have happened without the Department of Energy. Going forward it's even more speculative, as it were.

Okay, could I have the next slide, please? So, what we decided to do was think about a couple categories of risk, the same categories of benefits, and a couple of scenarios, and that was going to give us a different kind of matrix.

The next slide. And the scenarios, then, we were concerned, in fact we just heard the discussion about NEMS, about some kind of reference scenario and we used the AEO one. A high oil and gas price scenario and a scenario where carbon in fact is priced or regulated.

We were concerned about two kinds of risk. One being technical risk, was the project going to work? The other is market risk, suppose it works and nobody wants it?

And the market risk could happen because in the meantime someone has invented an even better way of doing it, or it could happen because in the meantime we've decided to change the regulatory regime. So, there's a number -- or the Koreans have come up with it, first. There's a bunch of different market risks.

Move on then, the next slide. And we decided to take a decision tree approach. I'll skip this slide altogether, and here it is.

So, here's how we dealt with it. And this is a basic way of also thinking about how to assign benefits to the public program versus the private program.

The first question we asked is suppose we go ahead, if the Department of Energy is going to do the program or not, so that's the first branch in the tree as it were.

And then if they do the program, there's some technology outcome. And we said it could be really good. Mostly this has to do with price, you could -- you could wind up with the technology but it's going to be very expensive. You could wind up with what you expect or you could wind up with a technology that doesn't work as well, those were typically what was going on.

And then if the Department of Energy didn't put any money in, it didn't mean nobody was going to be doing research in this area and so we could ask the same questions.

And getting beyond that then the next question was market acceptance, and a lot of that had to do, of course, with cost.

And then what we did, and I think I have one slide that shows one of these, the next slide. No, go one more. Okay. Was this is an example we worked for the lighting program, is we brought in experts in the area and made them choose probabilities for each of those branches on the tree. And we made the branches add, we made the probabilities add to one.

And this turned out to be we pretty much had to hold a gun to their heads to make them do this, but we made them do it. And they really didn't want to and we kept sort of pushing them and pushing them. And there were some experts that were involved in this project, who were experts in decision analysis, which is what was going on here.

And you see that what -- this is an example that just had to do with the lighting programs where what could have happened is you come up with a product that is, you know, better/worse basically, and we made them assign probabilities to that.

And then there was another -- I'm nearly done -- situation where they had to come up with some more probabilities.

And we wound up then going able to go through this and to fill in the different pieces, by the way, the right way to do it at that point is to use something like the NEMS model, that would do one of these interactive models. And then we put it together and came up with a number and the prospective benefits, then, were positive.

The next slide, please. What did we learn? Moving along. Keeping it very simple, because we were trying to do something that was extraordinarily complicated and coming up with the benefits numbers, the original number, the sort of thing that you get out of NEMS is only the beginning to try to do these evaluation because one has to figure out a way to incorporate risk and to incorporate expected value.

The cost benefit analysis, in turn, depended very critically on what kinds of policies were going to be implemented, things like whether there was a carbon tax.

I'm going to move on, next slide, please. We thought, nevertheless, and the feedback that we got was that it was a very valuable exercise. And like I said we didn't -- in terms of -- in terms of thinking about these probabilities this is where it seemed like the right way to do it was simply to bring in experts. And in terms of prospective analyses I have to say I don't have a better -- a better methodology at this point.

Okay, move on. Am I at the end? Oh, let me emphasize the first point and then I'll call it a day here. In terms -- as we looked at different programs we had to think very carefully about the best way to think about those decision trees.

The decision tree was extremely useful but you could easily get into millions of branches, and that was not very useful because we really didn't know that much, anyway. I mean, getting the experts to come up with three probabilities was hard enough.

So, it really took a lot of thought to figure out how to characterize what were the key issues that were going to go into the success or failure of a given project and how that related to other areas. And that probably is the most fundamental part of the analysis, as it were, is choosing which aspects of a project to focus on in that context.

Okay, I'm going to stop, now. I guess I get another crack at it this afternoon, so you haven't heard the last of me.

MS. BARONAS: Wonderful, thank you. Thank you, Linda.

MS. BARONAS: Just go through the -- just go through the rest of the slides.

MS. BARONAS: Thank you.

Moving on to Jeff Roark, Electric Power Research Institute, EPRI. Okay, Jeff, your title slide is being projected.

MR. ROARK: Okay, can you hear me?

MS. BARONAS: Yes, we can.

MR. ROARK: Great. I am a practitioner of 35 years' experience in the industry and it's taken be far and wide, but I'm relatively new to EPRI and I'm new to the research field. I hope I can contribute something here today that's worthwhile to you.

Some of the discussions today have involved benefits of research, others seemed to have involved benefits of specific technologies and, obviously, the two are related.

I have interpreted this as being about research programs in general, so we'll see how this goes, I've got a little bit of both here.

I do appreciate the opportunity, even though I'm new to EPRI, the opportunity to describe EPRI to you. And I understand that some people probably in the audience there don't -- don't know who EPRI is and where we come from, and to describe the collaborative approach that we have in developing an energy research portfolio in electricity, in particular. And I think you'll agree we're in a different niche from most everybody else that's talked today.

Give me my next slide, please. EPRI was founded in 1973 following some rather famous northeast blackouts in 1965 and 1967. EPRI is proud of its role as an independent, nonprofit center for public interest energy and environmental research.

This role grew from its founder, Chauncey Starr, who believed that science and technology should have a major social service and should improve the quality of life.

As I will emphasize and explain here, EPRI is a collaborative source of the electricity sector.

The next slide, please. Our mission is to conduct research on key issues facing the electricity sector on behalf of its members, energy stakeholders, and society. And I'm really proud to say, as I said I've joined EPRI recently, this mission is one that you feel working there, which I have been impressed with even though I'm a remote employee.

The next slide, please. Our role in the industry is not basic R&D but, rather, it's an accelerator to the development of technology for commercial application in the electric industry. I would emphasize, however, that commercialization is dependent on economic benefits, and that is the economic viability of technology, so we do evaluate those things.

And when we evaluate the economics of technology development and commercialization we view the economics in terms of value to the consuming public.

The next slide, please. As this slide suggests our value is in applying industry expertise, thought leadership in collaboration with the industry. I'll say the word "collaboration" a lot now.

Collaboration allows the needs and concerns of the major industry players to be organized for action, to fly in formation, if you will, to concentrate effort on the most important issues facing the industry.

EPRI's role as the focus point and its independent, nonprofit structure brings the research portfolio into alignment with the public interest.

EPRI's research product is available to the public on a nondiscriminatory basis.

The next slide, please. Our members, in the United States it's most of the utilities. We have 450 participants in more than 40 countries, we are an international organization.

The United States benefits from the funding that we receive from abroad and the utilities abroad receive benefits from what they contribute as well.

For instance, we have smart grid demo projects in France and in Ireland, and we all gain -- we all, as consumers, gain benefit from those projects just as we all gain benefit from demonstration projects in California, and there are several of those.

The next slide, please. Benefit assessment activities; what benefit assessment activities has EPRI undertaken?

And I have interpreted this question as asking about assessments of the benefits of energy research, do we do it and how?

By now you may suspect that in a way we don't do it. On the other hand we do it everywhere, so let me explain what I mean by that.

What we don't do is a top-down evaluation of the research portfolio, especially not in retrospect, mainly because the evaluations are imbedded in our annual recursive process of collaboration with our members.

Our specialized scientists and researchers collaborate at a detailed level with similarly specialized researchers and practitioners among the members. We get together at meetings and this takes place there, physically, but also through the research through the years.

These experts have local knowledge of the value of research in their fields and they determine the value and the funding requirements for the different kinds of research. And what rolls up is the major input to EPRI's research portfolio, which is consistent with the funding levels, and we don't need to sell the portfolio

And, again, I'm a fairly new employee, but I haven't noticed any looking back, it's generally forward looking.

The next slide, please. This shows the span of the research portfolio, we get into a lot of things and you can appreciate the variety of expertise and the number of relatively disparate areas that EPRI covers.

Every year utility and EPRI experts come together in each of these areas to discuss the progress of research, new research areas, developments in the field, and so forth. And the collaboration takes place here to determine what is it that we need to do, what has value, or the things we need to pick up, or the things we need to drop.

The next slide, please. What does EPRI measure? I want to chide you a little bit here on your choice of words, and I chide my companions at EPRI on the same account, even though it may just be my own sensitivity here.

Measurement's not quite the right word to apply to benefits of research because measurement sort of implies science, and it implies something physical. We measure things with rulers, meters, counters, and other kinds of instruments.

Economic benefits can be estimated from things measured, but when we measure, we measure things in the here and now. And we can only estimate things that haven't occurred, yet.

The benefits of today's research and, again, I don't even think about looking back. But the benefits of today's energy research occur in the future, and they haven't happened yet, and they really can't be measured.

When benefits do occur they can be devilish to measure, as just about everybody here has said. They might be avoided costs, they might be avoided problems, they might exist in business as usual. That is the benefit of research may be that business as usual can continue.

Often we have to point to -- almost universally we have to point to some counter factual. What would have happened without this research or what would happen without this research?

As Lord Acton famously said, "History does not disclose its alternatives." And it may be hard to build a convincing case that you've avoided train wrecks, even if you have.

So, even though research doesn't always produce a shiny, new thing you can point to and may not produce a change that you can someday measure, in my sense of the word measure, economic benefits are obviously real. And everybody here is here to estimating them, which I think is the proper work to put on economic benefits.

Reliable service is a good thing. Renewable energy is a good thing. And these are especially good if they can be accomplished at a lower cost.

The problem is we can only estimate them at best, and this is what utility planners do. I was a utility planner in most of my jobs, in one respect or another of the word. Utilities make decisions every day on estimates of present value of future benefits, that is what we do.

For EPRI, these assessments of economic benefits occur, they occur at the project level, they occur among the experts in the various fields, and they occur in the collaborative process that produces the research portfolio.

The next slide, please. Just to get down into some nuts and bolts, and this is similar with respect to some things that we've seen from others today, this is a list of benefits from smart grid investments. This is just a list of the things that you would consider to look at for any type of smart grid investment.

Every smart grid investment, every smart grid technology won't touch all of these things but -- but this is a list of things that can be touched by some technology.

And this is part of a methodology that we have put forward, in conjunction with DOE, for estimating the benefits and costs of smart grid demonstration projects in particular. And I think you recognize some of the categories here because this is very similar to what the gentlemen from DOE were talking about.

Fortunately, I think this table comes out of a document that is referenced here on the slide and I believe that document is publicly available, free of charge. So, if you want to get a copy of that book, you can, and that will give you some details on how we look at smart grid investments.

Notice we include reliability, environmental and security, in addition to economic. But in the end all of those things can be monetized to some extent. At most they're one or two degrees removed from being economic benefits.

Again, these are our evaluations of nuts, and bolts, and wires, not of the research activity, itself. And our demonstration activity, our concentration, economic benefits is intended to accelerate that beneficial technology into commercial application.

The next slide, please.

MS. BARONAS: Hi, Jeff, it’s Jean from the CEC. Would you please conclude your remarks in four minutes?

MR. ROARK: I am on my last slide, I think.

How has EPRI addressed attribution? I think I entirely misunderstood this question. I have noted no real concerns for did EPRI’s research make this happen, was it our dollars that did it or was it somebody else’s dollars that did it?

And what I was thinking here was we were concerned about who received the benefits.

In any case, this is not something we devote a lot of energy to trying to figure out.

So, finally, our collaborative process that through which we do our benefits assessment is working, is producing research with value that supports its cost. Or methods estimating research value will be project-specific and fluid, and following technology as it develops.

I believe that’s my last slide. If you can go forward one that's probably -- yeah, that's just the tail end slide.

I don't believe we have time for questions, so I will stop here.

MS. BARONAS: Thank you very much, Jeff.

We'll move on to Dr. Gretchen Jordan, of the U.S. Department of Energy Sandia National Laboratory. Gretchen.

MS. JORDAN: Yes, can you hear me?

MS. BARONAS: Yes, we can.

MS. JORDAN: Good. Well, my talk is going to round out the Department of Energy, Energy Efficiency and Renewable Energy Office presentation because I'm going to talk about strictly retrospective benefit cost studies that were completed last year.

So, if you want to move to the next slide? The next slide. I can skip the background because Pete and others have mentioned it.

I want to talk a little bit about the objectives of the study and attribution, in particular, and then the four kinds of benefits that were measured in these retrospective studies.

So, if you can go to the next slide. I would just say that it's interesting to me, personally, that at the federal level the pressure to demonstrate, in a quantitative way, the value of the programs is less than it is at the state level, but that pressure has been increasing particularly in the last five years or so.

Here's just a pretty visual of what Pete had listed of the various programs in EERE.

Next. So, in 2009 it was decided that there needed to be benefit cost studies to supplement what the NRC had done in the study Linda mentioned; "Was It Worth It?"

And so the four programs, wind, solar, in particular photovoltaics part of solar, in the vehicles program, the research in advanced combustion, particularly for engines, and then in geothermal studies were undertaken.

But the notion really was to see what could be done to improve on the NRC methodology that Linda described for retrospective. And the five-year rule was certainly one thing that people wanted to improve on. The idea was to look at what difference DOE R&D had done on more of a case-by-case basis, rather than using a rule of thumb for every single case.

The other notion was to move beyond economic benefits even further than the NRC did, and rather than calculate for individual projects to try to look at groups of projects or subprograms.

We did, indeed, develop a guide, because we were going to have different contractors doing these for benefit cost studies, and we were also extremely concerned that the methodology be credible. So, we had an expert panel review the methodology before the studies started. We have a lot of review of the studies in process and after they were done.

Next. So, one of the things that we wanted to do differently was a better job of dealing with attribution. And it is a very complex question, as many people have said.

So, one of the main ways we've dealt with it was this matrix for assessing attribution. And the idea, since we were doing retrospective studies that went back as far as 30 years, and DOE's involvement is primarily well before the commercialization state, primarily.

So, the idea was to look at across a technology timeline of, you know, the early research, component systems, validation, commercialization, and market adoption, and to ask these questions that you see going down the left-hand side.

Just generally, you had to have history, anyway, to do the benefit cost study.

And then what did DOE do in each of these stages compared to what others did. And so it would have been private firms or other national -- you know, other federal agencies. And it was also what happened in terms of rival explanations in the policy realm, as has been mentioned.

You know, was there the RPS standard, when did that come in, and those sorts of things.

And by looking at this over the life cycle of the technology, you'd be able to see that, well, DOE was investing in that preliminary research when nobody else was, and so on. So, we could come up with, you know, what DOE did, what others did, and then be able to say fairly carefully what the DOE affect was. You know, did it reduce the cost or accelerate the entry into the market of a particular product?

And then looking across the whole matrix to sum up what the whole DOE influence was.

In at least one of our studies they didn't do the matrix and they just took the cost share, the DOE cost share and used that as a percentage of the total benefit.

But using this matrix is particularly useful to try to tell the story, if you will, in a very qualitative way of what the DOE influence was.

Next. So, in terms of the economic benefit and investment costs we did look at the metrics of net benefits, benefit cost ratio, and internal rate of return. It's not too hard if you do one, to do the others, and different audiences wanted the different metrics. And we were particularly looking at any research, resource changes.

The findings in the four studies were subjected to uncertainty analysis. OMB has conflicting information -- my words, obviously not OMBs. They like to look at a three percent discount rate in some cases and a seven percent in other cases, so we used those as well as other sensitivity analysis.

And we had a fairly big range across the four programs that were looked at in terms of net present value from -- from one billion to more than 23 billion.

Next. We also looked at environmental benefits and I think there's one gem here that everybody might appreciate.

As Pete mentioned, I mean the biggest reason for and, therefore, the thing to look at for these EERE programs are the greenhouse gas effects and those can -- as you do in the PIER program, those can come straight off of the energy savings or clean energy used in place of the fossil fuels.

But we also found what we felt was a very credible way of going after the public health benefits.

It turns out that the Environmental Protection Agency has a model, now, called the COBRA, and it's a co-benefits risk, something or other, and it had been vetted by experts, as well as the Office of Management and Budget.

And you can pop in air emissions and out come these nice health effects that are monetized. So, we did go ahead and use that model.

And then the rest of any environmental effects were just noted qualitatively.

I would say that similar to what Linda said we didn't have -- we didn't ever have any intention of adding up economic, environmental and security benefits, and we were also very cautious, we didn't want to use any models or any quantitative methods that hadn't -- that weren't very, very well vetted. Because the feeling was that in order to have a credible study every -- you only wanted to quantify what you could quantify credibly and we didn't want to spoil the -- spoil the study with one number that would not be trusted.

Next. So, that really played out in security benefits because there are a couple of new ways of coming up with some quantification, particularly of barrels of oil avoided, I think.

But we did -- the expert panel didn’t feel they were sufficiently vetted at this point to use them. So, we didn’t apply any monetary value and the guide does not recommend doing that.

Nevertheless, we certainly discussed these things qualitatively.

And the one -- and the transportation program certainly came up with oil savings, given the improved efficiency of these truck engines.

Next. We also took a different look at knowledge benefits than what the NRC does -- did. And we actually did what many people have called historical tracing studies, or we were calling them linkages studies. But through publication analysis, patent analysis, and partnerships analysis we presented a pretty good story of out the DOE-funded R&D had really influenced the pool of knowledge that was out there.

So, in the best cases we had patents that went back to DOE research that are now used worldwide in various technologies.

But we also found that these knowledge benefits helped us to build the attribution story.

Next.

MS. BARONAS: Pardon me, Gretchen, this is Jean. Would you conclude in five minutes?

MS. JORDAN: Actually, we are at a conclusion. I would just say that the other thing that we really have taken a careful look at in the methodology is how to choose the next best alternative. What would have happened, what was -- what did the technology replace?

And lastly, that some of the studies actually looked at technology infrastructure rather than a specific technology. And so we could use -- and we looked at this cluster method which was -- which basically said here's a basketful of research funded by the photovoltaics program, for instance, and then we matched, we looked at those benefits against the cost of the whole program and tried to qualitatively bring in what -- what other parts of PV, not just what the specific technologies or infrastructure we quantified contributed or did not contribute to that cluster of benefits and costs.

So, that's all.

MS. BARONAS: Thank you very much, Gretchen.

Mike Gravely is here from the Energy Systems Research Office of PIER to give a review of this morning's presentations.

MR. GRAVELY: Yeah, thank you. I'm Mike Gravely from the R&D Division and my office is where this benefits team falls. And so I'm very appreciative of all of the attendees and speakers today.

In the morning session we've provided a lot of general information. Obviously, from a summary, there's a lot of consistency, there's some areas that have more repetition, more people use it in other areas.

The afternoon we will spend a little more time in some of the specific techniques and the specific opportunities to measure benefits.

The PIER program does have an advisory board and the advisory board has specifically asked us to do this research, and to help them understand the benefits so they can do it.

Our ultimate goal in the program is to use the benefits to help us make future selections, also, to guide us into where the best benefit is for the State, so using these techniques and these different opportunities to help us guide the program in the future.

So, for those online I realize we'll be going kind of late this afternoon. We expect to have more dialogue in the afternoon, we expect to ask questions. There are a couple of things that we're trying to get from this workshop; one is to understand what people are doing. We've heard most of that today.

In the afternoon we'd like to discuss in a little more detail some of the different opportunities and techniques we use to measure benefits, and to get a kind of a credibilities check and from industry, and from other experts.

So, we're interested to find out if there are techniques that people feel are better than others and if there might be some potential adjustments or tweaks we would want to do to the stuff we're considering.

We do anticipate going forward with a very substantial benefits assessment, because we've been asked to do that, and provide that continually to our advisory group and to our management team.

With that, we're running a little bit late so there's a question -- a few minutes for questions. We'll probably take three or four for anybody here in the room to ask questions before we break, because we may lose people after the lunch.

Is there anybody here have any questions they want to discuss or anything before we break?

Anybody online type in a question, if you have it, real quick before we break for lunch, and I'll give you a few seconds to do that.

We will reconvene a little bit late, we'll do 1:15. I think there's a little more time in the afternoon to absorb the little bit of lateness.

And again, those who are online we would hope that you would stick around and help us with our dialogue in the afternoon, and we will appreciate any input that you have.

And also, this is obviously an IEPR workshop, so we will take comments formally I think until June 1. So, we would like your comments. Again, we're interested in the credibility of what we're doing, we're interested in if certain techniques are more interesting to the general audience, than others.

So, if you have a preference, we'd like to know what that is. If you see challenges, we'd like to know what that is.

If you have something that we haven't seen, we'd like to know that, also.

And anything that you know, of reports or other areas, there's several that have been generated today that we could reference, will be useful because we will be preparing an input to the 2011 IEPR as a result of this workshop, also.

So, there appears to be no questions. Okay, so we'll break until 1:15. Thank you all very much.

(Thereupon, the lunch recess was held.)

MS. BARONAS: Okay, so it is 1:15 p.m., Pacific, and so we will continue with our Energy Research and

Development Division, California Energy Commission workshop on benefits assessment. This is an IEPR staff workshop.

This afternoon we'll have two panel sessions. The first is an overview of methods related to benefits assessment.

Could I see 12-a or 12, please? The next slide, please.

Okay, so here are our speakers. Adrienne Kandel, of the PIER program will discuss the effects on California's economy as we overview our methods related to benefits assessment.

Jeff Roark, from EPRI, will discuss the effects on grid reliability and security.

Adrienne will follow Jeff with her presentation on a few select estimates of generation side benefits, namely effects on electricity customer costs.

And then I will complete this panel with a presentation on qualitative assessment and potential surveys as an avenue for data collection.

So, if we could have Adrienne's presentation, number 13.

MS. KANDEL: My name's Adrienne Kandel; I work for PIER. This presentation's about how we have looked at the effects of PIER research on the California economy so for and thoughts looking toward the future analysis.

The next slide, please. Ideally, to evaluate the effects of projects on California's economy we'd have at least the following data, and we've have it for several years after project completion. Where products were involved we would have the sales, the prices, the costs, the cost to consumers of that additional technology.

We'd have jobs that were created by people we had funded or pursuant to that funding.

We would have information on knowledge spillover. By this I mean when you do a research program knowledge from that research program will affect research further on down the line in other projects, it will affect other products.

And, furthermore, the staff that was involved in that research program is also going out and becoming part of the wider world. And we do have some anecdotal stories of that happening.

In PIER, it would be something that we'd want to quantify.

Now, even if we get these things and even if we get them for several years, a few years after a program ends, this is still an imperfect solution. Product growth may continue much longer.

So, Tara spoke of the four-year lag to products entering into the market that she was finding in New York, and that's entering the market.

Professors Alston, Pardey and Ruttan have done a study on agricultural research and they estimate that the research peaks -- the effects of research peak in that domain 24 years after. And they were doing that in response to a previous research that tends to find results peaking 10 to 20.

So, you can find results in that range, their study's rather convincing.

The point is that research has many effects well after the project is over -- well after the research project is over is what I meant to say.

Now, what data do we have? We have follow-on funding to the PIER Small Grants Program. That is our one program area that has surveyed awardees every few years and asked what kind of follow-on funding there is.

And staff has supplemented that with research on a few companies that started with PIER grants. And what we have found is there is at least $1.3 billion in private, non-utility investment pursuant to PIER-funded research of small grantees.

This is consistent with the fact that states with publicly funded clean energy research on average attract four times as much venture capital as other states.

The next slide, please. Yes, you did it already, okay.

What this shows is that the market values the result at $1.3 billion so far. And if you look at that graph, it looks like it's growing exponentially. There's cumulative follow-on funding in the brighter red and in the paler red the cumulative electricity grants just straight line we've had $30 million since program inception for the electric grants.

These affected firms are growing, they will continue to grow and create jobs.

Recall the 24-year lag, Nobel Laureate, Robert Solow, estimated that over 90 percent of economic growth comes from investments and innovation.

So, we will never know exactly how much effect we've had, but what we can try to estimate with this, for example, is how this investment creates jobs.

Now, we found a data series on clean technology venture capital and clean technology jobs in California from 1999 to 2007, some of this was from the next ten group. And that is too few years to do a serious time series econometric analysis.

So, instead, we just did comparisons, compare investment to later growth; all possible time period durations. So, two years investment and then the growth for the next two years, or three and three, all possible lag lengths, what if it's one year after, what if it's two years after, and doing all these possibilities so we can make sure we're not picking out one little piece of what the data says.

And what we're finding, next slide, please -- oh, and also with and without correcting. To correct for the effective economy naturally you can make arguments about whether or not to compare against non-clean technology job growth.

Anyhow, our result is that these average out to for each $100,000 of clean technology investment, one California job has been created. By investment I mean put in one time and by a job, I mean the job's there. It's there, it's not one year of a job.

So, that means that our $1.3 billion investment has likely created over 10,000 jobs directly.

And in the sensitivity analysis I described before, most of the results ranged from 10 to 20 thousand. So, instead, we're trying not -- we're trying to be conservative here.

Then we apply to find out what about indirect and induced jobs, where firms and employees buy goods using the National Bureau of Economic Research RIMS II multipliers applied to the green job categories, and we get an additional 1.8 indirect and induced jobs, so that -- per job created, so that the total effect is about 30,000 jobs.

Please? Now, our next steps are we would like to implement surveys and/or reporting requirements, actually collect real data. For instance find out, ask people how many jobs were created rather than try to use a macro economic analysis to get there.

What indirect jobs they know of, such as installation, what jobs are projected? What is their knowledge spillover? What happened with the staff of the product development and research? And what is the outcome of the product in the market?

Oh, that’s it, thank you.

MS. BARONAS: Thank you, Adrienne.

Jeff Roark, from EPRI, if you could please describe the effects of the methods related to benefits assessment for grid reliability and grid security.

MR. ROARK: Okay. I don’t have any slides on this, I’ll just talk on it.

This will be a combination from my background as a resource planning and as a reliability planner at the system level, and more recently experience dealing with distribution.

So, I can speak a little bit about GNTND.

Somebody put up a slide this morning that showed the real crux of reliability assessment and it was the probability of interruption times the cost of interruption. That really is the crux of it.

But both of those numbers are fairly difficult to come up with. Getting to a credible and meaningful delta probability of interruption is an extreme difficulty in a lot of situations, especially when you're dealing with smaller research projects and especially at the generation level.

Getting to a cost of interruption is in a way easier because there are some numbers out there. And when you look at the numbers and you read about the numbers you realize you can't get too hung up on accuracy with those numbers because they are bare estimates.

As for the probability of interruption, I've spent a lot of time modeling systems of generation and, more recently, systems of generation in transmission.

There are models available that cover wide areas all at one time. There are, for instance, MISO, PJM, SERC, all of these areas have, at one time or another, run probabilistic evaluations of their generation and transmission systems. And, indeed, I believe that NERC is going to be requiring that each of the major systems do this. It makes sense to evaluate GNT reliability at that level. It almost doesn't make sense to evaluate it at a micro level because -- because it's a whole system that you're dealing with.

The results of these models I think are still quite rough, in spite of the extreme computational burden. If there weren't such a computational burden we would -- this wouldn't be such a problem. But I think that things like the handling of weather uncertainty is difficult. And weather, when you're dealing with large areas, is quite multi-dimensional.

So, there are many things that -- I mean you can model a lot of things, but the system is too complex for models to follow and so there are a lot of -- a lot of things, a lot of contingencies and possibilities that are just not modeled.

So, you have to realize that what you're dealing with, the model that you have that generates your reliability index is limited.

So, reliability improvements from small changes, you might be able to see one in a model like that, but it's likely, really, lost among the uncertainties and the things not modeled.

We have bigger problems that are coming into view and that is that these models have a great difficulty in dealing with intermittency and some of the issues that we're seeing now. The models handle -- handle yesterday's systems, I wouldn't say badly, but they have difficulty handling yesterday's systems. Tomorrow's systems are far more difficult.

For generation, at the generation level actual instance of shortage are rare. They do happen because of shortage, but they are generally avoided and incidents usually involve more than just the combinatorics that the models deal with.

Nevertheless, when you're looking at a project that changes the generation technology in some way that increases the reliability of a unit, decreases the forced outage rate, increases the flexibility of the plant, these things do improve system reliability overall, they do reduce the probability of shortage, or they reduce the need for capacity, probably not -- not both.

The news may actually be better at the distribution level. At the distribution level there are measurements of reliability performance, well-known indices at the distribution level, sometimes even at the feeder level within some utilities.

But when you're looking at a change that may slightly change the probability of outage on a distribution system or the transmission system, the natural variability of the experience on that feeder or on that system may dwarf the kind of changes that you're trying to evaluate.

And you can't necessarily get away with just looking at old performance versus new performance, it may take quite a long period of time and then things change over time. So, that doesn't really work out very well.

One of the things that we've done in evaluating distribution automation equipment, for instance automatic fault location and recovery, is to actually construct a counter-factual.

That is we know what actually happened in every incident, there was a fault, it eventually was cleared. The system caused some of the customers to be recovered in a shorter period of time. We know that because that's what was all measured.

What we can also do is look at say, well, if this system had not been in place, then all of the people on the feeder would have been out and they would have been out until this fault was cleared.

You still have to run a truck out there to clear the fault, so you know how long it takes to find that fault, so you can do some estimating like that.

And the number of incidents -- when you're looking at a feeder, the number of incidents is not so great as to make this impossible. Obviously, I'm thinking of demonstration projects here.

The other side of the coin, the cost of interruption is generally survey-based and it's differentiated by customer class and duration of interruption.

If you need those numbers, there are numbers out there. There's been a good bit of research through the years and several meta studies that are publicly available, where you can get a good feel for what those numbers are.

The numbers, if you've never seen them, they are eye-poppingly high compared with what you think of as normal power costs, or definitely as power prices.

But as reliability practitioners are quick to point out, the cost of equipment just to avoid a few hours of outage is very high, too, when you look at it on a per-kilowatt-hour basis.

I often ask the question, in terms of generation, how often do you want to use your very last megawatt? And I don't think you want to be hitting it very often because that means that you'll probably have outages pretty often.

Value-based planning balances the cost of interruptions, as we call it the value of lost load, VOLL, with the marginal cost of avoiding interruptions. And so far that planning approach seems to work out. We wind up with sufficient margin in the system, usually, to cover many contingencies. So, we don't have bad reliability in the United States.

But as a major problem, I think as an industry, we're introducing all new problems at a very rapid pace and, really, at all levels, generation, transmission, and distribution we're seeing new technical challenges and conditions of operation that we've -- that were never contemplated until recently.

So, the equipment that's out there may, may not be able to handle the challenges that are coming. So, there's a lot of room for good research in this area.

I'll conclude there, Jean.

MS. BARONAS: Okay, thank you, Jeff, very much.

Moving on to Dr. Kandel, from PIER, a few select estimates of generation side benefits, effects on electricity customer costs.

MS. KANDEL: Thank you. May I go to the next slide? So, the energy efficiency estimates, as you know, are pretty straight forward. If you succeed in getting a product developed and to marked, you just start summing up effects.

The generation side often requires an individualized approach and the two examples I'm giving here are explaining the numbers that we showed in the morning. One, the research related to synchrophasors and, second, related to automated demand response.

And I will be asking you questions about your thoughts on methods, again.

Please go to the next slide. So, grid reliability is a greater risk with intermittent renewables and electric vehicle charging, as you know.

Now, synchrophasor technology and applications help grid operators visualize grid activity much better. Here's one comparison that's often given; the current system cost data can be compared to driving through the fog very fast and opening your eyes every four seconds.

A system with synchrophasors and the appropriate visualization technology applications can be compared to opening your eyes every 30 -- 30 times a second instead of every four seconds, and when you open them the fog is cleared and you see better, you have more information.

PIER has a long history of funding

synchrophasor-related research. It is considered instrumental in bringing synchrophasors from the laboratory to the field, and work is continuing, including the applications for automation.

Please, the next. Thank you. So, look at that graph for a moment, please. The graph on the bottom shows what operators saw before a very big western power outage in 1996. They did not see it coming.

Above is what they would have seen with synchrophasors. The result -- and the applications that display them.

A result is that -- of synchrophasor work is that, one, you can see outages coming more readily and take steps to avoid them. And there have been at least one instance I know of, and possibly more, of that type of thing being seen since we've had more synchrophasors installed properly, and actions were taken and no outage happened.

And again, as Mr. Roark said, your counter factual is, well, would it have happened otherwise?

And then, second, you don't need as much extra margin for safety if you know what you're doing and, therefore, you can have electricity cost savings, which we'll look at in transmission and renewables.

Next, please. Well, how much is saved in outages? Again, we're going to look at -- this whole analysis is going to be done by 2020 and the reason is because that's what motivates -- this market research is being ready for a renewable portfolio standard with intermittent renewables, as well as all the other changes, including electric vehicles.

The reliability value, as I said, depends on probability and types of outages times the cost of these outages. And as Mr. Roark said, it is the figure on the left that is the hardest to come up with. And not having the benefit of the modes that Mr. Roark refers to, what we looked into was different expert assessments.

We ended up using four different sources for devising the numbers of the estimates of reliability value from synchrophasor research, with varying probability of outage, varying probability of affect of synchrophasors on that problem, and also varying preferences for which surveys they pay attention to, or which meta surveys on the cost of those outages.

Some of the lower ones are the ones that aren't survey based, that are based on other analyses.

All the numbers are uncertain. They have a wide range and they average to 85 million a year, and you can see the wide range in the graph.

Next, please. On reduced electricity cost, the first estimate I'm going to discuss is how we estimate them more full use of transmission lines, the value of that.

Currently, a lot of renewable electricity is not accepted into the grid because of grid uncertainty. Synchrophasor technology helps the operator see when accepting intermittent electricity may de-stabilize the grid.

A WISP consultant, E-3 -- WISP is the Western Interconnect Synchrophasor Program, installing synchrophasor technology and applications throughout the Western Electricity Coordinating Council area.

WISP consultants simulated a one percent and five percent increase in hours wind is accepted into the grid.

With this simulation, which is then run through at cost of generation modeling effort, the average cost of wind electricity drops 0.3 to 1.6 cents per kilowatt hour.

Here's why, the wind turbine's already built and its cost is getting split over the hours it feeds the grid, and the more hours it feeds the grid the less cost there is per hour.

The CEC is estimating that by 2020 9.2 million gigawatt hours of wind is to be supplied to California. So, just do the multiplication, if the average cost of wind is going down because on average all that wind is having its capacity factor increased one to five percent, that is to say it's not being spilled in such a way that there are one to five percent more hours that the wind energy's actually being used, that translates to 26 million to 150 million dollars a year in reduced cost of wind electricity and, therefore, a reduced cost to the rate payers to come back in their bills.

So, it's like a bill reduction of between .1 -- .01 cents a kilowatt hour and between .05 cents a kilowatt hour, with the cost of PIER at .03 cents a kilowatt hour kind of coming in the middle there.

Now, let's -- next slide, please. Next slide, please. Thank you.

Now, we get to the difficult question of attribution. To evaluate the attribution for the real-time display monitoring system, a consultant we hired, KEMA, conducted structured interviews of three key players, two researchers and one California independent system operator industry representative, a user.

There's a tradeoff when you do those interviews, you get people with expertise and familiarity with the program, but you get potential for bias. They tried to word their questions carefully and devise counter effectual scenarios.

And they concluded that without PIER the work would be less sophisticated, less useful, less targeted to California, reliability would not be ensured and there would be at least a seven-year delay in implementing synchrophasors, and the display, and visualization, and interpretation of them throughout the State.

Here's how KEMA attributed. They said, well, we'll take a ten-year stream of benefits and seven-year delay will give PIER 70 percent attribution when we're doing a benefit cost analysis.

I ask you, as a question, how would you translate a seven-year delay into attribution?

The next slide, please. The questions and comment in the afternoon discussion and also in written comments by June 1st.

A more general question about attribution, a more general question about shared research is suppose for, as an example, CEC and an outside state had shared research and each achieved benefits of $250 million for their own state, would you give each state organization full attribution of its $250 million benefit?

This is a public good, it's not excludable. The total benefit is the sum of individual benefits. So if, for example, it was New York and California chipped in money and got $250 million of benefit and New York did the same, and the total was $500 million of benefit do they each get their $250 million of benefit that is attributed to them, hence, a hundred percent attribution?

Now, the next question for you is, well, public goods in general are only provided if every group chips in. But you get enough people chipping in and some people can be free riders, they can say it's going to happen if I don't chip in.

Now, if California's crucial, it seems it's pretty clear that California gets the credit.

But what if enough other states are chipping in that we can step back and say we're not going to pay, it's going to happen anyway. Does California only get credit when it chooses to be a free rider because it would have happened without California?

Or is there a separate rule we should have that public goods only work if free ridership doesn't happen and everyone chips in?

And then, now let me make the question a little more complicated to give you an example of the type of questions we have to think about. In the case of synchrophasors, the Department of Energy research and PIER research were both needed. It was described by one researcher as a kind of tag team approach, getting this work done wouldn't have happened with either one -- without either one.

California is part of the United States, it's not a separate state. California and the United States both receive benefits, how do you attribute that? We're interested in your thoughts.

The next slide, please. The second technology I'll look at is automated demand response. This is where we reduce demand automatically at the customer command in response to a price signal. It helps reduce demand and it can also be used to help balance intermittent renewable electricity.

The next slide, please. First, we looked at estimating the effects on peak reduction. This one's pretty straight forward.

One, how much is the peak reduced? Well, so far, by the end of 2011 with installations to date and contracts, firm contracts by the end of the year, 160 megawatts will be installed commercial and industrial, most of that are installed already.

How much would be reduced without automated demand response? Automated demand response users are reducing their peak 24 percent. Demand response is otherwise achieving a six percent reduction when it's not automated.

Therefore, it's reducing one-fourth as much, so we attribute only three-fourths of the reduction to the automated demand response. One-fourth would have happened without automating it, that's 123 megawatts.

A third, the savings. That would be avoiding new peak generation, we multiply the 123 megawatts by $285 per kilowatt year, which our Energy Commission Cost of Generation Study has come up with, it's the price of a merchant gas peaker. And you get $35 million a year worth of savings and avoided new peak generation for these installed applications, already.

I'm not projecting into the future in this example.

Then, the net savings are then 30 -- oh, four, we have the savings, now we have to do the costs. We annualize them to $4 million a year, including rate payer costs to give money to participants.

The next savings to rate payers, who are not participants, is $31 million a year, which comes in as a lower price to them per kilowatt hour.

The next slide. More complicated to estimate is the effect of automated demand response on load balancing, and we've only had a beginning of this. So, PIER has funded modeling and has found that electricity storage, 3,000 to 5,000 megawatt hours of it, will balance load for intermittent renewables more cost effectively than gas-powered plants.

There's an instant adjustment, fewer plants to be kept running, there's up and down direction it can work.

And, furthermore, open -- the open ADR protocol or in general automated demand response can replace an estimated 1,000 to 2,000 megawatts of that storage at a benefit.

So, just valuing that part the open ADR or the automated demand response in general can be valued by the price of the storage it replaces.

The cheapest storage right now is costing about $155 per kilowatt year when you annualize it. That's lead acid batteries, it's not a best choice.

While the installation of the proper equipment for automated demand response is costing, when you annualize it, 16 and a half dollars per kilowatt year.

Thus, as a preliminary estimate, $138 per kilowatt year is saved by using automated DR for load balancing and you just multiple that by the number of megawatts and you get 140 to 280 million dollars a year expected to be saved.

Now, we're especially concerned about doing this as more and more renewables hit the grid, and during that time period we're also funding research and so are other people to try to drop the cost of storage.

So, if the cost of storage drops by half for that example, we lower our lower bound and then this particular aspect would be saving 70 to 280 million dollars a year.

The next slide. Oh, never mind, you did it. Attribution. So, PIER has been the major promoter and funder from inception through this PIER-funded Demand Response Research Center.

Should attribution be based on the percent of research funding, is a question for you?

Should it be based on a percent of California research funding as we are looking at California benefits?

Or should it be based on the influence of the Energy Commission in making the hardware and software happen that made automated DR become a world wide event, basically?

In all this case, all questions reach a similar conclusion, high attribution for PIER, but it remains an important question for other research projects.

I thank you for your time and for your future comments.

MS. BARONAS: Thank you, Adrienne. In the interest of time and because we ran over 15 minutes this morning, I'm going to ask your indulgence that we eliminate the ten-minute break at 1:50. Any opposition here or on the WebEx?

Okay, hearing none, my name is Jean Baronas; I work with the PIER program here at the California Energy Commission.

I'd like to talk to you about qualitative assessment and potential surveys as an avenue -- surveys as a potential avenue for data collection and benefits analysis.

As part of PIER's benefits assessment of PIER-funded RD&D we began a process of qualitative assessment. That includes interviewing PIER grant awardees.

The next slide, please. Why a qualitative assessment? Theories describe generally that research directions and problem solving often come from real world observations. They come from dilemmas and they come from success stories.

We found that when conducting a quality assessment by interviewing, with guided conversations, that it’s true, people like to talk about their experiences.

When PIER Benefits group interviewed some of the grant awardees we approached the process with an open mind and an understanding of the importance of listening, hearing and sharing others’ experiences.

We applied qualitative interviewing techniques to find out how the PIER grant awardees think and feel about their experiences of working with PIER.

We first defined common concepts before interviewing the PIER grant awardees. And while attempting to eliminate the interviewer’s personality, we introduced a limited number of questions and encouraged the interviewee’s to respond in depth.

We used a value-based perspective and that is what do PIER researchers really value.

The plan for future interviewing is a follow up.

The next slide, please? Yes, thank you. The plan for future interviewing is a follow up with the original set of the interviewees. We plan to obtain more information in depth and ask for examples of their experiences.

The next slide, please. There is a plan to possibly look at future surveys and the reason is after we have conducted the qualitative interviewing and our general inquiries, the Benefits Group may conduct a survey of a large number of PIER grant awardees and we may take a look at the resulting data for complexities, and interrelationships, like we've heard many of the afternoon speakers talk about, that are related to the benefits of the PIER-funded energy research.

We plan to incorporate the language of the interviewees to attempt to represent their work environments, their real-world daily work environments, along with any insight we gained from the initial qualitative interviewing.

Vanessa Kritlow, of the PIER Benefits Group, will describe more of this process in her presentation.

We plan to explore the possibilities of using an automated data capture process along the way.

That concludes my presentation.

In the interest of time we can move right in to the next panel.

MR. GRAVELY: Jean, before you do, if you don't mind?

MS. BARONAS: Sure.

MR. GRAVELY: I think we've had a lot of presentations and we haven't had a lot of chance for some discussion. I'd like to take a break here for a second and see if anybody online, or the group here could share a little bit. And I start with the discussion with EPRI, if you're still on the line there.

And we've talked about, you know, measuring in the economy in both financial and jobs, as well as impact, and you mentioned a little bit about the different ways that you plan for outages.

I was just trying to hear some feedback if the way we measured reliability, for example, with the synchrophasors has credibility, or has questions, or if there's comments on that particular approach, first. And I'd like to see if anybody has any comments at all.

And you can open up the lines, I guess. So, anybody on the WebEx interested in a comment? Okay, so one of the desires of today's workshop -- so, we're getting a repeat here. Anyway, I'll try -- stop.

So, one of the desires of the workshop was to validate, as we move forward, that the audience who is participating, and most of the people here have some interest or some background in this particular area of study, or that we are moving in the right direction.

So, I would like some comments from anybody. And, of course, NYSERDA, you talked a little bit about it today and you can start us off a little bit as to how this compares -- what you've heard today compares to what you've been experiencing in the last few years.

And just I'd like to take a few seconds to have a chance for something other than just the presentations. Go ahead.

MS. RAINSTROM: Sure. I mean, I guess starting with the jobs things, it's been very interesting to see how everyone else measures and evaluates jobs' impacts. And I know it's not -- I mean, I know it's not always about the jobs and the economic impacts but, certainly, that's of greater interest to people recently.

I'm curious if you guys have looked at other ways of measuring jobs, other than the impact of investments? Have there been any other --

MR. GRAVELY: Well, I'll -- I don't know the exact number, but when I know that when the ARRA numbers come out, and we have several projects that are ARRA related, and one of the things that's required in the DOE reporting is the amount of jobs, and they came up with a simple number. And I'm not sure of the exact number, but just say it's 93,000 a year seems to ring a bell as equal to one job year, or whatever.

So, when you have these contracts that are billions of dollars, or hundreds of millions of dollars you could equate what that would be to jobs retained or lost.

So, they did come up with an estimate. And I think, ultimately, as we go down the road with these projects, we've actually modified -- or are modifying our tracking system to be able to, as part of invoicing the customers -- I mean, the recipients of the grants are supposed to identify specifically how many jobs were either retained or are started, so there's some numbers there.

Of course, that's limited right now to the ARRA-related projects.

But we have, in our office, about 20 of those that we're tracking as we go forward and it will be a couple of years before you really get substantial data from there.

I don't know that in my nine years at PIER that we have been able to actually track the actual job-related numbers that go along with our contracts.

MS. RAINSTROM: Right, so you're talking about basing it on program expenditures, as well as investments.

Yeah, that's something that actually, ironically enough, we had an argument within NYSERDA this week about the fact that we're not tracking jobs on a project-by-project basis.

I mean the reason is, is just that it's just very hard to attribute the jobs to an individual project.

But I mean, I guess if you're looking at expenditures and the relative distribution of research funds that go to direct labor versus materials, you can probably get at that relatively easily.

But again, I think it's still difficult because you're assuming that that one person isn't -- may or may not be working on that one research grant. So, I mean, again, we're trying to -- I mean part of the problem is that, you know, that you might not see investments or you might not see sales for a number of years.

MR. GRAVELY: Go ahead, come up. Just come to the mike so people can year you online. Or give out a portable mike, if one would be better.

MS. COHEN: Okay. Let me just try to make it a little more complicated for the moment. Because the problem is that if there is not a lot of people who are trained to do the kind of work that you're talking about, and some of this is very sophisticated work, they may come work on your project and leave some other project within the State of New York.

So, it's a bit -- there's a certain amount of futility, really, in trying to figure out jobs at any level at all.

Now, it could be that the State of New York is bringing in people from Connecticut, and that's fine with you. I don't know how Connecticut feels about it.

But in a state as big as California it's really very difficult to try to look at the jobs impact from a high-tech project because there just aren't that many high-tech people.

On the other hand maybe you prefer that they're working on electricity reliability than on something else, in which case there could easily be a social benefit.

But just -- I know you guys have to measure jobs and I should be sitting here and lecturing the Legislature, not the Energy Commission, but the fact is that it's actually a very difficult thing to get a handle on.

And, of course, yeah, there is a lot of unemployment, but the people who are unemployed may not be the people that are going to work on your project. Probably they're not.

MS. BARONAS: So, this is Jean Baronas from the California Energy Commission. When we did our interviewing we talked with the program managers in R&D, who are developing two new combined heat and power applications of different sizes.

And they gave numbers about the estimated new jobs related to the new technologies that they're developing based on an acceptance rate that assumed that a certain number of installations would replace, with the new technology, to meet new air regulations.

MR. GRAVELY: So, before we go on, there is a question online. Go ahead and introduce yourself and ask the question for Adrienne.

MR. CONLON: Yes, hi, this is Tom Conlon, with GeoPraxis, with a question for Adrienne Kandel on the automated demand response portion.

Can you all hear me?

MS. KANDEL: Yes.

MS. BARONAS: Yes.

MR. GRAVELY: Yes, we can hear you.

MR. CONLON: Very good, thank you. I just failed to follow the -- kind of the product level metrics for the attribution case described for open ADR. And so I was curious if a hundred percent of the users that are implementing ADR in general, that is the potential that's been described here, are they all using the open ADR protocol and, thus, there's a kind of a one-to-one relationship between the PIER-funded open ADR research and the fact that ADR exists?

MS. KANDEL: So, this --

MR. CONLON: Or --

MS. KANDEL: Go ahead, did you want to --

MR. CONLON: Is that clear, the question?

MR. GRAVELY: Go ahead. Go ahead and finish, I'm sorry we've interrupted you. Go ahead.

MS. KANDEL: Well, if Mike would like to answer it, that's fine.

MR. GRAVELY: No, go ahead.

MS. KANDEL: But there's two things that PIER-funded -- I mean, actually, at least three.

There's the hardware that goes into the energy management systems which is now -- and other things, like industrial thermostats, it's now on like 50 systems. The development of that, called auto DR, that piece of hardware that does not have to be used with the open ADR protocol.

This has been something that the Energy Commission has been pushing from the start, as I understand.

So, it developed that, the small grants funded one of the successful vendors, DR Biznet, of using that and the software protocol, together, and the software protocol.

Now, the installations we have our separate from any installations that occurred of other types of protocols where a utility steps in and controls someone's thing remotely.

So, we are not taking the credit for whatever automating of DR came out of -- as a research benefit out of this unless it happened to use the protocol of open ADR.

And we do believe that right now there's this going on, and it may go into the future, and that's why I asked about projects.

I should turn it over to Mike, see if he has anything else to add.

MR. GRAVELY: Well, thank you, and you can help me, Adrienne, if I'm wrong. The 123 megawatts is in fact open ADR programs that are being managed by the Managed Research Center and the IOUs in California today. So, those are actually used in the open ADR protocol.

MS. KANDEL: Yeah, so it's 180 megawatts, of which we're taking three-quarters.

MR. GRAVELY: Okay. So, that number exists as a specific initiative that's open ADR protocols that's being managed today.

The projections that we're using for energy storage is in fact automation of DR, but automation of DR with a certain response time and certain duration that's based on a protocol like open ADR, and currently based on a protocol for CNI customers versus residential customers. And so -- and the pricing is based on what it would cost if an open ADR type of protocol was used. It's very possible that it could be done more expensively or cheaper, but we're using the numbers based on that information.

So, the information is based on what is expected to cost if that level of automation was implemented statewide. Does that answer your question?

MR. CONLON: Thank you, that's helpful. My question really is more methodological and to the general objective of the entire session today. Because I think when we do -- do try to make a case for attribution of impacts of these various R&D expenditures we sort of have an approach of either going up/down, as I think this case is largely a kind of up/down. Here's the potential of the impact and we're allocating three-quarters of it to PIER-related technology.

And I thought -- I thought earlier this morning, the session, the NYSERDA presentation, where the product level was very granular, this particular product installed in this number of facilities, I think it's more of a bottom up approach structured case, that explains both the market context of how some of these technologies are penetrating, and changing, and whatever the target area might be.

And so the way I would be inclined to approach this case, the open ADR impact case, would be to say these are the -- all the participants in the whole market chair of automated demand response, these are the technologies they're using, these are the ones that were PIER funded, and to kind of build a case up from a very structural granularization.

And that would, I think, have the benefit of clearly identifying which other technologies are considered with other products of open ADR is being implemented alongside of it, which is the hardware components, which hardware components, et cetera.

Obviously, there are going to be spillover impacts between manufacturers, between adopters of protocol. But it's a much richer story. And I think we should encourage more of that kind of evaluation protocol.

MS. TEN HOPE: Could I ask if you would mind submitting your comments in writing because you are cutting in and out. So, our panelists may be able to respond because we heard most of it, but I think you have some good detailed comments and we may have not captured it all. So, it would be helpful, if you wouldn't mind, either shooting in an e-mail or a comment letter.

MR. CONLON: Very well, I’d be happy to. And I’m sorry about the quality of the --

MR. GRAVELY: I’m not sure, you’re cutting in an out, but what I will say is I agree with your methodology, you’re looking at different opportunities. this particular case, again the synchrophasors and the auto DR were used as examples because in those areas we had some specific numbers we could work with.

But I agree there are -- when I normally talk about auto DR, and we look at auto DR as a service and different ways of getting there, one way of getting there is an open ADR protocol.

But in this case we were looking at it because of the numbers and detail that the demand response research team member was tracking.

I think from a larger perspective I would agree, looking at different types of techniques, different types of opportunities to get the automation could be considered so that PIER attribution can be better managed right now.

But these were forward -- with the exception of the 180, everything else is a forward projection.

But I would appreciate your comments because I think it helps us understand your -- the flow down that you're talking about to get the total picture. That's one of the areas that our office is looking for is trying to get a process. Because there are many other technologies and many other applications, we just chose those two for representation means, not necessarily for the definition of the process. Thank you.

MR. CONLON: Understood. Thank you.

MR. GRAVELY: Anybody else?

MS. TEN HOPE: I have a question for our panelists, particularly Tara, and Linda, and anyone else who may still be on the phone.

The credibility of the results depends on the accuracy of the input. And I'm just wondering who -- you know, what you rely on for the input? Are you taking some of the benefits numbers from the contractor, from the contract manager, from independent assessment, you know, how are you validating the input on the benefits saved?

MS. RAINSTROM: Okay, so our larger-scale benefits assessments, what we've done is taken our data and then have it, sort of our methodology and our approach verified by an outside party, and that's lent some credibility to our assessments.

As well as we work with a team, you know, our impact evaluation contractors that we hire, as well as our Energy Analysis Department that sort of buys into the methodologies that we come up with

So, it’s very team-based and, you know, without that approach I don’t think that we would have gotten, I guess, the approval and the credibility for all of the evaluations that we’ve done.

MS. COHEN: This is Linda Cohen. Yeah, I think that’s obviously a key issue and it’s one of the challenges when you’re doing a survey, and basing the estimates of benefits on particularly what the firms tell you they’re doing.

I think that it -- part of this thing comes down to whether the survey is done as some -- some of them have been described here today, that really involves very careful questioning and back and forth, and you’ve hired people who know what they’re doing, and they know how to ask questions properly, and they know how to back them up whenever possible with some, you know, some actual estimates of things, publications and, you know, anything that you can kind of get your hand on that one can count.

But it’s, I would say, a real problem and a real challenge. And sometimes it might be worthwhile trying to -- one thing that I find convincing is when you get a similar result using a number of a different techniques.

So, you've got your survey and that's one way of looking at it, and maybe there's some kind of macro analysis of the state and looking at what's happened to GDP in the state, or energy use. I believe you can get closer than that, energy use per capita, or something that one can actually measure, and then run a regression and come up with, you know.

It's just if you can run more than one study, I think that it is extremely influential in something like that.

And, of course, what one prefers is the kind of thing that Adrienne showed us, where you have three different methodologies and they basically lead to roughly the same sort of result, and then I think that it starts becoming a credible situation.

But particularly based -- if one is basing it on a survey, you have to think very carefully about that.

MR. GRAVELY: Thank you, Linda.

We have another question online. Do you want to go ahead and introduce yourself and ask your question?

MS. JORDAN: This is Gretchen, I'm trying to talk but you can't hear me. Now, you can?

MR. GRAVELY: We can hear you, now.

MS. BARONAS: Yes, we can.

MS. JORDAN: Oh, good. Good. Maybe I had to physically raise my hand on the computer.

I wanted to double up on a couple of points that have been made. One is that the -- on the -- it's probably just in the presentation, as you've said, but I agree with the commentator that said you need to give -- you need to put more stories on these and say, you know, what it was that PIER did, and what others did. Somewhat like that matrix that I presented earlier this morning.

Because I'm a little afraid that the R&D is getting lost in what you're -- in what you've presented so far today, and the difficulty of the R&D, and the length of time of the R&D because -- partially just because you're not telling that story, probably.

But, you know, when you present things like, you know, here's this one technology or product, and hundreds of millions of dollars, and the public is just going to say, well, if it -- if it was so successful, why did public R&D have to do it.

So, I think it just behooves everybody to put more of a story around the -- around the benefits analysis and explain, you know, the circumstances under which the advance happened.

The second thing is that a lot of people internationally, that are looking at R&D impact evaluation, are starting to talk about contribution, not attribution. And because the attribution is so difficult, you know. Let's talk -- let's take a share of the credit, let's say we were there and we contributed, but not try to be so specific in terms of, you know, getting the exact credit for something, or divvying up the credit.

And, lastly, I would say that at least at the federal level people in R&D evaluation have given up on jobs. You know, we tried it in the nineties, when the Government Performance and Results Act first came in and there just wasn't a way of getting at credible numbers.

And so, until ARRA came along, you know, it had really been sort of dropped as a metric.

Now, obviously, it's harder for a country because you can't be New York and talking about bringing people in from Connecticut.

But, you know, it's -- people had, indeed at the federal level, pretty much abandoned that as a metric just because it couldn't be credible.

So, that was it.

MR. GRAVELY: Thank you very much. Anybody else online with a question?

Okay, we do have some time after the next panel for more comment and we'll be opened up for anything that's covered today.

So, I'll now give Jean the mike back and let her do the next panel.

MS. BARONAS: Okay, thank you very much, Mike.

By the way, someone at lunch said that we needed to kind of make this -- have more fun, intonation of voice, and focal variety, and make it a little bit more entertaining. But I started to think I don't know how to really do that. But if anyone has any suggestions? Sing it. Okay.

Okay, so if I could just do a check of the speakers for the next panel. Of course, Dr. Cohen is here at the table.

And the second talk, Audrey Lee, are you on the WebEx?

How about Gabe Chan?

MS. LEE: No -- yes, this is Audrey Lee.

MS. BARONAS: Oh, okay.

MS. LEE: And my colleague, Laura Diaz Anadon, will be joining me, but not Gabe.

MS. BARONAS: Okay. Very good, thank you. And then, of course, Vanessa is here at the table.

Okay, so attribution, public and private sectors. This is Dr. Linda Cohen from UC Irvine.

MS. COHEN: Hello? Got it. Okay, thank you.

There are a lot of challenges in measuring the benefits from public RD&D and attribution is only one of them, but it's the one I've been asked to talk about, so let's go there.

The issue that has come up over and over again today is suppose you do this project, let's suppose it has some benefits associated with it, can we claim them for the public project? Can we claim them for the program, for the public program that's financed it?

And one issue is would the firm, itself, have done it had the public sector not put in the money? And there's a very big literature in economics about this at a -- at a more aggregate level. It's thought of as crowding out, but sometimes people even look at this at the level of the firm.

So, it's true that you've paid 50 percent, the firm pays 50 percent, but had you not put your 50 percent in maybe the first would have paid the whole 100 percent. So, that's one issue.

A second issue is it could be that the -- like I said, there's a very large literature in economics that's looked at this issue of so-called crowding out, and the results are a little ambiguous, although it's mostly ambiguous in a cross-section and we wind up getting some results.

It appears as if public funding does not necessarily crowd out private funding.

But what I find more interesting about the issue, which is not measured by very much of this literature, in fact there's very little on it, is it could be that you don't change the total quantity of money going into RD&D, but you do change what comes out.

And so then the question is we're thinking about how much have you redirected R&D and that, in a way, is even more difficult to try to get your mind around how to measure it than even just the total quantity of money going in.

And then in addition to that it's almost always the case, particularly, I should say, when you're dealing with public RD&D that there's going to be other people contributing to the project. There's going to be private sector firms, there's going to be other public sector institutions. And there can be other policies that play a critical role in it. So, then you have to try to think about sorting that out.

That piece of it, which I think is mostly what we've been talking about here today, in the context of the attribution problem, there isn't actually an answer coming out of economics on that issue.

Because if it turns out that you need all of those different pieces to come up with the final product, then it's genuinely ambiguous. Okay, this would not have happened had it not been for PIER. It also would not have happened if it hadn't been for EPRI. And maybe not if it hadn't been for NYSERDA.

So, there's really no way to sort through that except to say that they all deserve credit in a sense. And one may need a formula for purposes of, you know, going to the Legislature and saying here's our benefits and we're going to use -- it's definitely the case we're not the only people doing this, but we were critical and instrumental, and you can just use a formula.

But it actually doesn't have any theoretical basis if that's the situation you're dealing with.

There's a lot of ways that people have thought about doing attribution and we've talked about some of them today, there's cost sharing, there are surveys, there's attempts to not double count. Although, as I've just said, double counting, at least from a theoretical perspective, is actually fine because two people do deserve full credit, so there's not really a problem with that.

But the -- what I would like to propose and what I've been trying to formulate, and done some work, thanks to PIER, actually, is trying to think of this problem from the context of why it was that the work wasn't being done without the government participation?

Can I go to the next slide, please? I think this is the right one.

The primary case for public benefits come from market failures in the private provision of RD&D. And here I'm abstracting from the fact that two agencies may be doing it, I want to kind of get back to the beginning problem.

And when I say market failures, I guess economists are often criticized for thinking that markets are perfect but, actually, this is a technical term. We assume markets are perfect and then when they're not we say it's a failure, and that's all of the time, of course.

So, don't yell at me for being too market oriented, okay.

So, the issue here is that there are a whole lot of reasons why there's a lot of socially attractive RD&D not being done. And these include, for a lot of reasons, that there isn't enough capital being given to firms to invest, so there's what we call a liquidity constraint, okay, which we've heard a lot of lately with banking problems.

There are reasons why private firms, on their own, in particular, are likely to not invest in risky projects, even though those might be socially valuable. Okay. So, again this is even though they might be socially valuable, we're going to get under-investment.

And when you're dealing -- this is one of the things that's most interesting about the PIER and other energy programs is that when you're dealing with a product which is the market for it, the sales that you're going to get are very much tied up with government policy, say with a regulation.

There's even more reasons why the private sector are going to be reluctant to invest in that kind of activity because it isn't -- some people are going to want an energy-efficient car, but a lot more people are going to be satisfying the CAFE standards.

Okay, so it's true, there's a small people who get -- who just like energy efficiency, more here than in many rooms.

But then there's -- there's a lot of other people that are going to be relying on that regulation. And if there's -- the market risks that are associated with the product then are not just that somebody else might invent a better widget, but also that the government may change course. They sure have over the years, we have a lot of experience in that.

R&D investments are long-term investments, they pay off years in the future, and it adds a level of risk that is generally not present.

So, these are the sorts of issues where we would, you know, from a sort of pure economic perspective, argue that we should have public investment in RD&D.

And that's why when I, and some of my colleagues, were looking at this we tried -- we stepped back and tried to think can we do this, thinking about let's look at these market failures, identify the extent of the market failure, and think of a way to estimate that aspect of it.

And from that we can kind of conclude that there's going to be a role for the public sector and we can -- we can, to some degree, I'm not going to say assume, but try to get at the issue of attribution.

Again, there's not going to be a perfect answer because there actually isn't one. But this, at least, would give us a really strong argument to start talking about attribution.

Can I go through the next couple slides pretty quickly? Let's see the next one? Okay. I actually don't want to get into this. If somebody wants to know what this is about, come and ask me afterwards, okay.

But this is the -- these are different ideas of why it is that the private sector is under-investing in RD&D.

Do the next one. A better picture, let's talk about this for a moment.

So, all those dots off to one side, where it says "B", those are the high-risk projects.

And next one. Okay. One of the things then, getting back now to our public program, if what we're arguing, because we observe that there's high -- that there's a lot of risk going on and, again, the risk might actually be because of government policy, then what we should observe in terms of the projects that are being funded, is they have a different profile than ones that didn't get funded so -- but, nevertheless, got conducted.

Okay, that is to say it's going to look more like what the EERE programs actually look like at the Department of Energy, there's going to be some home runs and a bunch of duds, as opposed to a whole bunch of projects, each of which has a ten percent rate of return on it.

So, that actually gives us one -- what I would argue is we want to move back from there and then infer that as a result -- I mean, this is the argument that there must have been an attribution, that there is an attribution argument to be made because the nature of the projects had a different risk profile.

Now, what this leads to -- can I have some more slides? Keep going. More, more, more. Oh, dear, I forgot I had done that. Oh, let's just stop there.

Okay. What this definitely leads to is I would say that in terms of surveys, and we looked at an enormous number of papers that were trying to do attribution in one way or another, there's been a huge focus on what happens with the projects that get funded.

And every time I looked at this I couldn't figure out a way to start estimating these issues, and I think there's various econometric techniques one could think about, without knowing something about the projects that didn't get funded.

So, the key point I really wanted to push up here is that when you start doing these surveys that you survey the firms that you didn't fund.

Now, I admit, they're probably even less enthusiastic about answering your survey, than the ones that did get funded, but I think that it's really, really important.

Now, luckily, in California NSF has been doing a survey, and one of the things they've been -- of firms, and one of the things that they're asking a lot of questions about, actually, is energy, so it might be possible to jointly do something with them.

But one needs counter factual in order to do anything serious about estimating the benefits. And the counter factuals that most of the studies tend to use is they talk to the firms and say what would you have done in the absence of our funding?

And what we're arguing is that we just simply have got to get some information about the firms that actually didn't get funding.

And they're going to be different, which is one of the -- this is yet -- so, it's a different set of challenges because now we're going to have two sets of firms, firms that had money, firms that didn't get public money.

The firms that did get money were the ones selected by PIER to -- you know, specifically for various reasons. But that's the kind of thing that I think we have to start thinking about, putting together counter factuals and putting together ways of comparing those two groups, and that that would actually let us get at some of the issues that are very important here.

MS. BARONAS: You took care of my concern of monotony or lack of energy in speaking. That's great, thank you.

MS. COHEN: There are many more slides that you can now flip through very quickly because I've actually finished. Keep going all the way to the end.

We need randomized trials. But we're not going to get randomized trials, I don't think I can take you guys into taking the proposals that come in and just throwing them in the air and doing a random selection of them. That would be my first choice.

(Laughter)

MS. COHEN: But we might be able to do something in between. Okay, thank you very much.

MS. BARONAS: Thank you, Linda.

Okay. So, now moving on to Audrey Lee and Laura Diaz Anadon, "Uncertainty; Research Results in Funding," Kennedy School of Government, Harvard University.

MS. LEE: Hi. Can you hear me all right?

MS. BARONAS: Yes, we here you.

MS. LEE: Hello?

MS. BARONAS: We do hear you, yes.

MS. LEE: Okay, great. Hi. Yeah, thank you.

Well, thank you so much for the opportunity to speak today about our project. So, our -- this looks to be a little bit different than the other presentations today, but we developed a new methodology for benefits assessment. And this is targeted primarily to the

Department of Energy, but I think it’s applicable to other funding organizations, like PIER, as well.

I want to note that this is kind of forward looking methodology analysis and not retrospective, like some of the other presentations.

And in the presentation I’ll talk about how funding and allocation of a portfolio of energy technologies can be transformed in order to accelerate innovation and solve problems, like security economics, and environmental challenges, or the benefits from that.

I just want to make sure that I have a joint appointment with the U.S. Department of Energy as an economist in the Policy Office, as well as being a fellow at the Harvard Kennedy School.

And today I speak with my Harvard hat on, and so none of this is by DOE’s use.

The next slide. So, the objective of our project is to make recommendations to the U.S. Federal Government to accelerate energy innovation and to meet energy-related environmental, economic and security challenges.

I think that Linda already went over some of the points below, namely that, you know, the public, private sectors, and citizens all have roles to play in innovation, but the private sector is the main actor.

And the role of government really is to address market failures.

And this speaks a little bit to Gretchen's point earlier, I think, that showing all these benefits and the small costs, you know, why don't private companies do it? Well, it's these market failures listed here.

And then there's specific challenges that are particular to energy innovation, specifically.

The next slide.

Oh, and also wanted to address this third question that was posed to this workshop about attribution between the private and the public sectors.

So, the work I'll be talking today about is focused on the public sector, specifically, U.S. Federal spending.

But another part of our larger study is a survey that we did of firms engaged in energy innovation, to assess the private sector innovation. And it really goes beyond previously available data and surveys.

And this part of the -- this private sector part of the study also looked at partnerships between private firms and the DOE, and explored how they might be more effective.

But today I'll just be focusing on the public sector.

So, in this table you can see that there have been many calls for more energy innovation in the United States, and they're becoming more frequent. So, from 1997, the peak cost report to last year, there were three reports that came out that asked for -- that recommended increases in public research development and demonstration funding.

Next slide. So, I'll just go over the basic framework of our methodology to do benefits assessment, and it goes from doing expert elucidation to capturing the uncertainty around research development and demonstration portfolio investment benefits.

So, the first step is to do expert elicitations and elicitations is kind of a fancy word for surveys, where we try to link research demonstration -- research development and demonstration funding to technology improvements, like cost reductions, and performance -- performance enhancements.

So, first we asked experts in different technology areas to estimate uncertainty around technology performance and cost in 2030 under business-as-usual funding levels for research development and demonstration.

And then we asked experts what they would recommend that the funding levels should be from now to

2030.

And then based on their recommended level of funding what they think technology improvements would be based on that recommended level of funding.

In terms of attribution between the public and the private sector, we did ask experts to assume business-as-usual private funding throughout the survey and to comment only on the public -- to comment only on public funding in the survey.

So, we asked them to keep in mind that private sector funding is there, but not to focus on it.

And as I said, when we asked them for their recommendations, for their projections of technology costs, we asked them for the tenth, fiftieth, and ninetieth percentile estimates to get a sense of the uncertainty.

Our next step was to talk all of the data that we collected from these experts and put it into a energy system model, like the MARKAL model that Pete Whitman talked about earlier, to measure the benefits from that enhanced level of funding, research development and demonstration funding.

So, we took -- from that data we took three types of input on cost and performance for each technology area. Specifically, we took -- we separated the experts into optimistic, middle of the road, and pessimistic. We also estimated the correlation between technologies over time, and I'll talk a little bit more about this later.

And we also had interpolate for the data in time, because we only asked the experts about 2010 and 2030.

And then the next step in the process was to -- oh, can you go back?

Our step three was to look at the impact of different policies and market conditions on those benefits. So, how do you -- so, you know, in using the MARKAL model how do you translate the technology performance, like the dollar per kilowatt hour for a -- and benefits like kind of tons of CO2 reduced.

So, we ran about 25 different scenarios looking at different investment levels, different oil and natural gas prices, different policy scenarios like carbon cap and trade systems, or clean electricity standards, or CAFE standards.

So, basically, our approach is to incorporate technical uncertainty to quantify the uncertainty around the benefits and use this as a decision metric, ultimately. Like, you know, what is the probability of the CO2 price below a certain level, or what is the mean standard deviation of resulting oil imports, under a wide range of investment portfolios and assumptions.

Let's see, and I just wanted to make a comment that the expert elicitations are really difficult, and kind of echoing what Linda Cohen said earlier about asking experts to find probabilities of success to holding a gun to their heads. Our expert elicitations took numerous phone calls, and really walking them through the survey, and really took much longer than we expected.

Halfway through we did start doing online expert surveys, something that hadn't been done in the field before, and that really helped a lot.

And I should have mentioned this earlier, but in addition to the expert elicitations we did in the technology areas, we conducted qualitative interviews with funding decision makers, people in Congress, the DOE, as well as the private investment community, like venture capitalists, who help -- we asked them to help us sort through all the data that we collected from the experts.

The next slide. This slide just gives a base level view of the different technology areas that we covered. So, we looked at four of the five applied side technologies, nuclear, fossil, bioenergy, and photovoltaics. And within those technology areas we looked at different technologies. One enabling area of utility scale energy store, and then two demand side technologies, vehicles and buildings.

We covered a total of 25 specific technologies and we asked experts to comment on four different budget scenarios. So, the business as usual, their recommended level of funding, half of their recommended level, and ten times their recommended level, and so we could get a sense of that space.

And in all we had a hundred technical experts do the survey and 23 high-level reviewers.

The next slide. So, this just shows an example of the results of one of the surveys, the energy storage survey. And this is the average allocation, in terms of percentage of budget, by the experts that did the survey, among the different technologies across the horizontal, and then across different stages of research down the vertical.

You can see the level of detail that they went into in terms of technology. And we literally gave experts this game board or this matrix and asked them to allocate their budget using little poker chips.

And you can see this focus in this survey on, you know, commercial demonstration, or on certain technologies like that, or using compressed air, and batteries, and more of an emphasis on commercial demonstration for, you know, compressed air, which is a little further along into the technology development.

The next slide, please. So, this is a summary of the results. Again, from the energy source, we can see that the DOE energy storage budget in fiscal year 2009 and 2010, and then the range of the experts' recommended budget, ranging from 50 million to 20 billion. And most of the experts did recommend around $100 million for this survey.

The next slide. So, as I said before, we ran about at least 25 different scenarios to evaluate the benefits of different budgets, our expert type and different policy and market conditions.

So, in terms of funding level we asked -- we looked at business-as-usual funding, the half of the recommended level of the budgets -- excuse me -- half of the experts' recommended budget level, their recommended level in ten times.

We took different expert types in terms of their cost projections, optimistic, middle of the road and pessimistic experts.

We looked at different energy prices based on the annual energy outlook. High gas prices, high oil prices, low gas prices, high gas and high oil prices.

In terms of policies, we looked at a carbon monoxide cap of 17 percent below 2005 levels by 2020 and 83 percent by 2050.

To make things simple we did domestic offsets, only, and then no international offsets in allowed banking and borrowing.

And we also looked at a clean energy standard, which Obama announced in the State of the Union speech, of 80 percent by 2035. And also put in there -- because that's the electricity sector only policy.

Also put in that scenario 30 percent improvement in commercial building shell efficiency and increases in the CAFE standard.

And I think someone mentioned, you know, the -- I think Linda mentioned the importance that impact that policies can make, and we're starting to see that in some of our results, you know, that the policies can have a big impact, and RD&D can't act alone.

The next slide, please. So, this graph shows the results from our nuclear energy survey. These are overnight capital costs for our Generation III, III Plus design. And along the horizontal access are all the different expert projections.

The -- each expert has this series of dots and lines, and those are their 2010 projections for costs, 2030 under business-as-usual funding, and 2030 under their recommended funding.

And then there’s a vertical span that -- that encompasses their tenth and ninetieth percent estimate.

And so, based on our qualitative interviews we selected three sets of projections, you know, and used them as our middle, optimist and pessimistic experts in the MARKAL modeling.

The next slide, please. So, this figure goes back to the energy storage survey and shows kind of a picture of return on investment, so it shows the change in overnight capital costs compared to a business-as-usual RD&D funding case.

So, 100 percent means that the recommended level of funding that the expert proposed offered no change from business as usual. Less than 100 percent means that that capital cost is reduced because of that funding level, and over 100 percent means that it was increase in business as usual.

And then each line has three dots because the middle dot being the recommended level from the expert, and the one to the left being half, and then the one to the right being ten.

So, you can see with increasing RD&D funding you reduce your capital costs, but you do also see decreasing return for that funding.

The next slide, please. So, we also thought about the clusters of technologies where improvements are likely to be related. Because we did model distributions of technology cost improvements if you -- if you sampled, for example, a vehicle for -- if you sampled the vehicle costs and it happened to sample very low on the technology costs, you would think that in that same scenario improvements and vehicle costs would also result in improvements in battery costs for utility scale storage because they share those technologies. And I'll show you some data to clarify that.

But you can see the different clusters that we put together, so liquid fuels and electricity from coal and biomass to thermo chemical processes, liquid fuel from biomass and chemical processes. Nuclear Gen II, and Gen IV in modular nuclear reactors would be related in terms of technology development.

PV, for residential, commercial, and the utilities would have some overlap as well, and then different types of compressed air energy source technologies, whether they're above ground or under ground, would share some technology components. So, advancement within one would result in some portion of advances in another.

We did do Latin Hypercube sampling, instead of Monte Carlo to -- again the distribution of technology costs from the expert elicitations, and I'll talk a little bit more about that in the next slide.

And then used these correlations in these clusters.

Next slide, please. So, this demonstrates how we accounted for the fact that improvements in some technologies are likely to be related. So, this shows the sampling distribution for electric and plug-in hybrid vehicles.

So, on the vertical access you have the plug-in hybrid electric vehicle cost in thousand dollar -- in thousands of dollars. And on the horizontal you have battery electric vehicles. And so you'd expect that improvements in battery electric vehicle technology would result in similar improvements hybrid electric vehicles.

So, we designed a hypercube to do this, and the marginal distributions, you can see, provided by the experts are preserved.

The next slide. So, these are some of the metrics that we're hoping to get out of the MARKAL modeling in order to quantify the benefits of the portfolios and account for uncertainty.

So, I want to be able to show the distribution of carbon dioxide emissions in tons versus in time, the distribution of CO2 price under a carbon and cap case, the distribution of oil imports, the distribution of technology deployment in gigawatts, the distribution of technology deployment plotted against technology costs.

So, as you decrease technology costs you would move the distribution of technology deployment, further increase that distribution -- increase that to more gigawatts, excuse me.

And then, lastly, look at the share of technology types in that distribution. So, below that you can see a triangulish -- a triangular shape craft with renewables, fossil, and nuclear in each corner. And you can imagine, maybe, in scenario A you have a greater share of nuclear and less of renewables and fossil, and so forth.

The next slide, please. And then so this just shows one of the metrics I was talking about before, CO2 price. And you can imagine, on the left you have business-as-usual funding scenario and on the right you have an enhanced research development demonstration funding scenario.

Under business as usual, in 2030, you only have a 30 percent probability of the carbon price below $30 per ton. And these are just illustrative, these aren't real data.

And on the right, if you enhance RD&D funding, maybe you can imagine a scenario where in 2030 you have a 70 percent probability that carbon price is below $30 a ton.

And you can do the same analysis for uncertainty around CO2 emissions in a scenario.

I should -- I know this is probably all very confusing to see this for the first time, but so for each -- like I had said before, we've done about 25 different scenarios and each scenario contains 400 cases, or 400 model runs, each sampling along the distribution of different technology costs.

So, this distribution here in this plot is made up of 400 runs of the MARKAL model for a single scenario, so I hope that helps.

The next slide. So, this is the team that -- this is the team that worked on -- is working on the project. And, oh, I did want to answer the fourth -- and I think that this forward-looking exercise is very complimentary with the retroactive analysis that we've seen. So, we don't think it should be used by itself.

And it allows us to think about research and development areas as a system or a portfolio of investments. While retroactive analysis really considers technologies independently, so we're really looking at the whole system and how these technologies interact with each other.

To address the fourth question about future plans, we do plan to publish our report with all the data we have collected, and our results and analysis over the next few months.

We're working with Dewey (phonetic) to explore the extension of some of the elicitations in some of the other technology areas that we were unable to cover in the short time that we had.

The next slide. And that's my final slide. So, this work was funded by the Doris Duke Foundation. I'm done. Thank you. Any questions?

MS. BARONAS: Well, thank you, Audrey. There is a time period for questions after Vanessa completes her presentation, so people may come forward with some questions then.

Okay. So, now, we have our proposed PIER benefits approach, presented by Vanessa Kritlow, of PIER.

MS. KRITLOW: Hello. I just want to thank all the presenters today for giving such interesting and insightful presentations.

So far we've described some of our current benefits analysis and gave you some of our estimates that we've come up with.

Now, PIER would like to present what we feel would like to be included in like a perfect world kind of benefits analysis, and these are just some of our suggestions.

We are very interested in receiving input, so we're going to keep telling you to give us some written feedback on June 1st, and I'll tell you again at the end of the presentation.

Next slide, please. The intent of this presentation is to present ideas to innovate PIER's benefits analysis methodology.

The next slide, please. And let's keep going, one more slide.

All right. First of all we would really like to integrate these benefits assessments into work plans, if possible. When used appropriately, these could be used as a very good feedback took for policy management when deciding what types of projects to undertake for research.

The next slide. We would really like to incorporate benefits training into just our general PIER staff, provide at least one person in our program areas with a very general benefits overview, so that they're more aware of what to look for when they're working on these -- managing these projects.

This person, if we were to have one on each team, would be kind of a go-to person, so we're not always scrambling around or something.

So, they would be the go-to person for questions on data and, you know, maybe exceptional projects and things like this.

We are starting to develop training modules right now on how to, you know, train our cams.

The next slide, please. What we'd really like to do and we know -- I think NYSERDA does this, we would like to consider requiring our contractors to report on a pre-determined list of metrics, which we do not have, yet, but we hope to have them in the future, upon the project completion so that once the project is completed we can track these in the future.

But the question is how do we hold the contractors to this when they're, you know, finishing up the project and for how long?

We've heard various estimates on how long it takes for these benefits to, you know, hit the market, and things like this, so we'd really like feedback on, if anyone can give us a recommendation, on how to, you know, insert this in their contract and for how long should we follow up with the contractors.

The next slide, please. Like NYSERDA, we're trying to enhance our database. I really liked your presentation and I really like the way you guys are doing your -- kind of your bottoms up, trying to get to a program level from your project level. And we're going to review your presentation quite a few times to see if we can do something similar.

but we want to insert some -- some fields in our database, you know, to track our ex-ante, expected benefits that the contractors come to us with, their projected savings.

Then we want to come back and look at the realized benefits, do they meet what they said they would find?

And in the future, you know, annually keep track of these metrics to see the growth and benefits, because we know they're there.

Next slide, please. It would be neat if we could have some kind of auto fill function. So, once these people submit all their data, if we could find out, you know, which types of projects actually did achieve those expected benefits, why did they? Which ones did not; what were the reasons? I think that will really help us in the future if we were to integrate that into our feedback mechanisms to, you know, choose new projects.

The next slide. All right, those are a few foundational needs that I felt that, you know, we kind of need just to get our feet off the ground.

Now, we'll kind of present a few methodologies that we'd like to see in there, too.

And I'm ahead of myself, the next slide, please.

All right. So, we know that the analysis can be done at either the project or program level, it seems like a lot of it depends on, you know, just constrains, your staff, and things like this.

So, should these projects be, you know, individually looked at? Is there a way we can do a programmatic approach? Should we have third-party assessment so that, you know, everything's a little more transparent?

These are all the things we want input on. So, yeah, whether the research yielded or produced savings, how the market is looking?

Yeah, the next slide. All right, finally.

We, in PIER, think that most of the benefits, like I said in the morning, fall into economic and grid reliability, environment, and knowledge spillover benefits. And we do want to do surveys, we're developing surveys to, hopefully, capture future benefits.

And we know that they're not easily monetized. We want to come and -- maybe that MARKAL model does the economic to environmental translation of benefits. That's what I've picked up so far, but I'll have to look at that.

And almost the last slide, the next one. This is kind of almost a very similar grid that Linda showed us. We have our categories of economic, reliability, environmental, even though they're not so easily monetized, as I mentioned. We have those projected benefits that we have ex-ante. We have realized benefits.

And this is kind of a way we think we could present them. Not all of them are easily summed, you can't do that across all projects, they're very different. But this is kind of a very, you know, high-level way we think we could present these benefits.

The next slide. Input/output models; I think that they are very beneficial to look at but, you know, they might have some plusses and minuses in using them. They do have a lot of assumptions within them.

I like them because they answer the question, you know, what is the economic consequences of these projects?

Like Tara was describing, it's how do you input it by sector, it spits out a lot of information and tells you -- it breaks it up into direct, indirect. It will tell you by county how many jobs you've created by that type of investment in that project, and I think that would be really beneficial for us to look at.

The next slide. And we beat this like a dead horse, the question of attribution. There's a lot of parties involved in these projects, how do we split up the benefits?

Do you credit each partner's contribution according to the expense? We've looked at this a lot.

All right, so that's that last question. And this is instructions on submitting comments, which are also included in your workshop notice, if you'd take a look. You can just send an e-mail, which is super easy, or if you're old-fashioned, send us a written hand-copy over to the California Energy Commission.

All right, thank you very much.

MS. BARONAS: Thank you, Vanessa.

Okay. So, now we have some time for open discussion of the afternoon presentations, so please raise your hand if you would like to bring up more points for us to think about as a team, or as an organization?

Please, Ed. Yeah, please. I mean, because of the WebEx, especially, but for us, too. The wireless there or --

MR. VINE: Sure. This is Ed Vine, California Institute for Energy and Environment, and Lawrence Berkeley National Lab.

I was actually intrigued by one of the last questions and thinking of the big picture on how you evaluate research.

A number of the presenters provided their experience on evaluating energy efficiency programs, rather than R&D, and I think there's a rigorous industry and community in looking at evaluating those kinds of programs.

In California, we have the California Public Utilities Commission, and they have an evaluation effort, where they're evaluating their programs. They're relying on independent evaluators and they're also looking at both programs and portfolios, so that might be one model.

NYSERDA has a similar model, they have a panel of experts and advisers helping them, as well as a team of stakeholders in evaluating both programs and R&D, as well.

So, California really hasn't -- the Energy Commission, PIER hasn't really built in this sort of committed resources to a long-standing effort of evaluating the R&D, rather than come in, do a retrospective analysis and go out.

I think what you've heard before was what NYSERDA's doing and what DOE has done, in terms of the ARRA funding, is building in these mechanisms to reduce the cost of evaluation. So, when programs or projects start, these metrics are collected.

And I'm glad to hear the Energy Commission's thinking along the same lines because that will reduce the burden.

I mean one of the first criticisms you'll get about the evaluation enterprise is, well, isn't this too costly, how can we reduce costs? So, that's important to keep in mind.

I think the value of doing that is often very important.

One of the things, also, I wanted to comment on is think of who the audience is, and I think some of the earlier presenters were thinking about that.

The evaluation -- I think evaluators over time have been sensitized to that because different audiences require different kinds of information and, particularly, with respect to accuracy.

And then the last comment, about attribution, we deal with this all the time in evaluation and it is becoming a more difficult challenge because there are different actors involved in providing information or influencing the market.

And I wouldn't walk away from trying to do attribution, I think it's important to do that, particularly if you're interested in what is the effect of a particular program or a project, you still want to know that because, at the end of the day, you want to improve your programs and projects.

So, don't walk away, commit some resources to doing it. The funding, doing it by percent of costs, I think I've been sold that's not the right way of going about it.

Mainly, and particularly in California, there's a whole history, and the PIER program is a good example, of working in the R&D area, and they've committed a lot of resources.

And some of the work that gets replicated over time may be because of a PIER project, for example, conducted five years ago and that's just getting out, now. So, keep that in mind.

And then the last comment is a lot of what we've talked about is on sort of impact evaluation. You've heard about all these metrics, and coming up with numbers, or a confidence interval, or a mean. But I'd like to reiterate what Gretchen Jordan mentioned earlier, and which falls into what we call process evaluation. And so you want to tell a good story, you want to do your interviews as you've mentioned, and bring that information in.

Some people, depending on the audience, says, you know, give me a number, how much did I get because of this investment? But I think that, in and of itself, is not sufficient, that you really need to tell the story.

And that's why if you do commit to this evaluation enterprise, focus both on impact as well as the process.

So, thank you.

MS. BARONAS: Do we have other comments right now? And including from the web?

And, if not, we'll start reminding you of some of the questions we've asked.

MS. RAINSTROM: If Gretchen is still on the line --

MS. JORDAN: Yes, I'm still here.

MS. RAINSTROM: Great. I'm curious, you talked about contribution versus attribution and I know by definition the difference, but I'm curious from an evaluation stand point how you decide contribution, the relative contribution?

I mean, the gentleman that just spoke was talking about, you know, the percentage of funding isn't adequate enough, you know, how do you -- how do you go about looking at it from that perspective?

MS. JORDAN: I don't think there's too much difference in how you look at it, it's just in how precise you try to be. And so the idea is just to put yourself in the picture as having contributed, and to not -- you know, so not try to come up with something that says, well, we've put in 50 percent of the funding, so we were 50 percent of the attribution.

More like Linda said it, it's entirely possible, especially in R&D, that both should be a hundred percent credit.

So, it's more of the way you word it and how wrapped around the axle you get about trying to be exact. I mean, I think that's the one thing, and maybe it's just because I've been in this business approaching 20 years now but, you know, there isn't anything perfect, and there isn't any study you're going to do that isn't going to have somebody who's going to criticize it. So, just relax a little bit and know that you're doing -- you know, you're doing the best you can.

But I mean contribution, obviously, can have several levels. And that's, I guess, the other thing is to -- and just reiterating, too, what Ed pointed out, I mean R&D is a process and the public funding can have a lot of outcomes besides the fact that a product gets to market.

You know, the fact that you have catalyzed investment, that you have brought together networks of individual -- I mean, researchers and firms that have never worked together before, et cetera, those are also important earlier outcomes of the R&D and of the -- of your funding mechanisms.

And in my mind, the plus about stressing some of those is, well -- and your contribution to those is that you remind Legislators and the public about what R&D is, you know, how R&D happens. You know, it's not the black box miracle of doing some research and then a product pops out. It is -- it is a whole -- you know, it's this big network of people that end up coming together to make something exciting happen.

So, two answers to your one question.

MS. RAINSTROM: That's great, I'm going to bring that back to New York, thank you.

MS. COHEN: Can I put a little more onto that? I feel very strongly about this. It's interesting when you look at one area where we do tend to measure this is when you look at sort of a really aggregate level at, say, a national level at expenditures on R&D and what happens to GNP.

And in the same year it's very hard to get anything or you look at the industry, how much R&D is spent in an industry, what's the growth rate of an industry. It's very hard to get anything looking at small pieces.

Over decades it's very obvious that -- I mean, the estimates are that nearly all of the growth in the United States and other developed economies is in fact due to innovation, not to -- well, there's a little bit due to more people moving in and some more capital investment. But new technology, new ways of doing things accounts for pretty much most of the growth in per capita income, in any event.

Another piece of this is that typically when you look at an industry basis there's spillovers of maybe half the benefits. You know, that you'll get an estimate of a 12 percent rate of return or a 20 percent rate of return within the industry, for their expenditures in R&D, and you'll get an estimate of something like 50 percent if you look across industries.

So, there's so many spillovers involved in this business that, you know, it's just very difficult to get at that by trying to trace you did this work and now we've got this product over here.

And a lot of the public sector work is pretty early stage R&D as well. That's maybe more so at the federal level, but in the state as well, even though we're supposed to be doing something that has economic impact, and it is supposed to be applied research. But it still can be pretty far removed from market.

So, I think that trying to focus just on those benefits that are easy to measure gives a really big underestimate of what the value of the program is, so some of these other techniques have to be brought in to try to convey that.

MS. KANDEL: Thank you, Linda. Before we continue I'd like to see, are there hands up on the WebEx so to speak?

No. Before we continue asking you more questions, then is there more comment from inside the room?

All right. Then I hand the floor to Vanessa.

MS. KRITLOW: I would just like to go back to one of Adrienne's slides at the beginning of the morning where she mentioned that, you know, we're kind of going back retrospectively looking at some projects, while kind of building up our future methodologies. So, a lot of our projects from a long time ago really only have those technical potential numbers.

So, if we're trying to go back and look at, you know, today's, I'm trying to analyze benefits now, maybe, what would you do with the technical potential to possibly, you know, bring some more realistic information out of that?

MS. KANDEL: And to add, specifically, obviously, we will be looking at some sample, finding out what you can find out about the information later. So, this is also a question for looking forward when you're projecting what about technical potential? Thank you.

MS. COHEN: Well, one thing you have to be very careful about looking back, if your data isn't very good, is that it's easy to have a censored sample, to forget the ones that got lost early on. I just -- it's a very standard problem that happens in these that the successes live on.

Which is, actually, another good reason for doing the kind of routinizing, getting the data started when you fund the project, because then you will have the whole set of projects.

MS. KANDEL: You have to use the mike because it’s WebEx, I’m sorry.

MR. VINE: So, this is just a quick comment, Ed Vine. So, there have been studies in looking at technical potential, market potential, or economic potential, and achievable potential. And particularly the people who are doing those potential studies have made comparisons among different technologies.

So, I would use that as sort of a first start on how you -- the technical potential might not be the right metric you’d want to use, particularly if you’re looking at what are going to be the realized savings. Technical is the highest, as you defined at the outset, what you expect to get. It’s not -- and then it goes down in terms of potential savings as you head each layer. It doesn’t get to one percent but it is dramatically reduced over -- once you use those filters of economic and then achievable.

So, general suggestion, if you haven’t already looked at those studies and looked at those numbers.

MS. KANDEL: Thank you. So, I have a question, if I may. So, Ed and Gretchen both talked about the importance of stories, and then some questions were asked by Laurie about the credibility check on data. So, if you combine both, stories and credibility need, how do you -- if you put language around a lot of this, you know, we felt a certain way, and the impact of RD&D was important because, and you give ten points, and then you tell the story afterward, where do you add your quality check in the stories, in the language?

MR. VINE: So, this is Ed Vine, again. The best examples, which I can refer you to is some three studies that we did for the California Public Utilities Commission on market effects. We looked at CFLs, hi-bay lighting and residential new construction, and the question is what impact has this -- have these programs had not on the participants but, really, on the non-participants in the market?

And somebody mentioned earlier it's important to use multiple methods and that's what we did. So, we looked at sales data, we interviewed manufacturers; we, being the contractors.

Interviewed manufactures, went into stores, interviewed program managers of the utilities running the program, as well as experts.

And if you look at the reports, you have the quantitative data and then you have the qualitative data, particularly from the interviews that you've conducted, that either support or don't support the major conclusions you have in the report.

And so in addition to saying, well, we think this program did this for this reason we have a number -- we have interviews, we have quotations from some of those key players supporting that.

Because you do, you know -- there are, as anyone familiar with collecting data, either through analyzing sales data, or collecting sales data, or conducting interviews and surveys there are limitations with each method. But when you have multiple methods, you have more confidence in the results.

Hopefully, they're all saying the same thing. It doesn't always happen, sometimes you get conflicting views. But often, if you've done the right research, it often supports one another.

And so the findings are then considered more robust from other parties, because some people are suspicious of, well, you just interviewed the manufacturers, of course they're going to say this program was important or not.

So, again, multiple methods are the way to go. It's more expensive, but then you have more confidence and credibility in the results.

MS. KANDEL: So, a follow up question for you, Ed, because you're probably very experienced in this. Suppose I have a program that for which we gave a $90,000 small grant, or maybe a two or three hundred thousand dollars of complete PIER funding, how much do you think it would cost to do the type of analysis you're talking about to evaluate its effects?

MR. VINE: Yeah, I mean that's always a good question, you know, how much should we spent on evaluation? And we have a range we use for program evaluation going -- and it's, you know, going from, well, zero for some places who don't do any evaluation. But often we encourage people to go from two to eight percent of a budget.

And, you know, then you have to multiply it by the amount of dollars for that budget. So, if you have a small program, say you have a $50,000 project or a hundred thousand, you're not going to spend a hundred thousand dollars on the evaluation. So, you have to reduce your expectations on what you can do with that budget.

Of course, the higher the percentage, the more you can do.

One of the things, I think it was Vanessa was talking about, you know, when you -- the thing is you need to strategize and that's when you look at portfolio and you need to see what's in your portfolio and which of the programs you want to focus on.

Ideally, you'd like to do all the programs but because of budget constraints you can't, so then you use certain criteria. One might be potential energy savings. You might already know that from when people were at the planning, proposal stage, they were saying we expect this amount. That's just one indicator.

Another might be a new technology nobody's even heard of and it will be the first, say, in California. That's definitely worth of some evaluation.

And there are other metrics. Again, the California Public Utilities Commission, in their evaluation plan for the 2010-2012 discussed some of the criteria and approached they've used, because they're doing it from a portfolio style.

One of the criteria they're using as one element of their evaluation is what's called high-impact measures. So, these are measures that are expected to have a lot of energy savings in California.

If you think of the whole portfolio, you definitely want to make sure they're included in your evaluation rather than in some ones that don't offer that much savings.

I don't know, maybe NYSERDA, I don't know what approach -- do you evaluate all your programs or is there some sort of strategizing and --

MS. RAINSTROM: Well, I mean yes and no. I mean we're trying to evaluate all of our programs, we're trying to look at it in more of a portfolio-based approach, rather than individualized programs.

But I guess a couple of things that I didn't mentioned earlier is we do -- you know, we do the peer review, we do process evaluation, and some of those evaluations are based on the program level.

But our approach that we've been heading towards is more of the portfolio level approach. And currently I believe our evaluation budget's somewhere around five percent, if that helps?

MR. VINE: Gretchen, if you're still on the phone, the approach you're using, you've mentioned about clusters and doing clusters of projects?

MS. JORDAN: Yes, and that's to avoid the accusation of cherry picking just the successes, but also as basically a cost-saving measure so that -- and there are two -- you know, the U.S. Department of Agricultural, in their Cooperative Research and Extension Service, if you haven't looked at the way they were evaluating their R&D, I think it's useful.

And what they did and our EPA did that for their R&D, as well, is they looked at thematic areas and those could be uses, and then evaluated that way. So, EPA would, every three to five years, examine all of their research in multiple areas that was aimed at water quality regulations and say, you know, what did we contribute to that?

And Department of Agriculture pulled together thematic areas, actually did a logic model to explain to the peer reviewers how this research all hung together, and then did their expert panels on groups of stuff.

And, with the notion that if you're trying to speak to the taxpayers, it helps to be looking in a thematic area that is something that makes sense to them.

I did have some comments -- a comment on the technical potential, too, when you want to go back to that.

MS. KANDEL: Please go ahead.

MS. JORDAN: You know, what you saw -- was it Pete presented on the EERE benefits estimate, those are estimates, modeling estimates for R&D funding that hasn't even happened, yet. So, there's no question that all of that estimating is based on technical potential, rather than actual.

So, certainly, people are -- you know, and that process is something that EERE started in like 1994 and has been perfecting over the years. So, that would be something to look at.

And when they -- what's included in the modeling that they do are aspects of whether or not this new product or technology would be absorbed. And so work that me and others have been doing would -- you know, you could do some fairly loose qualitative analysis of the likelihood that this potential would have some payoff and you could do it with experts.

But you would look at the -- at the technology setting that the technology is in. Is it the last piece of the puzzle that means you've got a whole system ready to move forward?

Or is it like hydrogen vehicles where you've got so many other pieces, even of technical infrastructure, that have to fall into place.

And then look at the business side of things and say, well, does this need a while new supply chain or is it just something that can drop into existing?

So, I think you could present an analysis that says, well, you know, this is the technical potential and, look, it's got a lot of hurdles left to go. Or it's going to fit right in and is likely to be adopted quickly, and the you'd at least have that qualitative assessment.

And when you think about it, it's a little bit like stage gating, isn't it? I mean, at each stage of the technology development the questions that are asked review the technical case and the business case and see how rational it is to move forward and increase the investment.

So, that kind of analysis could be done around technical potential, I think.

MS. TEN HOPE: We've focused -- go ahead, Linda, did you want to --

MS. COHEN: No, go ahead.

MS. TEN HOPE: We've focused a lot on technical potential and realized savings, which fit a technology model. But often the barriers to achieving our policy goals aren't technology driven. They might be either environmental issues, or a lack of knowledge on how to incorporate renewables into the grid. There are other enabling technologies or science solutions that will help us get to those policy goals and they don't -- they don't fit into this model very simply.

So, I'm interested in your thoughts on -- I mean do those get lumped in your knowledge column, Linda, or as an enabler for the technology advancement?

MS. COHEN: One of the really interesting things we had to deal with, when we were doing the DOE study, the prospective one, was that there were a number of technologies that were going to be useless unless some other technology was successful.

So, it's kind of the reverse of everybody gets credit. It was more that here's five things, all of which are going to have to work in order for this to be economic -- you know, in order for it actually to have an impact at all.

So, it means -- I mean, one has to come up with some kind of decision about how you're going to evaluate the pieces of it, but it may well be that without some kinds of transmission innovations some of the stuff that you're doing in renewables isn't ever going to be valuable.

And that's the sort of thing that is -- I mean, I always feel more comfortable when I see this just discussed, you know, that we're doing this project and it relies on B, C and D. We're trying to do those other ones, too, and hopefully, some other people are as well.

MS. TEN HOPE: It seems like that would be helpful in evaluating some of the tools, for example, that we funded to help with visualizing the grid, and it would help deal with intermittency of renewables.

But then if you look at some of the environmental barriers to siting renewables it's -- you know, it's a lack of understanding on the --

MS. COHEN: Yeah.

MS. TEN HOPE: Lack of understanding of the impact or the appropriate mitigation. And without better understanding you're never going to get to the policy goal.

So that Science understanding, in and of itself is hard to attribute to an advancement in the -- in your goals.

MS. COHEN: And that is a reason why it's so hard to get private investment in some of these areas. They figure that they don't have a shot at changing it. After all, a lot of those licensing decisions are made by the Energy Commission, right, so they figure you have the inside track on some of this, even though it may not seem like it here.

One thing I noticed, this is a small point, but when you were looking at the penetration of these technologies, something to keep in mind is the -- if you're looking at greenhouse gases, it doesn't matter where it's happening. If you come up with a technology that's being used in Ceylon, that's good enough in terms of California benefits, right?

So, you have to take into account, in fact, the global market, it's not just California. Part of it is, you know, we may be selling to those guys, which is great, but another piece of it is actually the environmental benefits are outside.

MS. BARONAS: I think there's a person on WebEx with a question, maybe, and then --

MS. KANDEL: Go ahead.

MR. CONLON: Yes, hi, Tom Conlon here, again. I just wanted to underscore Gretchen's comment about thematic areas. And I've seen over the past that the PIER has really focused historically on evaluations at the contract level, primarily. And that's important, obviously, but I'm glad to hear NYSERDA moving in a more portfolio, whole portfolio oriented direction.

And I think the question is where do you -- how do you structure your portfolio level evaluation planning? And California we're fortunate, now, to have a strategic plan. And it would be wonderful to see how PIER programs, PIER R&D projects fit into the achievement of some of those statewide goals that are -- that are formally now in the CPUC process.

That might help answer that question about how much evaluation do you do for -- especially for some of the smaller projects. You may be able to get away with asking a very simple -- collecting a very simple amount of data on a smaller project, but having that fit into a much longer, much more comprehensive story about how that project is advancing on the more broad portfolio level objectives.

And so I'd encourage a re-think, frankly, of the evaluation planning in the PIER program and I'm glad to hear that that seems to be what we're focused on in this conversation today.

MS. KRITLOW: It seemed like that might have been a question for Tara. Was that a question or more of a comment on the level of benefits estimation?

MR. CONLON: It was more of a comment, but I would be curious to hear Tara's perspective on that and to hear if -- if there is -- how much correspondence or information they've been able to see between the R&D programs that are upstream in terms of filling the pipe at the house, and coupling that with downstream commercialization that's done by both --

MS. RAINSTROM: Okay. So, you were cutting out just then, but I think what you were talking about before is how we're structuring our evaluation approach, and what level of planning, and how the portfolio level has changed our analysis. Is that correct?

MR. CONLON: That's good, yes.

MS. RAINSTROM: Okay. So, it's funny, we were actually talking about this at lunch, and talking about evaluation planning, and it's sort of perfect timing for NYSERDA, as well, because the last, you know, four or five years we've been doing sort of trial and error. So, we are hoping to develop a new evaluation strategy and, hopefully, be, you know, benefiting and working with the PIER program in trying to, you know, learn from each other and come up with more comprehensive evaluation planning.

I mean, we don't necessarily have one written down, but we've been definitely been talking about one in theory, and we will be working with -- you know, we'll be hiring new impact evaluation contractors over the next year and at that point we'll come up with our new evaluation plan and, absolutely, on the portfolio level.

Does that answer your question?

MR. VINE: Yeah, this is Ed Vine, again. Tom, I can answer some of your -- I think some of what you were asking.

And then, you know, NYSERDA is nice because they do everything, it's one organization. In California we have the California Public Utilities Commission and the California Energy Commission, who sometimes work together and sometimes not.

So, putting on my CIEE hat for this response, I've been tasked by the PUC, who is working with the Energy Commission on their strategic plan, and the Energy Commission is taking the lead on preparing the research and technology chapter as part of this strategic plan. There is one already in there, but in terms of an action plan the Energy Commission is taking the lead on that.

And one of the tasks that I've been involved in is identifying what research is going on in the PIER program, in the IOU's Emerging Technology's program, DOE, BPA, NYSERDA are probably the five I've been looking at.

And so this is a very quick, just a few week study to compile that and then see what are the gaps for the strategic plan, what technologies aren't being promoted in California that could then perhaps be encouraged.

So that's where the strategic vision comes in and we'll see how it turns out, but that's sort of we're in the sort of preliminary steps for that.

MS. BARONAS: There's another individual on WebEx with a question.

MS. YIN: Hi, this is Carol Yin, can you hear me okay on my internet connection?

MS. BARONAS: Yes, we hear you, Carol.

MS. YIN: Great. I am a consultant to Southern California Edison's Emerging Technologies Program and I've been helping with the evaluation since 2004. I wanted to thank Ed for mentioning the efforts that California's ETP have been expending in the evaluation process.

And we'd be happy to share any of our experiences with that. But I also wanted to thank you for putting together this workshop because there is so much information that I wish the rest of the ETP evaluation folks could have been here to hear.

I was wondering if there are any plans to continue this discussion and whether ETP could take a role in that?

MS. KANDEL: This is Adrienne Kandel.

MS. YIN: Hi, Adrienne.

MS. KANDEL: Hi. I'm having feedback here, it's very distracting.

It would be great to get in contact. We should -- you should send us actual comment, with contact information because I would look very much forward to collaboration.

MS. YIN: Thank you.

MS. BARONAS: Is there another question on WebEx? Eli Pro? L.A. Pro? Elliot Crowe?

MR. CROWE: Can you hear me?

MS. BARONAS: Yes, we can, Elliot, thanks.

MR. CROWE: Okay, thank you. Okay, so a lot of this is new to me so this might come out kind of dumb, but it certainly seems like through the presentations there's the obvious challenge of trying to come up with an overall quantification of benefits.

And I was just wondering, just kind of brainstorming an alternative approach where maybe there's a threshold set, which is the cost benefit ratio that's considered acceptable overall, and the costs will obviously be known for the research.

And then in terms of quantifying benefits maybe you could just, you know, cherry pick what you think are the best ones to exceed what is the threshold and then you can say, well, yeah, we know we've at least been successful here.

And then, maybe for the lower-performing projects you can then, rather than getting too deep into the quantification you could focus more on the qualitative side of things and look for any clues for things which, you know, could be avoided in future in terms of avoiding similar failures.

MS. KANDEL: Hello, this is --

MR. CROWE: I was just thinking that might -- that might be somewhat more cost effective and also sort of circumvent any idea of the impartiality in sampling, and sampling size and selection criteria, et cetera. Just a thought.

MS. KANDEL: Elliot, this is Adrienne Kandel. These are great ideas. We've been looking at two approaches. We have been doing what you said, trying to get a lower bound. That is to say pick out projects and they are, in fact -- they are having savings that are exceeded cost of PIER. So, we can continue with that up to whatever point to say it's at least this, so that's the lower bound approach.

The other is if anybody actually wanted a benefit cost ratio, is actual stratified random sampling, picking things out.

But again, that means when you have a small project you may be spending some money on something that is of little value, other than its representativity.

But what I really loved in your idea was go to the small projects that didn't work when you do that, and maybe you have to do the sampling to find that, and learn from it, and find the story. So, this is great, thank you.

MS. KRITLOW: Do we have any other questions or comments?

MS. BARONAS: Any hands raised on WebEx that you see?

MS. COHEN: What comes up, sometimes, in these evaluations, if every project you did worked, then you probably aren't doing the right set of projects. And I think it's really important to communicate that, that this is supposed to be a risky endeavor and it's supposed to be research, and you can't just be funding the stuff that everyone knows is going to work.

Those are -- if that's what it looked like, I'd be really suspicious about whether we were doing the right things. It's very hard to communicate that thought to people who evaluate programs, but I just think it's absolutely critical.

MS. KANDEL: This is why the approach that Mr. Crowe was talking about is not so very far from capturing the benefits because insofar as the products become famous enough, or the results of research well-known enough for you to go looking after them, you're probably capturing your success stories, mostly.

MS. RAINSTROM: This is Tara, from NYSERDA, again. I just -- I want to bring up one question that Vanessa had mentioned earlier, it's something that we're struggling with at NYSERDA. And that's, you know, trying to assess the research projects and knowing that the majority of the benefits happen well after the project is over, or after you've maintained contact with the project.

I'm curious how other people have figured out how to get the data? Behind just maybe like spending money to do surveys, what are other methodologies that people have used? Because we're really struggling with that and I'd love to learn from anyone that has any kind of success in that area.

MS. COHEN: I've seen some studies where people do it backwards, but this doesn't -- you know, you sort of start with the ten big inventions, according to the American Chemical Society, or something, and then look and see how many of them had public funding in the background.

MS. RAINSTROM: Oh, interesting.

MS. COHEN: This is -- it doesn't necessarily get at NYSERDA, in particular, but it's a different way of trying to see, you know, whether there's something that seems to be distinctive about public projects or public support.

MR. VINE: This is Ed Vine, for the record. In California, in the earlier days of evaluation we had a series of what's called persistence studies, or measure retention studies, which were conducted three, five, seven and nine years after a program put something in place.

So then the utilities at this time were in charge of that, so they would go back and do studies, either random sample, or some sort of sampling technique, of those measures that were incentivized, to see whether they were still in place. Basically, a very simple, somewhat simple exercise.

So, from a looking at the benefits, and I'm talking now off the top of my head here for looking at the benefits of the research products that are out there, you would then go back and start where you left off. You know what was funded, you know who received the funds, you know what they did, and see what has evolved from that, use that as a starting point.

And then, of course, as we've talked about, many of the speakers, looking at the market and seeing how the market has changed, as well. So, that would be one strategy.

MS. RAINSTROM: A very interesting approach, thank you.

MS. KANDEL: Okay, one more call for questions or comments, do we have anyone on WebEx or in the room?

All right. So, we're a little bit past our agenda time, so we're going to go ahead and bring up Fernando Pina. He's going to do a summation of today's workshop. He's from the Energy Systems Research Office within PIER.

MR. PINA: Thank you. Again, my name is Fernando Pina, and I'm a supervisor with the Energy Commission's Energy System's Research Office.

And I'm going to tell you, I'm pretty lucky because I get to work with three really sharp individuals, very dedicated individuals, Jean, Vanessa, and Adrienne.

I want to also take this opportunity, before I start summarizing, to thank all the panel members for your time and contributions. I know you're all busy and so we appreciate your time coming to the Energy Commission.

And, also, those who are on WebEx and those who attended in person.

And, of course, I can't forget our WebEx people over here that kept the system running for the day, thank you very much.

Okay. So, what did we cover today? The main things we covered are we gave you some perspective on what we did in the past as far as benefits assessment, some of the work we're currently performing, in addition to some proposed methodologies for the future.

We also asked you, other researchers, how you assess benefits and then we asked for your feedback and recommendations.

With that said, what I have here today is some real-time information for me, that I just received, and so what I'm going to do is I'm going to read some of the things that we want to use, that we heard today, basically, and I'll read these off.

Benefits assessment is necessary and complex, and often hard to quantify. Analysis is historical, current, and forward looking and provides different levels of data.

Many and various angles are needed and, therefore, used to approach benefits assessments.

And I was wondering if I was going to say this, but I think I'm going to say this one; a few approaches are simpler. For example, benefits cost ratio versus surveys.

And the reason I say this is because I used to work at Employment Development Department and surveys I never found to be a simple thing, so that's why I was kind of contemplating that.

Must have clear objectives and goals at outset of your assessments. For example, what are the community needs? What are policy implications? And what outcomes are measurable?

Matrices prove useful -- prove a useful way to plan and organize objectives and data.

Collaborative and case-by-case approaches are useful.

And the list goes on, so I think I'm going to jump over to some additional items that we discussed today.

Length of time of collecting data needs to be defined, but how long is long enough?

Job creation; actual jobs created would be ideal, but may be problematic.

As far as grid reliability, models are limited, will have new conditions of operations with increased integration of renewables.

And then there was the discussion about attribution; do we consider attributions or is it really should we be considering them contributions?

And I think I'll leave it at that as far as this is a real long list and we'll share some additional information later.

With that, I'll go on to the next slide. We've reminded you a few times about we are -- if you haven't provided comments today, we would be happy to receive additional comments via our docket process. Please refer your to your workshop notice.

Written comments should be submitted by, at the latest, 5:00 p.m. on June 1st, 2011. Include the docket number, which is 11-IEP, which stands for Integrated Energy Policy, dash 1N, as in Nancy. And indicate PIER Benefits Workshop in the subject line or first paragraph of your comments.

Another point I want to make is that with Jean, Vanessa and Adrienne, the point I want to make here is this is a continuing process of improvement for them.

I consider them -- and I hate to use a nonrenewable resource, but I consider them the oil that keeps the benefits machine rolling. And what I mean by that is they have to continue coordination and communication with our internal Energy Commission partners, as well as our external partners, which is our contractors and other stakeholders. So, they have to continue that communication in order to carry on work that was done in the past, move it forward so they can improve their methodologies for the future.

So, the bottom line is what they want to do is they want to work with the Energy Commission to ensure that we tell the best story out there, we're fair and objective in telling our story about how we add value to California, in addition to what are the specific, tangible benefits provided to Californians?

And with that, the last thing is that keep in mind that the information collected at this workshop will feed in -- will be input into the Energy Commission's 2011 Integrated Energy Policy Report.

And thank you very much for your time.

(Applause)

MS. BARONAS: Thank you, Fernando.

So, we are calling for public comments, now. This is slide 23.

So, on the phone, WebEx, or in the room any public comments at this time?

Okay, so at this time we'll close our meeting, adjourn. And thank you, everyone, for participating.

MR. GRAVELY: So, one last comment, just for those that will take the time to provide us written comment, one objective today and one of our discussions that I certain had, if you follow some of the discussions and there are things that are left out, like we had the auto DR discussion and there were ways of enhancing that benefit assessment or that analysis, we would definitely appreciate your criticisms, as well as your comments of how we're good.

It's just difficult for us to understand, sometimes, if it's not followed -- if you can't follow the sequence. So we would encourage you, in your comments before June 1st, if there are examples where we can enhance it or we can make it make more sense, or that the process follows better, like we used -- again, I'll use the auto DR discussion as an example, where we definitely have learned from our discussion today. We would like those comments in writing to help us make this process more transparent to everybody.

So, thank you all very much. Anything else? Appreciate it very much and thank everybody.

I thank Jean, and Vanessa, and Adrienne for all the work that you did for this workshop. And the only disadvantage is, I'll remind you, is you have to do a written report for the Commissioners, now. Since they weren't here, you get to tell them what they missed.

Thank you all very much.

MS. BARONAS: Great.

(Thereupon, the Workshop was adjourned at 3:49 p.m.)

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