BEFORE THE
CALIFORNIA ENERGY COMMISSION

In the matter of,	)	
	)	Docket No. 10-BSTD-01
	)	
2013 California Building Energy Efficiency Standards	)	

Workshop on the 2011 Proceeding to Upgrade the Building Energy Efficiency Standards

CALIFORNIA ENERGY COMMISSION
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Also Present

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P R O C E E D I N G S

NOVEMBER 16, 2010 10:02 A.M.

MR. SHIRAKH: So, this is the first 2013 Building Standards Staff Workshop and some of you might have received an agenda last Friday. I think we had to change it this morning a little bit because Joe Huang was going to be presenting the Weather Files, he won't be here this morning. We had to move him later this afternoon. So, I'm going to have some brief comments and then Cathy Chappell from HMG is going to make a presentation on behalf of the IOUs and the CASE Initiatives. And then, after that, the first topic will be the Life Cycle Costing Methodology of AEC, and Dan will present that. And just before noon will be the first Time Dependent Valuation for the Base Standards.

If I may ask all the people who are on the phone, if you can mute your phones, we are apparently getting some feedback here, and then if you have any questions, you can unmute it yourself.

And after the lunch break, at 1:00, we will be talking about the TDV for the Reach Standards. And then, following that will be the Weather Files by Joe, and then the last presentation will be by Bruce Wilcox, the New Simulation Engine for Residential Compliance, and he has run some interesting scenarios and he'll share his findings with you. And hopefully we can get out of here by 4:00. I know

some of you guys have flights and other plans. So, if we can go to my presentation first?

Before I start, I would kind of like to acknowledge a few people in the room. Bill Pennington is the Office Manager for the High Performance Office; my partner in crime is Martha Brook, the Senior Engineer; and Patrick Saxton, I think, is in the audience; and Gary Flamm and our consultant team; Bruce Wilcox, who is leading the Residential Technical Contract; and Dan Suyeyasu of AEC for the Non-Res; and E3 will be presenting the TDV. Amber, I don't know, is Snuller going to be here, too? Oh, there he is. I'm not wearing my glasses. And so, I was expecting Commissioner Eggert to be here, but I don't see him, so if he comes, you know, we'll acknowledge him.

So, I am Mazi Shirakh. And we can go to the next slide, please. So, this is probably – many of you have seen presentations like this in the previous cycles of standards, we always start by, you know, identifying our policy goals, which for the next few cycles is going to move towards the Zero Net Energy for 2020 for residential buildings, and 2030 for non-res. And the goal of Zero Net Energy has been identified with several policy documents that we rely upon, for instance, the 2008 CPUC/CEC Energy Action Plan, the California Air Resources Board Climate Change Scoping Plan, and the CPUC's Long Term Energy and Efficiency Strategic

Plan, and CEC's own IEPR Reports. Also, the Governor's Executive Order, which establishes mandatory reductions for greenhouse gases, which was codified by AB 32 in 2006. Next slide, please. And also, the Green Building Standards Code that was published in July of 2008, and went into effect January of this year. And also, there is the new document by Governor-Elect Jerry Brown, his Clean Energy Jobs Plan, which reinforces many of the policy statements that we've been following, the Zero Net Energy, the Renewables. And I have a link to that report and we'll be putting up the slides on our website and you can click on that and get a copy of that. Next, please.

As you generally know, the Standards is not just a CEC thing, you know, we have many collaborators that help us, first and foremost, the California IOUs, PG&E, SDE, SDG&E, and Southern California Gas, you know, they are helping us with the funding and the contractors teams. Also, PIER is providing substantial help to those standards, and the members of the public, you know, as usual, we get many comments from the public through our workshops, stakeholder meetings, e-mails, and that's always very helpful. Next, please.

So, this is the so-called Rosenfeld Graphs that we've updated and it actually goes through 2010, and again, I guess many of you know the story of this, this is

basically – the green is the per capita electricity consumption, which excludes transportation, this is metered data at the buildings for res and non-res buildings. And the story here is that, before we had buildings and appliance standards, California was basically on the same slope as the rest of the country, but in the mid-'70s when we introduced the first appliance standards, and then the energy standards, California has pretty much stayed level when the rest of the country has – and what's interesting is, if you notice, both California and the U.S. graphs have been dipping the last couple of years, and I suspect that is the result of the recession we've been experiencing. Next, please.

This is another interesting graph that shows the per capita consumption by state, all 50 states, or 51, they must do something here, maybe, yeah, the Virgin Islands or something. But, anyway, California is the most efficient State in the Union, followed by New York, Rhode Island, Hawaii; we're actually more efficient than Paradise. And I guess if you're curious, the bottom is Wyoming and Kentucky. Next, please.

So, our goals for this round of standards, 2013, is – and we probably envision three cycles, including this one and 2020, and so we're hoping for big savings for each cycle so we can get to the goal of Zero Net Energy, and the

savings would be in this range for each cycle. We're also including Reach Standards into the Title 24 for the first time, so that will go into the Part 11. And one of the things we're doing, we're aligning our schedule with the Billing Standards Commission, that all of Title 20 will go into effect, published – adopted, published, and go into effect at the same time. Next, please.

Other goals of this round of standards includes simplification of standards, which is always in some of the comments that we hear from the Building Departments and practitioners, even our own staff, that the standards at times are confusing, and they're complicated. So, to the extent possible, we would like to address some of these issues. Some of the things we're doing is migrating some proscriptive requirements that could be different between climate zones or can be traded away from proscriptive requirements into mandatory measures, what makes sense. Also, one of the sources of complexity and standards having so many exceptions, often times we have a simple rule that says cool roof reflectance is .20, but then we have nine different ways of circumventing those, and so the message gets lost in there. So, to the extent possible, we'd like to look at these exceptions and eliminate where it makes sense. And another thing we're pursuing is developing user-friendly compliance forms and creating online forms that

make it more convenient to people. When people see that stack of three-inch forms, it's kind of intimidating, even if they don't have to fill out all of them, so, by reducing the amount of forms and making it easier to do it online. And some other things we are pursuing, we're hoping to reduce some of the burdens. Improvement of third-party field verification and acceptance requirements – that's an ongoing struggle we have, and so we're working with various stakeholders to improve upon those. And another major improvement would be electronic record-keeping and creating a CEC central repository for electronic forms. The 2008 Standards, we took the first step of having HERS Provider registries and uploading of electronic documents for residential electronic signing. Right now, this data is kind of scattered, at least in three different places. We're going to keep that structure, but we'll have one central place where people can go in and do research enforcement action, and so forth. And also, we're considering measures that would integrate efficiency with demand response, and a prime example of that is the controllable electronic ballasts for non-res buildings, this is an effort we have been pursuing with the IOUs through a CASE Initiative and we've had numerous meetings throughout the State, and I think that's pretty much ready for prime time. Next, please.

This round of standards includes some measures that are not directly energy-related, but are caused by systems that use energy in the buildings. For instance, air-conditioning systems, or refrigeration systems that leak greenhouse gases, even though it does not have a direct impact on energy, which it might, I mean, a refrigeration system that is improperly charged does not work the way it's supposed to. But, on top of that, it's going to have some environmental effects that are indirectly caused by this. We're also including considering water saving measures, that's a new mandate we have, is to try to reduce water consumption in the buildings, and encouraging proper building orientation for both – you know, we all know that building orientation has an impact on the budget of the standards of the building, you know, depending on where the glasses are, and overhangs, and so forth. And also, building orientation has an impact on future installation of PVs on the roof. If the roof does not have enough surface, free surface, facing the proper orientation, then you won't be able to put PVs on that building later on. And we're also considering innovating ways of introducing photovoltaic's into the buildings as compliance options, not as mandatory requirements. And the key here is to make sure that we're not trading away basic efficiency features of the building against photovoltaic's, that is, you know, you

can't – I had a request here for people who are on the line, if you can, please mute your phones because we're getting some background noise here. I would really appreciate that.

So, again, going back to the PV's, the goal here is to introduce PV without sacrificing efficiency in the buildings. Next, please. So, this wonderful slide is our new schedule for the 2013 Standards. By the way, you may have noticed, I keep referring to this as 2013 Standard, it's no longer 2011, it doesn't mean the standards have been delayed by two years, what it is basically is part of our realignment with the Building Standards Commission, we are using publication date of the whole Building Code, which is this date here, July of 2013. So, the upshot of this is the three dates that are marked in red, the March 1, 2012, is the adoption date, July of 213 is the publication date of the whole Building Code, and July 1, 2014 is the effective date of the Standards. And we're someplace in Phase II, I'm not going to spend a lot of time on this, but if you have any questions, give me a call, or send me an e-mail. Next, please.

So, the way we typically update the Standards is, you now, we do a lifecycle costing for each measure. There is always this debate whether the standards have to be cost-effective as an entirety, or each measure, and traditionally we demonstrate that cost-effectiveness is for each measure,

and we think that approach has served us right, and this is actually the topic of the day for the rest of the day today, so we'll get to that. And one of the things that are a little bit different about this cycle is, in the past, staff at the Energy Commission as pretty much conducted the whole pre-Rulemaking and the Rulemaking phase here at the Commission. Many of you know that, with this cycle of standards, it's been up to this point the IOUs who have been running the show and we've been involved in the process, but we've kind of taken a back seat until the IOUs are completely done with their stakeholder meetings. Next, please. And I want to urge everyone here, because the Round 2 and 3 of the stakeholders meetings are coming up this fall and in the winter and it's very important that stakeholders participate in those because that's where the first draft of the Standards is coming from, is going to be the product of the stakeholder meetings. So, come in spring of 2011 when we go to the pre-rulemaking workshops, we'll be presenting the draft standards that have come out of this process. Next, please. Any questions on any of this? Just one second. We're still getting some background noise. Ron is not here. Maybe what we can do is, when Ron comes back, we'll mute all the lines. I hate to do that.

Before I go to Nehemiah, if you would please leave a business card so we know who attended, there is supposed to

be a sign-up sheet here, but I think the most convenient thing would be to leave a business card for everyone. Yeah, just on that. That would be really helpful. And the presenters, you can either present from here and we'll advance the slide, or you can go to the podium and run your own slide show. Ron, if there is any way to mute all the lines that would be really good. We're still getting some – okay. People on the line, we just muted you because we're getting background noise. If you want to ask a question, raise your hand and then we'll unmute your line. Nehemiah.

MR. STONE: A very short question. Nehemiah Stone with Benningfield Group. Going back to the slide that had the schedule on it, the next round of standards after this was supposed to be the 2014 standards. Do I take it from that that is now going to be the 2016 standards?

MR. SHIRAKH: Yeah, we're going to stick with the Building Standards Commission, which is a three-year cycle, so it will be presumably, we call it 2016 and 2019 Standards. Bob.

MR. RAYMER: Thank you, Mazi. We're going to be meeting with some of CALBO's leadership tomorrow night and one of the questions they're going to be asking is about the schedule, and to the Energy Commission staff, what is the best manner in which CALBO can get their comments regarding simplicity and documentation into you guys in sort of a

cohesive way? Is there a particular time period you would like to see that happen, like over the next couple months? Or would you like them to come up here or send it –

MR. SHIRAKH: Yes. I think you had mentioned in your e-mail that they would like to come and meet with us.

MR. RAYMER: Yes.

MR. SHIRAKH: I think that would be the best way.

MR. RAYMER: Thank you.

MR. SHIRAKH: Any other questions under the Intro here? So, the next presentation is going to be by Cathy Chappell, and she works for Heschong Mahone Group (HMG) on behalf of the California IOUs, and she is going to give you a rundown on the CASE Project's progress to this date.

MS. CHAPPELL: Just turn that on? I guess this is the easiest place to be. I am Cathy Chappell with the Heschong Mahone Group and we are managing the contract for the Investor Owned Utilities, the IOUs that are PG&E, Southern California Edison, San Diego Gas & Electric, and SoCal Gas. And so the four of those are collectively referred to as the IOUs and we are working on Codes and Standards Enhancement, or CASE, studies that are submitted to the Energy Commission. So, sometimes we tend to talk in those acronyms, as long as everybody understands us. And Heschong Mahone Group and Energy Solutions are the primary contractors for the IOUs working on a whole host of CASE

measures and we have several subcontractors working on a variety of the measures. We can move to the next page. And the IOUs, basically the role of the IOUs is their Codes and Standards Program, which is actually part of their energy efficiency program portfolio that the CPUC is regulating, is to actively work on Codes and Standards efforts to be adopted by the Energy Commission, and it is supporting the Energy Commission in developing these standards. And what we're looking at right now is, as Mazi said, the 2013 Base Standard, which is Part 6, as well as the Reach Standard, which is Part 11. And what the Codes and Standards Program is looking at is not just the snapshot of what we can get done this round, but also looking at these topics, looking at what needs to be done to get measures incorporated into future standards, as well, heading towards the 2020 and 2030 Net Zero. And so what we have been looking at is obviously residential standards and non-residential standards, and we're also moving into some process measures and PV and other topics that haven't necessarily been in the Title 24.

So, what I'm going to show you is obviously kind of an overview and this isn't meant to give any of the details, but I wanted to just show you the breadth of the topics. For residential, we have envelope, we have HVAC, we have some solar measures, which is both PV, as well as solar thermal, and we have some DHW, Domestic Hot Water, and some

plug load issues, lighting and plug controls. And all of these cover both a variety of single family and multi-family and, again, this is just a snapshot of the breadth of what we're covering. Next slide. The non-residential measures, the envelope, lighting, HVAC, and water heating, as well as the next slide, which is refrigeration measures, which are a new area that we're moving into, last round there was refrigerated warehouse requirements, we're revising those, making some clarifications and improving – we're also looking into commercial refrigeration, which is supermarkets. Some of the process measures are data centers, looking at cooling towers, which will cover both the water and the energy savings, looking at a variety of other measures that are under process that ASHRAE 90.1 has already looked at, and looking at how that can be incorporated into Title 24, and then a variety of other measures, including PVs for commercial buildings, some solar pool heating, some commissioning requirements, and acceptance testing.

And the activity that we are working on, as Mazi said, is we're developing these CASE Reports, which are basically the analysis and the assumptions that go into why we're proposing what we're proposing, and developing draft code language. And the idea is that we will have these CASE Reports ready for the Energy Commission that we'll be

submitting by March of 2011. And one of the key activities that the IOUs are doing is to host these stakeholder meetings and part of that is to get earlier involvement in the whole outreach that the Energy Commission does with their formal rulemaking process, and start the discussion earlier. And we've been working with the Energy Commission to make these as publicly noticed as we can be, to get all the stakeholders involved, have them accessible, both in person, as well as remotely – webinars and phone, and specifically to get industry input and to get feedback on what we're proposing. And, again, what we're looking at is not just, you know, does it get into standards or does it die, but what do we need to do to move things forward to get more efficiency within the standards -- how is it best going to work.

And so, the stakeholder meeting purpose is, again, basically to publicize what the IOUs are doing, and to do this in a forum that's similar to what the Energy Commission is doing, but for the IOUs to basically take on that responsibility and do this outreach to industry, and with the earlier stakeholder meetings, we present our methodology as we go and basically get agreement that, yeah, we're looking at the right things, we're not missing anything, looking at where we think we're headed, should we look at things sooner than later, we don't want to get to the end of

the road and say, “Oh, gee, you should have considered this technology or this methodology,” and to look at what the market is, what’s feasible, what we think will be feasible in 2013, 2014, and then, again, to just do the straw draft code language, where we think we’re headed, and get feedback. And then, what we want from the audience is to get additional data, cost data if we can get it, market penetration data, and information from manufacturers about what’s feasible, if the code requires something in three years, can we get there with where they’re headed. And what we want ultimately is to have these CASE Reports that have been fully vetted so that, by the time it gets to the Energy Commission and the workshops and the 45-day language, that it’s not new, that it’s information that most of industry will have seen.

And so the schedule that we have is we did our first stakeholder meetings, which was basically to roll out the process, say, “Here we are, this is what we’re doing.” And we did those earlier this year, spring, and just kind of get the discussion going. We have our second stakeholder meetings, which is the initial analysis of what we’ve done, present our results, do some initial cost-effectiveness analysis, for example, with some of the supermarket refrigeration, we looked at some simple payback during our second stakeholder meeting since we hadn’t yet done any of

the lifecycle cost analysis, it was a way to just get it out there and get the discussion going. And, again, where appropriate, say, “Here’s what we think we want to put into the Code,” kind of the straw-man, put it up there, you know, as target practice, and see what people say. And we have had most of the lighting topic second stakeholder meetings, earlier this fall. Most of the other ones, there are several scheduled for early December, and a lot of the residential topics will actually happen either later in December or early next year, January of next year.

And then, what we’re calling our third and final stakeholder meeting is basically after we’ve done all the analysis and had the discussion, gotten feedback, perhaps done additional analysis, come back and say, “Here’s what we want to present to the Energy Commission as our final Code language.” We hope that the majority of what happens in those third stakeholder meetings is that we have our final draft Code language. There may be a few measures where we need to do additional analysis and we may have more, you know drafty Code language than others, and I think that will evolve as progress happens with the rest of what we’re going to talk about today. So, this is our current schedule, there may be some slight revisions, but that’s what we’re posting publicly. We have all meetings set up so that they can be attended in person, as well as remotely, and probably

by the end of the process, we'll perfect how to get all the presentations working and the communication with the people on the phone working.

And what I want to end with is basically just the process of how this is publicly noticed. There is the calcodesgroup.com that is for all of the IOUs, it is housed at Southern California Edison, so they have to obviously – there's a few corrections there on dates and so forth that need to happen, and I decided that, instead of trying to be slick and walk you through it live, I would just show you where to go for this information, and you'll notice that, at the calcodesgroup.com, there is the link that says to access the stakeholder meetings and the stakeholder schedule, click this link. And we'll hopefully get that updated so it is more, you know, CASE topics, and has more of the information because, if we go to the next slide of what happens when you click on that is that it will take you to this page that will list all of – basically list an overview of what the IOUs are doing, and then list all of the CASE topics. And this is just a screen shot, but the Title 24 CASE topics, if you were live and scrolled through it, have the residential topics, lists all of them, give a real brief synopsis about what the topic is, and then there's the links to the stakeholder group meetings that will show you when the stakeholder meetings are, and what topics they cover. And

what we're trying to do, instead of having one meeting for every single topic that were listed on the previous slide, is to group the meetings according to interest, you know, so we have residential envelope together, and we'll have non-residential HVAC, etc. And then go to the next slide, I think, yeah. So, then, once you click on that, the link that was over in the lower right-hand corner, it shows you what is covered in residential HVAC, for example, what topics are covered, and then when the meetings are, the meeting notes for previous meetings, and the agendas for future meetings. And we will also have additional information as it develops; we'll post all of the analysis that we've done and reference this to studies and, as the CASE Reports get developed, we'll have Draft CASE Reports there, as well. So, I think, yeah, that's the last slide. Obviously, there's a lot more information there, but that's going to -- starting at the calcodes website is the best place to get information.

MR. SHIRAKH: Any questions for Cathy?

MS. CHAPPELL: Great, thanks.

MR. SHIRAKH: Thank you. We're being a little bit late in posting these reports to our website, but everything you see today will be on our 2013 website, this report, and all the presentations and the background reports, all of them will be on the website.

So, the next is going to be Life Cycle Costing by Dan, and basically this is the big picture, the Life Cycle Costing Methodology, but a lot of information goes into this methodology, which includes the TDV and the Weather, and those details will be filled in later. At the end of each section, we'll open it up for questions.

MR. SUYEYASU: And this presentation will be broken in two sections, one covering the basic standards, and then just a brief diversion into the Reach Standards, and what we're thinking about for modified Life Cycle cost methodology there. I'm Dan Suyeyasu with Architectural Energy Corporation (AEC). We are managing the non-residential contract with the California Energy Commission to help develop the new Title 24 Standards. We are also, just by way of context, working for HMG and the independently owned utilities, doing some of the case research projects, as well. So, the methodology we're going to set forth here, we are dealing with on a day-to-day basis as we do some of those case research topics. Just going back to the basis of why we are doing cost-effective analysis, it all goes back to the Warren-Alquist Act, Section 25402, probably don't need to read that to most of you because you've read it before.

California's Energy Efficiency Code Development process is somewhat distinct from a lot of other efficiency

codes in that it is driven by this cost-effectiveness test, whereas many other standards such as ASHRAE 90.1, it's generally a consensus-based process, instead. There, you know, ASHRAE will use cost-effectiveness analysis in making some of the decisions, but it's much more a central component to California's process.

The Life Cycle Cost Methodology really has not changed much since the last cycle. Most of the changes are actually on the input side of it, the TDV numbers and the weather. So, what I'm going to go through over the next couple slides shouldn't be anything too radical here, probably at the last 25 percent of the presentation is where things start to change this go-round. The basic test that we're looking for is to reduce the negative – reduce overall the life cycle cost of a particular efficiency measure in a building, or trying to get a negative delta in the life cycle cost, compared to the base case. The delta component of the life cycle cost methodology certain requires that you have something to compare to, which is the base case, it is described in the Warren-Alquist Act as historical practice; base case is the term that we use most often as we go through this process. Our current definition of the base case is the 2008 Standards for most measures that are already regulated, such as existing efficiency levels if we want to move them to higher efficiency. If we are looking

to evaluate a measure that is not currently part of Title 24, we essentially look to conventional building practices and make some judgment calls as to what we should be comparing against in determining how much more efficient, and what the cost premium is for our new building technology.

So, looking at the various components of our life cycle cost analysis here, there are two sides to it, there is the change in the measure cost, and this is in some ways the much harder part for us to determine as what is actually the market price out there for various measures. We need to collect measure cost on both the base case, what is the cost to install conventional building practices right now, and what is the cost for the proposed measure that we're looking to implement as a part of the code. This looks at materials, labor cost, variations in maintenance and replacement costs, some of those – if there is an increased maintenance issue with something we're proposing that's going to happen 10 years out, we will discount those costs to net present value with the three percent discount rate that is the standard for the Commission analysis. And we will add in any other notable cost differences if there are any.

The TDV number, which is what we have finished developing with E3's assistance. It is Time Dependent

Valuation and it is basically a method for evaluating the use of energy hourly throughout the year so that energy demands that are happening at periods of high strain on the electricity grid are valued more than electricity demand that is happening at periods of low energy use. These were developed for electricity, natural gas, and propane separately. The natural gas and propane TDV numbers are developed on a monthly basis because there just is not as much variation in those markets. The details of the new TDV numbers will be explained in much more detail later today by E3.

So here is just a little sample of what TDV numbers look like, graphed over a 10-day period, it is in the fall, September 21 to September 30th, the numbers are quite high and this week it is a warm week, if you look on the right scale, the red numbers and the red line, these are mean daily temperature, so they are not reflecting the peak temperature for that day, which was probably close to 100. So, a 78 mean degree day, you're getting high TDV values; as the temperature drops, going into the next week, the TDV numbers step away from having these peak incidents, I don't know if there's a proper term for that, and reduce themselves to sort of baseline levels that they are much of the year when we're not having hot periods in the State. This graph just happens to drop down in the Saturday and

Sunday period, it looks like that's corresponding with the temperature, and somewhat it is, but usually the numbers will be quite low on weekends, just due to the reduced commercial load on the grid.

So there are two different types of TDV numbers that are probably worth explaining because we see, say, TDV as if it's a noun, but it's really a process, it's Time Dependent Valuation and there are Time Dependent Valuation dollars, and those are the numbers originally produced by E3 when they do their analysis. This includes cost of energy, cost of transmission, externalities such as carbon prices, and this value, TDV dollars, is ultimately used as the common denominator because traditional source energy metrics couldn't bring in some of these externalities and convert them to Btu, so dollars are sort of the universal equation that everything can be converted to for producing E3's TDV dollar spreadsheets. This will be expressed in the spreadsheets in terms of dollars per kilowatt hour, dollars per therm. We then convert that to TDV Btu, which is the energy metric that is used in the modeling tools that are used for compliance calculation purposes and for doing the modeling as we develop our case measures. So, these outputs, it's somewhat analogous to the source energy and metrics that used to be used for compliance calculations, giving a Btu – source Btu – number. It, of course,

incorporates some non-energy elements in it, the transmission costs, the externalities, but it is the closest analogue that we could develop as part of the TDV process.

There are single numbers to scale, they are different for residential and non-residential for 15-year and 30-year, but there is a single number to scale from the TDV dollars to the TDV Btu, which means the shapes of these curves across the year are exactly the same, they're just at different scales with different units, and E3 will get into that a lot more, later today.

So just something important as we go through the details a bit further, they are now the 2013 Standards, but we will be talking about 2011 quite a bit because that is the base year for our economic analysis, it is the year that E3 has used, 2011 dollars, as the basis for their TDV numbers. The 30-year projection of utility demand and load and cost are going from 2011 through 2040 for the 30-year standards, 2011 to 2025 for the 15-year standards. So, we will still be mentioning 2011 quite a bit, even though it's now the 2013 Standards, just so you know.

And I just want to walk through a little hypothetical example of how the Life Cycle Cost Methodology process is put into place. I just tried to get the most simple thing for everybody to visualize – residential attic insulation, we are not currently analyzing this as a case

measure, and we are analyzing some variations on it in terms of raised raised-heel trusses and things like that, but not the base insulation level, at least not right now. So, just for this hypothetical, assume R30 is our base case, and assume we are proposing to measure R45, is it cost-effective? So, our objective is to reduce the life cycle cost for the building if that is true with R45, then we will try to have it adopt as a measure assuming other conditions are present such as availability to the market and other issues. So, the inputs in this case for a life cycle cost analysis are for the change in measure cost, we are looking at the cost of the proposed measure, which would be the R45 insulation minus the cost of the base case. So, what's the cost of R30 insulation? This might be an extra dollar per square foot for this change in insulation level. So, same thing on the TDV, we looked at the modeled energy use, and here we to some degree invert it, so the base case comes first, and this is just because, in our delta explanation equation, we like to subtract out the TDV so it looks like you're comparing, but you can move around your negative signs as you want to make the equation work out the same. But we're looking at the model, the R30 insulation, and TDV dollars as compared to the modeled R45 insulation, and TDV dollars, we'll run an energy model of the proposed building with and without these insulation levels, with both

insulation levels for a year, it will give us a kilowatt hour usage for the building for each hour of the year, a therm usage for each hour of the year, we'll then multiply those by our TDV multipliers for each hour of the year, and we'll come up with a total dollar cost for the year with and without R30 and with R45.

Graphical representation of what goes on with these measures is – we call it the J-Curve in our analysis. And the J-Curve is most useful when you're looking at continuous measures, something where you can implement a standard at any level on a continuum, and insulation is at least one such example. And then, at least that insulation, you can just buy it in certain increments, but if you're doing blown-in insulation, you can basically get any depth and any R value you want. So, as you do an analysis of a measure, if it's not the most cost-effective measure that is the base case right now, as you become more efficient, your cost per square foot over the life cycle of the building will go down until you get to some point where you're not getting enough return on your dollar from your extra insulation, and the cost of your extra insulation starts to overwhelm the additional energy benefit. And this curve is going to look different for each climate zone and for each measure. So, on this curve for insulation, you know, we were analyzing R45 down below and the cost – the life cycle cost of R45 is

below R30, so it would be cost-effective. On continuous measures like this, what we'd like to do is look for the measure with the lowest life cycle cost, so we look – on this chart, it would be R41 and we would set the standard there based on this outcome. And that is going to save the – I shouldn't say the owner of the building because we're looking at this at a broader societal level, but it will save the State of California, broadly, $.25 per square foot of new construction, residential, if we adopt this measure. So, this is just hypothetical data, how this works out.

Now, having shown that graph, just a caveat that, at some point as we go through the CASE measure analysis process, people are going to say, "Where's the J-Curve?" We're probably not going to produce a J-Curve, we get a lot of data that dumps into a spreadsheet that defines a whole bunch of comparable attributes, a bunch of different comparable costs, and we run a function that says, "What's the lowest life cycle cost of these data?" And we could probably go back and produce a J-Curve if somebody needed it, but generally it won't be produced – put expectations where they should be.

So, geographic variations in the life cycle cost analysis – for measures that involve HVAC issues and envelope measures, anything involving temperature issues in a building, whether issues in a building we're going to

evaluate measures separately for all 16 climate zones, and to do that, we use the 16 designated primary weather stations locations for each climate zone. Lighting measures will just be analyzed on a statewide basis because those are the same across climate zones.

What's new? This is where things start to change for 2013 as compared to 2008. We have new weather files, one of the biggest improvements this go-round, new data that's been updated from previous cycles, and Joe Huang will get into this much more comprehensively this afternoon. We have much better correlation between climate zones in the weather files, all 16 climate zones are sort of acting like they are in the same state at the same time, so that's a significant improvement. And then, new to TDV, the numbers are much higher now just looking at new projections on the price of electricity and natural gas on the open market, and some amended incorporation of externalities and other issues. The numbers are approximately 20-50 percent higher compared to where they were three or four years ago, on the lower end for non-residential, on the higher end for residential. That doesn't necessarily mean that the value of energy savings from a measure is going to be 20-50 percent because it's got to interact with the weather, it's got to interact with the models which are being updated some, but just as a ballpark estimate of where our average

values have changed, that's where it's moved. And one of the significant accomplishments that E3 has accomplished now is correlating the weather across the state much better with the TDV, which was permitted by us getting the weather files between the different climate zones correlated to begin with, so that's going to make a big difference in the model of output, and we'll talk about that some more later.

This is just a graphic example of the new TDV numbers. The blue lines are annual numbers, just averaged by hour is just one way of looking at it. There's obviously already a thousand numbers for the year, so you can slice it all different sorts of ways to try and summarize it for people, this is just one way of looking at it. This is non-residential, so you can see the increase in the non-residential side is much more in the peak hours, and there's not much increase in the non-residential TDV values in the off-peak hours at late night, and then the orange and red lines is the increase for the summer months, I think that is about four months in the summertime, and you're essentially seeing the same pattern as the annual. And that summer peak is essentially driving all the change, probably that you're seeing in the annual numbers; if we were to look just at the winter, it would almost be a flat line across all hours.

Here is the same summary for residential. Here you'll see residential actually increase quite a bit in the

off-peak, there is a baseline increase for the residential numbers as compared to the 2008 numbers, which by and large explains the much larger increase in -- the overall residential increase in the TDV numbers.

So, any questions on the life cycle cost –

MR. SHIRAKH: If you have any questions, please come up to one of these microphones and introduce yourselves.

MR. STONE: Nehemiah Stone, Benningfield Group. I'm actually kind of curious, the 2011 Standards which are now the 2013 Standards, won't actually affect new construction until sometime in 2013 for single-family, sometime in 2014 or 2015 for multi-family and non-res, but you're making the choice to use the 2011 measure costs as the base case, and I'm curious as to why that would be the case.

MR. SUYEYASU: Partly, it's a practical matter. As we do the measure analysis, in terms of figuring out what the costs are for the materials, for the labor, to go into producing these higher technology improvements in the buildings, it's much easier just to evaluate in sort of here and now dollars as we talk to suppliers and builders. We could obviously adjust that to 2014 dollars, and to some degree, when we think about measures, we do make some projections if we think a measure is going to be reduced in cost once it is adopted, looking out toward 2014, if it's a particularly new product to the market, we'll make some

projection and say it's going to cost less in 2014. But in terms of the actual dollar year that we analyze, it's our assessment that it's not going to make much difference if we do it in 2011 dollars or 2014 dollars, both sides of the equation are going to scale and you're going to end up with the same measures, either cost-effective or not cost-effective.

MR. STONE: So you're starting the string of energy values at 2011 also?

MR. SUYEYASU: Yes.

MR. RAYMER: Thank you. Bob Raymer with CBIA. You mentioned that you look at these items, well, on an item by item basis, cost-effectiveness. Do you also look at the interactive effect between the various items such as ceiling insulation mixed with cool roof, mixed with radiant barrier? Is that considered?

MR. SUYEYASU: Yes.

MR. RAYMER: Okay.

MR. SUYEYASU: Yes.

MR. SPLITT: This is Pat Splitt from APP-TECH. I had two questions, one, just on your example going up to R45 insulation, you were mentioning that, well, all we're doing is blowing in more insulation, but if we have a standard that requires more roof insulation, there are a lot of buildings that have vaulted ceilings where there is a lot

more involved than just blowing in more insulation. You have to add thicker framing, or much more expensive insulation to get in the same distance, so do you look at all options? Or do you just pick the one that proves your case?

MR. RAYMER: I would word it differently, but –

MR. SUYEYASU: We, of necessity, try and focus on conventional dominant building practices, which is usually a triangular attic space. This was just a hypothetical, so we haven't gone into all the details on this. You know, we are conscious on some of the measures we're evaluating where, you know, there are all sorts of different ways a person can build a house or non-residential structure, and those are going to have additional costs. We can't analyze all construction types and the impact of these energy efficiency measures on all construction types. If it's a significantly dominant construction type, we'll probably look into it and look at how it will affect our standards and what the implications would be. So, we would look for feedback from you to the case analysis team on if, you know, our dominant construction type that we're looking at and somehow is missing some significant gaps in the building market.

MR. SPLITT: Well, I'm just going to say right now, there are a lot of vaulted ceilings in California. And one other question –

MR. SUYEYASU: Luckily, we're not analyzing that measure, actually, so just by way of example.

MR. SPLITT: Okay. Then, the other thing that I haven't seen mentioned in the meetings that I've gone to so far for Life Cycle Cost Analysis is any analysis of added cost for some measures that require HERS testing, or acceptance testing, or commissioning. A lot of those are mandated and, in some features, they're not significant, but there are other controls, schemes where it's a very significant cost. And I haven't seen that they are actually included in the analysis.

MR. SUYEYASU: Yeah.

MR. SHIRAKH: Actually, we are. For instance, that controllable ballast that I mentioned, we are considering all the acceptance testing, commissioning and all of that, it's going to be part of the cost that's going to be discounted, and we are considering those costs.

MR. SPLITT: So would that also include features that maybe the feature itself hasn't changed, but you're going to require more acceptance testing?

MR. SHIRAKH: Yes.

MR. SPLITT: Okay. That's it.

MR. SHIRAKH: Going to Bob's first question about interactive effect, we do, in fact, when you have like – when you raise the efficiency of the air-conditioning

equipment, it's going to impact the envelope features and vice versa, so, yeah, we do take those into consideration.

MR. SUYEYASU: And I guess just one thing to add is I think there are also, in a lot of the guidelines that the Energy Commission has set up, a lot of conservative assumptions about cost in terms of looking at these on a measure by measure basis, as opposed to collectively, where you could have certain measures helping other measures be cost-effective. Also, in terms of their interpretation of historical practices, to just look back to the last code, so historical practices for points of analysis is the code that just went into effect nine months ago, and that's not terribly historical by some people's standards. So, there are a lot of assumptions that the Energy Commission is making in setting their guidelines that are making sure that everything that gets adopted is part of this methodology, is cost-effective, and they are certainly limiting the reach of the codes to some degree. Any other questions?

MR. SHIRAKH: How about online? Can you unmute? Does anybody on the WebEx have a question for Dan?

MR. SUYEYASU: Let's move on to the Reach code part of this presentation. This will be much briefer. And this, to some degree, picks up on what I was just saying about the Energy Commission making some conservative assumptions about the Life Cycle Cost Methodology for the base code, and they

are somewhat changing the methodology and the standards for Reach measures, just because that's the nature of a Reach code is sort of looking for it a little bit more.

The Reach Code Methodology is a work in progress right now, these are basically some proposed ideas that we're working on, and it is under development, but we thought this would be a good hearing to basically lay them out for people and share what we're thinking and where we're moving with it. The Tier 1 and Tier 2 Reach Codes will be optional standards available for adoption by local jurisdictions, so the Tier 1 and Tier 2 won't be implemented on a statewide basis, but maybe implemented in some cities, but not in others, depending on what those local jurisdictions want to do. And the Energy Commission is going to be using the Life Cycle Cost Methodology with the Reach Standards to help those local jurisdictions in adopting Reach Tier 1 and Tier 2 by being able to show that these standards are themselves cost-effective, although perhaps using different metrics that we'll be outlining.

At this point, it's a relatively simple set of toolboxes for moving from the base code to the Reach Code, one is to use higher TDV numbers for valuing energy savings. The main issue is basically in these higher TDV numbers that E3 will be developing for us. They will be based on higher assumptions regarding our obligations to basically put an

end to, or at least curtail, global warming. Right now, we use a valuation of carbon that is based on the market for carbon out there that various firms are trading. That is not, perhaps, the best valuation of what we actually owe to future generations to try and bring some end to global warming emissions. And the details of those higher TDV values will be explained as part of E3's presentation. As part of the Life Cycle Cost Methodology, there will be at least a new objective for some of the measures that we're analyzing; this probably won't be applied to all measures, but instead of looking to adopt the measure with the lowest life cycle cost, we'll be looking to adopt the measure that is the most efficient with a life cycle cost that is equivalent to current practice. So, this basically is a change in the J-Curve interpretation to prioritize efficiency over economics to some degree. It will still be cost-effective in relation to the base case relation to current building practices, but it won't necessarily by the most cost-effective.

So, bringing back this graph one more time, what we would be doing on the J-Curve in this situation is, instead of moving to the lowest point in the curve, we would be looking at our current lifecycle cost for our third insulation, which is about $2.00 per square foot in this hypothetical, saying "what's the most efficient we can make

this insulation standard and still cost $2.00 per square foot," and using this hypothetical data, we would say it's around R54. So an R54 is cost-effective in comparison to the base case of R30, it's the same cost, but it's saving a lot more energy. So, we have not determined exactly when we will be using this modified methodology as compared to the standard, look for the lowest lifecycle cost methodology in the Reach Code, but it is just one of the tools in the toolbox going forward that will be paired with the higher TDV numbers.

And that's where the Reach Code Methodology stands right now.

MR. YASNEY: Dan, Bruce Helft has a question.

MR. SUYEYASU: Yes.

MR. YASNEY: "What additional HERS compliance tests are being considered?"

MR. RAYMER: Probably all of them.

MR. YASNEY: I do not know.

MR. SUYEYASU: As part of Reach Code? Or as part of the Base Code? I guess that's hard to answer. Cathy and Mazi, are there new HERS measures currently under evaluation?

MR. SHIRAKH: As far as I know, there are not any measures that require additional third-party HERS verification – yet.

MS. BROOK: There could be things that come up; it's too early to report on that right now, so I don't think we can really answer that question.

MR. RAYMER: Yes, Bob Raymer with California BIA, with a number of questions with regards to the Reach Standards. Do you have a ball park idea of when you'll have your methodology sort of hammered out and available for us to review? You mention, of course, it's a work in progress, but –

MR. SUYEYASU: Yeah, we have sort of set an internal deadline of hopefully sometime in December, but it's hard to know how much back and forth we're going to need internally to get that solved because that's a lot of questions.

MR. RAYMER: And, to sort of predicate my next question on this, keep in mind that a Tier 1 and a Tier 2 Reach standard, while voluntary at the State level when local jurisdiction adopts it, it's a mandatory, and that becomes the base at the local level, and with that in mind, we're going to be looking when we get this in December, whenever, we're going to be looking to have a clear understanding of what all of this means, in particular the societal benefits related to greenhouse gas reduction, and that kind of leads to my simplistic question that may well have a complex answer, and that is, in looking at what is going to be Tier 1 and Tier 2, using your modified

methodology, will the homeowner in a jurisdiction that adopts either Tier 1 or Tier 2 see a reduction in utility bills over a 30-year period that will pay for the changes to the standards? In essence, will they actually see the present value of their energy savings basically be more than what the cost of installation of these new standards? Something that we've had over the last 30 years, but we're sort of heading into a new area now?

MR. SUYEYASU: The TDV numbers that we use, of necessity, don't reflect actual utility rates for the users. They are based – they have an adjustment for utility rates, so they, on average, come close. Is that correct, Snuller?

MR. PRICE: Yeah.

MR. SUYEYASU: Do you want to jump in on that?

MR. PRICE: We are going to have the opportunity to kind of run through our thinking on the Tier 1 and Tier 2 Reach Standards and economics in a couple of side presentations. I think that the short answer to your question is the Base Standard TDVs get you to that point. And the Reach Standards, I'm going to be talking about what the economics are, but from a strict bill savings calculation, the answer is no.

MR. RAYMER: Pretty much what we thought. And –

MR. PRICE: The Base Standards already get you all the way there.

MR. RAYMER: I hear you. And, as you can well imagine, you know, where the rubber meets the road, we have to market this to the consumer, and I hope it's very clear to the local jurisdictions and to the consumers that the CEC is making a rather historic departure from past practice here in that the definition of cost-effectiveness won't necessarily mean you can get your money back, even though that money back is over a very long period of time, you're going to get other benefits, but it's not going to be in dollar signs, and that is something that the general public, particularly the home buying public, well, we're going to have to sell this to them.

MR. PRICE: Yeah. And I'm going to talk a little bit about that in a minute.

MR. RAYMER: Anyway, looking forward to getting the information. Thank you.

MR. STONE: Bob, you and I can sit up here. Nehemiah Stone with the Benningfield Group. I want to introduce hopefully a complexity that makes things have more sense to me, which means probably not make as much sense to a lot of other people. But, anyway, the value of energy efficiency is a lot higher in occupancies where the occupants, the tenants, do not have the ability to retroactively improve deficiency situation. In other words, in a single-family home, a subdivision, once you buy the

home, it's your home, and you can put more insulation – you can put in better HVAC equipment. If you live in a multi-family building, you do not have that option. You don't have the ability to upgrade anything, and therefore, to the tenants of multi-family buildings, there ought to be a higher value to efficiency savings and push the envelope a little bit farther than there is for single family. You could make the same argument for tenant spaces in commercial buildings, but we all know that tenant improvements happen all the time and people pay for that, so it doesn't quite apply the same there, but it certainly does for multi-family. Building, also, a little bit off of Bob's question, I'm not sure I heard the answer, maybe I will hear the answer later, I'm not sure if this is actually the same question Bob was asking, I can't tell for sure, but we are moving towards having time of use rates be more and more prevalent and if we evaluate the cost-effectiveness measures today based on a forecast of rates the way the rate structure is, and then 10 years from now virtually everybody in those buildings is going to be dealing with the time of use rates, there's a whole different set of measures that we might have chosen, and so I don't know if that was the question Bob was asking in a different way or –

MR. SUYEYASU: I think the TDV component of our Life Cycle Cost Analysis is very responsive to that design

decision, putting elements into a building that are going to reduce peak rates, or reduce energy use at times of peak rates, in a time of use world. So, TDV, it's not exactly analogous to a time of use rate, but it at least serves much the same purpose and incentivizing design that brings the elements into –

MR. PRICE: Can I take a shot at this? So, I think this is an area that there is actually a fair amount of confusion around how the TDVs have been established. At its core, the economics of a TDV used the underlying marginal cost of delivering electricity to the customer. And that actually is fairly stable over time, that's why we have these peaks, is because, when we have a hot summer day, the system reliably peaks, you know, the load. And so, the way the TDV works is essentially – well, I guess one thing I should say is, marginal cost of electricity is one issue and one criteria for rate design and it is the dominant one driving towards TOU rates, but there are a bunch of others in terms of equity between classes and transitions and bill impacts when you're trying to do new rates. So, what the TDV does is it essentially creates a true marginal cost rate, so it's at the rate level where you would collect the same amount of money from customers statewide, but the pattern underlying the TDV rates is based on the underlying societal value. So if the state moves toward TOU rates, the

rate design will actually move more towards the way we've modeled it in terms of TDV. So, it's done that way so that we have a very stable basis for calculating TDVs from standard to standard, and we're not chasing the latest retail rate design, we sort of start with the underlying marginal cost of delivering power, and then use that as the basis.

MR. STONE: The marginal cost at peak is going to be getting higher and higher as whether cap and trade or anything else happens, those dirty plants are going to be more expensive to run, so your stream of values includes an escalating margin at the peak?

MR. PRICE: Yes, it does.

MS. BROOK: This is Martha. I wanted to respond to your first comment.

MR. STONE: Thank you.

MS. BROOK: So, is what you said about multi-family TDV should be higher, is what you described what is meant by an "opportunity cost," or not? It's like you don't have the opportunity to make the decision later, so it should cost more to – it should be valued more at the time that the decision can be made?

MR. STONE: That's a novel way of thinking about an opportunity cost, but what you said is what I meant.

MS. BROOK: Okay, so I shouldn't call it an

opportunity cost, but –

MR. STONE: There ought to be an adder in value for occupancies where the occupants can't make that decision later. You know, as the cost of energy goes up, you know, they're kind of locked out of making that decision. They still have to pay the cost of the energy, so it's a higher value for those occupancies.

MR. PENNINGTON: So, Nehemiah, have you seen any techniques for coming up with an estimate of that pattern that would be useful?

MR. STONE: Well, no, but I can give you some ideas heading toward it, and then the smart economists in the room can come up with exactly how to do it. One of the criteria that ought to be applied is what percentage of your income goes to paying utilities, and to the extent that those of us here in the room typically pay just under four percent of our income, monthly income for utilities, and people in multi-family, where the average household income is $31,000 compared to $61,000 for single-family, pay about 20 percent of their monthly income for utilities, then the value of the energy savings ought to be four times as high. It's four times the size of their monthly budget, so it has four times the meaning to them. Another way of looking at it – another way of looking at it is that, if you and I save a dollar on energy efficiency, a certain percentage of that dollar will

go into the bank for savings, a certain percentage will head off to some college, and a certain percentage will stay locally. If somebody in affordable housing or any multi-family housing saves a dollar, that dollar is going to get spent again in the neighborhood and it has a local economic impact of a multiplier of about $4.00 compared to 78 percent of the dollar spent on energy by those households leaving the local economy. So, I know that we don't take the local economic activity as part of it, but you know, the value to the tenants of those savings ought to be included. And as I said, you leave it to the smarter economists in the room to figure out how to actually do that. But, you know, I've collected a lot of data on this and I'd be happy to share that on, you know –

MS. CHAPPELL: This is Cathy Chappell and, in response to that, I think that, if that's going to happen, we have to be very clear about whether we're talking about multi-family, or whether we're talking about affordable, because there is also a lot of not-affordable multi-family and probably expensive owned multi-family, I mean, I understand the building is different. But I think it's a good argument as long as we don't just apply a blanket assumption.

MR. STONE: The argument about the economic activity does depend upon the income of the household, and so for

high income households and multi-family, that argument does go away. But the argument about the lost opportunity, the inability to make the changes later, applies across the board, as long as you're talking about for rent instead of for sale of multi-family.

MR. SHIRAKH: Thank you, Nehemiah.

MR. SPLITT: Pat Splitt from APP-TECH. I had a question about the features you're going to put into the Reach Code. For the Code that starts in January, as far as energy use is concerned, it's really simple, it's either 15 percent or 30 percent over the base. And for just a percentage, I don't think you would need to do a life cycle cost at all because whoever is selecting the features that they're going to get to 50 percent, they're picking what is cost-effective to them, it doesn't matter whether it's cost-effective to anybody else. But it seemed like – are you intending, then, to have specific features, not just a percentage in the Reach Code for the next version, where you're going to mandate higher levels of whatever.

MR. SHIRAKH: Well, I think – and Martha can probably speak to that – is to come up with a prescriptive equivalent which we would call that Package R for Reach Code, but you can also use performance method to do trade-offs and to get to a goal that you're describing. I'll let Martha elaborate on that.

MS. BROOK: So we envision that the Reach Code would still be met predominantly by a performance compliance approach where you would go X percent better, but we wanted the baseline in the modeling methodology to be a Reach baseline, to not be the same proscriptive requirement that is in our base standard, and we also wanted to give guidance in our compliance manuals about how you would actually get to that level of a Reach performance level. But we might actually have some requirements, so some prerequisites, if you really say that you're X percent better and you have ducts and unconditioned space that have to be sealed, so that would be like an example of a prerequisite where, you know, it should be there in the base, but we couldn't quite get it there for one reason or another. We anticipate the next time we will, so for a first step of a voluntary standard, there are a few things that you absolutely have to do. We would love to have that in there.

MR. SPLITT: So then, what you're saying is, instead of having the same base, and just go a higher percent over, you're going to change the base, and then you don't have to do any percentage over it if you're the first level, you're just basically – the softer, then, is going to have to have a switch to tell it which level you're going for?

MS. BROOK: Yeah, that would be ideal. I mean, we haven't really nailed it down, and the communication of how

we communicate our Reach standard, I think, is still under discussion. We really like the idea of saying X percent better because it's really easy, but we also wanted to have integrity, we want to know that we can get to that level if we say that it is appropriate in every climate zone, so that balance of a clear easy message and going forward with buildable buildings, that's what we're going to be tackling.

MR. SPLITT: So we have to wait and see.

MS. BROOK: Yeah.

MR. SHIRAKH: Mr. Hodgson.

MR. HODGSON: Hi, Mike Hodgson, ConSol. In the Life Cycle Costing Methodology, I haven't quite made it to Reach yet, the objective of the standards is really to reduce peak load and that is why TDV is so strong in the standards, and it looks like it's going to get stronger. And kind of the logical outcome of that is we focus on residential air-conditioning, which is the cause of peak load in California. And so, I'm wondering, in your costing, that you're adding the cost of litigation and insurance to downsizing mechanical equipment, and whether that is one of the considerations you have when you look at either just basic life cycle costing, or Reach Codes. And that's for the consultants. I have a follow-up question for staff.

MR. PRICE: I am not conducting that analysis, I don't know.

MR. SHIRAKH: We will let Bruce –

MR. WILCOX: I don't think we're proposing to do anything about downsizing air-conditioning at this point, Mike, so, we learned something about that from you before.

MR. HODGSON: Okay, well, the problem is still prevalent in the market and it's growing, and so I think it should be one of the considerations because it's a significant cost to any mechanical system in today's market, in the bidding of the mechanical system, so I would think that you're a little negligent in not looking at that. Second, the question for staff is, we brought this question to staff in the 2008 Standards, we brought it in 2005 when it became kind of a new issue to us, and so what is staff doing in language to protect in the Administrative Code mechanical engineers and mechanical subcontractors who downsize per Code, and per approved certified software in the State of California, and Star sued and lose in court? I mean, if the CEC is interested in reducing peak load, we should reduce mechanical systems, we should right-size, and we should active manual JD&S. When the market does that, and someone has a bigger box than the other side of the fence, then the person who does it per Code and per, really, the drive of the Energy Commission, is liable and is held in court to be liable. So, I'm wondering, if you're serious about this, which I know you are, how can you change the

Administrative Code to protect the mechanical design community and the HVAC installing community from – and it's not frivolous liability because it holds up in court – from direct liability?

MS. BROOK: I don't think we have an answer now. If you could make recommendations about what changes you think need to be made in the Administrative Code that would help you, then that would be hugely helpful to us.

MR. HODGSON: We would like to do that, but it really – I mean, it's your Code and you're the one who are driving mechanical engineers out of business in the State of California, so it really – you propose a Code, you should understand the consequences, and so we'd be happy to work with you, but we really think it is on the Energy Commission's back to assist the mechanical engineering community to do what you would like this to do, which is design systems correctly, which we do. And unfortunately, because of our litigious state, we get sued and there are consequences, which are quite substantial. And I'm not being insignificant in the cost of mechanical equipment, it adds not quite 10 percent, but it adds a number, and I'm sure you're not looking at that number and you need to. It's a real number in today's market.

MS. BROOK: So, is that kind of the same as – this is probably a really bad analogy, but it's the only one I

have is – when somebody has insurance, like we just hired somebody to cut down a few trees on our property, and we paid more so that they would have the insurance in case the tree fell on our house when they were cutting it down, they would have to pay for that, instead of us. So, you are proposing that we try and figure out – assess those additional costs of your insurance –

MR. HODGSON: It's not only insurance, it's the settlement that gets you. The insurance –

MS. BROOK: But, still, all of that is sort of buried in with that tree cutter is paying for his insurance, right? That's how they determine the insurance rates is on how often you have to settle, how often you have to pay out from the insurance pool and all that.

MR. HODGSON: And why would the tree cutter have a settlement? What did he do wrong or right that would cause a settlement? Typically, he did damage, correct?

MS. BROOK: Right.

MR. HODGSON: In the mechanical design community, if you have a smaller box than the person on the other side of the street, it performs, it's designed, it matches software, and it is designed per active manual JD&S. None of those are defensible arguments in court.

MS. BROOK: Right. So, I mean, that's the problem that we're struggling with, right, because we're all

logical, you know, technically oriented people, and so we don't understand when that happens, just like we don't understand when a Union contracts isn't held up in the State of California. I mean, maybe we need to figure out a way to get legal counsels that we –

MR. WILCOX: Well, Mike, I have a question – what is the basis for the settlement, then, if it's not performance? Is there something in the law that says that equal tons are the right of a homeowner or something?

MR. HODGSON: No. It becomes –-

MR. WILCOX: I mean, what could we change, I guess, is the question.

MR. HODGSON: The change would be – and I don't know, Bruce, I think we need legal minds to do this, which I'm not one. I presume the Energy Commission has attorneys.

MS. BROOK: Uh huh.

MR. HODGSON: And they should be fairly good at administrative law process. There are a lot of attorneys in the market, which we could also go get, but they cost money to hire. And we could go and say, "Look it, how you put something in statute that says if you do this, this, this, and this, you're indemnified." Now, I'm not trying to indemnify anyone from doing someone who did a poor job, who is unsafe, or causes harm, but if you follow these guidelines and match this performance, which as logical

people we think works, it does not in the State of California in the court system – it doesn't in other states, either. So if you want people to right-size, you have to protect them. You guys are not protecting them and what you're doing is driving people to do more and more of this work, which is just what the defense attorneys are loving. They think you are the best thing since sliced bread.

MS. BROOK: Uh huh.

MR. HODGSON: And not for a positive reason.

MS. BROOK: Right, exactly. All right, well, appreciate your comment and –

MR. WILCOX: Well, actually, Mike, I mean, to respond slightly, it's not clear that the standards has anything to do with your problem because, you know, you're bound to end up with boxes that are a different size on different sides of the street, just due to random occurrences. Right? Otherwise, every house in California will have three five-ton air-conditioners. I mean, that's the only way to not get sued, right?

MR. HODGSON: The way the lawsuit typically happens is like-size houses in similar jurisdictions have different tonnage air-conditioners, and the people who have the smaller tonnage air-conditioners are always uncomfortable for some reason, and that's because they can make $100,000 in a plaintiff's case, correct?

MR. WILCOX: Yeah, and there's probably people running around, you know, building a house in each location with putting in big air-conditioners, and then renting it out to the lawyers. I mean, unless you've got something in the law, then you're just stuck with that sort of approach, right?

MR. HODGSON: I don't know.

MR. WILCOX: Yeah.

MR. HODGSON: I think it's a problem that, if we want to try and solve peak load and residential reduce air-conditioning size, we should attempt to address; if not, then put the costs in, because the costs are real.

MS. BROOK: Thanks.

MR. SPLITT: This is Pat Splitt from APP-TECH, I just had one thought, is that for a lot of these, one way of getting around this might be as – we have all this documentation anyway, we could add a document, sort of a release by the homeowner where either they accept that we spell out what the standard is and the performance standard that we're meeting, and this is what this building is designed for, and please sign here if you're willing to accept this. If not, we have an exception box where they can justify having a higher load, but then they have to justify it up front. So, either they justify it, then we'll have a process where, okay, we can put in the larger system,

or they signed off on it, and then later on, if they decide they need some money, it's too late because they signed off and accepted it.

MR. HODGSON: Yeah, a lot of builders, Pat, have that in the market, in their contracts, and they don't hold up in court. Good idea, though.

MR. RAYMER: Bob Raymer again with CBIA. Kind of following up on a comment that Nehemiah had made and, by the way, I echo everything Mike Hodgson just said, that is a real problem. In terms of taking the standards in their totality, CBIA always looks at total cost of compliance, that's you know how we effectively sell the set of standards to our membership. They want a very clear picture of what compliance with the base case minimum is going to be. We'll be doing similar analysis for the other Tier 1 and Tier 2 packages. We would like the ability to work with the CEC to make sure that our assumptions are correct, that the computer programs that we're using are appropriate, and so we look forward to working with you on that. But I would like to provide you with the current economic situation, and if you open up the paper at any given day, you recognize that California's housing market is at its worst condition in our lifetime. We begin keeping statistics in 1955, the numbers for 2009 and the numbers for 2010 are worse than they were at any point in time in the last 55 years.

Unfortunately, given what you've seen about the State budget problems, there's a direct correlation, one-third of the State's unemployment is directly related to the construction industry, and it's that bad. And unfortunately for the State budget situation, we're not looking at jumping out of this. We've had some bad economic times over the years, late 1980's and mid-1990' where we came right back out of it, with a lot of gusto. That's not going to happen. When we were in the San Ramon stakeholder meeting a couple weeks ago, I saw a figure, a projected figure, of 110,000 single-family homes, I think it was either 2012 or 2013, that's not going to happen, that's not even going to be the combined number of single-family and multi-family units. And ARB is sort of revisiting its AB 32 projections because, right now, it looks like the projection of the residential construction industry is about twice over the next 10 years of what it actually will be. I guess what I'm telling you is that we're going to come out of this slowly. We will be coming out of it, but we are looking at probably a three to four-year cycle now, as opposed to a one-year cycle that we've seen in the past. And so, with that, much like we had in the mid-1980's, and once again in the early 1990's, the total cost of compliance with the Energy Regs will be a very important item to us simply because we've got to be able to sell the home, and we're starting to see for the first time

in my experience, in decades, I'm seeing where the new sprinkler mandate that will kick in January 1st is actually going to be either pushing back construction dates, or killing some construction dates because these standards are going to cost $3,000 to $4,000. We're going to be looking at the Energy Commission standards, as well. We understand that you've got to try to focus on getting to Zero Net Energy, but we also have to produce a product that the home buying public can buy, and if that product isn't there, they're going to buy the existing less efficient home and, inadvertently, that is not something that the CEC wants. I realize you're going to be focusing on existing housing stock, as well, but if you look at both multi-family and single-family, we've got to get an affordable product out there. And, in closing, I also was surprised to see that we now have jurisdictions where new homes are selling for under $200,000, that is happening all over the State. I did not expect that to ever happen again, and here it is. And by the way, the jurisdictions that we have the greatest concern with are from Stockton all the way down to Fresno where the sprinkler mandate is effectively running some projects aground already. So, with that, we look forward to working with you and particularly finding out what the total cost of compliance is going to be.

MR. SHIRAKH: Is that the fire sprinklers?

MR. RAYMER: Yeah, a requirement of the 2009 IRC, which California uses the basis for its residential code has a mandate for sprinklers, residential fire sprinklers. We've already got that in multi-family and have had that as a requirement for the last 20 years. When the 2010 California Residential Code takes effect on January 1st, all new homes in which a permit application is submitted, it will have to have sprinklers. And there's a differential cost of $3,000 to $5,000 on average, in some cases it could be higher, depending on local add-ons, but we're looking at $3,000 to $4,000, sort of the base number here. And we're seeing – I'm hearing the projects that aren't going forward now that may go forward later on, but right now they just simply can't – they had designed a product that was going to sell for $185,000, and they can't sell them for $190,000, the market is now that tight. Back in 2005, you didn't really have to worry about a huge increase in cost, we saw a lot of fluctuation in prices back then. If you had a pulse, you could a loan. That's never going to happen again. And so, yeah, I mean, we saw variation in housing prices of $20,000 within a week or two, that's not going to happen again. And so, once again, kind of like it was back in the '80s, we are going to be very interested in total compliance costs and how that's going to affect us on a statewide basis. Thank you.

MR. SHIRAKH: Thank you, Bob. I kind of want to move to the next topic, it's 11:35. If you have any further comments for Dan, feel free to e-mail him or us and we'll respond to your questions. The next topic is the TDV Base, and that's going to be E3. Which one of you would like to?

MR. PRICE: I think I'm going to give some quick detail and I can do that from here. I am going to do sort of the introduction, a little bit about E3. This is actually the third cycle of codes that our team has worked on, starting really working in 2001 with the Energy Commission and PG&E, and the other utilities, to sort of develop the Time Dependent Valuation, and that was introduced in 2005, and then we were part of the 2008 update.

Parallel to the work that we've done for TDV and the Energy Commission on Title 24, we have been working with the California Public Utilities Commission on cost-effectiveness of energy efficiency, and the track is very similar. In other words, the cost-effectiveness framework that we use for TDV and Title 24 in the Building Standards is almost identical to what is used on energy efficiency for utility programs, utility energy efficiency programs.

A little bit about us. I know we're kind of behind schedule, so I think I'm going to turn it over to Amber to kind of run through the latest iteration of the TDVs. I

guess I would characterize them as evolutionary and not revolutionary, but I'm sure we look forward to your comments.

MS. MAHONE: Okay, thanks, Snu. My name is Amber Mahone and I've been working on the development of the 2013 TDVs with E3, and I'll quickly talk about some of the key changes in this latest iteration, compared to what we had in 2008, and then I'll turn it over to Snu to go through some of the nitty gritty details around the methodology.

So, some of this, Dan covered earlier, but just to quickly reiterate, the purpose of the TDV is to really value energy savings based on when they occur because the cost of delivering energy varies by time of day, by season, and we're trying to capture that to reflect sort of an underlying marginal cost of energy. We try to use rational repeatable methods so we're sort of using the same methods that were applied in 2005, 2008, and just sort of updating that process. And we develop these on a climate zone basis, there are 16 climate zones, seamless intervention with Title 24 climate compliance methods is referring to the fact that we convert the TDVs into something that was akin to source energy, which was used in past standards.

So, some of the key changes that I'd like to touch on are we've updated all of the data inputs using the latest publicly available information, and that includes updates to

the natural gas price forecast, the CO_2 price forecast, the retail rate forecast, we've updated the underlying shape of electricity prices, and I'll talk about how we do that. We've updated the avoided cost of transmission and distribution, T&D is a component of retail rates and the cost of delivering energy. We've updated the cost of capacity and ancillary services, which is a more minor component of that, but we updated that, as well. Then, in terms of methodology, there's been some big improvements this go-round. The biggest one, I would say, is that we have new Weather files which Joe will talk about this afternoon, and those Weather files are now correlated across each of the 16 climate zones, so that means that a hot day in Santa Rosa is also probably a hot day in Sacramento, and so you can kind of get a statewide electricity peak. And in the past, each climate zone was sort of developed separately, so this is a nice improvement, which has allowed us to develop load shapes, which are correlated with the weather, and I'll show what the impact of that is, but basically electricity demand in California is highly correlated with temperature and hot days lead to higher demands, and so this is now explicitly built into the TDVs whereas in the past it was sort of generally worked out, but we didn't have sort of a regression-based forecast underlying that.

We've also now included the expected impacts of compliance with the statewide Global Warming Solutions Act, AB 32. AB 32 includes a 33 percent Renewable Portfolio Standard and a few other things that are expected to increase retail rates, so you'll see that that has sort of boosted up the retail rate forecast that we applied. We've also improved the capacity cost methodology which Snu will talk about, and we've sort of also applied more of a standards statewide avoided cost for most of the climate zones, as opposed to having different avoided costs by utility service territory, and I'll talk about that in more detail, as well. Just a clarification note, Dan mentioned this in his slides, as well, but we refer to these as the 2013 TDVs, but the period of analysis really spans from 2011 to 2040 for that 30-year avoided cost. The TDV dollars are reported in 2011 year dollars. And then, another change that you'll note if you're actually working with the data file itself is that the TDV calendar year is 2009, whereas, in the past, it was 1991. And that was just an old year and we wanted to move it up to present day. So this figure shows the correlation between drywall temperature and TDVs for representative climate zone, in this case, climate zone 12, and you can see that there's a pretty strong correlation between temperature and higher TDVs, so hotter days, higher TDVs, and it's not a perfectly linear line because there are

other impacts that go into the value of a TDV, including the day of week and whether it's a holiday or not, and there's a few other things going on here, but in general you'll see this sort of shape across many of the climate zones.

This figure is the same climate zone, but using the 2008 TDVs and so you can see that there are just, in the past 2008 numbers, there wasn't quite as tight of a correlation, so this just illustrates how having the new Weather files be correlated with the load shapes has improved the overall numbers here.

This is the same figure for a couple other climate zones, I don't want to get into the details here, but just to show you that this same pattern is repeated across all of the climate zones in terms of a tight correlation between temperature and TDVs. There's a bunch of underlying policy assumptions that go into the development of the TDVs that we wanted to sort of highlight explicitly so you understand what kind of a future scenario we're talking about because TDVs do represent a 30-year or a 15-year forecast of what's going to be happening in the State of California, and we're trying to capture that in these numbers. So, some of the key policy sort of assumptions that go into this are, a) around the retail rate escalation, and so, as I mentioned, the retail rate forecast is now consistent with compliance with AB 32, so that means it's a higher retail escalation

than in the past, and we got that forecast from a calculator that we developed, actually, with the Air Resources Board, looking at the impacts of 33 percent renewables and higher energy efficiency, all kind of wrapped in together. We've used higher CO_2 price forecasts, as well, and that comes from a forecast developed by Synapse Consulting. It's used in other proceedings at the Public Utilities Commission, as well, in their energy efficiency proceeding, also in their Market Price Referent proceeding, which determines the value of renewable energy related to gas generation, so this is a fairly typical CO_2 price forecast used in the state at this point. We also assume that the CO_2 price is refunded to consumers, so the CO_2 price affects the shape of the TDVs, but it doesn't affect the absolute level of the TDVs, if that makes sense. So, you have a higher CO_2 price impact when you have less efficient generation running, so that will increase the peak of your TDVs, but it doesn't impact the overall level. I already mentioned the Renewable Portfolio Standard. The other impact that comes out of this Renewable Portfolio Standard is an effect on the shape of the price of energy. We use a production simulation dispatch model that the Energy Commission has in order to develop the market price shape of energy, and we run a few different cases, including a case that has 33 percent renewables in it, and that means you have more wind

generating during some hours of the day, less natural gas, and that sort of actually changes the underlying market price shape that we're looking at. So we've incorporated that change in electricity prices due to renewables being on the grid in these numbers. It's a pretty subtle effect, actually, but it's an improvement over what we had in the past. We also assume that the solar PV energy efficiency goals consistent with AB 32 are met in 2020.

So, this chart shows the retail rate price change between 2008 and the 2013 TDVs and this is really important in terms of what the overall level of the TDVs are doing. The retail rate forecast doesn't have anything to do with the shape of the TDVs, but it does affect what the level is sort of scaled up to. And so you can see that we do have a higher escalation in the 2013 TDVs, those are the solid lines on the top. But the other sort of subtler change is that, in the 2008 TDVs, the non-residential rate forecast was a bit higher than the residential rate forecast, and that just reflected the situation at the time, I think, back in 2005 when we were pulling these numbers. Now the situation has switched a little bit and, so, actually residential rates on average across the state are slightly higher than non-residential rates, and what this means is that you'll see if you are comparing 2008 to 2013, you'll see that there's a little bit bigger impact on the

residential numbers than there is on the non-residential numbers, kind of relatively speaking. So, that's one thing to keep in mind if you're looking at these numbers and wondering why it looks like residential and non-residential are not doing exactly the same thing.

This chart shows the whole year, AB 760 hours in a year for a representative climate zone, here we've picked climate zone 2, and the red line there is the 2008 TDVs, and the blue is 2013. And you can see that the absolute magnitude is not very different for the off-peak hours, but for the on-peak hours, there is an increase, and this is just a different way of representing actually the stuff that Dan was showing earlier. So you can see the shape has changed a bit and the absolute magnitude of the peaks has increased. This is for the 30-year TDVs for the residential and you can see that the off-peak has increased a bit more and that's partially to do with the retail weight forecast that I was showing earlier. And you've also got even higher TDVs. And the reason that the peaks are so much higher in the 30-year than in the 15-year is because you're discounting over a longer time period. So, you've got higher retail rate escalation, so those later years matter more, whereas, in the 15-year, you're kind of cutting off the analysis after a shorter period. So that's the overview of what's changed. I know there was a lot in there. I'd

like to let Snuller go through a little bit more of the details step by step, so hopefully it'll all make a bit more sense, and then open it up to questions.

MR. RAYMER: All of this is going to be on the website, right?

MS. MAHONE: That's right.

MR. SHIRAKH: Yes.

MR. PENNINGTON: I'm wondering if you can give a feel for what of each of these changes – what's kind of the consequence relevant to the total change. It looks like the escalation is a really big part of it, but I'm wondering if there's other things and you could sort of – maybe you don't know it precisely, but if you could give a feel for it?

MR. PRICE: Let me – I think, let me try to pick that up as we go through the step by step, sort of what the biggest drivers are and the change. I think Amber kind of focused on what those really are, which is this correlation between what the simulation models are telling us and when TDVs are highest. I think that's going to matter quite a bit, and then the retail rate escalation given what rate forecasts are likely – what rates are likely to do in a AB 32 compliant scenario, those are the two biggest things, I think.

So, just to kind of break it down in three basic steps we use, and the first is to do a long run forecast of

not just electricity, but natural gas and propane, out 15 and 30 years, what is it going to cost? Once we have a long-term forecast, we do present value, kind of like Dan said, and then we convert dollars per kilowatt hour, dollars per therm, into a KBTY basis, so they can be used and integrated into all the building simulation tools, residential and non-residential. So what I want to do is really focus mostly on this first piece, which is the bulk of the analysis, the step 2 is an NPV formula in Excel, and step 3 is just a divide by formula, so most of the work is focused on number one. For electricity, we build up the marginal cost of delivering a kilowatt hour in different locations and different times, but summing a bunch of different components, and so the first component is generation energy and that's the piece Amber mentioned we've simulated what the wholesale market prices are going to be as the State develops more renewable resources out through 2020. So we've got a underlying generation infrastructure that is consistent with AB 32. In addition to the energy piece, we've looked at system capacity, so when is the state going to be short of capacity in terms of the peak loads growing? What are the costs of building new plants to be able to meet that peak? Ancillary services, one of the things that's happened since the last round of Standards is that the California ISO has implemented their MRTU markets,

so we actually have a different wholesale market operating in California. And one of the things that has changed quite a bit is how we do system load balancing and ancillary services market, so we've integrated the CAISO MRTU market and market prices into this analysis. T&D capacity is the cost of adding new transmission lines and distribution lines as our peaks grow. Kind of like generation capacity, T&D capacity is really focused on serving the highest load hour, literally the distribution engineers and our utilities around the state are trying to predict, you know, what the single highest load hour is and making sure they have enough capacity online to deliver that energy down to the local level, final line transformer into the house. And so we've updated what the marginal cost is of providing T&D capacity. Greenhouse gas emissions, we've used the synapse forecast, as Amber described, and we've looked at what we expect the marginal emissions rate is of all the power plants and all the hours kind of forecasted out, so when we say the kilowatt hour on a particular hour, say, in July, what the avoidance of CO_2 is in terms of the re-dispatch of the system. And then we have a retail rate adjuster, so we've already talked this morning about the fact that what we want to capture is bill savings to customers, ultimately. And this will come up again when we talk about Reach, but we set this marginal cost framework at a level where customers – we

are modeling bill savings to customers. And as Amber showed, the retail rate escalation is quite a bit higher, as we're forecasting under AB 32 compliance, than it was in 2008.

The NPV hasn't changed, really at all. We're still using the three percent real discount rate, it's been the same since I've been involved in the Standards. And for residential measures, 30 years, and for non-res, 30 or 15, depending on whether you're talking about shale or appliances. And then, step 3, converting TDV dollars into TDV energy factors for the simulation tools, we've basically divided by a constant number, okay, and it's a dollars per KBTU number. It's the same number that we've established in 2005, so we haven't actually changed the denominator, and in that way, you can compare 2008 TDVs to 2011 in terms of their source units and you'll see the same relative differences in terms of the dollars. Those happen to be the numbers, but it's not anything other than just dividing through your whole answer by a constant factor.

So, to dig in a little bit more on the electricity, we've got 16 climate zones. They're the same climate zones. What we've done is gone through each climate zone and looked at the utility that serves most of the customers, this is the electric here in each of those zones. And most of the TDV costs are statewide average, so this assignment of

particularly utility to a particular climate zone has pretty small impact the way we've done the TDVs this year. In 2008, it had a bigger impact and I think that might come up in a slide or two, but we could talk about that if people have questions.

I already walked through this whole list, so I'm not going to do it again, these are just the components of the electricity TDV that we add up. I guess it's gotten more information in here on the methodology and data sources, so when you're reviewing the Powerpoint after the meeting and you want to have a question, this might be a good place to look. I don't think that – I don't think there's anything on here that we haven't covered already. Most of the work that we've done, well, I wouldn't say most, but a big chunk of the work that we've done is trying to figure out how to correlate the Weather files in the forecast of energy, and so our team, in combination with the Commission, actually spent quite a bit of time at this, and the first step, Joe will talk about, was getting a set of Weather files, where it is the same time across the state because the market price of electricity in California is correlated with overall state demand, so if it's just hot in one place and not in another, that's not necessarily going to be a high price day, it's when we have a lot of heat all over the state, which doesn't always happen, it doesn't happen that

frequently, and so we needed correlated Weather files to be able to predict that. So, we created a regression model by looking at the relationship of historical observed temperatures and loads, then create a relationship, then use the new TMY Weather files, use that relationship to estimate what the loads are, then fed those loads into the production simulation model that does all the generator dispatch around the state, and looked at what the marginal generator is that would be operating, and use that to predict what the market price would be. And we have a 2012 simulation, so sort of the existing generator fleet, and then, as we build towards more renewables going forward. And that's the reason for the better correlation that Amber showed in her chart.

So, the regression analysis to take temperatures and predict load is not trivial, it's not impossible, but it's not trivial because there are a number of things you have to think about that's not just dry bulb temperature, we also use dew point. We also look at the lags because, when you have a heat storm, heat builds up in buildings, and so it's important to look at not just whether it's hot today, but what it's been doing and trending, so we include that. The Time Of Use effect is important – weekends, I think Amber mentioned, or maybe Dan, that they almost always have lower market prices just because there are a number of commercial and industrial load that is not operating. There's some

skewness [sic], so you have to adjust for the fact that a standard regression model would be nice and normal all the time, and it doesn't really look like that, there's a long tail, but we adjust for that.

So, some detail went into creating the overall regression, we think it works pretty well. Here is a look at taking the model and then running it back over a period that we actually observed for Southern California Edison example, just to kind of check, and we get pretty good, it's not perfect, but you know, it's also a real world data and a regression model, we we're really quite happy with the way we could predict what California's system load will be with our 16 weather station data.

I think Dan showed a plot that is somewhat like this, he talked about all these different components, and here is how they add up for just a typical week – actually, it's not a typical week, it's a summer week in climate zone 2, and the reason why we show the summer is so we can see that spike and sort of where it is and what composes it. And it's really T&D capacity and generation, so where it says "T&D," that's just shorthand for T&D capacity, and where it says "capacity," that's shorthand for generation capacity, the power plants, but there they are, they sort of add up.

The retail adjustment factor, to get to retail

levels, we add just a flat block, and the reason we do that is, then, if you take the differential between any hour, what you're really seeing is the true marginal cost difference between any hour. So, we can preserve the underlying marginal cost differences across the state using that approach, but still get to retail price levels. Here is it is sort of zoomed back out for the whole year. Some of the components that are in there, we look at the forward contracts for natural gas delivery to California, so first we look at Henry Hub, which is in Louisiana, and it's sort of the basis for the market pricing in the United States for natural gas, and that gives us – we can get a market price out to something like 2020, something like that, that Henry Hub. Then, there is also a financial instrument that is sold that will adjust Henry Hub gas to California Burnertip, to we get to that. And then we project forward using the Federal EIA, the Department of Energy's Environmental Energy Information Agency forecast, which is just a long term forecast for Pacific Region to kind of extend out, so a publicly available forecast.

For the wholesale energy, the average energy prices, we use also forward data, so we just take a look at the markets. They don't go out as far as natural gas, they go out about three years, and then what we do is we look at what the market heat rate is, and we just go straight

across, so it's sort of a flat market heat rate. Since our market is almost entirely natural gas, what a flat market heat rate means is that all the price changes will be driven by the forecast in natural gas. So, once we have a natural gas forecast and a heat rate assumption, we can forecast out the consistent long run energy cost. Then, we allocate the generation capacity value to the highest load hours, so we have a estimate of what it costs to build a new power plant, to provide the capacity. We also have an estimate of how much money that power plant will make in the market, and we subtract that out, and we end up with this sort of differential which is the pure cost of adding capacity. And we take that and put it over the year in those hours with the highest load, and this is pretty similar to the process that all the investor-owned utilities use in their process. A couple differences, we used actually a fairly simple model to allocate the capacity to these hours, so we're just looking at load in the top hours. More sophisticated utility analysis might also look at power plant availability and adjust for maintenance and down time and do a little bit more there, and they might get a little bit more capacity in May, which is a time of the year where you might have power plants down for maintenance and a heat storm. But essentially taking the low forecast that we develop with our regression model, we've got a predictor of exactly kind of

where we would expect those peaks to occur and we spread the capacity value to those hours.

For the T&D capacity value, we used exactly the same methodology, to allocate it out to hours as we did in 2008, which is based on the local weather file, so if you're in a particular climate zone, say this is climate zone 2, we look at what the temperature is, and we've created a methodology that goes from temperature to what our allocator is, and we could talk about that if folks want to. We think it mirrors pretty well what the distribution engineers use for their capacity planning at the utilities and then allocate the T&D capacity to those hours.

CO_2 price forecast, Amber mentioned the Synapse forecast, we're using their mid-forecast and what it is that they do, and why we like it, and why the other State agencies like it, their forecast is really a meta analysis, so what they did is they went out and looked at, I think, over 100 different forecasts of what the carbon prices are going to be and then they grouped them into high, medium, and low, and so it's a way to get kind of that consensus forecast, if you will, of carbon prices. And so we're using their mid-case. And just to give folks a sense of this, it's got a number that's in the teens in the near term, and it escalates out and, by 2030, it's got a carbon price in the sort of $80.00 a ton kind of range. I had mentioned

that we look at what the marginal heat rate is of the plants in each hour. This is a curve of the market heat rate sorted by hour. And what we've got is, once you know the market heat rate, that is how efficient is the marginal plant, and you know that they're a natural gas plant, then you can compute what the marginal emissions rate is, so just sort of divide by the gas price. So, this is our marginal emissions rate curve. You will note that there are some hours where the market heat rate would imply a lower level of emissions than we're crediting, and you will see that in the market. There are hours where the market price does dip below the operating cost of a natural gas plant, and they still run so that they're running to be available through the next morning, so they're doing kind of an economic optimization, is it worth shutting down and coming back, what have you. And there are not that many hours where that is the case. So, that's electricity and I know I'm just sort of zipping through, but we'll have time for questions in a minute.

Natural gas is very similar. We add up essentially the same components for natural gas, although there's not really an hour to hour variation in the cost of natural gas to deliver to a customer, it's more of a seasonal type of differential and that's just because you can store gas. So, we have storage facilities. Also, you can store gas in the

pipelines themselves. So, the pattern and the shape tends to be higher gas prices in the winter when we're using it for heating, and lower in the summer. And you can see the different components. For gas, most of the component is the commodity, so that's just the actual cost of buying gas and transporting it from Henry Hub. Then, there's an emissions piece, which is that same CO_2 price, but applied to the carbon released when you combust the natural gas. And then T&D is the storage facility, the large seasonal storage facilities in the state, plus the high pressure and low pressure pipelines, and pipeline expansion. And then, finally, we have propane and propane forecast, so here I think we rely, again, on market prices, and it's sort of spotty, and then a long run DOE EIA forecast for residential and non-res. And also we look at what the seasonal shape is of buying propane in the California market and apply that. And then we have an emissions rate that is based on the carbon. If you compare the propane numbers to the natural gas, you will see that propane is quite a bit more expensive, and that's why the emissions rate proportionately looks quite a bit lower, it's just because propane is quite expensive in terms of the commodity.

Okay, so that was my whirlwind through how we've done it. Again, the slides will be up on the Web and we're also happy to take questions now.

MR. SHIRAKH: The slides and the reports, actually, underlying reports.

MR. PRICE: Oh, yeah, actually the reports, too. Thanks, Mazi.

MR. SHIRAKH: Nehemiah.

MR. STONE: Nehemiah Stone, Benningfield Group. I have – my first question is about the propane price forecast. The data has shown a pretty strong correlation between propane prices and oil prices, but the EIA forecast doesn't show that correlation, and so if you believe we've hit peak oil, and there's good evidence we have, you would expect oil prices to be going up a lot more sharply than that. And there may not be any good logical reason why propane is so tied to oil prices, but the fact is, historically it is. Why such a shallow curve here?

MR. PRICE: So, I think what you're seeing is what the DOE is forecasting for the Pacific Region propane, so to answer that, I kind of have to get in ahead a little bit of what's going on at the EIA, which is only – not very close to it. I don't think that they have oil prices shooting up through the roof in the EIA, so I think, if you looked at – and I don't have it here, unfortunately – to overlay oil, but I don't think that this is that different than what they're predicting for oil. Now, I know there's a lot of politics potentially in the DOE EIA forecast, and not

forecasting gas prices to shoot through the roof, I don't know. Just a guess.

MR. SUYEYASU: And just one thing to add is that we don't actually use the propane numbers and the life cycle cost analysis process, we just use natural gas for evaluating proposed measures. The propane is only used for compliance calculation purposes on a home or building where they know it will use propane.

MR. STONE: I did not know that.

MR. SUYEYASU: And that –

MR. PRICE: I didn't know that either.

MR. STONE: What's the reason for that when you have, for example, climate zone 1, the bulk of which is not served by the natural gas, so therefore propane is the driver there?

MR. SUYEYASU: Okay, well, maybe I have a misunderstanding there.

MS. CHAPPELL: Climate zone 1 –

MR. STONE: I'm not in Climate Zone 1 anymore.

MR. YASNEY: There's a similar question from the phones, "Has the gas projections taken into account the future supply of shale gas?" That's from Ed Becker.

MR. PRICE: Yeah, I do believe it has. Do I have the gas price forecast? Yeah, so – and also, on natural gas, the other part of the answer is the first through 2020

is actually just the forward market price, so it's actually not – it's a forecast that what a trader thinks that is the fair price to trade, and I'm almost certain that they've accounted for the shale gas.

MR. HODGSON: Mike Hodgson, ConSol. Very informative, by the way. Thank you for your presentation. Market price seems to be very strongly correlated with demand, and in your demand, you use some estimates for, I presume, new construction. And I'm wondering how significant is new construction to the whole demand picture in what you're presenting.

MR. PRICE: Yeah, so correct me if I'm wrong, Amber, but I believe the demand forecast is just from the latest round of the CEC's IEPR load forecast? 2009 IEPR load forecast, so we've taken that which is the latest load forecast we have that the Energy Commission has done. It does have some new construction in it, I'm not sure how much or what the prediction was on the Economic Recovery.

MR. HODGSON: Is that dissimilar to what was used in the Scoping Plan for AB 32 and the forecast numbers there?

MS. MAHONE: So, the Scoping Plan doesn't, I believe, directly develop their own load forecast, they rely on the CEC's load forecast, so we use the CEC's load forecast, as well, which is adjusted for energy efficiency included in the Scoping Plan, and then run that through our

production simulation model.

MR. HODGSON: Okay, and my concern is, I'm not sure how big new construction is to the issue because, you know, we're less than one percent of greenhouse gas production in the state on an annual basis, but the forecast that the ARB used, which I believe came from the CEC, had 186,000 single-family residences being built per year between now and 2020. We're not quite – we're less than 42,000 at the current market rate, and we're not quite sure when the recovery is going to be, but probably more significant, the load forecast – I shouldn't say load forecast because I'm not sure, but the building forecast that was presented to the ARB, I believe, from the CEC, had 115 million commercial square feet being built per year on a flat line between now and 2020, and currently the market is less than 10 million, and then, in fact, the industrial portion, which is the largest chunk, Wells Fargo just predicted last quarter that they probably do not expect any new industrial construction in the state until 2018, just because of oversupply. So if it's a significant issue, and I don't know if it is, I think it would have an impact on demand. I don't know if one percent or two percent is that, but I know capacity building tends to be a driver and what builds capacity typically could be new structures. And so I'm just wondering if that's a significant issue, and if you are relying on ARB's

data, which relied on CEC's data, it really doesn't reflect market, nor has it been corrected over numerous requests from the industry.

MR. PRICE: So, I don't think – it's not the key driver, new construction and the overall growth. I would say it's completely a non-issue, either. We've done some forecasting, you know, if you add up all these assumptions. And the other assumption that really affects electricity supply in California is the once-through cooling issue, which is we have a number of power plants that use water from the ocean, cool it, and put it back into the ocean, and that is the Federal Clean Water Act is making that basically illegal. And so we have an issue of retiring old power plants, as well, so we tried to factor that in, along with – and that's probably as big a driver as growth, it's getting rid of the old power plants. So, we factored in the once-through cooling, some of those will be repowered, some of those will be retired, and the result of that is that, in this modeling, is that 2015 looks like the year when we are going to need new power plant capacity, given the CEC's forecast that we talked about and the retirement of once-through cooling. And we call that resource balance here in this sort of electricity demand forecasting. So, the question is, is it 2015, or is it 2020, or is it farther? And it's hard to predict. It's hard to predict the economic

recovery. I don't think we've done a sensitivity to the resource balance here, although I would say one of the things that's important is that all the utilities do purchase capacity from all of the existing power plants on our behalf every year, just to keep them so they stay there and as sort of a reliability issue. So, in 2015 and on in our model, we assume that the cost of those capacity payments are equal to what it would take to get a new plant to come into the market, that between now and 2015, we still have a capacity price in there that's based on the utilities basically purchasing enough capacity from existing generation, that it would also be an avoided cost. So, I don't know, that's probably a way longwinded explanation from your question, but –

MR. HODGSON: In your summary somewhere, it would be nice to have – and I'm not trying to ask for additional work, but some type of best guess from an educated individual, not like us who don't know what you're doing, but would say, "Here, we looked at where those numbers came from, from new construction…," because that's the interest that I have, "…and from new construction, even with the diminished market, it would have this impact." Whether that is significant or non-significant. And I don't know the answer to that, and I don't want to guess, so I'd rather have someone who is a better guesser, a more knowledgeable

guesser, I would say, say that that is or is not an issue; if it is an issue, what impact would that have, then, on our life cycle costing because that's where this feeds into. I would appreciate that.

MR. PRICE: Sure thing.

MR. SHIRAKGH: Thank you, Mike. Marc.

MR. HOESCHELE: Marc Hoeschele, Davis Energy Group. I'm just curious with the gas TDV how much that has changed. I mean, the electric is in the 20-50 percent and I'm assuming the gas isn't very much from 2008?

MR. PRICE: The gas price is almost flat, I believe, from 2008, and that's because natural gas prices are lower.

MR. HOESCHELE: Right. So I guess there's some implications there for – I mean, they're not for Title 24 on, say, on water heating, when we're looking at heat pump water heaters or gas cooling on commercial buildings, things are going to change pretty significantly there.

MR. PRICE: I don't know how much they will change what the measures are. I don't know if you have any of that in your slides, Bruce. Later today, we can kind of start to look at what the implications are in terms of measures. That's one step down the road from where we've been.

MR. PENNINGTON: Snu, could you explain why the natural gas prices would be flat and the electricity price is largely driven by commodity costs, would be escalating

considerably?

MR. PRICE: Yeah, so the natural gas prices hit kind of a peak and, in about 2008, probably before we took a natural gas price for the 2008 Standards cycle. And then they've since come down for shale gas or other issues, demand is low. So that's why – and I don't have a 2008 comparison chart, but from my memory, I think it is relatively flat. The overall TDVs on the electric side are driven in part by the commodity price, and that will also be flat, but if you look at the other elements of the retail rate escalation, there's the investment required for the 33 percent renewable energy standard, which is going to go into the rates and is going to drive some increases. There is also an effect, perversely as it might sound from energy efficiency, actually drives rates up because we have our established infrastructure, and with less through-put, you get more higher rate per kilowatt hour. So all of our dollars per kilowatt hour rates are actually going to be higher. Total bills are lower, but the per unit costs are higher. I'm trying to think what else – but those are the key drivers.

MR. PENNINGTON: I was imagining that the fuel costs were going up and that was a significant cost of the escalation, but you said it's not that case.

MR. PRICE: Well, here's the fuel cost on this slide

that we have, and the natural gas prices do rebound within, you know, 2020 to being where we sort of saw them before, and then they go – so if you're talking about a 30-year life, actually, you know, there is pretty significant commodity increase, it's just the more near term. Other questions about the TDV? Yeah?

MR. SPLITT: Well, it's not a question about your presentation, but I didn't see anywhere else on here to moan about something, and I've been quiet for too long. One of the stakeholders meetings had to do with solar water heating. There was a proposal to re-do the net solar fraction calculation and base it on TDV, and to me that is totally wrong because it skews – this is supposed to be something used for designing and sizing a system, and a Btu that you put in a water tank at 10:00 in the morning is no different from a Btu that you put into the tank at 3:00 in the afternoon, and I just want to –- since I'm at the Commission here -- let you all know I think it's a really dumb idea and you should not do it.

MR. SHIRAKH: Thank you, Pat. Any other questions on TDV for the base standards? If not, we're around 12:25, I would like to propose being back here at 1:15 sharp. I know some folks have to leave early and we'd like to go through as much material as possible, so we'll start up again at 1:15. Thanks.

(Off the record at 12:25 p.m.)

(Back on the record at 1:15 p.m.)

MR. SHIRAKH: We're going to start the afternoon session. Quickly, the agenda, the first item is going to be TDV for Reach Standards, then after that is going to be the Weather File, Joe Huang is here, so he'll present that, and then after that will be Residential Compliance Software, Bruce Wilcox. So, take it away.

MR. PRICE: All right, thank you, Mazi. I'm going to walk through and go over the next half an hour, or 45 minutes or so, the latest thinking on developing the Time Dependent Valuation for the Reach Standards, the Reach Tier 1 and Tier 2. Unlike this morning, where I was kind of blaring through the slides to get us all to lunch, I think we will actually have the time to walk through a few things at a little slower pace and have a chance to talk about it and we'll take questions afterwards. I'm going to try to leave plenty of time for questions. I would also like to say, though, that I don't think we have all the answers on how Reach Tier 1 and Tier 2 will be implemented, or what have you. I look at the work that E3 has been doing as sort of the first step, so you know, what are the rational ways we would look at developing the economic framework for Reach Tier 1 and Tier 2, and we think we've got a workable economic framework, and we're going to talk about that. I

know that's an interest – it was a question this morning. I don't think we yet know, though, if we take that economic framework, how will it all work out, and how will it all be rolled out? I think those are all questions that the Commission is starting to explore and I'm sure that's areas where feedback and comments are welcome. So, I look at this talk as sort of the step 1 as far as economic perspective, not necessarily all the answers on how all the Reach Tier 1 and Tier 2 will play out.

So, the purpose of developing Reach TDVs was to create more aggressive Title 24 Standards for adoption by local jurisdictions and building designers, and so the Reach Standards are adopted by local City Councils, or just building designers who want to build a building, or design a building, to reach Tier 1 or Tier 2 Standard. I will talk a little bit about the policy context, what's going on in California sort of driving us toward that, I think some of that is talked about this morning, and then I've got a proposed Reach 1 Standard approach, and we're going to talk about the economic framework, and then, similarly, a proposed Reach 2 Standard approach to talk about. And hopefully this will all lead to some discussion.

I think anybody who has been following California energy policy has sort of seen a whole suite of things that are focused on reducing the carbon in our economy. The

picture on this chart is of the AB 32 Climate Change Scoping Plan, which basically is the roadmap for laying out how the state will reduce carbon over the next 10 years or so, it's got market mechanisms, it's got complimentary measures, what we call complimentary measures, it's pretty cross-cutting, I don't think there's really an industry or an energy using part of the California economy that isn't addressed directly somewhere in this Scoping Plan. It's pretty much the whole thing. And Building Standards are part of it, as is energy efficiency, transportation, agriculture, pretty much the whole thing.

California buildings represent over 20 percent of statewide greenhouse gas emissions, so it's not an insignificant part of the overall climate picture for California, the energy use in our buildings. I wanted to say a little bit about long term challenge of hitting a level of carbon emissions that the IPCC, which is the International Panel on Climate Change, says we need to meet in order to prevent catastrophic climate change on earth because this long term goal is really driving the overall need for reducing carbon and it's a long term target. If you look at 2020, it's a nice milestone, and it's on the way, and the AB 32 goal of bringing California emissions back to 1990 levels by 2020 is a step in the right direction, but in order to prevent catastrophic climate

change, we really need to hit 80 percent below 1990 levels – 80 percent below. So this chart contrasts the business-as-usual trajectory of the state's total economy-wide carbon emissions, which is now at about 520 and will increase to something like 875 at a business-as-usual baseline, and the trajectory that we would need to take in order to hit the aggressive GHG reductions. And you could see that the 2020 target is on there and our analysis shows that the mix of AB 32 measures do just about get us exactly to that 2020 target. The long term picture for decarbonization of the entire economy has a lot to do with buildings. And I think, while we can do a lot of things to reduce carbon in the short term, when you look at the long term, our built infrastructure is really the dominant driver of overall carbon emissions, and building standards, while the amount of growth between now and 2020, new building standards will not have so much impact by 2020 just because we're not building that many new buildings. When you look at what the real problem is around climate change, you realize it's a long term. And over time, as we roll through the building stock in our state, the building standards become more and more an important role in the overall meeting. Governor Schwarzenegger has issued an Executive Order that states that it should be California's goal to meet the IPC of 80 percent below 1990 levels. We've done some look at what we

think the viable pathways are for reaching that long term goal, and I don't want to take up too much of our time talking about it, but energy efficiency is really the first and sort of critical piece we need to take on in order to get to this type of goal. Really, there are not that many pathways that can get that much carbon reduction, and the three elements that you really need are, first of all, energy efficiency, and then you need decarbonized electric generation, and then you need electrification of end uses, including in the buildings, as well as in the transportation sector.

UNIDENTIFIED SPEAKER: What does that mean, electrification?

MR. PRICE: Electrification means taking something that is burning a fossil fuel now, like your car, and changing it to being an electric car, or changing a boiler that is a natural gas-fired boiler at an industrial site, and making it an electric boiler. So, with that background of sort of the long term, and the importance of building standard in the long term, as opposed to just in the short 2020 time frame, we set about trying to create, well, okay, given these goals, how should we set the Reach Tier 1 and Reach Tier 2. And for Reach Tier 1, what we call a "carbon constrained world," basically we set an economic framework together that says, given this is a multi-generational

problem for carbon reductions and the long term goal of 2050, how can we set an economic basis so that we're basically sharing the burden of ourselves vs. our children and our children's children. So, if you look at the base standard TDVs, which is this basically will the investment pay back on my bill savings, and you look at that and you look at, well, is that enough to basically take our share of the responsibility for abusing carbon? And you find out you're not. So, for Reach Tier 1, what we said is we're going to share equally the amount of carbon reduction that we're taking on in the buildings we're building today, and that if our children do the same level of effort, and the children's children, we will be on the path to hitting the long term goals. So, the economics are based on this equal sharing concept. And I'm going to talk about how we implement that.

For the Reach Tier 2 Standards, we've changed the economic framework once more. We've said, well, maybe we need to take responsibility for reducing the carbon ourselves in this generation. And so we've set the economic framework for basically Zero Net Energy ready buildings, essentially what we would be doing in Tier 2, then, is making buildings that go all the way up to Zero Net Energy. And in that framework, we've taken the responsibility in this generation for reducing the carbon for the long term.

I'm going to talk a little bit about how we implement that, but that's the framework. Tier 1 is equal sharing, Tier 2 is we're going to do it in this generation. So, we really need two changes for the Reach Tier 1 standard, carbon constrained world, and this idea of sharing. So, the first change is we use a higher CO_2 emissions price. And the reason for that is that, if you look at the carbon price trajectories in the Synapse Forecast that we looked at this morning, it is exactly that, it is a market price of what the marginal abatement cost will be of carbon in years kind of from now, moving forward. But if you look at how the physics of carbon dioxide works in the atmosphere, carbon dioxide has a life of over 100 years in the atmosphere before it is reabsorbed, so carbon that is released today will still be in the atmosphere in 2050, and so, rather than use a market price, what we look at is, okay, if we fast forward to what it will cost in 2050 to remove some carbon, and we use that cost as our value of it today, since, after all, that carbon will still be there, then we end up with a higher carbon price trajectory. So, this is a long run cost of avoiding carbon, not the market clearing price in a cap-in-trade carbon market, okay? So, that's the first change and that increases the cost of carbon from something today, from something like $14.00 a ton to $57.00 a ton. And so that's the first piece. The

second piece is we lower the discount rate. And the reason we lower the discount rate is that we're taking this multi-generational perspective and this idea of equal sharing. So, in the way that the current based TDVs work, there is a 3 percent real escalation, and so when you review our NPV to do a life cycle analysis as they are presented, you get a discounted stream. If you look at it a little bit differently in this multi-generational perspective and say, "Well, I want to share." "If I have to pay, or my child has to pay $10.00, to reduce carbon in their lifetime, I'm going to be willing to pay $10.00 myself in my own, okay, of equivalent buying power." And so, we use a zero percent discount rate, zero percent real discount rate, so it is equivalent buying power. There is a lot of ways to think about discount rate. We didn't change it lightly because it's actually kind of an underpinning of a lot of the TDV methodology, but in this case, where we're trying to get the equivalent level of investment for our generation to share in the problem, we think it's the right answer. The other way to think about the discount rate is opportunity cost, so, rather than put it in an investment in something that will save energy, I could put it in the bank and get some interest. Basically, what we're doing is we're ignoring that opportunity loss. In other words, I'm not going to put it in the bank, it's a conscious decision, I'm not going to

put the money in the bank and invest it, what I'm going to do is put it into my house and save carbon. Sorry, I was a little surprised by the little pop-ups here. So, we could talk more about discount rates and why we chose Zero Percent Real, but essentially it is equivalent buying power. And if my child has to spend $100 to solve the climate change problem long term, I'm going to be willing to. That's the framework. So, if I roll those two things into the TDVs, what happens? Well, I find that my TDVs go up by about 20 percent, 20 percent higher, and particularly in the on-peak period. This is just that example, it's – oh, I guess this is the TDV times energy consumption for a typical commercial building, which is why it's particularly a non-peak period. So, you get an answer, you can get a whole new set of TDVs, all of the same methodology and framework that we've talked about, that Dan set up this morning in the LCC in terms of, you know, could you use this to create a proscriptive Tier 1? Yes, absolutely you can. Could you use it in the ACM? Yeah, absolutely you can. All of our methodologies for looking at Building Standards work, it's just a different set of fundamental TDVs. All right, so that's Tier 1 in a nutshell. Looking forward to comments on that.

Reach Tier 2 is, as I said, more aggressive. This is we're not going to do this equal sharing, what we're going to do is solve the problem right now. And so, the

principle is, basically Zero Net Energy buildings, net energy ready, right? So, what we mean by that is, we're not thinking of requiring the on-site self-generation component, but a building that is the next economic choice for reducing energy in the building would be on-site self-generation. Okay? So these are Zero Net Energy ready. And self-generation, to get it all the way to zero net energy could be added at the discretion of the builder, which would be fine. And in a parallel process to this, we are looking at the cost of integrating photovoltaics into new building construction, and I think that's going to come back around and be sort of synergistic with the Reach Tier 2. So, then the goal is identifying the suite of measures that lead to a least cost path for this Zero Net Energy ready building. Now, in practical terms, what it means is, if the cost of adding – if we're talking about, say, residential rooftop solar, the cost of solar PV is something like $.28 a kilowatt hour, which is roughly what it's projected to be. That means that we can – it would be cost-effective to do energy efficiency all the way up to measures that cost $.28. Now, there's probably lots of different combinations of measures and there are probably a lot of measures that save energy in that building that cost less than that. But that's sort of the framework.

So, there is a number of ways to implement Reach 1 and Reach 2, and I don't think the Commission has decided, I think this is a great forum for providing comments. The proscriptive and ACM approaches could work just the way we've got them; basically, for each one, you just use the higher Reach 1 TDV values, given the assumptions that I talked about, and then, for Reach 2, what you could do is set the overall level so that the cost is the self-generation option, which is probably solar PV. The thinking through this, there are some implications about it and probably some – this is, I would say, our own comments, and work in progress, but as you push down the total energy consumption in the building, I think that the interactive effects become pretty darn important. So, we are going to have to think about how that works rather than a measure by measure type of analysis. How do we look at passive features, which have a lot of implications for how the buildings are modeled and all that. And data availability on the higher cost energy efficiency measures are, I think, all challenges for implementation. But I think that's what this forum is for and I'm sure comments are appreciated. I think that's the last piece. But, I would love to have a discussion around concept and make sure, at least, that I'm communicating it clearly and hearing your comments.

MR. RAYMER: CBIA, this is Bob Raymer with CBIA. We'll have a lot of comments to get in to you over there in the coming weeks and months. As the Building Standards Commission and HCD went through its development with the Green Building Standards, their Tier 1 and Tier 2 were sort of prefaced on a 15 and 30 percent increase. The picture that I'm seeing here would seem to clearly indicate that, with regards to Tier 2, 30 percent is kind of not going to happen, it is going to be something probably much larger than 30 percent. So, it seems to me that, where some of the other agencies were heading in a direction of taking the base standards in California and trying to figure out ways to sort of ratchet things down at levels of 15 and 30, that's not necessarily the direction that the Energy Commission is heading at this point. And it would probably be a good idea to express that to the other agencies, particularly HCD and the Building Standards Commission, so that they were aware of that is where you're heading because they are going to be working over the next two years on updating their Green Building Standards. Having said that, I'm looking at, you know, you indicated that there's going to be a whole lot more information coming out in December with regards to the Tier 1 and Tier 2 methodologies that you're using. But from what I see right now, a great great many things will be able to be justified as being cost-

effective, given the assumptions that you're using here. However, I think that the general public, and to local elected officials, when they hear the term cost-effective, they're thinking in the simplistic of terms, that it's going to pay for itself; in essence, "My long term reduction in utility bills over that 30-year period is going to pay for the upfront costs and installation." And this is a huge departure from that, and it points in a case that the CEC is taking a huge shift in past practice over the last 30 years, and the fact is, I think when you call something cost-effective and use these type of assumptions, you need to put a big asterisk by the term "cost-effective." And it's important that those that are listening to this understand that cost-effective isn't what we've thought it was over the last 30 years, and there's going to be a dialogue problem here. So, that being the case, you know, whether or not a Public Resources Code, they don't have a whole lot of definition of what is and is not cost-effective, and so there's a whole lot of flexibility here. But I think a lot of people on both sides of the aisle are going to be very interested in the concept that you've got here. Now, we can discuss carbon reduction, things like that, and we get that, but I just don't see the average person on the street having a clue as to this. They're going to think, if somebody calls it cost-effective, it pays for itself, bottom line.

And so we're the ones that are going to have to sell this to the public. And unfortunately, it's been my experience in the last couple of years with the advent of the Green Building Standards, whether you go to LEED Gold or LEED Platinum at the local level, whether you go to Build it Green at 50 points, or Build it Green at 110 points, a lot of local jurisdictions particularly the decision-makers, have no understanding of what actually is within the standard itself, where that standard has come from over the last 10 years, and where it's headed, they just think, "Well, we want to be a little bit tighter than the state, so let's go ahead and do this," without any actual technical understanding of that. There's going to be a lot of jurisdictions that will take Tier 1 or Tier 2, as you are proposing, and just simply say, "Well, Tier 2 is a good idea, let's go for it," but not quite understand what is in Tier 2. And so that's the problem that we're going to have, we're going to have to sell all this. We would like to do it in cooperation with the Commission, but I'm seeing a price tag associated, especially with Tier 2, of being at an astronomical level, such that you'll see housing significantly hampered, hampering the ability to actually get an affordable product out there. Well, we'll have a lot to talk about over the coming months.

MR. PRICE: Yeah. I mean, I think your point about the explanation, if you just say it's "cost-effective," that's very different than what I was trying to build up, was, if you take this view, I'm going to share the cost between me and future generations, then it's cost-effective. So it's definitely the messaging is, I think, important to understand what this really is trying to reflect.

MR. RAYMER: Yeah. SMUD has had some very progressive energy efficiency programs over the years. They've always made a point that, you know, it's cost-effective, etc. etc. and they've got hard numbers to back that up. You're going to be getting away from dollar signs here, necessarily the direct connection between the individual and the savings that they're going to have in utility bills. People are going to have a hard time understanding that. It's a huge leap. Thank you.

MR. PRICE: Any other comments about the –

MR. SPLITT: It's Pat Splitt from APP-TECH. The way I look at this, it seems to me that this talk about cost effectiveness and adding all this stuff into these tiers, I don't see any reason for not keeping the tier structure the way it is now with Tier 1 being 15 percent better than energy code and Tier 2 30 percent, because in my mind, at a certain point in time, anything that you calculate is cost-

effective should be in the Code, should be required. Why wouldn't it be in the Code if it's cost-effective? So what you do is you go move along each standard as you raise the code up, but as high as you can that it is cost-effective, then you can add these other options where people just pick whatever they want to get better, but you don't have to justify it. I mean, there are mentions of adding some of the optional characteristics of the current Code into the next one, but they didn't mention QII, Quality Insulation Installation. That doesn't need a lot of equipment, why wouldn't that be in the Code next time around? I mean, it makes no sense. It's cost-effective – anything that's cost-effective, it should be in the base for the Code. Why wouldn't it be?

MR. PRICE: Yeah –

MR. SPLITT: And if it's on the Code, you've got nothing left to put in your other tiers.

MR. PRICE: No, I understand what you're saying, and I think we've already got to our first case of the exact same misunderstanding that Bob was talking about. So, in the base TDV, the way we've defined cost-effective is it will pay the bill, savings will pay for it, and that's what you're talking about, and if it passes on that, it should be in the Code, and it is in the Code, and all of us are doing the case studies and all that to figure that out. Okay?

MR. SPLITT: Yeah, maybe.

MR. PRICE: Maybe, okay. In the Reach 1, I've used different criteria for cost-effectiveness; I've said, if we're going to share the amount of investment and energy efficiency and spend the same amount of our own resources that we're going to ask our future generations to spend, given the fact that we're in a long term climate change problem, then it's cost-effective. So, for example, the long term carbon price, so the cost that they're going to have to pay to reduce carbon, I will be willing to pay that myself, right? So it's still cost-effective, but it's cost-effective from a different world view.

MR. SPLITT: I just think what you ought to do is create a new term, not use "cost-effective." "Cost-effective" should just mean one thing.

MR. HODGSON: You've got three different definitions –

MR. PRICE: Please come up to the mic.

MR. HODGSON: Mike Hodgson, ConSol. Just a quick question, then. So, for Reach 1, what increase in stringency in the Code are you predicting for Reach 1 standard? Do you have a ball park?

MR. PRICE: I don't know because I haven't heard from the building modeling folks. I know that it gives you about a 20 percent higher number in terms of what the

overall value of energy is. But I don't know how anybody else –

MR. HODGSON: Are we going to be talking about 1 and 2 today, Bruce? No? Okay.

MR. WILCOX: Well, I've got some stuff to talk about, but it's all base standard stuff, so you could look at that and say, "Well, what if the savings were 20 percent more? Does that change it? But I don't pretend to analyze this yet.

MR. HODGSON: Okay, curious.

MR. PRICE: Yeah, we're curious too.

MR. YASNEY: On the phones, Abhjeet Pande had a comment that I want to get in the record. Dan, would you like to read that comment and then see if there is any discussion?

MR. SUYEYASU: And this is in response to, Pat, your earlier question about using TDV for solar. So, this is what Abhjeet said, "The plan is to not use TDV to calculate the solar fraction, but to use hourly solar fraction derived from solar thermal calculation tool. The hourly solar fraction will be an input to the calculation of hourly energy of water heating."

MR. SPLITT: Okay, that sounds more like what I was looking for.

MR. SUYEYASU: Okay, great. Thanks, Abhjeet.

MR. SHIRAKH: So, I have one question. You know, Pat Splitt, I guess your suggestion is to basically save 15 percent for Tier 1 and 30 percent for Tier 2, and just leave it at that, and then let people decide how they want to get there?

MR. SPLITT: There's the next time around that it's going to be 15 percent of a lot lower, you know, of a much more stringent number, so it's not like we didn't change it, we just brought everything down together.

MR. SHIRAKH: So would that be easier for you guys?

MR. SPLITT: I'm a deer in headlights right now.

MR. SHIRAKH: But his proposal is to define Tier 1 as 15 percent beyond whatever 2013 standard is, and Tier 2 would be 30 percent beyond that. I'm sorry –

MR. SPLITT: I understand.

MR. RAYMER: This is Bob Raymer, CBIA. I see great merit to that, although I think there's going to be a huge price associated with the 30 percent given some great basic calcs that we've already done. You've got a lot of local jurisdictions, particularly with Build it Green out there that has been very popular in the Bay Area, where they have for many years been looking at a 15 percent increase. So, with respect to Tier 1, there's a rather large consensus out there of understanding, 15 percent beyond the energy

Regs is where the next tier goes. Furthermore, that's been reinforced by the adoption of the Cal Green, which specifically comes out in states, 15 and 30. And you know, we're doing a lot of training out there right now, half the people coming to these training sessions are local building departments. We probably should get them thinking that this is perhaps a temporary thing. I don't know where this is all going to end up with the Energy Commission, but switching from a 15 and 30 is going to be significant. And given what I've seen, what you've discussed today in terms of what is cost-effective, or will be considered cost-effective for both Tier 1 and Tier 2, is much much different, and actually more. As you said, probably 20-25 percent for Tier 1, and who knows what that number would be for Tier 2? And that's much different from where we were kind heading. See, we are looking at water efficiency provisions at 15 and 30 percent increases, we're looking at other things at 15 and 30 percent increases, we're trying to look at life cycle analysis for these things so we can measure the greenness of one to another, and that's why, you know, who is to say that 15 and 30 is the best numbers to pick, it's just what we're familiar with right now, and it's probably a whole lot of where some of these private sector programs have been heading. This goes in a significantly different direction.

MR. PRICE: One thing I would –

MR. PENNINGTON: I have a question for Bob. When you say that we're looking at 15 percent and 30 percent for water, is that with respect to the Code that would go into effect in 2014?

MR. RAYMER: No, 2011. HCD is already starting to look at residential provisions, as is the Building Standards Commission for commercial occupancies, and it may well be a lot easier to look at the Tier 1 and Tier 2 requirements for water efficiency than it is for resource management, simply because we're kind of getting – we're new to this recycling on a large scale basis and resource management on a large scale, we've got to figure out a way to calc it. But, yeah, they are looking at 15 and 30 for water conservation.

MR. PENNINGTON: For 2014.

MR. RAYMER: For 2014, but it's not chiseled into stone, it's just right now they have no idea that you're thinking about this, and I'm sure they, you know, it would be nice for everybody to kind of talk to each other so they're on the same page. I can assure you right now, the assumption is that you're going to have 15 and 30, that is the clear assumption about HCD and the BSE.

MR. SUYEYASU: I guess just two things to point out here, one is the 20 percent that the TDV has increased won't necessarily result in 20 percent savings, we're only

going to apply this to a certain subset of existing efficiency measures, so it's just based on capacity of researchers to do the work. So, it could just be a third of the efficiency measures, and a building will actually get evaluated and move to a Reach 1 level, I have no commitment as to what that number is.

MR. RAYMER: Off the top of my head, I'm thinking the numbers are going to be much higher than 15 and 30, respectively, unless the CEC takes a different direction.

MR. SUYEYASU: Yeah.

MR. WILCOX: One of the things – this is Bruce Wilcox – one of the things I like about this proposal vs. the flat 15 and 30 percent is that this, it seems to me, responds better to opportunities and that are there because of the climates and the building styles and the market for efficiency measures that exist. We've run into past versions of the Standards where we tried to do alternate proscriptive packages to, you know, we did an alternate prescriptive package to the glazing package last time and, in some climate zones it was easy, and in some climate zones you couldn't get there. And I think you get the same problems with 15 and 30 percent, you know, it may be in Climate Zone 15 that 30 percent is too far, and maybe in Climate Zone 1, it's too easy, or vice versa. And in terms of resource use, putting the statewide resources into the

measures in the places where it saves the most energy, it seems to me, fundamentally makes more sense than some flat number.

MR. SHIRAKH: So, Bruce, do we know if that's a problem, actually? Or is it something we've assumed, that it's going to be a problem in some climate zones?

MR. WILCOX: Well, we know from past experience that it was very hard to get a package in Climate Zone 15 that allowed you to go back to the – I don't remember exactly the problem but the previous window standard or something.

MR. RAYMER: Yeah, hard conducted frames.

MR. WILCOX: Yeah, hard conducted frames.

MR. SUYEYASU: Bruce, some of the graphs you produced for your presentation will kind of illuminate this different effect, won't it?

MR. WILCOX: Some of the comparisons I'm going to show you, things are really different in different climate zones for what the effects are and how the measures trade off against each other.

MR. RAYMER: One last point, an issue that Mike Hodgson touched on earlier, and that is ARB's projection of housing production. As he did indicate, ARB is looking at 185,000 to 190,000 units being constructed – this is residential – being constructed in California from the years

2008 through 2020. There are already a half million units short because of the economic downturn and it's not like we're going to come back to business as usual and then build those 500,000 units on top of business as usual, so there is greenhouse gas production from those 500,000 units that are already not built that isn't going to be occurring. ARB will most likely be revisiting its numbers, but if you're assuming overall net energy efficiency benefits to California from the new housing stock, the numbers are probably going to be significantly smaller if you start using the revised numbers that the Legislative Analyst's Office is using and that ARB is perhaps reconsidering. It's not to say that energy efficiency in new construction is not warranted, but just to be looking at the global projection of benefits that we're going to have over the next 20-30 years, you're not going to see the greenhouse gas reduction numbers – total numbers – come from that. So it's a real concern.

MR. PRICE: Yeah, we already have a to-do list, some statement around the impact on the economy and housing starts, so….

MR. YASNEY: I have a comment from online from Tim Rosenfeld, a comment and a question. "I applaud the direction for rethinking of TDV for Reach Codes, however, I work with local governments that want to go beyond the State

Code to reduce greenhouse gas and keep more money in the local economy. Today, many local officials don't understand TDV and equate a 15 percent TDV beyond the State Code is the same as a 15 percent reduction in greenhouse gas for new buildings. TDV combines electricity and natural gas and doesn't clearly allow for us to understand and value the real greenhouse gas impact, especially for the future potential to reduce greenhouse gas. For example, orientation, better building envelope measures over slightly more efficient HVAC, pre-plumbing and pre-wiring for future solar. How can we disaggregate some of the components that go into calculating TDV to better look at the localized greenhouse gas impacts and local monies that might stay in the community?" Any comment?

MR. PRICE: Well, I can comment on it, I mean, because that is exactly – the way we build up the TDVs is we actually have an estimate of carbon emissions, sick [ph.] reduction, bi-hour for your building, so you know, the disaggregated components are there to actually do that analysis that the commenter is talking about. I don't know what's involved with, you know, creating a formal process and getting all of that out to everybody, but that's fundamentally how we build up the carbon part of our TDVs, so with an estimate of carbon savings.

MR. SHIRAKH: Nehemiah.

MR. STONE: Nehemiah Stone. Bruce, you mentioned that one of the arguments for doing it this way is the differences between climate zones. I'd like to add to that, that if you set a percentage of 15 and 30 percent as your targets across the board, you're going to find that you end up imposing a much higher cost per square foot for high-rise buildings than you do for lower rise buildings. It's a lot harder – multi-family, I'm talking about – it's a lot harder to get a higher level of percent savings in high-rise buildings, so doing it in a way where you've got a target that's a reduction rather than a percentage of the energy makes it more fair across the Board. I have a related question and I don't remember who was making the presentation, I still don't remember who it was, I thought for a moment, anyway, with the J-Curve and the difference between setting the standards or the base level being at the lowest life cycle cost, and I thought I heard you say that, then, the Tier 1 would be set at the level where it was the same life cycle – a higher level of efficiency, but the same life cycle cost, so where the J-Curve hit the horizontal line for the base, the current conditions, that's not the same thing. Did I mis-hear?

MR. SUYEYASU: They work together. We have not decided affirmatively that we're going to use that different interpretation of the J-Curve. We may use it for some

measure analysis. The point is that, if you do that reinterpretation of the J-Curve, that is still cost-effective, the new measure that you're implementing, as compared to your base case, even though it's a different point, cost-effective -- it basically leaves open any solution underneath that line as cost-effective. It works in collaboration with these new TDV numbers. The new TDV numbers will basically help determine the shape of the J-Curve and where it's positioned on that chart in relation to the Y axis.

MR. STONE: The reason I ask is because, if you're going to set a target that is consistent across from one measure to the next, whether -- you may be 5 percent better than the base case condition where your J-Curve crosses the equal cost –

MR. SUYEYASU: Yeah.

MR. STONE: -- or, you may be 80 percent better, and so – and it's not until you look at all the measures in aggregate for that kind of building in that zone that you're going to be able to get that kind of percentage.

MR. SUYEYASU: Yeah and, you know, certain measures may be close to cost-effective out there at the edge of the J-Curve where it's still less than present base case cost, but for one reason or another, they're not quite as market-ready, so we may just back off a little bit, but

we're just sort of putting that out there as one of the tools in the toolbox here.

MR. STONE: If I may, I'd like to make one more comment. When we were working on the 1992 standards, there was an argument made that we were pushing too hard and we were going to make housing unaffordable. And I'm hearing echoes of that same argument today, and I'd like to remind people who were around there at the time that we did a study where we looked at the sale price of new homes in one large region, Sacramento, tracked that over a 20-year period, compared to the cost of the two largest cost inputs, labor and lumber, and found that they had absolutely no relationship. The cost of new homes more than probably any other item we could think of is not driven by the cost of the inputs, it's driven by the demand of the market. And when you can get a lot for a home, you're going to make a lot of profit. When you can't, you won't. They keep building, then they go out of business. That's not a fault of the Standards.

MR. SPLITT: It's Pat Splitt again. I just wanted to go back to the 15 and 30 percent. I was assuming that this is going to be successful come January, but if there are these problems with areas that can't make 30 percent and the Building Departments are going to adopt these, they're going to do it in January, and your Reach Codes will be a

failure before you ever get around to doing this and nobody – it will be too late. So, if there's a problem with those, I think maybe somebody should think about it right now and start talking to the Building Departments and, say, maybe you don't want to go to Reach 2, or don't do a Reach 2, or – it just seems like either it's a good idea or it's a bad idea, it's not –

MR. PENNINGTON: I would just comment that most of the local government ordinances that we're seeing are shooting for a Tier 1 level kind of ordinance, maybe some exceptions for very large buildings. But, in general, they're not shooting for Tier 2 currently.

MR. SHIRAKH: Bill, we can hardly hear you.

MR. PENNINGTON: Okay, so I just was saying that most of the local government ordinances that we're seeing are shooting for Tier 1 levels, rather than Tier 2 levels, to respond to Pat's concern that maybe Tier 2 is overshooting, that's not what they're choosing to do, with maybe the exception of for very large buildings.

MR. YASNEY: And we're about 15 minutes late, so we want to –

MR. SHIRAKH: That's okay, it's important to have this conversation. Mike.

MR. HODGSON: Just a quick comment. Mike Hodgson, ConSol. Being part of the collaborative process, it came up

with Cal Green and the impact of why Tier 1 and Tier 2 exist. I haven't heard that mentioned in here today and the way the process worked at the State agencies, the Energy Commission was one of the groups that participated, was that Tier 1 in the existing Cal Green Code is basically what they're going to look at to adopt in the next adoption cycle, so it's like a three years heads up practice with this stuff, see how it works, and bring that product into the market. Tier 2 is three years out, plus three years out, you know, the next Code cycle, so it's six years plus out, probably leading edge technology, no market traction, no real quick cost data. So there are a lot of State agencies who treat Tier 1 and Tier 2 like that in the Building Code now that we've adopted, and by the way, that is relatively innovative nationally, no one has done that, that I know of in the United States that has a code voluntary –- first of all, codes really don't have voluntary sections, but when they do, or if they do, they usually don't look forward, they have like an ancillary cost, ASHRAE 6022, or pick a fun one, right? So, we're really moving away from that philosophy here, and I'm just making you aware of it, I'm not saying that's good or bad, but the way California Building Codes are going is the first standard is supposed to be what we're going to be adopting theoretically in the next revision, and if that happens to be Reach 1, I

don't know because I don't quite get what's going to come out of Reach 1 yet, and it definitely would not be Reach 2 because Reach 2 is way out there, it's a zero energy concept. So, just so you know, there are a lot of agencies that are kind of thinking about what Tier 1, Tier 2 mean, I appreciate they're called "Reach 1 and Reach 2," but I know eventually these are going to be blended, at least I think that's the intent, to have these actually adopted by State agencies, so just be interesting to let other agencies have input into this process, too.

MR. PENNINGTON: So, my question, is it your view that having sort of long term notice like this for upcoming changes for code is attractive to building industry, for one, and also is a presentation that effectively communicates to the people that you're trying to train and that you're getting an appreciation from it?

MR. HODGSON: Well, I think the idea of having a look forward of a Code is very valuable to the building industry primarily from the manufacturing standpoint and the implementation standpoint. As an example, we have in our 2008 Standards a charge indicator device that doesn't exist, but we get credit for it, and we have Title 24 consultants up and down the State who take credit for it, and it doesn't exist, but the Building official doesn't know that, it's check the box and so what? It's an enforcement issue. If

we try not to adopt things that don't exist in our code, which I would recommend, then we could have a three-year, six-year timeline to try to bring those products that look very useful into the market and try to implement them, and try to build them, and try to manufacture them, and try to distribute them, and figure out what they cost. I mean, we shouldn't do things that we've already done, so I thought the Tier 1 and the Tier 2 process adds great value to the Code development process because it's a practice area and it's a heads up – this is what we think is valuable in the future. Now, it doesn't mean Tier 1 becomes Code, it just means that we look at those things when we get to the next Code cycle.

MR. PRICE: I, before just really quick, in thinking about that, I talked about AB 32 a lot and one of the policy goals for 2020 is the Zero Net Energy concept, and so I think this isn't completely divorced from the idea of putting things out there that will then march towards the Code, right? Although it's not obviously proposed as being prime time in all buildings, and everything that was envisioned in the policy, it is a test ground for what it would take to do these buildings before 2020.

MR. SUYEYASU: So, at least on the residential side, it aligns perfectly with 2020 in terms of being two additional code cycles past 2014.

MR. SHIRAKH: So, Mike, if I may ask a question, you are having this horizon three years and the six years, it would seem to argue that we should have a package or proscriptive requirement for Reach 1. Presumably that Package "R" will become Package D in 2016. That's basically what you –

MR. HODGSON: Well, it could be a package or it could be a percentage.

MR. SHIRAKH: Yes.

MR. HODGSON: I mean, if you have a package, you're going to tell them 15 things to do, right?

MR. SHIRAKH: Right.

MR. HODGSON: If you have a percentage, then you're going to let the market say, "Here's what I can do to get the 15 percent over code," there's more flexibility. I'm not saying one way is better than the other, I don't know.

MR. WILCOX: There's no more flexibility.

MR. HODGSON: There's no more flexibility, okay.

MR. WILCOX: If you get to meet the Tier 1 using the performance method, you know, it's just not 15 percent, it might be 14 percent, or 17 percent, that's all. The flexibility is the same.

MR. RAYMER: In answer to Bill's question to Mike, yes, there is benefit, particularly with Tier 1. For the

building industry and the building officials, but mostly the industry, to know where, in 2017, where they need to be for minimum compliance, we've seen this happen for the last two updates where there was a good idea of where the CEC was heading, i.e., a 15 percent update or a 15 percent increase, this last time was around 20 percent, but at least we had a good ballpark understanding and a transition, and this is the important part. The transition was made somewhat easy because we could sort of pre-suppose what the CEC was going to be, and you had a number of projects where the builder went ahead and had his architects design to that 15 percent increase, and they implemented the standards in some cases early because the start of the project – you don't want to change your brochures and everything half way through. So, there's benefit to knowing a long term plan and that's keyley [sic] important with Tier 1.

MR. PRICE: Any other comments on the Reach. I know we're a little bit behind on our agenda.

MR. STONE: Yeah, I'll be really quick. Maybe I'm mathematically challenged, but it seems to me that, if we're going to get to Net Zero in 2020, then the logical progression is, in this next Code, we reduce by 33 and a third percent, and then in the next Code we reduce by 50 percent, and the next Code we reduce by 100 percent. I mean, how else do you get there? You know, how many times

can you multiply 15 percent times something before you get to zero?

MR. SHIRAKH: Net Zero presumes there's going to be renewables on-site, so it's not all from efficiencies.

MR. STONE: Okay, then let me bring it back again to high-rise residential. You know, where are you going to put the solar on high-rise residential? You got equipment up there? You've got a whole lot less roof space per square foot, so, I mean, that would argue the opposite of what I was saying earlier that, for high-rise residential, we ought to push twice as hard on the Code.

MR. PRICE: But, so, Nehemiah, that's one of the reasons why we're proposing Zero Net Energy ready, so we're not actually saying that the high-rise has to generate, maybe it's unfeasible where they're at, urban area, who knows, it's all the efficiency up to the point where that would be the next option.

MR. STONE: That's what I was afraid of, so we're going to redefine the word "zero." And net zero doesn't actually mean net zero?

MS. CHAPPELL: This isn't the first time that that's been –

MR. STONE: I know that.

MR. SHIRAKH: This issue of what is net zero, where the renewable source is going to come, if it's going

to be site built, I mean, those are all things to be determined.

MR. STONE: Because it gets real hard to explain to people who are developing that we're going to get to net zero in 2020 and, oh, by the way, here's the definition of "zero," and it's not what you thought it was.

MR. SHIRAKH: Okay, any other comments on Reach TDV? Okay, we're going to move to the next topic, which is the Weather Files. Mr. Huang, you're on.

MR. HUANG: Okay, first, I'd like to thank Pat and the Commission for rescheduling my presentation from earlier this morning because I had an emergency to fight with the Passport Office in San Francisco, and the good news is that everything worked out, so now it looks like I will be able to go to China on Friday.

What I was asked to do was to give a report on a project that I'm doing right now, it's a PIER project, it's to update the Energy Commission's Weather Files for use in building Energy Standards. So, the scope of the project, in the beginning I was told that, well, everything is on the table; but, very quickly it became a can of worms, and are we going to redefine the boundaries, are we going to have – how many climate zones, etc. So, we decided pretty early that this is not an attempt to evaluate or revise the current CTZ boundaries, this is really – the focus is on

just developing a more current set of reference weather files, taking advantage of – and I have to emphasize that, there is a great increase of availability of weather and solar data within the past five years that will give us the potential to do a lot better than what we've done before. And what I was doing was – it's really a two-step process, a procedure to first develop and archive as many historical weather files as possible for California locations, and so what you have is like an archive of all these actual year historical weather files for as many locations as we could find. And then, once we had these what I call "historical weather files," or "real weather files," then it's just a statistical effort to come up with a typical year weather files. And so, we ended up with 88 locations with typical year weather files, and then we also created from that, or we selected from that, 16 of them as the certified weather files for use in updating the Title 24 Energy Standards. So, we didn't want to over-burden our consultants to run a huge mass of weather files.

The work that is yet to be done, and this is what I need to emphasize, that this is really PIER research – P-I-E-R, not P-U-R-E, this is PIER research, and it's not meant to impact the current 2013 Energy Standard effort, so consultants don't have to be worried unnecessarily, but the work, especially the last part, that work is going to

explore the potentials that we could have, you know, what we can do with the weather files, but it's really up to the Commission whether they want to do that, and one of the things is that – and I'll get into this later – we really have the capability now of creating weather files that basically would be at a 10 kilometer grid for the entire state, and so this would cover all the microclimate variations, that we have that capability, you know, whether it's a wise thing to do, or whether it's going to be an administrative morass, as some people have mentioned, you know, that waits to be seen. But we do have that capability. The other thing that I've been asked to do is to develop future year weather files, which means take the current weather files, which is really the weather for the past 12 years or so, and then, using global climate change models, and predict regional trends and global climate changes, come out with weather files for the future, like 2030, 2080. I've already done that on a previous PIER project, so the procedure is pretty clear to me, and this is really, of course, hypothetical, and so that's really for the analysis side of the Commission. Even myself, I don't suggest that we use these future year weather files to set the standards, so nobody needs to get too worried about that.

Okay, so just to back up a little bit, what's the existing weather files that we've been using, it's hard to imagine, but for the past 30 years? So this is quick review. They were done by the late Loren Crow, who happens to be a personal friend of mine for totally unrelated reasons, he did this in the early '80s, defined 16 California Thermal Zones, CTZs, and then he developed for each CTZ a reference weather file using raw data for the 30 years previous to that. So, you could just keep this in mind, that the existing CTZ weather file used weather data that is from 1950 to 1980, that's a little bit shocking when you think about it. And then, of course, the 16 climate zones are boundaries, and they were originally defined in the early '80s, and then they've gone through lots of revisions, but overall, I mean, my own feeling is that the definition of the 16 climate zones has proven workable. I mean, all the revisions, you know, people fight over whether it's on this side of the street, or that side of the street, these are little tweaks. Another change that was made to the existing weather files is that, in 1990, they were modified because there was a real limitation in the amount of weather data so that the location that got picked may not be the mean weather of any region, and an effort was made in 1990 to adjust these weather files to better represent the mean within each CTZ. I have a lot of concerns about that,

but that was done, and those were the files that we're not using.

On the right, I just show you, this is the first CTZ boundary map done by Loren Crow in the very beginning, and it's almost naïve, you know, there are these straight lines along latitudes and longitudes, but then this quickly got changed to something that is more realistic, and you'll notice that this is 1983, and this is what we're using now, and you have to look at it very carefully to see where the differences are. So, you know, I give Loren a lot of credit, I think what he has done has stood the test of time. There are problems or limitations because the data when it was done, data availability, but I think he did a pretty good job. So, having given Loren his due credit, what are the limitations? Well, the first glaring one is that the average age is 45-years-old, and if you take the average between 1950 and 1980, go from there to now, so the average weather we're using is 45-years-old, and the climate may have changed. Everybody has heard about global climate change, but I'm also concerned about human effects that are irreversible, like urbanization, like the weather file for Riverside at the time it was made, it was probably not very settled and now, you know, it's all urban. So, what effect does that have? The selection of the referenced locations, highly limited by data availability. In those days, in the

early ‘80s, Loren was still working with open real tapes, and then many of the CTZs really just had one location from which he could choose. Solar data on some of the files are questionable. I know Bruce has noticed that, that they have – some of them differ significantly from average values from weather sources such as National Solar Radiation Database, also heard horror stories that they were taken from one site and from a different period of time, and just mapped on to the weather data that was there. And then the last limitation – and this is really no fault of Loren’s, but it is because of increased usage of the CTZ files, and maybe Snuller talked about that earlier this morning, but I wasn’t here – the weather files are not synchronized. In other words, a file for one location uses a different period of time, different months, historical months, then the neighboring one, so there’s no way to correlate these, there’s no way to interpolate, and when you add on the TDVs which are very time dependent, it gets to be a mess. So project status right now, this is very current. I created historical weather files for the last 12 years, 1997 to 2008. Incidentally, what I consider an advance that we’ve made is that we’ve gone away from the fixation of more data is better because, if you look at the TMYs, we’ve always used 30 years, and yet I’ve seen studies that say that, if you do seven years, you’re probably doing pretty well in

capturing what they call the “synoptic variations.” And if you go longer than seven years, you’re just picking up more long term trends. So, we’ve all decided, the Commission and myself, to just stick with the last 12 years. And so I’ve created historical weather files for 88 locations from NCDC, that’s National Climatic Data Center, Asheville, North Carolina, and they’ve provided this database, fantastic, it’s called Integrative Service Hourly Database, I’ll mention that a little bit later on. I’ve gone through the ISH basically and pulled out all the locations that had enough data to produce historical weather files for the last 12 years, and I ended up with 88 California locations. Then, the second part, I’m also very enthusiastic about, solar data is always a big problem, you know, solar data is like justice, you know, if you look closely enough, there is never any real solar data, it’s all model data. I mean, even if you look at TMY, it’s all model data because nobody puts out a Pyranometer and lets it run for 30 years. And the second point is, Richard Perez at State University of New York has been working for years on getting solar estimates from satellite observation, so he’s developed an algorithm that looks at a satellite observation of cloud cover, then he does a lot of fancy correlations, and he’s able to create solar estimates for any place in the U.S. on a 10 kilometer grid starting from 1998 until now. And of

that, from 1998 to 2005, NREL has purchased that from Richard, and then has made that publicly available, and so, for California, we've obtained that data from '98 to 2005 for California, it's on a six-mile grid, and then we have incorporated that, we've just put that into the weather files in place of the model results that I have been generating. And then, after you have all these weather files, '88 locations, 12 years, or actually it's eight years because of the solar limitation, then you do a search of the typical months, so a typical year is just 12 typical months strung together. And the wrinkle here is, the Commission and I have discussed the problem with files not being synchronized, and we decided that, well, let's just do statewide typical months; in other words, we pick a month to represent – we pick a year and a month, like let's say March of 2000, that will be used to represent March for the entire state. We're not going to do that city by city, so that way you can interpolate between two locations, TDVs will not have any of this time problem, and we've done that, and I have a few slides here, I'll skip through that if people find that too boring. But we've selected these statewide typical months and then we create a typical year of weather files, which are really the same as the CTC weather files we now use, but now we have 88 of them. And then, and this has happened a couple months ago, the Commission and I and Bruce

Wilcox, we went through all 88 and we selected the reference locations for the 16 Climate Zones, and I looked at some fancy algorithm to do the selection with population weight and all this, but in the end, you know, you still only have like three to five locations to choose from and, in the end, the choice always requires a human element. And the remaining task is that I've also just very recently also obtained from Richard Perez, the satellite derived solar for the last three years, and so I've got that data, and now I'm going to put that into the pool so that we now have 11 years of weather files, and then I haven't done this yet, but then I will create modified weather files that would represent typical data from the 11 years. Then, the second point is really serendipitous, I never asked for it, but when I was getting the solar data for the last three years, the person who was providing it to me said, "Oh, do you want the temperature and wind?" I said, "Yeah, why not?" So, when I got it, what I found out was that this is METAR data, and METAR data is not really measure data, it's the stuff that you hear when you have the TV Broadcast, you know, the temperature for Moraga will be such and such tomorrow? That is all METAR data, it's model data pushing forward from current conditions, but now I have METAR data for temperature and wind speed on the same 10 kilometer grid for all 11 years for the entire State of California. So, the

task there is to see if I can merge that data with the human observations of the 88 locations, and then, if that is successful, I'll be able to create weather files for any location on this six-mile grid for the entire state for 11 years. But that's a future research effort.

Then, the last thing I've already mentioned, develop future year weather files. Okay, I'll go through this very quickly. The ISH database NCDC has decided that their main service to the country and to the world is to provide all of the data that they've been archiving with the World Meteorlogic Organization, so they've taken this huge huge database, the ISH, which is like 12,000 weather stations around the world, report their data for the last almost 30 years to the NCDC, and instead of keeping it on a computer in Asheville, they have put it on the Web, and so that is the data I'm using to create these 88 weather files. The solar data, I've already mentioned this, this is a technique developed by Richard Perez. This is a map that he's provided to the Commission for California, these are long term averages. He also has hourly records on this 10 kilometer grid, and I've already sort of gone through that, so I won't mention that anymore, but we now have 11 years of that data for a 10-kilometer grid for the entire state.

Okay, so, where are we? This is a map, the standard CTZ map, very colorful. And if you count them,

there are 88 dots, and those are the stations that I've created typical year weather files, as well as the 12 years of historical files. And these are the 88 locations. You notice that, within each climate zone, now we have a choice. We have at least three stations in some climate zones, like 16, which really isn't a climate zone, this is everything left over. We have like a maximum of eight stations and then the colors represent which ones are to standard –- what I call CZ2010 locations -- the red are the ones where it's a reference location also was an old CZRV2 location, and the orange is a new reference location, and the blue is the old location that is no longer used. I have better maps later on.

Just a little bit on selecting typical months. This is really the TNY method developed by National Renewable Energy Laboratory, you know, it makes a lot of sense to me. What you try to do is capture the long term cumulative distribution of the weather, so you have a bold line there on this plot, the bold line is the 30-year average, the temperature distribution for a location. And then, the thinner lines are each year. And what you try to do is define the year where the difference between the thin line and the bold line is the smallest, so one thing that always annoys me is when people say, "Oh, a typical year is a very bland year," it's not a very bland year, it's really

the most typical. You have average amounts of variation. So, I think this method works quite well and I notice that recent efforts to do typical year weather files all use this method. And you learn a new word, the Fingleston-Schaffer statistic, that is just a measure of how big the difference is between the thin lines and the thick lines. I'll skip through this. This is – and then what I did was, I looked at the FS statistic for all 88 locations and then summed them together, weighed them by the population because you don't want to get a typical year that is really good for the mountains and then kind of bad for the places where the houses are built, so I put in the population weight, and then I add it altogether, and then it's very simple, you pick the year that has the smallest photo weight FS value. This is March for the entire state, I've only showed the first few stations, you notice, with the little asterisks, the year that was picked was the year 2000. And you also notice if you scan down there, that the year 2000 happens to be the best year, or the most representative year for a lot of stations. However, I do want to point out that there is a complication or a flaw in this method. Take a look at Arcata. Arcata for the year 2000, it's actually not very good, 2001 would be better for Arcata, but now we're stuck with using 2000. And I'll show another plot later on that shows you some of the problems. Okay, so we go through all

of this, a lot of statistics, and then this is what we ended up with, so these are the certified Energy Commission typical months pulled from these eight years. This may change when I add in the three newer years. You may not change, who knows? So, January is 2004, February is 2003, etc. for the entire state. So, one advantage of this is, let's say you want to have a weather file for your location, like Pittsburgh, let's say, well, you're able to find data for Pittsburgh and you have these time periods, you put them altogether and you have a TMY, and of course, with the METAR data that I have, I may be able to do that on the 10 kilometer grid, so you will see one of the advantages of having everything synchronized. What you have is a map for the entire state that you could then pull out what you need.

Okay, these are just some plots showing – this is Sacramento, the thick line is what I came up with for the 12 months for degree days, heating and cooling degree days, radiation, wind speed, and then the little lines are the individual historical records. And this is mainly to convince ourselves that the algorithm works, that we're picking the average. So this is Sacramento, this is Oakland, you know, these Oakland cooling degree days aren't very much, so there is a lot of variation, but we seem to be doing decent job in coming out with an average. Okay, now, focusing in on these maps, I've cut it into two. You notice

this is Northern California, the big change relatively, for Climate Zone 16, we're no longer using Mt. Shasta, we're using Blue Canyon. I wonder how many people have heard of Blue Canyon. But it turns out that Blue Canyon represents the statistical weather and climate zone, 16 better than the other seven stations, and so we moved Blue Canyon instead of Mt. Shasta. And then, at the bottom, Climate Zone 4, well, we have been using Moffat, Mountain View, that station is actually defunct now, so we've moved it now to the San Jose Reid Airport, and everybody feels better about that. Okay, Southern California – you notice that, actually, there's been a good number of changes. You know, first we thought, well, we may end up with the same locations because population weighing by itself would force you to the bigger airports, but Climate Zone 14, we had China Lake, I don't know how many people live in China Lake, but now we're using Palmdale. Climate Zone 16, instead of El Centro, we now use Palm Springs. I think most people would say that's much closer to where people live and it's probably more representative. Climate Zone 8, instead of El Torro, which is another defunct station, we're using Fullerton. And Climate Zone 6, we're using Torrance in place of Long Beach. So, here is the list of – on the right are the existing locations, on the left are the new ones that we're proposing. Oh, I forgot to mention Climate Zone 9, instead

of Pasadena – actually, nobody is very sure what Climate Zone 9 – where the file is because there's no airport at Pasadena. But anyway, Climate Zone 9, we're now going to Burbank, Glendale. So, these are the proposed list of reference locations. You know, if you just want to use 16 for your Building Standards analysis, although keeping in mind that these are just 16 out of the 88. This is some comparisons between the old ones and the new ones, just for the 16, and the diagonal, if it's on the 45 degree diagonal, it means exactly the same. If it's on the left, then that's 20 percent more for the new files. On the right, the dollar line is 20 percent more for the old files. And this is a little bit surprising to me. I had assumed that we would have weather files a little bit warmer; as you see here, on heating degree days, actually a lot of the locations had more heating degree days on the new files than the old locations, in particular, Climate Zone 1, which is Arcata, has 20 percent more heating degree days than before. It's also somewhat surprising that the places where we switched locations, there was actually no big change in the degree days and the locations where we did not switch, like Climate Zone 5 is Santa Maria, still Santa Maria, actually had a big change. Cooling degree days, you will notice that it will tend to be a little bit warmer, although not very drastic, going to cooling degree hours, 75 is a better measure of

sensible load, not that big of a change. You shouldn't pay too much attention on just the outliers. But it is interesting. Climate Zone 11 for some reason has a significantly more cooling degree hours than before. Average wind speed just shows that it's sort of a random scatter, no real bias, no real change. And solar, for all the hoopla about the solar, the average totals don't change very much. You see that it's pretty random, no bias, and keeping in mind that these two are not plotted starting from zero, so you're looking at just the smaller section from 1000 to 2000 Btu's per square foot or whatever. There is actually no bias observable between the new files and the old files.

Okay, then, the last thing we did was compare the files to TMY3's, these are the latest set of TMY files developed by NREL. They have actually got 48 of these 88 locations that I did, and if you compare them, and I put up Arcata to point out that you notice that the red line is what I produced, and you see that Arcata, March, looks someone anomalous, that March actually had the most heating degree days of all the months. That doesn't show up on the TMY3's, it could be, you know, I think that's just because we're using statewide typical months. But the solar, you'll notice, is very close. Wind speed is also very close, and cooling you can ignore because look at the scale, I mean,

this is Arcata, there is no cooling. Actually, we looked more intensely on the solar radiation predictions. Now, this is really not a fair comparison between – because TMY3's also use the same method, they also use Perez's model to derive their solar. So, what you're looking at here is really whether the months I picked are typical vs. the months that the TMY3 picked, and I'm gratified to see that, in cases where there are little spikes and jumps, it's actually the TMY3. Like, you look at Marysville TMY3, it has a jump in May, and mine don't. But most of them, I was struck at how close they are, like look at the first two, Alturas and Bakersfield, we predicted almost exactly the same. And once again, that's no surprise because we're using the same technique. So, the current status, there are 88 files created with eight years of data, completed in June. It's been provided to the Commission staff and consultants and people have been using them. I've heard some glitches that were found, not in the TMY2 version, but in the DOE-2 version, that has been fixed. I'm not sure if I'm – I don't know, I'll leave it to the Commission on how they want to disseminate these, but I have made them available to the Commission staff and consultants. The weather files are available in several formats, the sort of official version is TMY2 format, there is also what I call a FIN4 file, which is a text readable file that I like, then

there is also TMY3CSV file, DOE-2 bin file, and Energy Plus EPW file, so you could use any of these, they are all equivalent. And then, the subset that I just mentioned for the 16 climate zones, and then the ongoing work, I've already mentioned this, I've got more solar data, and I'd like to merge those in there. I've also got this METAR data that I'm very curious to start working with, see if I could come out with, you know, micro-climate weather files, and then the future year weather files, I haven't started on yet, but I did a previous project on that and so I have the methodology all in hand. And that's it. That's my compact information, and I'm happy to answer any questions about this project, and you could also e-mail me if you have some questions I can't answer here. Nehemiah.

MR. STONE: Nehemiah Stone, Benningfield Group. I'm glad to see that you're redoing them, it's about time, I'm glad to see that you're using a 12-year scale. Unfortunately, I think that is where my happiness with it ends. First off, some of your data about where the current files are from is wrong, they are not the files from 1950 to 1980, the ones that were current. When they were redone in 1990, it wasn't just modified; what we did is we looked at every station that was valid, we went out and visited stations to find out if they ought to be considered valid, picked five years out of the previous 15 years, actually

going – not the nearest five years, but five years out of the 15 years before that, so the oldest of that data would have been 1970, and it would have been 1970 to ’75, that’s what the oldest files were that would have been used. The reason I bring up the fact that we went out to sites and looked at them is because the primary reason that I ended up working at the Energy Commission was because the Arcata site is wrong for that zone, it’s just flat wrong. It’s not in Arcata, it’s the McKinleyville Airport. The McKinleyville Airport was built in World War II because the Army Air Corps needed to find a place where they could test out their flying blind planes, and so they picked the foggiest place in the nation, windswept, etc., to build the airport. It doesn’t represent Climate Zone 1 at all. What we did in that period was to – even though it says there is a referent city, there is no referent city, it was all of the valid stations were melded into a typical file. I guess I would encourage you to a) go away from feeling like you need to pick a city because that’s where a lot of the problems came up before, and I can see the same sort of problems, you know, creeping back in and, secondly, statewide average, I understand the advantage of doing that, you know, picking “this is the best month statewide,” but picking something that is right on average for the state means it’s going to be wrong definitively, and I’m not going to bore you all,

most of you heard my joke about “on average,” so I don’t do that one again. But it’s going to be wrong for a lot of the individual climate zones, and you know, Climate Zone 1 there jumps right out at me, going back to McKinleyville, picking a month that is almost 50 percent off the norm because, well, that’s kind of the month that looks best for the rest of the state, it’s just the wrong thing to do. So, I don’t know when you’re planning – if you’re planning on pulling these files into the ACM, but I would recommend that Jim Augustyne, who ran that project, Chip Barnaby, who was on it, you were on it, I think, too, weren’t you, Bruce? No? Well, anyway –

MR. HUANG: Yeah, could I respond to that?

MR. STONE: -- I would suggest that you have them all take a look at the methodology because, I mean, you’re going back to some things that we’d fixed before, and one last thing, Joe –

MR. HUANG: Okay.

MR. STONE: There are Pyranometers around the state. Jim Augustyne runs a fleet of them and collects data on them, so there is solid solar data from sites in the state, probably not for every climate zone, but you don’t have to use a model to come up with, “Well, here’s what the solar ought to be.”

MR. HUANG: Well, you've mentioned a lot of things, so I don't know if there is enough time to address all of it. I'm very familiar with the work by Barnaby and Augustyne, and I don't really agree with you, I don't think they've actually created the hourly files from the aggregate of the stations. They took the aggregate of the stations, came up with a mean for the climate zone, then they stretched the hourly files that were already there. But, you know, I mean, I'm extremely familiar with that project. I actually don't like the idea of creating an artificial year because then you don't know whether you're right or wrong, like the stretched years, I never use them because I found that, in Climate Zone 4, after it got stretched, you had a wet bulb that was higher than the design wet bulb for the Bay Area. So, and also, you know, when you look at these CZRV2 files, you don't know what you're looking at. I mean, I can't evaluate it, it's just right or wrong, I can't tell. So, I have a difference of opinion about that. The other thing is, I like Richard Perez's work because it's not a model, I mean, it is a model, but it's a model that uses observed cloud data, and then many other climate factors to come up with the solar. And I am aware, there are measured solar, but it's not uniform, you know, it's different places, different instrument, different groups maintain them. One thing I want to do is have a researcher compare

Richard's data with available data in California. There are probably a bunch of other things, but I don't think there's time to go into that. Thanks.

MR. SHIRAKH: Any other comments on the weather data. Just one comment, though, and I'm actually very familiar with Humboldt County, and it seems like Arcata is fairly representative of the coastal communities up there. You know, if you're talking about Eureka and –

MR. STONE: Mazi, Arcata is, but the Arcata weather station is not in Arcata, it's at the McKinleyville Airport, which is fogged in and, on the top of that cliff, it's in the wind all the time, so it's not representative, it's called Arcata, so you think, well, geez, Arcata is pretty typical, but it's non-Arcata weather, and because of that was used before, the proscriptive requirements in the Climate Zone 1 were way out of line with the cost-effectiveness compared to the other climate zones at the time.

MR. HUANG: But do you think it's too mild or too severe?

MR. STONE: The McKinleyville Airport is too cold to be representative of Climate Zone 1. It's too windy, it's too foggy, it is not typical Climate Zone 1.

MR. HUANG: Yeah –

MR. STONE: If you have data from Eureka, I'm not sure why you wouldn't use Eureka because –

MR. HUANG: Yeah, we have Eureka.

MR. STONE: -- I mean, that's almost half the population of the County and it is pretty typical.

MR. HUANG: Okay, thank you.

MR. SHIRAKH: Sir.

MR. CUMALI: My name is Zulfikar Cumali, I'm an energy consultant. I'm trying to figure out why is it difficult to make synthetic data, and the reason for that is, all you have is some input and something that takes it and then transforms it into energy, that is really what you're going – you're not trying to replicate the data, you're trying to find out that it creates an equivalent amount of energy, depending on how you pick it, so you can slice it and do it all kinds of ways, and I've done this maybe about – quite some years ago using fast four-year transforms, and you can maintain all the statistical qualities, as well as the wet bulb doesn't exceed the dry bulb, all that kind of constraints, and you can do these and you can come up with almost identical end results, and it's much simpler because you're never going to be able to go into an area, find out there is going to be some excuse it's not quite the same as something else, so you've got to fix something. So, what you can do is use methodology of that

type, and then come up with fairly usable information because your end result is not to predict the weather, but actually get something that is a base that can predict energy. What's your –

MR. HUANG: What is my feeling? Well, I mean, it sounds like you're supporting something like Meteonorm, which the Swiss have done, and is promoting it and it gives you weather anywhere in the world if you type in latitude and longitude. My question is, the only way you could tell how good it is are if you get some real data to compare it to, you know? So –

MR. CUMALI: Well, obviously. I mean, you can do it with 10 years of weather data, or 20 years of data, which one are you going to use?

MR. HUANG: I would use the real data.

MR. CUMALI: All 20 years of it?

MR. HUANG: No, no, that's why we're coming out with the typical year. I mean, but, you know, it's tricky.

MR. CUMALI: I mean, it's the same idea because you're making a transformation.

MR. HUANG: Sure.

MR. CUMALI: And it's the transformation that determines which one is typical.

MR. HUANG: Yeah, but I mean, you know, the yardstick that you use has to be the real data, so we're

just stopping at that point. Yes, we could go one step further and do a four-year transformation and call with this mathematical weather, but then we've already got the data – I don't know the advantage of that.

MR. CUMALI: You only need a few dozen constants and then you create the whole thing. No.

MR. HUANG: You'll create something, but it won't match the real records.

MR. SHIRAKH: When you start talking about the four-year transformation, you've lost me. Any other comments on the weather files. Thank you, Joe.

MR. HUANG: Thank you.

MR. SHIRAKH: So last, but not least, Mr. Wilcox and his improved Residential Compliance Software and he's going to have some sample runs for us.

MR. WILCOX: Thank you, Mazi. So, this is kind of a status update on where we are on our new Residential Standards Research Tool and New Calculation Engine, and just so that things would be interesting and Mike would stay for this part of the talk, a little preview on how things are actually kind of looking for when we exercise all the parts of this complicated system we've just been talking about today. Okay, so what I'm going to talk about is the new California simulation engine, although I'm not going to go into details on that because I've talked about the details

of that before, and it will definitely put you to sleep at this time of the day. I'm going to describe this 2013 Standards Research program that we're finishing up, and then I'm going to preview some results using the combination of the new weather files, the new TDV files, and the New Research program, and show how things are sort of trending. Of course, none of the results are definitive at this point because the simulation program isn't completely finished and debugged and so forth, so just keep that in mind.

So the CEC public domain simulation engine was a project that's been supported by investor-owned utilities and the Energy Commission, it's a major revision of the models that have been used up until this point, including the 2008 standards, CALRES model, and the goals were to improve the treatment of solar gains to get a better, more accurate picture of cooling energy, particularly on peak, to deal with building shale and interior mass effects, as related particularly to cooling and ventilation, and to also deal with ventilation and its impact on cooling loads, so that we could differentiate between the benefits of openable windows and advance mechanical ventilation systems, and so forth. We've also been forced to stretch and add new capabilities for comfort analysis, mechanical ventilation and evaporative cooling to the capabilities in the current program. So there's a lot going on there.

So, the program that we're actually going to be delivering is what I've been calling the 2013 Standards Research Tool, and this is a computer model that's developed specifically for use in developing the 2013 Standards. It's the same approach we've used in the previous two cycles of the Standards where we make a custom program and it is based on the current – in this case, the 2008 – Standards modeling rules and so forth, and then we build in the capabilities for handling new algorithms and so forth that can be used in the next version of the Standards. And it's used by stakeholders, by the Case Project Authors, by the CEC and the consultants, and so forth to do the Life Cycle Cost Analysis that we've been talking about earlier today for residential. So it has built in the TDV factors and the weather files, and all the stuff to do the Life Cycle Cost Analysis for the measures. This particular version has got this new calculation engine, it has got the attic model that we developed for the 2008 Standards, and then we hang this -- for pragmatic reasons, we're embedding this in the current Micropass CALRES user interface as a way of making it available to people to use right away. We didn't have the time or budget to develop a new user interface and particularly some of the more sophisticated stakeholders that are already well versed in using this software tool, so this is a good approach, we think, for the short term. And

part of that is the new weather files new lifecycle cost using the new TDV values, and that's all in place now.

So, the primary thing I wanted to show you today is kind of as a way of seeing where we're at with the economic analysis structure that we've been talking about, is looking at the changes in the sort of likely outcome for interesting representative measures and buildings, and comparing the 2013 analysis approach with 2008 analysis approach to see how things have changed. That includes the change due to the weather that Joe just talked about, and to the TDV values that Snuller and Amber talked about earlier, and also to the preliminary version of this new engine, which is a completely different calculation of the base loads in the residential building. And my approach here was to take a prototype that happens to be the 2700-square-foot CEC official prototype that is documented in the ACM Manual, start with the 2008 Proscriptive Package D, and the 2008 ACM Rules that determine things like thermostat set points and all of those things, the assumptions in the building. And then, just compare the calculation results for heating, cooling, and domestic hot water for the base case package D version of this building in the 16 climate zones, and then it went on to compare measure savings for some example measures, increasing the air-conditioner EER, the air-conditioner efficiency, increasing the furnace efficiency,

increasing the water heater efficiency, how does this look in terms of it essentially whether things are going to be more or less cost-effective than they were the last time we did this exercise.

I also looked at the insulation quality, Pat, I just wanted to mention that while I'm here, adding roof deck insulation is one of my favorite approaches to the world, and that's in here, too. Infiltration reduction is also of some interest and kind of trades off a whole bunch of things going on with weather and the model calculations, and so forth. So that's what I'm going to show and there are a lot of – there are a lot of red and white bar graphs. So this is a picture of the 2700-square-foot prototype house, just to give you an example, it's pretty straightforward, very simple, two-story, single-family house. So, here is the prototype approach, the lights are a lot brighter on this screen than on that screen, so sorry. So, this is the standard approach that I'm making for the presentations here, we have the 16 climate zones across the bottom, 1 through 16, and then up the side here, we have a measure of energy or life cycle cost, or whatever, in this case it is a measure – it is source energy KBT per square foot, and then, for each climate zone, I have two calculation results. And in this case, what I'm comparing is the 2008 weather data to the 2013 weather data, so the white bars are the 2008

current building standards official weather files, and the red bars are the 2013 official weather files, so this is looking at what Joe just presented, how much, you know, how much has changed when you change the weather files, and the reason is this source energy over here, being kind of an archaic term, the reason it is a source energy is that, since the TDV factors are intimately connected with the weather files, there is no way to separate the TDV factors and look at TDV for -- and look at the weather for the two different sets in TDV versions because they don't really compare. So, this is a source energy version. And my assessment of this is that, yeah, there's some changes, but by and large, the difference is not enormous. The ones that Joe pointed out, Climate Zone 11, you know, the energy consumption went up, Climate Zone 15 went up, 15 is probably because we changed the weather site to Palmdale. Climate Zone 1 is because we did the wrong thing, just as Nehemiah said, and Climate Zone 5, something happened in the climate, the change, because that's the same location, and so forth. Climate Zone 9, it's a different location now, same with Climate Zone 6, and so forth. But, by and large, I don't think this is, you know, not shocking. Mike?

MR. HODGSON: So when you say source, is the source TDV or not TDV?

MR. WILCOX: Not TDV.

MR. HODGSON: Just straight source?

MR. WILCOX: This is just straight loads, basically. But it's some of cooling and heating, right? So, in order to get that, the source is one set of units that do that. Okay, so the next plot, same format, and this is a comparison of the new residential model and the current residential model. And again, it's source energy because, in the context I was working with here, that keeps the thing consistent so this is the 2008 CALRES with 2013 weather and it's the 2013 CSE with 2013 weather, so it's the same weather for both sets, and the difference here is strictly the calculation engine. And so, actually, the loads go down in most climate zones, they go down quite a bit in the cooling dominated climate zones, and I think that's something that those of us working on the project expected to happen because we're doing what we think is a more sophisticated job of calculating the cooling loads than the old model did. Joe.

MR. HUANG: Do you have any explanation why 15 –

MR. SHIRAKH: May I ask you, I can see the anguish in his face when people start yelling from the audience.

MR. HUANG: Yeah, this is Joe Huang. Do you have any explanation, Bruce, for why, from going from 15 to 16, it went up before, and now it goes down?

MR. WILCOX: Yeah, that has to do with the bottle. I'll show you the separate heating and cooling in a minute here, it'll help point that out, I think. So, if you combine the TDV and weather together, this is the same – this is the new calculation engine with the old weather and TDV vs. the new weather and TDV, and this is where Snuller's description of the changes in the TDV in residential really comes out, that in spite that the models predict lower loads in the new model, and so forth, there is a big difference here, and I think it's almost entirely due to the new TDV values for residential that we're getting substantially bigger values. And then, if you put it altogether and you compare the old CALRES calculation engine for the 2008 weather and the 2008 TDV with the new calculation engine and new weather and new TDV, again, in general, everything goes up. And it particularly goes up in places where we change the climate zones to Climate Zone 15 moving to Palm Springs because Palm Springs is a hotter place, and I think that is right, and Climate Zone 11, for some reason Red Bluff got a lot hotter. Red Bluff is now the second hottest climate zone in the State, or the third hottest, I guess, behind Fresno and Palm Springs. If anybody has questions, please interrupt as we go along, but we're going to see the same things in different ways. So, if you look at the breakdown in the calculation one step further and look at the

components, this is cooling calculations. The previous one was total of heating, cooling, and domestic hot water, and everything combined together. But if we look at cooling, which, as we all know, is one of the big drivers of electric demand in California and one of the more important parts of the TDV valuation approach and everything, so this is the impact of the new weather files only, again, it's the new calculation engine, and the only difference is the weather and this is, again, we're back to source energy, so we don't have TDV as part of this, this is just the weather. And Climate Zone 15, the weathers change quite a bit, John, I think that's part of what's going on, and also in Climate Zone 11, the weather changed quite a bit. And Climate Zone 6, but the cooling is so small, you can't see it on here. So that's the impact of new weather. Here is the impact of the new calculation engine and, as I said, by and large, the cooling in the hotter, sunnier places is substantially lower with the new engine, and I think, you know, it's our opinion that that is a result of doing a better job of calculating the actual cooling loads on the building. And Climate Zone 15 is – I'm not sure exactly what's going on there that keeps it as close as it is, but that's the way it came out. Go ahead.

MR. CUMALI: Do you get the same results –

MR. SHIRAKH: Can you come up, sir, please?

MR. WILCOX: I can't get the same results doing the same run twice, let alone whatever your question was!

MR. CUMALI: This is Zulfikar Cumali. I wondered if the old engine and the new engine, if you run on the same weather, what kind of results – differences are you getting?

MR. WILCOX: Old weather, new weather –

MR. CUMALI: No, not the weather, just same weather. I mean, and two different engines, what kind of results are you getting?

MR. WILCOX: That's the one I just showed you, I think. Let's see, one of these is that one, here it is – that is this one, this is the same one, so they are two engines.

MR. CUMALI: Why that much difference, I mean –

MR. WILCOX: Well, it's a completely different calculation engine.

MR. CUMALI: Yeah, but have you checked it against something else as to – well, the cooling load is much lower, you say, well, why is it lower compared to what it was before? Is it being compared to something else?

MR. WILCOX: Well, I have a lot of answers for that, but I'm not sure this is the –

MR. CUMALI: Well, no, I'm just –

MR. WILCOX: I'd be happy to talk about that in detail and there will be other places to talk about it in

detail, but we have looked at it in detail, for sure, and it has to do with the way the solar gain is handled, the way the solar gain through opaque surfaces is handled, all of those things have been changed –

MR. CUMALI: I mean, when there is that much difference, one has a big number of questions, that's all.

MR. WILCOX: Yeah. All right, and if you combine the TDV and weather, you're back to the same picture that the TDV values really change the story on cooling with the same calculation engine. And if we combine all three together, it looks sort of like that overall one where the cooling is generally higher and, in some climate zones, it's a lot higher, part of that is weather, and part of it is the TDV values. Any questions on that?

MR. STONE: When you combine the new weather with the new TDV values, did you go through and shift all 8760 values to match the peak hours in the new weather? Because you have 8760 multipliers in there for each hour and they're based on, you know, the peaks in the system at that time; well, if you now shifted the peaks in your weather file –

MR. WILCOX: No, because we're using the same weather file that was used to generate the peaks – this new approach with the coordinated weather files is really very powerful because the same weather that we're running here is

the same weather that Amber ran through the production model that generated –

MR. STONE: To get the TDV values, okay. So that's a yes to my question.

MR. WILCOX: Yeah, I feel very confident that this is a very sort of solid and integrated approach here that we're taking.

MR. PENNINGTON: Question, it seems like the comparisons that Joe was showing indicated that the cooling every day changes, were relatively modest, in general no greater than 20 percent, and your weather only change is showing a bigger change than that, I think?

MR. WILCOX: Do you want to back up to the weather – there's the weather only. Part of the reason is the cooling degree days is not really a very good way to estimate cooling loads because it ignores all the solar gain, which is a big part of what's going on in residential buildings.

MR. PENNINGTON: So that's all within 20 percent, except for Climate Zone 11?

MR. WILCOX: Yeah, Climate Zone 11, there was some big change, I'm not sure exactly what is involved there, and Climate Zone 15 is the one where there is a different weather station. So the combined impact and the combined changes is a substantially bigger effect, substantially

bigger TDV values in the new analysis for the hot climates. If you go to the heating calculations, the differences are much smaller, except for Climate Zone 16 and so that's why that Climate Zone 16 difference, I think, is that the heating and cooling difference, part of this, we have a new infiltration model, and I suspect that is a big part of what's going on in the cold climates. We also have, you know, the difference between Mt. Shasta and Blue Canyon, in terms of solar and a bunch of other things that are going on there, too. I'm not sure I've looked at the details, but I think that's part of what's going on. Otherwise, it's a very small difference in heating.

MR. PENNINGTON: This is just the engine, not the weather.

MR. WILCOX: I'm sorry, the engine, I'm – there is the combined changes. So, the engine causes a pretty significant difference in Climate Zone 16, and generally it is lower everywhere. And if you throw the combined TDV and weather and engine together, the results are mixed, but, you know, as Snuller explained, the big difference is in the electrical TDVs, not so much in the gas TDVs and so I think this represents that kind of situation, as well.

MR. PENNINGTON: So, question. Did you change the internal loads for this new model?

MR. WILCOX: No, we did not change the internal loads. One of the things that Bill wants us to do is to change the internal loads, and we're –

MR. PENNINGTON: Consider a change.

MR. WILCOX: -- so we're starting to look at that, but we have not done it yet. As I said, it's basically all the current ACM rules for calculations, we haven't changed anything except we changed the natural ventilation slightly to reduce the effectiveness in window ventilation slightly. Okay, so there's the domestic hot water calculation, it's basically a six or seven percent increase in the TDV for natural gas, that's the only change, that's the calculation, it hasn't changed at all, and nothing else has changed so that's the impact. And that's the TDV value.

MR. SPLITT: Bruce?

MR. WILCOX: Yeah.

MR. SPLITT: Are their plans to change the water heating calculation?

MR. WILCOX: Marc is working on that, but I don't know whether there are plans or not.

MR. HOESCHELE: We're planning to change the distribution system modeling.

MR. SPLITT: Is there a lot – to get to zero net energy, I'm also working with Passive House, really efficient homes, and already I'm coming up with there are a

lot of systems that combine hydronics systems, air to water, heat pumps, that we can't model, and there's a lot more stuff in Europe that, by 2014, it's going to be here. And if you don't do something to make this more heating/space heating calculation more robust, you're not going to be able to model half the equipment that people want to use to get to that zero. So somebody should work on it.

MR. WILCOX: Start working on it.

MR. HOESCHELE: Okay.

MR. STONE: When Marc said – Nehemiah Stone – when Marc said he's changing the distribution, while he's talking about single-family home, or in the dwelling in a multi-family, the distribution model for the multi-family is a separate issue and the biggest thing that you can do to save energy, and that you can't model today either, and that's a temperature modulation control or a demand control, and Yanda has the research to hopefully get us to that new model. So, is that part of the plan to that for this set of Standard, too? Mr. Project Manager?

MR. SHIRAKH: Do you recall – I mean the CASE project you are sponsoring?

MS. CHAPPELL: Yeah, I think they will be –- Cathy Chappell, Heschong Mahone Group -- we're looking at that for multi-family [inaudible].

MR. WILCOX: Any other questions? Joe?

MR. HUANG: I'm learning to use the mic. Although I didn't quite agree with Zulfi on the weather stuff, I do share his surprise at how big the differences are between the engines for cooling loads.

MR. WILCOX: Uh huh.

MR. HUANG: And it's particularly surprising because the comparisons I've done between – let's say I go to an Energy Plus, it shows at a more detailed model generally produces somewhat higher cooling loads because it's taking radiant effects into account, so I'm wondering, you know, when you show the cooling loads going down by a half, I mean, that's quite bothersome to me, and I'm wondering, is it because you're venting a lot of the loads or something? And maybe you should do some parametrics where you turn off all these things that are modeled differently and just look at the conduction part, just look at the ventilation part, and maybe, you know, find out why the changes are so large.

MR. WILCOX: I think that's a great plan, Joe. It's sort of – I've spent a lot of time doing that, I don't have any answers to show today, but I think that's a very important thing to do. Okay, so now we get to the interesting stuff, which is sort of the relative value of different measures and different climates, and this first one here, which was the – again, we're showing the 2008

analysis with the light bars, and the 2013 analysis with the red bars, and this is for changing your air-conditioner from ER10 to ER12. This is one of the measures that is defined in the ACM standard, and so forth. And so all these climate zones for the cooling loads are really small, you know, you don't get much out of that, but the climate zones over here where the cooling loads are big, we get a big TDV savings, and generally it's much bigger under the new analysis than it was under the 2008 standards. And these numbers are pretty big. In these three Climate Zones 11, 13, and 14, which are the hot Central Valley Zones, just changing from 10 to 12 EER in your air-conditioner is 9 percent of the total energy consumption for the building. So, when we start talking about these 15 percent and 30 percent numbers, you know, if you happen to be in Palm Springs, all you have to do is buy an efficient air-conditioner and you're there, Tier 1, everything else could be the proscriptive standard, and they're cheap. Well, so, the question is, is it cost-effective? Well, so if you look at this pattern, and Snuller made this point earlier, that the TDV KBTU's per square foot is exactly proportional to the TDV dollars, so this can be directly converted into dollars saved, right? And that's what I'm showing on my next graph, this is exactly the same shape, this is the dollars per house for this 2,700-square-foot house that you save by making this

change, and then, in these hot climates, we're talking $4,000, Climate Zone 15, $8,000 to go from EER 10 to EER 12. What? What's the time period? This is the present value according to the Energy Commission Life Cycle Cost Analysis Method we've all been looking at today, so this is the savings side of that, so I haven't tried to estimate the cost yet. I don't know if everyone saw this, but Mike, when I put that slide up, said, "Oh, these things are cheap!" So, I don't know how cheap is in relation to $4,000, but I bet it's less than $4,000. So, I guess the point is that these are likely to be cost-effective, they probably would have been cost-effective even under the 2008 analysis approach, and you know what? We've never done this before because this is all NAECA covered equipment and we weren't allowed to look at the life cycle cost-effectiveness of this equipment because it was federally preempted. The difference – there are a couple of differences that makes this interesting at this point, one is that I don't think we're preempted, at least fully, or maybe not as much, or maybe not at all, in the Reach Standards from using non-NAECA minimum equipment. Certainly shouldn't be pre-empted, it seems to me, in the second Reach level from using NAECA minimum equipment, in which case, then, all this stuff is open to get into that infamous packaged R or Package R2. That's one of the reasons why I think a simple 15, 30

percent thing may not actually give you the answer that you really would like to get to. Nehemiah.

MR. STONE: Quick question. Are there any EER 12 air-conditioners that just meeting the Federal standard for SEER?

MR. WILCOX: I don't know, actually. There may be. I picked this out of – I know you can get the EER12, that's what Proctor did with its hot/dry air-conditioner project and I believe there is equipment available.

MR. STONE: SEER13.

MR. WILCOX: I don't know whether it's SEER13, probably not.

MR. STONE: So if you set a standard at EER12, then – if you set a standard at EER12, then you're –

MR. WILCOX: Not violating the NAECA Standard. Well, see, there are all these political things that were going on in the background and may or may not be anymore, and stuff that would allow California to have their own EER standard. I don't know if that's really going to happen or not.

MR. HODGSON: My comment on the timeframe is in the lifecycle cost, how many times did you replace that air-conditioner over the 30-year period?

MR. WILCOX: Oh, I did not replace it at all. This is just a simple – I did not forget the cost.

MR. HODGSON: Okay, so, I mean, that's an issue because your air-conditioners don't last 30 years, in fact, they don't perform that well over a few years. But on the preemption issue, that's actually an argument for percentage rather than 12 EERs, because we have this argument – excuse me, discussion – going on right now with the LA jurisdictions who are going 15 percent over code, Tier 1, and to get there, they want to go with 14 SEERs and they can't. And the reason they can't is the preemption issue. So, what we're doing to circumvent that is we go with the percentage and then give them more than one package of tradeoffs on how to get there, so there's no unique specification for that piece of equipment. And if you say 12EER, then I don't – I think you will violate the preemption, but I'm not a trade attorney. So, if you said 15 percent over Code, or pick a number -– 27 percent over Code, whatever your number comes to be -- and you give them packages which include an EER of some number, but it's not a singular package, it's package, you know, P1, P2, P3, then I think you have some flexibility.

MR. WILCOX: Thank you. Yeah, we've been talking about the possibility of having alternate packages as sort of a way to talk about it.

MR. HODGSON: There's a bunch of us who have been doing work on that, including HCD, on how to – can't speak

for HCD – on how to avoid the preemption issue. How's that? Being diplomatic.

MR. PENNINGTON: We'd love to see results from that.

MR. HODGSON: Yeah, I think that's a discussion you should have with Doug.

MR. PENNINGTON: Okay.

MR. TAM: Bruce, I've got a question online. "Why are the Climate Zone 12 cooling loads and savings so low compared to Climate Zone 11 and 13?"

MR. WILCOX: The question is why are the Climate Zone 12 cooling loads and savings so low compared to 11 and 13. Well, I thought about this and looked at it some, but I think the answer is that Climate Zone 12 is where we are right now, it's Sacramento, it's actually a much milder climate than anyplace going north or south from here because Climate Zone 12 gets a lot of wind from San Francisco Bay and tends to be cooler in the summertime than the ends of the valley. That's my theory.

MR. SHIRAKH: That's Delta breezes, basically.

MR. WILCOX: Yeah, the Delta breezes is the answer, I think. So, any other questions? Okay, so here's the other side. This is what happens if you go from AFUE 72 which is the standard minimum NAECA – the current standard furnace, to an AFUE 95, which is a condensing high end

furnace. And the lifecycle cost savings here are, I think, also impressively high, but that's, again, we've never looked at this, so we don't have any feel for this, but we're talking 10 percent savings in all these 1,2, 3, 4 – not 3 – but 1, 2, 4 and 5, and also in Climate Zone 16. So, I think there's some benefits to be had by figuring out how to get around to make preemption rules, particularly for the Tiers. Pat.

MR. SPLITT: Did you look at all at heating savings with the heating side of a heat pump with these changes?

MR. WILCOX: No, I haven't looked at that. We heard this morning that, in the long run, we have to get everything electrified, so maybe we should start looking at that now. I haven't looked at that. As I said, this is mainly to try and – what I was looking for here was a range of measures that people could look at and kind of understand where we're going with the weather, the TDV, and the calculation engines for residential, so this is – I think heating has got some possibilities. Coastal Southern California, you're not going to get much benefit in the cold places –

MR. SPLITT: But the electrical TDV for heating – for a heat pump, it's not the same rate, so it may come off totally different.

MR. WILCOX: Yeah, that's right. It's been so long since I've done a heat pump, I don't even remember what the basis is for that comparison. Okay, here's the one that Mike doesn't want us to find out about, I don't know, I did it anyway. So, this is what happens when you go from a standard minimum gas - efficiency gas – water heater to an energy factor of .85 gas water heater. And it doesn't matter where you do it, except for the change in water temperature which is minor and the TDVs are slightly different from zone to zone. It saves between $2,000 and $2,500 of present value in every climate zone, so I think that might be cost-effective. I bought at retail a grade A5 water heater for my daughter a few years ago and it cost $1,800 installed on a retrofit basis, so….

And so here is the adding R13 insulation to the roof deck of your house, so you take that amount – I'm not going to say this is an optimum solution here, but if we start with package D, whatever ceiling insulation is required, whether it's got a radiant barrier or not, this is the proscriptive package, so in some climate zones it's a .2 reflected shingle, in others it's a .08, and so forth. And just to make things real simple, I just added R13 to the bottom of the roof deck, so it is like putting an R13 that stapled up between your roof trusses. And that's $2.00 a square foot at present value if you do that, $2.00 a square

foot of roof deck, sort of, in the high climates. Whether or not this is okay to do or not is another question and we're going to look into that, but I think there is certainly some perspective here that's positive. And here is the insulation construction quality, you just flip that switch and, in the simulation, it says we're going to change from our use to improved construction quality, which implies a HERS Rater inspection, and you're going to do a number of things to make the insulation work better. And, you know, that range is up to $1,500, $1,600 in Climate Zone 16 – what's the old standard -- $1,000 plus in a lot of climate zones? I don't know whether that's cost-effective or not, but that's something relative to look for some costs.

MS. CHAPPELL: Did you change anything in the methodology of how you calculated it?

MR. WILCOX: Well, except for the model is completely different, I mean, so, yeah, it's –

MS. CHAPPELL: Other than that.

MR. WILCOX: We converted the insulation construction quality model to work with our new simulation, so it's different, but it's the same basic impact and the same – almost the exact same factor of improvement. Any questions on that? Okay, but I'm assuming when you reduce the air leakage, and to get a bump here in the standard, this house gets a 3.8 SLA under Package D and I dropped it

down to 2.5, which means it's reducing it by about a third. So, this is a substantially tight house, but not ridiculous. Mike does these all the time. And that's worth a thousand dollars in all of the hot climates and a few hundred dollars in every climate. So, I don't know whether that's cost-effective or not, but, again, it's certainly something we ought to do a cost estimate of. And this is one of those defined measures that we have never tried to put in a proscriptive package before, but clearly could be put in there if we want to do it.

Okay, now, to cut this the other way, very quickly, to sort of demonstrate how these measures compare and how different climates are different, I've done the comparison cutting the other way, so those six measures, EER12, AFUE95, energy factor of .85, roof deck insulation of R13, insulation construction quality and the reduced air leakage 2.5, and, again, it's the 2008 version vs. the 2013 version, the red bar is 2015, and this is Climate Zone 3, Oakland. And you get 10 percent savings overall out of the water heater, and 6 percent out of the furnace, and the roof deck 6 percent, and so forth. So, the only thing it doesn't do anything for you is the air-conditioner because we don't have any air-conditioning really in Climate Zone 3.

MR. SHIRAKH: The roof deck doesn't do anything for you either, right? It's higher.

MR. WILCOX: Well, it's doing 8 percent of the total, that's better than all the other ones, except for the water heater. Sorry?

MS. CHAPPELL: Can you explain – it's percent of total TDV savings?

MR. WILCOX: If you just take the total TDV budget for the house, everything – the water heating, everything – and look at the savings due to this one measure, what percentage of the total is it.

MS. CHAPPELL: So, the higher value is more savings, so roof deck insulation is the only one that is giving you more this time than it did in 2008?

MR. WILCOX: Yeah, in this climate zone.

MS. CHAPPELL: In this climate zone.

MR. WILCOX: That's only one of the points of this. The other point of this slide is what do we get out of the new TDVs and all that stuff. So, here's Climate Zone 7 in San Diego, and boy, you'd like a water heater in San Diego, that's the official water heater, and that just all by itself gets you 20 percent savings on the total energy budget. And, again, air-conditioning doesn't do anything, heating doesn't do anything, as you would expect in San Diego where there isn't any air-conditioning or heating, really. Here's climate zone 9, Los Angeles, Burbank, that whole area, things are kind of moderate, but again, there's

two measures – there are several measures that are in the 8-10 percent range. Here's Sacramento, very similar and moderate. Palm Springs, this is where the EER12 air-conditioner really shines because EER really only pays off, and particularly in our model, the EER factor only pays off when it's 95 or above. So, that's part of the reason that it pays off in these hot zones so much. And the roof deck insulation is a big factor. You know, the savings from the energy efficient water heater is basically the same as they are in all the zones, which is that all the other energy consumption is so big that it doesn't save proportionally as much. This is why I think that – personally, this is why I think it makes sense to make a proscriptive package, because all of these things trade off differently in different climate zones, but that's to be done either way. And there's Climate Zone 16, similar. The R13 pays off, the energy factor pays off, the AFUE pays off.

Okay, so in terms of where we are with this residential analysis model, we're finishing up the window model, which is not in the current – we're going to a state-of-the-art window model, and that's being finished up right now. We still have to add the comfort analysis and evaporative cooling, so Abhjeet will be happy. And then we have to do this – review and revise the rules, including looking at the internal gains, maybe looking at the

thermostats, maybe adjusting that. We need to add new thermal mass rules because we're now explicitly modeling all the stuff in the building and we can't use the Btu numbers like we used to use for thermal mass. And then we need to maybe make some further adjustments in natural ventilation. And then, hopefully, that will be done very quickly and Ruben can start analyzing away.

MR. PENNINGTON: Could you explain what you're doing related to the comfort analysis, what will happen there?

MR. WILCOX: Yes. We're making a facility in the program so that you can take the results of a simulation and run it through a comfort model as a standard, well, it's actually several standard comfort models that are ASHRAE and various – it's a standard 55PMV, Predicted Mean Vote analysis, I think there are two other ones, as well, it's a package that was developed for us by UC Berkeley, Center for Built Environment, and they're developing the same package for ASHRAE and LBL, and so it's basically the consensus methods for evaluating comfort, and you will be able to – this will read an hourly results file from the simulation and from there on, we're not exactly sure what you do, you know, do you use 8,760 hour average comfort? Or is it peaked hours? The models are complicated and, for example, you have to know how much clothes people are wearing hourly

for the entire year in order to tell whether they're comfortable or not. Earlier today, Martha Brook said she was probably uniquely qualified to figure this out. Somebody is going to have to do that in order to understand what it means. So, this is a tool that, at least, Abhjeet and some of the people he is working with think is very important in terms of analyzing cooling and passive houses so that you can compare on a comfort basis, rather than strictly on a temperature basis how successful the designs are. So that's – we're building the tools. I'm not sure exactly what the rules are yet for using them, I think we'll have to experiment with that and figure it out.

MR. STONE: Can I ask a question related to that? To do that, can you turn off the HVAC equipment so you get your data for the comfort analysis, assuming no heating equipment nor –

MR. WILCOX: Well, in the research mode, in principle, you can do anything with the inputs in the program, so, yeah, that would be the idea, is you would run your high mass, well shaded, well insulated house with no AC, and compare it to the base case house that has the air-conditioner and see how different they are. I hope it doesn't turn out to be related to the low value you assume in the middle of the night and in the winter time.

MR. STONE: I have another question. Traditionally, we've approached looking at the standards and the analysis work on how residential affects single-family homes, and all of your analysis here was with that one base case building, the 2,700 square foot house.

MR. WILCOX: Yeah.

MR. STONE: I would posit that you would end up with some startlingly different results than if you were looking at, you know, a garden style apartment building, or looking at a six-story multi-family building, both of which are also residential.

MR. WILCOX: Yeah, well, we have a defined eight-unit garden apartment that we have been using.

MR. STONE: You're running all the same graphs?

MR. WILCOX: I could, but I have not done that yet. But I was looking for a simple case that we could, you know, for this presentation that we could look at and having more prototypes, it's making it that much harder to figure out what's going on, in my –

MR. STONE: Yeah –

MR. WILCOX: -- but you're right, I mean, you do get different answers with different prototypes, and that's how we got the different prototypes.

MR. SPLITT: Bruce, I had a question about the adjust natural ventilation to match data. We now met

mechanical ventilation requirements, but that hasn't been around long, so I don't think there's a lot of data yet that you can –

MR. WILCOX: Yeah, I'm talking about cooling ventilation, opening windows, basically, so we're talking about adjusting.

MR. SPLITT: Right, but then would you assume that the mechanical ventilation is going to keep going all the time? Or someone would shut it off when they open the windows?

MR. WILCOX: No, it goes all the time. That's the assumption. I mean, that's not – there's nothing religious about that.

MR. PENNINGTON: So, I'm curious about the ventilation, also. Will there be an ability to model whole house fans?

MR. WILCOX: Yes. That is –

MR. PENNINGTON: So, mechanically assisted ventilation.

MR. WILCOX: Yeah. The plan is to be able to model window ventilation, whole house fan ventilation, and we've actually carried out some experiments. Marc Hoeschele and his crew has done some measurements in some houses with whole house fans to figure out some of the characteristics so we can develop the model for that. And then we also plan

to have a model for economizer style natural ventilation systems and use the central air handler fan and run to cool the house at night. Right now, well, the proposal is that those kind of systems can run 24 hours whereas the windows right now are not allowed to be opened in the middle of the night, so there are some differences.

MR. PENNINGTON: So, you know, my concern with openable windows is what are the driving forces, you know, is wind really enough? Is wind not oriented properly relative to the windows enough to draw very much? And if you have whole house systems, or some other kind of economizer type systems, then you can create a driving force, so you really get something out of those openable windows.

MR. WILCOX: Yeah, I think there is a strong argument to be made –

MR. PENNINGTON: And the other piece of that is that you really want to try to vent the attic because, if the attic is sitting up there hot, you know, especially in a heat storm or something, then opening the windows doesn't do a lot – in my experience.

MR. WILCOX: You don't have enough windows in your attic.

MR. PENNINGTON: That's true, no, I have plenty of windows in my attic, none from the house to the attic.

MR. SPLITT: Another question is, with ventilation, would one be able to model like an attached sun space and the model of ventilation between the space to the house for solar – trying to get to Zero Net Energy, or no?

MR. WILCOX: Boy, is that out of the past.

MR. SPLITT: Well, we're going back there.

MR. WILCOX: I think it's in the model, I think the current model we're using right now, I think, allows you to do that. We haven't done anything about setting it up in this model for the Standards development – so far.

MR. SPLITT: It's what goes around comes around.

MR. WILCOX: Yeah, I know. Any other questions?

MR. TAM: Bruce, there are a couple questions on the line. The first one, "Are these differences between the 2008 and 2013 software largely due to how the two deal with the cooling loads?"

MR. WILCOX: I think that it has mostly to do with cooling, I think, but it has to do with the different approach to modeling opaque surfaces that applies to both heating and cooling, I think, is really the answer.

MR. TAM: The second question, "Are you looking at introducing EE targets and standards that can apply to existing residences, or inefficient existing homes fully exempt from EE Standards?"

MR. WILCOX: Well, it's a complicated subject. In the 2008 standards, some parts of the New Building Standards apply their existing buildings if you do retrofits or replacements. The 2008 Standards, the cool roof requirements, a version of them, applies to existing buildings if you replace your roof. The ducts standards apply under certain circumstances when you replace your air-conditioner. And I think there's a general interest among a lot of people involved to expand the application of the standards to existing buildings. I'm not sure how far we're going to go.

MR. SHIRAKH: Well, in general, the standards we developed for new construction also applies to additional alterations, but in second 152, sometimes we modify those based on climate zones or other criteria. But typically you can assume that all of these would apply to additions and alterations.

MR. WILCOX: So, the big step is whether you would ever be obligated to upgrade your house simply to save energy. And at this point, I don't think that ever occurs, but there's no reason why it couldn't.

MR. NITTLER: Ken Nittler with Enercomp. I think the question on additions and alterations, it's interesting to answer, is does this mean, by 2020, that alterations are

supposed to be net zero energy, too? That's a pretty big question.

MR. SHIRAKH: I really don't have an answer to that. I mean, that's too far – we haven't even figured out what the definition of Zero Net Energy is.

MR. HUANG: This is Joe Huang. This isn't meant as a criticism, but – I got your attention now, right – but, you know, I'm still struck by the big differences between two models that are really – one is a derivation of the other, or they have similar progeny, or whatever, done by the same people, right? I mean, I'm just struck that they're that different, and I am looking for evidence that we're getting better results, and I'm suggesting that, you know, it might be very illuminating to do some benchmarking against other models like DOE-2 or Energy Plus. I mean, especially since your numbers are going down in cooling, it really troubles me. That's all.

MR. WILCOX: Okay. Any other questions?

UNIDENTIFIED SPEAKER: [Inaudible]

MR. WILCOX: That's a good approach, too. Any other questions? Okay, thank you.

MR. SHIRAKH: Okay, so that concludes our formal presentations. Any other questions related to anything that was presented today? Either in the room or online? Okay, so with that, we'll conclude this workshop and there will be

transcripts of this workshop and we will post it on our website and all the presentations and reports. Thanks so much.

[Adjourned at 3:45 P.M.]