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CALIFORNIA ENERGY COMMISSION

STAFF WORKSHOP

In the Matter of:	) Docket No.) 16-BSTD-03
2015 Building Energy Efficiency Standards Residential ACM Reference Manual and Compliance Software	) STAFF WORKSHOP RE:) 2015 ACM Reference) Manual and Compliance) Software Updates

CALIFORNIA ENERGY COMMISSION

THE WARREN-ALQUIST STATE ENERGY BUILDING

FIRST FLOOR, ART ROSENFELD HEARING ROOM

(HEARING ROOM A)

1516 NINTH STREET

SACRAMENTO, CALIFORNIA

THURSDAY, MARCH 29, 2015

10:00 A.M.

APPEARANCES

CEC Staff

Todd Ferris, Building Standards Office

Larry Froess, Building Standards Office

Martha Brook, Existing Buildings and Compliance Office

Christopher Meyer, Building Standards Office

Maziar Shirakh, Building Standards Office

Panel Presenters (* Via telephone and/or WebEx)

Todd Ferris, Building Standards Office CEC

Bruce Wilcox P.E., CBECC-Res Consultant Team Project Manager

Eric Rubin, Statewide Utility Codes & Standards Team

Larry Froess, Project Manager of the ACM Manuals CEC

Martha Brook, Existing Buildings and Compliance Office

Public Discussion (* Via telephone and/or WebEx)

Bob Raymer, California Building Industry Association (CBIA)

Marc Hoeschele, Davis Energy Group

Brian Selby, Selby Energy Inc.

George Nesbitt, HERS Rater

Bill Dakin, Davis Energy Group

Jon McHugh, McHugh Energy Consultants, Inc.

Garth Torvestad, ConSol

APPEARANCES (Cont.)

Public Discussion (* Via telephone and/or WebEx)

*Brian Zimmerly, SolarCity Corporation

*Eric Turowski (phonetic)

*Mark Essler, MegaWatt Consulting (phonetic)

Mike Hodgson, ConSol, representing CBIA

Ken Nittler, ENERCOMP, Inc.

*Nehemiah Stone, Stone Energy Associates

I N D E X

I N D E X (Cont.)

P R O C E E D I N G S

MARCH 29, 2015 10:00 A.M.

MR. FERRIS: We're going to get started with today's ACM Update Workshop. I want to go over a few housekeeping items that we normally go over when we have these.

In case of an emergency we will meet across the street at -- what is the name of that park -- Roosevelt Park. And basically just follow CEC staff over there if there is an emergency and we have to evacuate. Restrooms are located outside in the atrium to the left. If you need to something to eat or something to drink, we have a café on the second floor. It's open right. (Indiscernible)

We're broadcasting in WebEx. Today's meeting is going to be recorded, so everybody should know that whatever they say we're writing down. For those of you in the room that want to be added to the contact list, we left them out on the table. Staple your business card or sign in, whichever you'd like. We used those when we scheduled this meeting, so that we could contact people who had come to previous meetings on the ACM.

We had planned to have hard copies of the presentation ready in the morning. They're actually being printed right now, so before you leave for lunch they should be out there and you can pick them up. We're going to have multiple public comment periods. We figured the topics are kind of varying and we also didn't want somebody who wanted to do comments on water heating to have to wait for the end of the day, if they had to leave or something.

Let's see, WebEx participants, we will keep you muted until it's time for you to make a comment. Use the raise your hand feature to let us know that you'd like to ask us a question. And we're going to take comments from those people in the room first and then WebEx second.

We have quite a bit of information to cover today, so if it looks like it's necessary we're going to limit comments to three minutes. If, you know, only two people get up, you can have more time, we're not going to be draconian on that. But if we're looking like it's taking a lot of time we're going to have to keep it short.

So for those of you who didn't know, Eurlyne Geiszler retired in January. And beginning this month CEC hired a new office manager for the Building Standards Office and I'd like to take this time to introduce Christopher Meyer. And he's going to take a second to tell you a little bit about himself.

(Off mic colloquy)

MR. MEYER: (Indiscernible) Christopher Meyer. I came to the Energy Commission more recently, but had spent about ten years or so as a consultant to the Energy

Commission on various projects, mainly up in the Siting Division and also in the Compliance Division, but very happy to be here in Efficiency. So it'll be a very interesting process going forward. Thank you, very much.

MR. FERRIS: One of the things that I think all of you will appreciate is that Christopher shares the same view as Larry and I, is that we're really here to solve problems. We're not here just to write codes that don't work, so hopefully we can slowly but surely steer this ship in the right direction.

So I want to go over the agenda for today's meeting. We're going to start off with our discussion on domestic hot water. We've updated the domestic hot water draw schedules based on the new higher efficiency fixtures and appliances. We've improved the heat pump model and then we're going to give you time for public comment on that topic.

We've reviewed and revised the miscellaneous electric loads based on a new study, so we'll go over that and talk about what we're proposing to change and also allow for public comment.

Then Larry's going to recap what we talked about at the previous ACM meetings, is just a recap on the Photovoltaic Compliance Credit. No public comment, it's already approved, so it's already part of the Code. We just want to make sure that people understand that there's two distinctive PV topics: Compliance Credit and EDR Credit.

Do you want to make a comment now? Sure.

MR. RAYMER: Bob Raymer with CVI. I understand that it's approved. We were strong supporters of that, but our initial calculations are showing that there's not the equivalency that was initially discussed. So where would that be appropriate to bring up in the conversation today?

MR. FERRIS: So I guess with that we can talk about it. I think the best thing to do would be for you and Larry and I to talk offline. I mean, we've only heard that from one person and we actually sent back our test data, which says exactly the opposite. So you know --

MR. RAYMER: Well, actually there's at least two other energy consultants that are coming up with the same thing only much worse than ours. And so we've got -- well, I don't want to take your time up now, but yeah, there's an issue.

MR. FERRIS: Okay. Well, I mean we're more than willing to discuss that, but it wasn't on today's agenda and we weren't aware of it until today. So I mean well, we can revise it and have public comment during that. I mean, basically what we wanted to do is just distinguish between the two. And I mean, we can surely carve out 15 minutes to have public comment on that.

And so then we're proposing to break for lunch. Probably if things go according to our plan that'll probably be around 12:30. We're going to come back at 1:30 and we'll dive into the Energy Design Rating s background. Martha Brook has done tremendous work helping us align with RESNET and getting the IECC Baseline. And then we're going to move into the actual CALGreen calculation, which uses that EDR calculation. And then we will end the day going over the PV Calculator.

And then that last public comment, we'll basically take comments on the PV Calculator as well as any other things that we haven't had a chance to do. So that'll be a longer public comment.

And then I will come back and we'll talk about our next steps as we move towards our targeted June approval of the software.

So with that, I will turn it over to Bruce Wilcox. And he's going to talk about domestic hot water changes.

MR. WILCOX: Thank you, Todd.

So you added this to my slides? Oh, I see. So these are pictures that weren't in my slides when I emailed them to Larry this morning, so I just wanted to make sure that they're in the right place here. So these are domestic hot water heaters. (Laughter) Well, maybe I passed the first test here, huh?

So the subject here is domestic hot water changes in the new 2016 release to software. And this is actually a large topic. It's pretty complicated. We've done a major set of research and made some serious improvements, so I'm going to talk about a lot of relatively complicated stuff here. I'm going to try and go relatively quickly, but I want to lay it all out, so you get a sense of what's going on. And if there are things that don't make sense we can have questions. And otherwise, please bear with me if you're not in to hot water.

(Colloquy off mic re: slides.)

So there were a group of us working on domestic hot water heating revisions from the Consultant Team and I just want to give credit to these guys for doing a great job. Chip Barnaby, Jim Lutz who's here in the room, Neal Kruis from Big Ladder Software, Bill DeOreo from Aquacraft, Ben Larson, Nick Kvaltine, and Mike Logsdon from Ecotope who are actually being supported by PG&E as part of a case project, and Danny Parker from the Florida Solar Energy Center all did significant things with this work.

So the agenda for my talk this morning is I want to cover some of the background on where we are right now. And I want to talk about changes -- well talk about the new loads model, talk about how we made a draw schedule that can be used in the simulation performance software, talk about a new heat pump water heater simulation that's another big piece of work we're bringing into the software in this revision. I'm going to talk a little bit about compliance results although we don't actually have any results to show you yet. And then we're going to talk about the status and the plan going forward.

So background, what is domestic hot water, what is the current DHW load model, what is the current hot water heater energy use model, and what does current DHW energy use estimates look like? Sort of summing up where we are, so -- and this is actually not strictly summing up where we are.

So domestic hot water in the context we're talking about here is heated water that you use in the house. And it's used for five end uses, and we're actually considering all five of those end uses separately on our new load model. So I wanted to start out by defining these.

So there are showers, which are distinctly -- well all these five uses have actually individual characteristics that are different. And showers are a use in which you have to mix cold water and hot water from your hot water heater. And when you get it to about 105

Fahrenheit coming out of the shower nozzle then things are okay and you get in the shower and take a shower. But so showers and baths are similar, are characterized because the temperature of the use water is always more or less the same and independent of anything else. So showers are the biggest end use according to our research.

The second biggest end use are faucets in kitchens, bathrooms, etc. And there's a miscellaneous set of uses going on there. You might be drawing water to get a glass of cold water to drink. You might be drawing water to fill up your tea boiler to make tea. Or you might be running hot water, because you want to wash a set of dishes or you want to wash your hands or there's a huge mixture of uses.

The detailed data we have indicates that about 50 percent of faucet use is hot water. This is a difficult thing to pin down, but that's based on a large sample and pretty careful measurements -- 50 percent hot is our conclusion there.

Then there are clothes washers and clothes washers actually have a huge variety of hot water situations in terms of the temperature that's used. You can wash your clothes in all cold water or all hot water, anything in between. And modern clothes washers have a variety of cycles available and use a lot less water than traditional clothes washers from even ten years ago.

The data shows that on average 22 percent of the total water use in clothes washers is hot, so we're using that in our figures modeling.

Dishwashers are another different animal, because dishwashers use 100 percent hot water. There's no mixing going on, and in fact inside the dishwasher there's a resistance heater that heats the water up even further to get it to the point where it can sterilize the dishes. And dishwashers also use a lot less hot water than they used to based on recent standards.

And finally, there are baths which are mixed hot and cold similar to showers. These are the smallest of these five end uses according to our data on California houses. And so that's where they are. This is what we're talking about when we're talking about domestic hot water.

The current California DHW load model that we use in the performance software, and have been for quite some time, predicts the gallons per day total of hot water used, delivered from the hot water heater on the left axis there, gallons per day, GPD. And it's a function of the Conditioned Floor Area, the CFA, of the house only.

So a 1,000 square foot house uses 35 gallons per day and a 2,500 square foot house uses 62 or 63 gallons per day. And that's the current load model period, both multifamilies and single families, both the same.

That gallons per day, of hot water, is turned in to hourly gallons per hour, using these two hourly schedules that are in the current software and have been stable for some time. They each take the same gallons per day, the gallons per day is the same every day, but if it's a weekend day the schedule in blue is slightly different than if it's a weekday. Weekdays people get started earlier, they have showers in the morning. There's a big peak right at the first thing in the morning. And then there's a second peak in the evening. If it's a weekend, there's two peaks, but they're all shifted a little bit later.

And the current water heater energy use model is pretty simple. It's all based on the DOE rated Energy Factor for the water heater as the efficiency input for the equipment, the Energy Factor is called EF, for the acronym. And, you know, I don't want to go into the details of this load, of this model, but it's very simple. The energy used by water heating is basically the load, the gallons per hour we just looked at, divided by EF with some adjustments. There is adjustments for distribution losses and some climatic things and so forth.

But the cold water temperature affects the load, etcetera. But otherwise it's a very simple straight forward model that was really adapted from what started as an annual model where you calculate the gallons per year and divide by the energy factor and calculate the total energies from that.

Okay. So and here's the results of this current model. So this bar graph is one bar for each of the California 16 Climate Zones. Climate Zone 1 on the far left is Eureka and so forth up on the North Coast. And Climate Zone 16 on the far right is Lake Tahoe and the mountains. And we have a wide variety of climates in between.

But to try and put the DHW part of what we call the regulated loads for the Building Standards, I've made the PDHW be the red bar at the bottom. And you'll see given that current model we just described, the energy use for hot water heating varies from climate zone to climate zone, but not very much. And it's in some climate zones, like Climate Zone 7, which is San Diego where the heating and air conditioning loads are pretty small, the domestic hot water heating load is getting perilously close to the whole thing. That's all there is in San Diego compliance.

And then at the opposite end, Climate Zone 15, which is the tallest bar there which is Palm Springs, has a very large cooling energy use and the domestic hot water heating is a pretty small fraction of that.

But one of the reasons why we're trying to pay more attention to domestic hot water heating loads is because of this fact that the other things are shrinking as we make the houses better and better and the domestic hot water heating loads are not changing as much. And for all those coastal zones: Climate Zone 3, which is Oakland; Climate Zone 5, which is Santa Maria; 6, which is Los Angeles; 7 San Diego and 8, which is Orange County, domestic hot water heating is at least one half of the total energy use we deal with in the performance standards for all those climate zones.

So, what we're proposing here is a new improved domestic hot water heating loads model. This is a completely new loads model produced straight for California homes. It's a different load model than I think anybody else has ever tried to develop anywhere in the country. And so it's unique and it's really aimed right at our use here in California.

So first off, it's based on an analysis of a very high quality representative sample of 730 California families living in California single-family homes. We have for a subset of those 730 families -- for 462 families we also have in addition to the hot water data or the water data -- we have a survey of family characteristics, family size, types of equipment and so forth that goes along with the water use data and makes this kind of a unique set of data on water use in homes. It's unique and valuable because it's a much larger data set than normally you get with measured hot water data. It's representative, meaning that it was designed to represent all of the houses in California, all the single-family houses. And that's pretty important, compared to a lot of the ad hoc surveys and measurement data sets that don't really represent the full range of California situations.

So what was actually done in this California data set was they were measured -- and we'll talk about this in a minute in more detail -- but there were metered end-use water consumption done for water flows at the fixture. So this is -- unfortunately it's not metered hot water end use at the fixture. It's metered total water end use at the fixture. And so we have to do some massaging to get to the hot water part here, but it's still I think by far the best data set that is around for doing this kind of work.

We're able to estimate the hot water heater part of this water flow at the fixtures from a similar research study. It was done by the same people, not in California. And that study included a subset of the houses where they actually metered the hot water in addition to the total water.

And the last point here is that, as I said a few minutes ago, we're making a load model here that actually has separate estimates of hot water use for our five hot water end uses. And with a model that's actually broken out that way, we can apply different efficiency measures to the different end uses and estimate the credit for those things in a very precise way. So there's I think lots of advantages to this new model.

So we have a new loads model, but why are we so interested in DHW and this revision? Well, part of it, as I mentioned earlier, is because domestic hot water heating is getting to be a larger part of energy use and so therefore a bigger factor in our goal to get the ZNE for new homes.

Of course, I'm thinking that heat pump water heaters may be part of the solution to this ZNE problem, partly because of some people think that we should be electrifying California houses to make ZNE more practical. And if you're going to do that then time of use for DHW becomes a much bigger issue than it is in the current situation where most California water heating is done with gas. So having a better model that can deal with a time of use is very important.

And then the second interesting thing about heat pump water heaters -- and we'll talk quite a bit about this later -- is that the efficiency of a heat pump water heater, unlike the efficiency of say an instantaneous gas water heater, there's a big impact on the efficiency from the size of the load. If you make a lot of little small loads, hot water draws spread out over time, that's something that's very easy for your heat pump water heater compressor to respond to. You can run this very efficient little machine making hot water, using a very small amount of electricity and as long as it has a nice long time to make that hot water it can recover from the load.

But if you draw a whole lot of water at once, then the compressor can't keep up with that and if you run the tank down to a certain point, than the system will switch over to electric resistance backup. And all of a sudden you then have an electric resistance water heater meeting your load. And the efficiency goes down by a factor of three or four or something like that, at that point. And you have a whole different situation in terms of energy use.

So to account for this in the Building Standards calculation, we want to end up with diverse loads rather than average loads. If you take the loads and average them and all the loads are small every hour, that's a perfect situation, imagined situation, for a heat pump water heater. Whereas in reality, and we'll look at some load patterns in a few minutes here, it's a the big loads that are all happening at the same time that will drive the efficiency of that heat pump water heater. And as we want to improve peaks that cause the back-up resistance heat and peak load fails also happen when the Time Dependent Valuation factors are big.

Another important thing going on here with this hot water loads revisions is that I think it's important for us to understand that people use hot water, not houses. And so that curve that said that the hot water load is a function of the square footage of conditioned floor area in your house, there's really no relationship between the floor area in the house and how much hot water is used. If you look at the statistics from the measured field data and so forth the size of the house, floor area or number of bedrooms, explains only 20 percent of the variation in hot water use from house to house.

What really matters is how many people are living there and maybe to a lesser extent, who they are. And one of the important things is that occupancy of homes changes over the lives of the house. And we'll talk about that as well. And we think we've proposed a load model that accounts for that diversity. And we think we need to consider the hot water heating loads for the full range of families that would live in any particular house over its life. And that is really the basis for the proposal for our new load model.

So part of the work in figuring out this new loads model was figuring out about families in California homes. And we used a really great data set for this, which is what's known as the RASS Survey. That stands for the Residential Appliance Saturation Study. And its traditionally been produced by the utilities and then by the Energy Commission and the utilities, periodically to look at the energies and characteristics of California families, and who they are and so forth. And it's a very careful survey that's intended to be representative of every family in California, single family, multi-family, mobile homes, everything. And so we used that data to look at the issues of what kinds of families are living in what kinds of homes. So this is a somewhat complicated table here which shows the relationship across the top.

Somebody -- something happened here, I went to the end. That's what happened, okay. Wrong button here, sorry guys. You missed out on a whole lot of really good stuff if I kept going there. (Laughter) We're almost there. It's really easy to just push these buttons, except there's one right next to it, the "page down" that says "end."

Okay. So part of the work in figuring out this new loads model was figuring out about families in

California homes. And we used a really great data set for this, which is what's known as the RASS Survey. That stands for the Residential Appliance Saturation Study and it traditionally has been produced by the utilities, and then by the Energy Commission and the utilities periodically to look at the characteristics of energy use characteristics of California families, who they are, and so forth. And it's a very careful survey that's intended to be representative of every family in California: single family, multifamily, mobile homes, everything.

And so we used that data to look at the issues of what kinds of families are living in what kinds of homes. So this is a somewhat complicated table here, which shows the relationship across the top. If you look at homes by a number of bedrooms: one, two, three, four, five, six. And then down the side on the rows, we have the number of occupants, one through eight.

And if we look at the yellow highlighted column there, that's for three-bedroom homes. And what that tells you is what fraction of all the people living in three-bedroom homes in California are -- or what fraction of all the three-bedroom homes in California have two occupants, one occupant, three, four, five, six, seven, etcetera. So this is the fundamental basis for the way we're relating hot water use to home size in a new home where you know the number of bedrooms, but you don't know who's going to live there, because this is a house that hasn't even been built yet.

And there's some really interesting things you can see from looking at this table. One is that if you have a two-bedroom, a three-bedroom or a four-bedroom house, the most common family size in all three of those house sizes is two people. So the strong relationship between the size of the house and people, it's not really there if you look at the data. If you have a five or six-bedroom house then you begin to have families that are -- four people is the most common family, but not until you get to five bedrooms -- and there are not very many five-bedroom houses.

So any way, we're using the data in this table and so our model says that if you're trying to get compliance for a three-bedroom house we're going to assume in domestic hot water heating load model that 14 percent of the time there's one occupant, 37 percent of the time there's two occupants, 18 percent of the time there's three occupants, etcetera. And that's built into the simulation so that we get the diversity of low loads when there's one occupant all the way up to very high loads when you get the large numbers of people. And you'll see how the people relate to the DHW in a few minutes here.

This is another interesting thing that at one point we were talking about building into our load model, but we've since gone for a simpler version. But the other thing that's interesting is that the age of occupants is highly related to the number of people in the family. And that's of interest because there's some research that shows that teenagers, those in the second column up there age 6 to 18, use about twice as much hot water as adults use and babies 5 or less use maybe half as much as an adult.

And you can see that this, again from the RASS Survey, and it's the number of occupants down the left column there and across the top are age groups. And then the numbers in the cells are the fraction of the people living in the family with that number of occupants who are of that age.

And you'll see that if there's a household with one occupant, almost 60 percent of the time, that's an elderly person. If there's two occupants, 44 percent of those are elderly. And when you get to three and four, then you start getting regular adults and some teenagers. But you don't get serious teenagers until you get into the four and five-person families. And as we saw earlier, you don't get very many of those until you get to big houses. So there's this relationship between family size and house size. And it's complicated in general, but not very precise.

All right, so now let's talk about measured data in California for hot water draws. There was a revolutionary study done about ten years ago now, called the California Single Family Water Use Efficiency Study. This is the one I referred to earlier where there's data on 730 single-family California houses. This was done by a company called Acquacraft in Denver, who sort of I think invented the measurement scheme here.

And this study was done for the California Water Resources Agency. And it's really a study aimed at trying to figure out how to save water in California houses. But as a byproduct here we get this amazing data set on water use. They worked for 40 some water agencies to get a representative sample that is like the RASS Survey. It's intended to represent every single family house in California, so it's balanced and so forth. And this is the source of the measured water data.

So the approach here -- these are the water agency guys -- they figured out a way to install a data logger on your water meter in the street. So the water guys can go out and they can install this data logger. They don't even have to talk to you. It's their meter, they can put the data logger on there, and it measures every 10 seconds measures how much water is flowing through the meter. And they put these on the house and leave it there for a week to two weeks and they get this detailed 10-second data set on all the water flows going into this house. It's cold water, not hot water, but it's all of the cold water. And if you look at this study, there's a huge analysis of landscape watering and all the end uses that are done in these California single-family houses.

So when they get the 10-second data for each house they look at it on a computer screen. And this is sort of a colored version of what the 10-second data looks like with time across the bottom and gallons per minute up the side. And so the minimum width of each colored bar there is one minute in this data, or maybe 10 seconds, anyway it's a very short time sub data.

And the key to the approach is that you can tell by looking at the pattern what kind of a water use is happening. So that red thing on the left plot, the red blob there is a shower. And it's a shower in a bathtub with a diverter valve on it. It starts out with a high flow rate while people wait for the water go get warm. And when they get it adjusted, then it's sitting there running at two gallons a minute for whatever that is, 10 minutes maybe.

And so they use a computer model and people who look at this, each one of these data sets, to identify what the shower in this house looks like. The blue-green bars there are toilet flushes. The yellow ones, I believe, are dishwashers, yeah. That's right. So there's a pattern for a dishwasher that's got several draws. It always looks the same. There's a pattern to a washing machine that's got several draws. They always look similar.

And so this is how they take this water meter data and end up with the end uses related to hot water. And what we get out of this is the total use for that shower, which is total water at the shower.

All right, so we have this data for 730 houses. And if you average it all up and look at the total flow at the fixtures -- so this is not the hot water flow, but the total flow at the fixtures for showers faucets, clothes washers, dishwashers and baths -- this is what the hourly average for all those houses looks like. And in terms of gallons per hour average over a 24-hour day.

So it looks quite similar to our current average water draw schedule that we looked at earlier, right? There's a peak in the morning. There's a peak in the evening. And everything is sort of consistent with what we thought it would be.

One of the things that this graph is intended to show is there were two data collection events here. One is the measure of the water data at the street. And as I said that can be done without talking to the family. They don't even know you've been there. They don't know anything about it.

And then in this big California study they followed up with a survey to ask people about how many people are living is this household, what are their ages, and how much money do you make? All of the standard sort of survey kinds of stuff. Only about 60 percent of the people answered the survey, which is kind of typical for these kinds of things.

So one of our questions was, "Well, do the people who answered the survey use a radically different amount of water than the people who didn't answer the survey?" And so the three lines up there, the blue one in the middle is the average for everybody. And the orange one is the people who did not answer the survey. And the bottom curve, which is very close to -- it's green or blue, I don't remember which, it's blue maybe on the bottom. Anyways, that's the ones who did answer the survey. And they're not identical, but they're real close, within 4 or 5 percent total.

And our statistical analysis says that they're not actually different at a 95 percent competence interval. So for our model here we're using mostly the data from the houses where the people answered the surveys, because that gives us what we need to know to make the model.

Okay. So once you know how much total water is used at each one of these fixtures how do you get from there to the hot water at the water heater, which is what we need to actually estimate to figure out how much energy was used. So these are the steps we had to do to process this data to get to where we want to be.

So first off, we have a set of things called distribution factors, distribution multipliers in the current hot water model that take into account the fact that if you have a big house and long pipes more hot water gets wasted sitting in the pipes, etcetera. So since these houses, we're actually looking at how much water was actually used at the fixtures, they include all of those waste factors.

So to get back to the hot water heater we first undid the distribution losses. Then we did, as I said earlier, we know showers are 105 degrees Fahrenheit so we calculated based on that. And we know there's a new standard for showerheads in California that will be in effect in 2017. And that reduces the maximum flow to two gallons per minute or less.

So we took all the shower flows and that calculated the amount of hot water was needed to make 105. And we also reduced the GPM on those that had a flow higher than 2 GPM. So we're converting these showers to new 2017 showers, basically. We're saying that the length of time is the same. People are still going to take a long shower or a short shower, but just the flow rate's going to be different. Now, that doesn't work if in fact, as somebody suggested, the new California showerheads are going to be so bad that people would jump out of the shower immediately, because they couldn't stand it anymore. But I think that's kind of unlikely.

Then for faucets we adjusted to a 50 percent hot water fraction and a lower overall flow rate, because the flow for faucets has also been reduced. It's not a huge impact on the way we estimated it for faucets, but it does have an impact.

Clothes washers, we have all the clothes washer events that were identified here. And so what we've taken from that is we've adjusted the amount of water to match the latest DOE Standards for clothes washers, which have a significantly reduced water demand than old clothes washers. So we assume that people are going do the same number of loads of wash, but it'll take less water. And we've assumed that it's 22 percent hot water, which is the fraction that's been measured in houses across the United States, in a similar study.

And the same for dishwashers, we've adjusted for the latest DOE Water Use Standard. Dishwashers are all hot water, so there's no adjustment for that.

And baths, we adjusted for 105 degrees Fahrenheit. So far, the Energy Commission hasn't done anything about bath efficiency. And I think this is an area where there probably needs to be a lot of work in the future. We think that if you made smaller bath tubs that would probably reduce water consumption for baths. And we think we should look at that.

UNIDENTIFIED SPEAKER: What's the bath?

MR. WILCOX: What's a bath? Well, interestingly enough, only about half of the single-family houses ever took a bath. So baths are not a big part of the standard occupancy.

So if you take all of this data from our 400 plus families, and you look at it based on water use for one-person families up through six plus -- that's the different lines on this graph here. The green line at the bottom is for one-person families, there at n equals 50. There were 50 one-person families in the data set. And they used an average of 18.1 gallons per day, total of hot water.

On the other end of the scale is the six plus, meaning families with six or more people. There were 25 of those and they used 60.8 gallons per day, or over three times as much hot water.

They all have sort of the same curve. But the curves are actually twisted and different. You'll note that the big families use a lot more water in the evening. The small families have a -- the one-person family has the big spike in the morning and almost flat the rest of the day and so forth. So there are differences in the pattern as well as the family size changes.

And then if you look at the end use average for all the houses, then all the total is the yellow on the top there, average for all of our entire sample, 33.7 gallons per day. And the showers are the green one, the biggest one there. Yeah, unfortunately the legend doesn't go with the lines, but the light green line there that's the next one down is showers; big morning peak, smaller evening peak. And then faucets, which is the magenta line there, which has the double peak use over the whole day. And then bathtubs, clothes washers and dishwashers are all much smaller end uses in this hourly picture.

So I wanted to go very quickly through the end use average of hot water by family size here just to give you a picture of how it changes and how different it is. These plots all have the same vertical scale in gallons per hour. And so the one-person family got an average peak in the morning, about two gallons in the peak hour, and there's showers and faucets and so forth.

If we go to two-person families the shapes changes slightly and the uses get bigger.

There's the three-person families, we have the most three-person families of anything. So there's -- I don't know, maybe it's the most two-person families. Anyways, there's quite a bit of data behind these.

And here we are, four persons, here we are five persons, and there's our six-person family which has showers in the morning, showers in the evening, almost the same peaks. There's actually more faucet use in the evening than in the morning, etcetera.

So these families are really different, depending on how big they are. And that affects the loads.

Another way to look at this is if you look at the gallons per day for weekdays, weekends, and holidays the interesting thing is that weekdays are the lowest, weekends are slightly higher, and holidays are the biggest use. So this has some interesting implications for TDV energy use, because there's not so much peak issues on holidays and weekends.

So those are all just averages. If you take all the houses together and average them what kind of answer do you come up? None of those patterns actually fit any particular house. And we're interested in trying to estimate how a heat pump water heater works in particular houses with real people. So what do those flow patterns look like? Well, here's one and this is straight out of that Aquacraft data. This is for actually a four-person house that we think is very close, fits into our typical schedule. But you see here are a bunch of individual intense draws of water. So there's some shower draws in the morning, starting at between 8:00 and 9:00, there's two or three showers there. There's a clothes washer load and so forth. And we go for hours during the middle of the day where there's a few faucet draws. And then we have another shower at 9:00 o'clock in the evening. Then we get a dishwasher load or another clothes washer load.

And so this is sort of the kind of a draw schedule we'd like to run the water heaters on, because that group of draws there in the morning is the one that's going to empty out the water heater and get it go into resistance heat. So we want to have that rather than that nice smooth curve.

So here's another house in the sample. And it's one day and you can see just it's completely different than that previous one. And there's some big shower draws and there's some very small other stuff and not very much happening.

So how do we get a set of these kinds of draw schedules that will represent the average total hot water use for a family for a three-bedroom house? And will have the right load shape, so that it looks like it's going to generate the right load on the electric utility for using an electric water heater and so forth? So I wanted to go through how we did that here.

So what we've done is we've assembled a set of draw schedules. And they're all an accumulation of real measured days from the measured houses in the Aquacraft Survey. We've adjusted the loads as I described earlier so that they represent a 2017 new house rather than the old houses that were measured. And then we have divided that data set up into subgroups by number of occupants, so we got a big group of measured days where there were three people in the house, and a different group with four people in the house, and keeping those separate.

And then for each subgroup we have the weekdays, weekends and holidays. And for each of those subgroups we calculate the total domestic hot water gallons per day for each monitored day. And then we divide that group into strata. So what we're trying to do here is get a representative diversity here.

So we say okay, we want to have one weekday from the top 20 percent of all the draws, one weekday from the bottom 20 percent of all the draws, and the other three from the middle groups. And so that way, we're going to get a day that's a big load and a day that's a little load and we mix those all together with more average loads. And in the end the idea is to get the average of all of that stuff to work out to be the average.

And we do that by trying different alternative sets of days and minimizing the route mean squared error as calculated as the difference between the hourly profile for the big average for that whole group, versus the average if you just had the five days you've got now.

And the gallons per day for each end use. So we're trying to make sure that we get the right amount of showers and faucet draws and so forth compared to the average for that end group. And we compare all these days using rout mean squared error. And then we end up with, for each number of people, so for three-person families-, we end up with a one-week schedule that's got seven days plus a holiday. So there's five week days, two weekend days, and a holiday for three-bedroom families, another set for four-bedroom families, etcetera.

And so we have these schedules for one-through-six-plus occupants. And then we assign those to our annual simulation calendar, using the fractional number of days that each one of those family occupies in this house with this number of bedrooms. So I recall that the three-bedroom house had two people 37 percent of the time. So we take 37 percent of the days, randomly distributed over the year on high TDV days, low TDV days, etcetera. And that has the three-person schedule. And so we have a set of fixed schedules by bedroom, each of which is a different mix of occupancies.

I'm afraid Mike isn't following, he's kind of -- anyway, so one of the key things here is that the same schedule is used for every three-bedroom dwelling unit, for every simulation, so you always get the same answer and then you do it again. The standard design has the same schedule as the proposed design, although that stuff is built into the software, so there's no variation involved there. The variation is within the model itself.

And so I wanted to show you, the one question is how good are these assembled draw schedules compared to the averages? So what you see on here is the three fat lines down at the bottom -- the black line is the average for the whole group, hourly, load shape, total water use for the whole group of one-person occupancies. The blue fat line is the average of the five weekdays, in this case for this group. And the orange line is -- if you take that five weekday group and smooth it over five hours instead of one hour at a time, which I think really represents what we're looking for in a load shape, you can see we got pretty close. The orange line's pretty close to the black line for one bedroom -- for one-person families.

And here's the two-person families, so now all those other spikes in the background are actual draws from real houses that occur in this very spiky and unsmooth way. But when we mix five of them together, we can end of up with an average hourly profile for the week that looks very respectively like the average profile for all of the two-person families.

So there's three-people families, four-person families, five-person families and six-person families. And, you know, as you see we get the different load shape for the six-person families that have a much bigger evening bump and so forth. That's all represented in this data.

Okay, so that's the loads part of what I wanted to talk about here. We've got that loads system now implemented and we're testing it. And now I want to move on and talk about the other part of the heat pump water heater improvement here, which is the improvements to the calculations for the efficiency of the heat pump water heater.

And as I said earlier, we're interested in heat pump water heaters in particular because of the ZNE goals. We think that energy factor by itself is not a very good way to estimate how much energy is going to be used in the TDV world for a heat pump water heater.

And we also urge that modeling in the interaction of the heat pump water heater in the home. Traditionally, heat pump water heaters have been installed inside the kitchens and house and in garages and in basements, so they actually interact with the heating and cooling requirements of the house. It may turn out that in California we put them in our garage, but that doesn't have much impact on heating and cooling, but that's at least potentially an issue.

So what we've done here is our goal for our software project for the last few years is to be operating in an open source world where we make computer software openly available to other people and they reciprocate. And we share development effort and we share the cost and we all benefit from that. And so this is a perfect open source project here.

The model we're using for heat pump water heaters was developed by a company called Ecotope in Seattle. It was funded by the Northwest Energy Efficiency Alliance, which is a large utility group in the Pacific Northwest. And this model is open source, and we've worked with the Ecotope team and adapted that model for use in the CBECC-Res Simulator in California. What that model is, is a relatively sophisticated engineering simulation of a heat pump water heater system. It's kind of on the same level of simulation that we're using for modeling houses with all of their mass effects and ventilation and all the interactive things that are going on. Although this is not as complicated as our heating and cooling loads models, but it's in the same kind of ballpark.

The compressor efficiency of the heat pump water heater depends on the temperatures that it's operating in. It uses a stratified tank model that looses heat to whatever environment the tank's located in. It has a heat exchanger and a backup heater that are explicitly being modeled. There's a control structure that controls when the resistance heater turns on. It runs on a one-minute time step, which sounds short but we're actually running a CBECC-Res on a three-minute time step, so it isn't really very different than that. And we now have this implemented and running inside of CBECC-Res.

This model accounts for different kinds of heat pump water heater designs. This diagram shows a couple of set of standard variants. The blob that's red at the top and blue at the bottom is depicting the tank of water that generally is hot at the top and the cold water that isn't heated yet is stratified and sits on the bottom, so you have this hot-to-cold stratification from top to bottom. There's resistance heating elements, generally one for the top of the tank, sometimes also one in the bottom of the tank, and how you operate those is key to how the thing works.

There are different condenser designs. The one on the left here has the condenser wrapped around the outside of the steel tank or the metal tank. And that's how the water gets heated. The one of the right has the condenser located inside in the water and that's how the heat gets transferred to the water. Each of those has a different kind of impact on the efficiency of the unit. And our anomaly handled by differences in the characteristics in the heat pump water heater model.

So the detailed models in this heat pump water heater model are based on laboratory data that goes way beyond energy factor. And there actually are calibrated models for specific heat pump water heater models. And so to get to that kind of a model, you need to know things about the input power to the compressor, depending on the temperature that it's operating in. You need to know something about the COPs, based on differences in temperature of the environment and the water. You need to know something about the control logic, tank heat loss rate, and how the heat's added back to the tank when the compressor runs.

All this has been collected by NEEA for a very large fraction of the current heat pump water heater models that are on the market. And that's what's being used inside the model.

So, for example, here's measured performance curves for a 50-gallon heat pump water heater. And this testing goes beyond the energy factor test in the green line up above there showing the test step. I can't see that the -- I need a bigger screen for old guys like me. But one of those lines is for a test at 50-degrees Fahrenheit. And the other one is for the standard DOE test at 67-and-a-half degrees Fahrenheit. And for both of those we end up with the COP and the electricity use and so forth. And that's part of the parameters that are put into the model.

There's a 12-node model of the storage tank, which each one of those 12 layers has its own temperature and is managed separately. At each time step in the simulation you figure out what the stand-by losses are and take the heat out of all the layers. And if there's a water draw present you take the hot water out of the top layer and put cold water into the bottom layer and move them all up. Keep track of what the situation is in each layer. And if the cold water hits the place where the thermostat is then that turns on the backup heat or the compressor, whichever is the control that we're talking about there. And each is a very simplistic look at how the thing operates.

And Ecotope spent quite a bit of time showing how this model works compared to laboratory data and field data. Here's a DOE 24-hour test pattern on a 50-gallon heat pump water heater. I think this might be the old test pattern probably, not the new EF test pattern, but --

UNIDENTIFIED SPEAKER: It's the new one.

MR. WILCOX: It's the new one? Okay. So you can see that the top set of graphs is the temperatures of the layers in the tank. The middle set of graphs here are the water draws, individual water draws sort of like the ones we've been looking at, and the bottom graph is the power that's used by the compressor. And the dotted lines are the simulated and the solid lines are the measured.

And when the water draws start happening over there on the left the temperature in the tank drops down, the compressor turns on and the water gets heated back up. And then you wait a while and then everything's fine, you draw some more water, and then you draw some more water. And the simulation it's pretty much right on for the energy was used there.

This is a standard DOE test sequence, right? You'll notice that the backup resistance heater never comes on. That never happens in the DOE test, so the energy factor has some limited ability to have something to do with that, predicting the performance in those conditions.

Here's a different DOE test. This is the one-hour capacity test where you figure out how much hot water you can get out of one hour. And everything starts hot up -- the same plots, everything stops, starts hot and you start the big bump up on the middle curve there as you start taking close to three gallons a minute out. And you do that for as long as you can get hot water I guess is probably what the rule is.

And so you can see that the tank temperatures drop and pretty soon the compressor turns on and you get down to that 500-watt level there or something. And that goes on for a while and then in this machine when the cold water gets up to the top then the compressor turns off and resistance heat turns on. And now you're running at 4,000 watts and you run 4,000 watts for the next 12 hours until you heat the tank back up with the controls in this model.

So that's the anomalous efficiency behavior we're attempting to account for here. That if your load is too big for the compressor to carry than you switch over and you become an electric resistance water heater and then you're at a completely different efficiency until things recover again.

Again, the simulation does a pretty good job of predicting when those things happen and what the energy use is.

And finally, here's a piece of data that sort of looks like that Aquacraft data. This is measured in an occupied house as part one of NEEA's studies. And it shows that this is a combination of a shower and some other load happening in this house and the green bar there or the green area is the energy use measured and the red line is the energy use predicted. And they're doing actually a very good job of predicting total energy use including the big spike up when the backup resistance goes on because the draw is too big, under this condition.

And there's a lot more measured data that's been used. There's a big validation study that was published a couple of years ago on this model and so I think that's a useful thing to look at. So that's all I wanted to say about simulating the heat pump water heaters.

So now -- so where are we here? Larry asked me to comment on the compliance results from this new system. Well, so the situation is that everything is running mostly complete, but not completely tested. And so we don't want to get everyone excited about things that are wrong, particularly if they're wrong optimistically or pessimistically or whatever.

So some observations I think are worth making here. It's my belief from doing testing and looking at the results here that the new model DHW loads are significantly more seasonal than the old model, than the current model. They have smaller summer water heating loads and larger winter water heating loads than under the current simplistic model. And so this has a lot of significance for TDV energy accounting in that the TDV energy factors are much higher in the summer than they are in the winter time.

And heat pump water heaters also have higher capacity meaning they don't need to use backup resistance as much and are more efficient in the summer time. When it's 105 degrees in your garage in Sacramento that heat pump water doesn't have to work very hard to make 125-degree water. And so that may turn out to be a big deal here, and particularly since TDV is the highest on the hottest summer afternoons. We have kind of an energy going here.

So as I say, we're not ready to say what the answer is yet, but I think that generally we can say that the annual TDV is in the new model is much lower than it is for the current heat pump model. And so I think that means that there's something going on here that we're going to need to pay attention to or make use of in California.

And the status here is the heat pump loads model I just described is finished. The heat pump water heater model is nearly finished. We're still doing some testing and cleaning up some issues with what happens when it divides by zero and input you didn't expect and things like that and where the software team is testing things right now.

The next step is to get the Commission to review the model and make sure nobody has a problem anything. We're now committed as of right now to having this stuff available for public review on the 15th. I think this will all work really well, because you can all shift over from TurboTax to CBECC-Res, you know, and not even slow down. And that'll be a smooth transition from one realm to another.

And then of course the schedule, as Todd had mentioned earlier, is that this software is scheduled to be certified along with the ACM Manual and so forth and released in June. So that's the ultimate schedule.

So questions, if we have time?

MR. FERRIS: Yeah, let's open the floor up to any public comments.

MR. HOESCHELE: Marc Hoeschele, Davis Energy Group, consultants for PG&E Codes and Standards. I have a bunch of questions, some of which may be too detailed for this. I won't go into them. But are you able to handle central heat pump water heaters, say for multifamily?

MR. WILCOX: No, not yet.

MR. HOESCHELE: Okay.

MR. WILCOX: I hope that's not -- actually, you should tell us that that's a big issue, because presumably you wouldn't be using a residential heat pump water heater for that purpose. So it's probably we wouldn't be using the simulation model for that.

But the other aspect to this is that at the moment the specific detailed hourly draw profiles -- once you get into a 50-unit apartment building then those things don't ever get through as peak spikes to the water heater, because you've got 50 units all doing it. And so you're really into the average case at that point.

And so we think that regular heat pump water heaters in a multiunit building are fine. If you're going to do something where you to need to have that kind of detail at the central system level, then we need to do something about blurring the loads better now, because otherwise you will get spikes coming right through to the central system.

MR. HOESCHELE: Yeah, and so that relates to another question, technology such as drain water heat recovery, I mean right now in multifamily --

MR. WILCOX: What?

MR. HOESCHELE: Drain water heat -- there might not be diversity in multifamily applications. We would see all the loads would be simultaneous. I mean, they'd shift back on top of each other?

MR. WILCOX: Yeah, we haven't -- we've looked at drain water heat recovery. It's not implemented in this version of the model, so we haven't looked at that very seriously yet. But I think there are definitely some simultaneous issues there, for sure.

Well, let me just to make it clear, and maybe someone will answer this question, at this point we're only using this new heat pump water heater model for heat pumps. And maybe we'll end up using it for (indiscernible) electric resistance. But the plan is to continue to at least for right now, the version you're going to see in two weeks for sure. It's going to have all of the old models for gas water heating and the other technologies, but the load model is migrating backwards.

So we're taking all the loads from the new load model will be converted and used for the loads on the old ones, so that actually the hot water loads are identical no matter which one you're doing.

MR. HOESCHELE: Yeah. And are shower durations variable when we go to discrete draws?

MR. WILCOX: Well, there are shower variations built into the load model. And we're assuming that --I think the current assumption is that we're not doing anything to change the length of showers in our efficiency measures. We're set up do that you can say how many gallons per minute a shower is and change that, but duration will be fixed. The way it's set up right now the duration is fixed, although anything is editable with enough.

MR. HOESCHELE: Sure. MR. HOSHLY: Sure. And then the last question is CO2 water heaters, are they at all applicable or being able to be modeled with this?

MR. WILCOX: So Marc's asking about a special category of water heaters that use carbon dioxide as the refrigerant. And there is one manufacturer that I know of, Sanden in Australia. And their units are starting to be imported to the U.S., I understand. And there are two Sanden models in our library, implemented in the simulator. It's one of the things we're trying to clarify is what if any of the limitations are on that model.

But while we do have the model (indiscernible) stuff and so forth there. There may be some limitations on CO2 that we've started hearing things about like high temperatures, we may not be able to use them in real high temperatures. We're having a meeting tomorrow to try and figure this out, actually.

MR. HOESCHELE: Okay. Thank you.

MR. SELBY: Brian Selby from Selby Energy, just a question regarding the standard design for the analysis software. If somebody were to use one of the heat pump water heaters, currently the standard design for 2016 Standards would be a .83 energy factor tankless water heater. Would the technology change to the standard design would be a heat pump water heater if somebody used this new -- or would it still be the gas tankless water heater.

MR. WILCOX: To my knowledge, there's no change to the standard design for the 2016 Standards, which we're talking about here. And so that's what's implemented in the software.

MR. SELBY: Are there any talks about changing what the standard design would be, based on the technology for 2016?

MR. WILCOX: There's a lot of people who have thought a lot about that, I know. No, but as far as I know we're starting to work on the 2019 Standards soon here too. So there's lots of talk about things that might get changed for 2019, but for 2016, that's already in the books and adopted and it would take a pretty big change to change that I'd say.

MR. SELBY: Yeah, cool. Thank you.

MR. NESBITT: George Nesbitt, HERS Rater.

So if I get it right, my three-bedroom house with just me in it means I'm an old person?

MR. WILCOX: Well, the real case that I like to talk about is if you look at the RASS Survey I think there are seven children, less than five years old, living by themselves in a studio apartment. So, you know, you're nothing, George.

MR. NESBITT: In my neighborhood that could happen. (Laughter) What year RASS did you use; what version of the RASS?

MR. WILCOX: 2009, the last one.

MR. NESBITT: Okay. So domestic hot water, certainly in multifamily it's long been the case that that's been a pretty dominant part of your budget. And for high efficiency homes, it's also been the case previously.

Question on multifamily, you talked all this study with single family. To what extend are these load patterns or amounts, hot water draws, going to be used for multifamily or is that not changing?

MR. WILCOX: No, and I didn't actually probably explain it well enough, but the intension here is to use the same draw schedule by family size for multifamily and single family. But the number of people in a two-bedroom dwelling unit is different in multifamily than it is in single family, so there'll be different patterns of occupants by bedrooms.

This is maybe stretching things a bit, it would be great if we had a similar measured data study on hot water use in multifamily. But there isn't any such thing that I know of, partly because of most multifamily buildings don't have a unit-by-unit water meter. So there's very little way to measure this kind of data in a multifamily context. It takes a much more expensive approach basically.

MR. NESBITT: So it would seem that one of the effects of what you're doing is probably be rather than your budget going up with house square footage, is it'll be a flatter line and based on bedrooms, which we don't define occupancy in the software, we define number of bedrooms.

MR. WILCOX: That's right.

MR. NESBITT: And so what you're saying is that really the difference even between bedroom sizes is smaller, so a smaller house is essentially going to have a higher hot water use relative to what it used to be. And a bigger house may or may not. I mean that's sort of a net effect?

MR. WILCOX: Yeah, I know. That's one of the things that I will try and summarize, but haven't been able to yet, because it's kind of at the end --

MR. NESBITT: Because you don't have the results.

MR. WILCOX: Yes, but it's very complicated, because of disconnect between size of a house and number of bedrooms and that's really true in multifamily too as well.

MR. NESBITT: And perhaps we need to define bedrooms as like LEED for Homes does. If you could sleep in it, it's a bedroom, because of that kind of manipulation. But anyway, a couple of things I want to hit on with the standby loss on commercial water heaters. Pre-CBECC, it was pretty sensitive results. I haven't really looked at it to see how sensitive that still is, but it's an easy place to manipulate.

And I've seen that lots of times, which really gets down to the issue of having a defined water heater database in the software, rather than the user putting in all the inputs and different users putting in different inputs for the same piece of equipment.

Appliance and fixture efficiency, less important for the new home. Washing machines and dishwashers, there is some variation even that meets code, but when we get to the existing homes far more important. And I just want to say that today, we are actually talking about the existing home and HERS Rating System, whether we want to acknowledge it or not.

And I guess just one other broad comment about complexity. More accuracy and yeah more complexity is great in some places, but I think one of the issues with

CBECC-Res and CBECC-Com is longer and longer calculation times and whether really in our compliance tool, whether we need more complexity, especially when it means more processing time and whether we can't come up with simpler ways.

MR. WILCOX: Yeah, our experience so far is that this doesn't really slow the calculation down that much. It's pretty efficient.

And George, in applications for older existing buildings, it seems to me that there's no problem producing a set of hot water loads from the same data here that we'll have appropriate numbers for older houses. And we have the data for older houses, so that's part of the intention. But for the 2016 Standards it's all new houses.

MR. NESBITT: Yeah. Well, actually part of that comment is really we don't actually recognize how much hot water is used. And so in older homes, older fixtures, higher flow rates, there's an energy savings by saving water.

MR. WILCOX: Uh-huh.

MR. NESBITT: Of course, some of that also gets into lower flow and higher distribution losses.

MR. WILCOX: There are an amazing number of 30-minute plus showers in that data set that we have here. So just think about how much water that is.

MR. DAKIN: Bill Dakin with the Davis Energy Group, as part of PG&E's Code and Standards. I had a question. In one of the slides you talked about you had that the clothes washer assumed the latest federal standard, so that makes me think that we're assuming that all clothes washers are going to be assumed to be new; is that true?

MR. WILCOX: No, and actually I feared Eric was going to beat me up about that one. And we probably need to adjust, because I don't think we actually have -- I'm not sure you ever gave me the right number to use for that. What fraction of the --

MR. RUBIN: 72 percent.

MR. WILCOX: What?

MR. RUBIN: I think it's 72 percent are older.

MR. FERRIS: Are old? Okay, so yeah we may be underestimating the (indiscernible)

MR. DAKIN: Yeah, I know that the Energy Solutions has done the work on that, what their percentage -- and just wanted to make sure that that was being coordinated.

The other question was regarding heat pump water heaters, is there going to be -- for the user in the CBECC tool, is there going to be just listed manufacturers, because the data there is much too complex for a user to find.

MR. WILCOX: Yeah. Well, we haven't actually figured out what the end is going to be here. The plan is that there will be an energy factor input of some sort, because of NECA (phonetic) Rules and so forth. We need to have a simple energy factor input we think.

And exactly how that will translate to what gets simulated is not completely clear yet. We spent some time, as you probably know the Ecotope guys spent some time to try to figure out a generic energy factor input for various levels. And we haven't had a chance to really test that stuff and look at the other alternatives yet, so that's kind of up in the air yet about how it's going to be done.

So I think it'll be sort of like the situation with the air conditioners two cycles ago, where if you didn't want to report your EER, then you had to assume you had a low EER. And if you wanted to get credit then you had to be listed and you had to do that. And I think the same thing will happen with water heaters, but that's not a topic we've figured out yet.

MR. DAKIN: Thanks.

MR. FERRIS: Okay. So we're going to -- Jon, did you want to (indiscernible)?

MR. MCHUGH: Jon McHugh, McHugh Energy.

Bruce, I wanted to understand a little bit. You had some slides there where you're showing the, I guess there are five different load profiles and then you were then sort of it looked like averaging those. And I was wondering, it almost looked like the peaks were decreasing and that there was maybe some smearing that occurs? Does that actually result in less operation of electric resistance of the heat pump water heater than might happen under an actual day, versus the load profile?

I mean when I looked at it I saw the (indiscernible) mountains in the back and then I saw sort of this little humped curve in the hill down below, which I think what you're using for your model, right? Or --

MR. WILCOX: No, no. So what we're using for the model are all the peaks in the background. And so we're actually taking real days with all their real weird spiky peakiness and we're putting those together to make a profile. And you'll get this string of days in your simulation.

But what we were trying to show was that we could do that and we could still end up with the average load profiles for that number of people. And so because we want this to end up, if you do the simulation, you should get the average gallons of hot water per day that you would really get in a three-bedroom house, right? So you have to work it both ways in. And I think the way we've worked it out is you can actually get very close to the right answer for both ends.

MR. MCHUGH: Okay. So what you're saying is you're going to -- moving forward in the ACM, you're going to have these peaky load profiles in there. I was interpreting it just the opposite direction. Okay, now I understand. Thank you very much.

MR. WILCOX: Yeah.

MR. FERRIS: Okay. How many more people do we have in the audience that would like to comment, one? Why don't you come on up. And then we're going to open it up to people who are participating online.

MR. TORVESTAD: Garth Torvestad, with ConSol.

Given where your presentation shared today in terms of the annual TDV going down considerably for the heat pump, and based on my understanding of how it compares to the current prescriptive of.82 gas tankless, does it then begin to outperform in several climate zones? And then would it be on the table for the 2019 Code; and if so, how would you redefine it by -- if energy factor is inadequate then how would we define what that new prescriptive code would be?

MR. WILCOX: Very good questions, Garth. So I think the answer is maybe. I mean, as I said we don't -- I've looked at some results that might lead you to think exactly like just what you said. That now it might start to be competitive, it could be a code requirement, could be -- anyway, so but before we announce this new kind of radical departure I want to make sure that everybody's has had a chance to look at things and check them out and make sure it's -- you know, you're going to get a chance to look at this and so forth.

MR. TORVESTAD: That'd be great.

MR. WILCOX: So I'm not sure that's the answer, but it looks like it might be, even against instantaneous gas water heaters.

MR. TORVESTAD: So does that mean there's a case study that -- case report that will come out, most likely focused on this. And then at that time we can --

MR. WILCOX: Yeah.

MR. TORVESTAD: -- that's when we find out?

MR. WILCOX: Well, and if it turns out that way you guys will have a great new measure for the 2016 Standards too, right?

MR. TORVESTAD: Right, for '19. Anyways, thank you.

MR. FERRIS: Okay, for those of you participating on the phone, we're going to open up the line to Brian Zimmerly.

MR. ZIMMERLY: Yeah, hello. Can you hear me?

MR. FERRIS: Yes.

MR. ZIMMERLY: Great. Yeah, Brian Zimmerly with SolarCity, thanks for the great info today.

I had a question about whether or not there's any work being done to develop alternative draw schedules on modeling grid-enabled water heaters? Like if the energy consumption in a given time period can be decoupled from the actual hot water draws in that same period, with potential significant benefits from that TDV perspective? And if not I mean, what would be the appropriate forum to engage on that topic for the 2019 Code?

MR. WILCOX: Well, the answer I think to your questions, in case people couldn't understand, I think the question had to do with modeling for grid-enabled water heaters which are water heaters that have an Internet connection and can be operated, I think at least the simple story, is by your local utility to help do demand response stuff.

And of course we're very interested in that topic going forward, especially for 2019 where people are talking about batteries and this is another way to do a battery, is with a water heater, which is what those machines are. But there's no current rules or any infrastructure in the California Standards to support grid-enabled water heaters or any special credit for them, to my knowledge. The 2019

Standards going forward, I think there will be all kinds of opportunities for people to suggest measures and make proposals and so forth.

And you should -- Mazi Shirakh is sitting right here in the front row at this workshop. And you can probably find his name online and send him an email if you'd like to communicate about that.

MR. ZIMMERLY: Yes, very good. Thank you.

MR. FERRIS: Okay, Eric Turowski? (phonetic: 1:37:00)

MR. TUROWSKI: Yes, I've got a question, not necessarily about heat pump water heaters, but have you given consideration in any of the models to kind of weigh the pros and cons of water efficiency and the actual product efficiency for the energy used as well as the water used based on different water heater technologies?

MR. WILCOX: I'm not sure exactly what you mean, but we're trying to pay attention to water use in California all the time and the Commission's had proceedings on that in the last year. And our business here is looking at the energy use, so I think we're paying attention to that stuff. But if you're talking about specific interactions, I'm not sure what you're talking about.

MR. TUROWSKI: Yeah. What I'm really referring to is, for instance, tankless water heaters. You don't get necessarily hot water immediately out of the -- if there's been a long period of time between water draws you have what you call a cold water sandwich. So there's a period of time before you're actually receiving hot water from the water heater versus a tank type water heater, which is maintained at whatever temperature.

So there's a disadvantage of that technology of your typically using more water over time, overall, because it's actually tepid in addition to the benefit of using less energy, because its perceived as a more efficient product.

MR. WILCOX: Okay. Now, I understand what you're talking about. That's been a topic for a number of years at the Energy Commission. And I believe there's a factor in the current water heating calculations that attempts to adjust for some of that kind of differences.

Marc, do you want to -- Marc Hoeschele is going to say something about that. He was responsible for developing that.

MR. HOESCHELE: Marc Hoeschele, Davis Energy Group.

So there is, within the current code, there is a 10 percent hot water savings associated with recirculation systems. So that will reduce the hot water leaving the water heater. There's a separate accounting for the energy of the recirc loop. (phonetic)

There is no distinction between tankless and storage water heaters. And there have been a few studies over the years, one of which we were involved in, one in Minnesota, where there were houses where both pre and post-monitoring with storage water heaters and with tankless, and there wasn't any clear indication that overall consumption changed in that comparison.

Usage patterns change when people go to tankless. They drop a lot of the small draws that are challenging for the unit to meet. But there isn't enough data really to say that there's definitively a different usage between the two water heater types.

MR. TUROWSKI: Okay. And then was there any consideration of comparing your draw profile that you looked at compared to the new UEF test procedure that is technically in effect for DOE?

MR. WILCOX: Well, the UEF procedure is a laboratory test that's intended for ratings. It doesn't -- I mean, what we're looking for is how much water people use in their houses. I think that's a completely different subject, in my opinion, actually. But did we consider using the UEF for our draw schedule, no.

MR. TUROWSKI: Okay. All right, thank you.

MR. FERRIS: Okay. Mark Essler, we're opening up the microphone for you.

MR. ESSLER: This is Mark Essler with MegaWatt Consulting. (phonetic: 1:41:00) Thanks for taking my questions. I appreciate all the work that you guys are doing here. This is very through and all very interesting.

In particular, I thought it was interesting that the heat pump water heaters look more attractive now from the TDV perspective. It's a really interesting finding there.

Along those lines, I was wondering if you have looked at whether the new draw schedules or the new load profiles are in any way, shape, or form also benefit or hurt some of the technologies that are used for water heating. In part, I think the previous person asked a question about that.

The only way I think there could be a difference is if the simulations methods that you're using for other technologies considers the cold water sandwich and distribution other things like that, which I don't know of whether it does or not. So I just thought I'd ask the question anyway. Have you compared all the new draw schedules with respect to whether any technologies benefit from it or get hurt?

MR. WILCOX: Well, we focused on the load model here, the amount of water that's being used by houses and the families of different sizes. There's this whole other set of factors that relate to how much more water do you use if you have an inefficient piping layout, or as Marc just said how much water do you save if you have a recirculation pump of various kinds? And we have a whole system set up to account for that in single family, multifamily, etcetera, etcetera, with lots of different options and all those things are in play.

But we didn't consider that in this new draw schedule. And we're assuming at this point that all of those factors are going to remain the same and get applied to all these systems, both heat pump water heaters and non-heat pump water hearers, equally.

MR. ESSLER: Okay, but then considering all that, is it not so that if you apply a new draw schedule and a new load profile the total energy consumption of one technology versus the other, under otherwise identical scenarios, could change?

MR. WILCOX: The intention here is that all water heating systems will use the new loads model, so even the ones that are using an energy factor model will construct their loads from the same draw schedules that we're using for the heat pump water heaters.

I mean, the fact that you have lots of large loads simultaneously or spaced out or whatever doesn't affect the current model for a gas tank type water heater at all. But we're going to make sure that the amount of hot water being heated is identical regardless of what the technology is. Put it that way.

MR. ESSLER: Okay. Thank you.

MR. FERRIS: Okay. So now we're going to switch gears. I want to introduce Eric Rubin from Energy Solutions. He's going to talk about our work on miscellaneous electric loads.

MR. RUBIN: Thanks so much for that intro. Good morning, I'm Eric Rubin from Energy Solutions. And I'm presenting today on behalf of the Statewide Utility Codes and Standards Team, which is comprised of PG&E, SCE, SoCal Gas, SDG&E and LADWP. We appreciate the opportunity to participate in efforts to update the ACM Reference Manual, which is a critical step to achieving our statewide ZNE goals.

For the past 18 months we've worked closely with CEC staff to develop the plug load and lighting algorithms I'll be presenting today. I want to thank CEC staff for working so collaboratively with us throughout the process, and for their commitment to the quality of these models.

So this slide summarizes the topics I'll be covering today. I'm going to begin with some background on the plug load and lighting algorithms that we're proposing updates to. Then I'll talk about our proposed methodology for determining the Annual Energy Consumption, or AEC of plug loads and lighting. Then I'll present the AEC results and how those compare to the AEC estimated by the old equations. And finally, I'll talk about load profiles, for plug loads and lighting, which is how the energy use is distributed over the course of the day and the year.

So right now, the building software uses rule sets that can be found in the 2008 California HERS Technical Manual to model the annual plug load and lighting energy use. And these rulesets estimate AEC for various categories of plug loads and lighting based on home size, measured in either number of bedrooms or conditioned floor area. And those two charts at the bottom of the screen right there, that is the estimated annual electricity use on the left and therms on the right as a function of home size. The X axis ranges from zero bedrooms, which is a studio, all the way up to five bedrooms. The algorithms continue indefinitely, but that's the vast majority of homes.

The rulesets that we're proposing updates to also have assumptions for daily and seasonable load shapes, and I'll talk more about those at the end of the presentation.

The two main impacts of the rulesets that we're proposing updates to, both the AEC and the load profile assumptions, are that they affect the internal gains estimated from plug loads and lighting. And that's because equipment and lighting produces heat. And that heat, in addition to the heat from the sun and from the body heat of occupants constitutes the internal gains that then affect the HVAC calcs in CBECC-Res.

Also, of course, the energy use from plug loads and lighting and what their timing is affects the Time Dependent Valuation or TDV of plug load lighting and energy use. And that affects the Energy Design Rating and is particularly important, because beginning January 1st, 2017 there's going to be a CALGreen voluntary ZNE Tier. I'll talk more about the importance of that in a moment.

So as you'll see in the coming slides, the current algorithms and the ones that we're proposing are based on a relatively narrow set of predictor variables.

In general, these algorithms can really only take as inputs things that observable features of a newly built home. Which is to say many of the things that would be nice use as predictor variables, such as how many occupants there'll be or which devices they'll be bringing, how many TVs they will be bringing, historical billing data even, those things aren't available to us for newly built homes. So instead, we're generally predicting based on home size, which we operation-alize as number of bedrooms or floor area.

The current 2013 ACM methodology for estimating AC relies heavily on the RASS 2009 CDA. Bruce talked a little bit about RASS. That's the Residential Appliance Saturation Survey, which was a 2008 mail-in survey of 25,000 California households.

Respondents were asked about the characteristics of the house like bedrooms and floor area, about the people who live in the house, how many there are, their income, demographic information and the energy-consuming devices they own: so how many devices, what type, or what configuration of the refrigerator, size of devices, how often they are used.

The CDA part of the RASS 2009 CDA stands for Conditional Demand Analysis. And that is a statistically adjusted engineering analysis that was conducted in order to estimate the AEC for each of the end uses in the home. So I think there's sometimes the misconception that the energy estimates that come out of the RASS CDA are sub-metering. In fact what it is, is that for every person who responded to the RASS Survey the analysts were able to get their whole home energy use. And then using statistically adjusting engineering methods, just aggregate that whole home energy use into estimates of the energy use for each of the constituent end uses. And that was done in large part using the survey data.

So this visually shows how the RASS 2009 CDA was used to strongly inform the current AEC Rulesets. On the top is the RASS 2009 CDA average AEC estimate for homes of varying sizes, again ranging from zero bedroom or studio on the left to five-bedroom on the right. A couple things you can notice is that the results of the RASS CDA support that larger homes have more energy use for each of the constituent end uses.

You can also see that the proportions of the different colorful wedges are relatively similar across the RASS 2009 CDA and the 2013 ACM. And again, that's because the current method relies heavily on those results.

There's a few key motivations for updating these results. One of the main ones is that an accurate estimate of plug load lighting and energy use is key to sizing the PV systems correctly for homes that will meet the CALGreen voluntary ZNE Tier, which as I mentioned earlier goes into effect January 1st, 2017. And so just to complete that circle it's because the TV of the PV needs to be equal magnitude to the TV of the energy consumed by the home. And since plug load and lighting is such a large portion of energy use of the home -- in 2008, it was 81 percent -- it's important that we have the TDV of those energy uses right.

The 2013 ACM Rulesets weren't sufficient for meeting this goal for a few key reasons. One is that many people believe that they overestimated the plug load and lighting energy use for large buildings. Also they have very simplified load profiles, which don't reflect the unique timing of different end uses. And they relied on the RASS 2009 CDA, which is going to be a decade old by the end of the 2015 Energy Code Cycle. And it can't be very easily updated to reflect the new data.

So in accordance with those motivations our goals for the update are to update the rulesets to more accurately estimate plug load and lighting AEC and load profiles for homes that are built during the 2015 Energy Code Cycle.

Specifically, we want to take advantage of data from the whole period of 2008 to 2015 to account for updates to Energy Efficiency Standards, to establish a modeling framework that we can update on a regular basis as plug load and lighting technologies continue to change, and as data become increasingly available. We want to correct that overestimation of AEC for the large homes and make the load profile assumptions more specific to each end use and more reliant on sub-metering data and real studies.

So this flow chart here summarizes our general methodology for all of the individually-modeled plug loads. And that's things like refrigerators, dish washers, televisions, computers, sort of the top largest plug load and lighting end uses, sorry just plug load end uses.

Going from left to right we have our data sources. You can see that orange box there is the RASS 2009 Survey, not the CDA. And some of our data sources for determining efficiency assumptions were often used federal standards or the ENERGY STAR specification that we thought most of products would meet, beginning in 2017 or during the 2016 Energy Code Cycle.

The first calculation that we do is to calculate the unit energy consumption of each device in each home in RASS. So we're looking at this large spreadsheet that has all the raw data from the RASS 2009 survey. And it's got 25,000 rows, one row for each household. And for every household, we're calculating not what we think the UEC of those devices was in 2009, UEC being the Unit Energy Consumption of one device over the course of the year, but instead given those devices what would their UEC be during the 2015 Energy Code Cycle, given how efficient products will be in these coming years.

So to do this, we're taking two things from the RASS data depending on the particular end use we're modeling. We're taking the usage patterns, so for example how often is the device used per week. And the device characteristics that could be things like the size, the configuration, the features. And combining that with an efficiency assumption, which again comes from federal standards or from an ENERGY STAR specification that we think is most representative. And through engineering calculations combining those three things, we can estimate the UEC of a given device or a given end use, for a given house in RASS.

So then once we've estimated those UECs, we multiply that by the saturation in each of them, which is for each home in RASS the respondents report how many devices they have. And the UEC times the saturation is what we call the AEC, or the Annual Energy Consumption of all devices in that home for that product category, again in kWh per year.

At this point for all 25,000 homes in RASS we have an estimated AEC for the end use we're modeling if that home were constructed during the 2016 Energy Code Cycle. And we also know from RASS how many bedrooms that home has, so now we have these two really long columns of data with AEC and number of bedrooms. And we're able to conduct a regression analysis that captures the trends, in average, on how that calculated AEC varies with number of bedrooms. And that gives us our linear equation, which predicts AEC based on the number of bedrooms in the home.

Let me give an example, next. So this is dishwashers. It's an adaptation of that flow chart for a particular rather straight forward end use. Here, we're using the RASS 2009 Survey data and the 2015 Federal Standard. We're using the 2015 Federal Standard because we assume that dishwashers will be new in a new home and therefore they'll be compliant with that Standard. And we're combining those two things, the efficiency from the Standard and the usage from RASS, in order to estimate UEC.

So just to unpack that a little, we have the weekly uses in RASS, we multiply that by 52 and then we get the uses per year. We multiply that by the energy per use from the 2015 Federal Standard and that doesn't include the hot water heating use. That's just the machine energy use, because we don't want to double count the hot water heating and so the uses per year times the energy per use is the energy per year for one dishwasher.

And actually for dishwashers the UEC is the same as the AEC, because we're still paring RASS so we're only looking at the homes that have a dishwasher. We actually do that for a number of the end uses. For example, it the same for clothes washers and clothes dryers, not televisions, not computers, not set-top boxes, but the devices where you're going to tend to have one device or no devices.

So now we have an AEC for every home in RASS. We know the number of bedrooms in each of those homes. We conduct our regression analysis and we have an equation that predicts AEC for dishwashing is a function of the number of bedrooms. And that's able to capture that average trend in how dishwashing energy tends to increase with bedrooms, because weekly uses tend to increase with bedrooms.

An important caveat here is that this equation will likely not predict an individual household with any great precision. That's because there's so many other factors that affect the amount of dishwashing that someone does in addition to the number of bedrooms in the household. However it is effective at capturing the trend in the averages and predicting the average AEC for a given number of bedrooms.

This equation is only applied to homes that have a dishwasher installed or will have a dishwasher installed. If there's a dishwasher installed and there's information from the energy guide label available -- the FTC requires that all dishwashers have energy guide labels -- the information from that label can be used to override the default assumption based on bedrooms. And that's good because the default assumption is based on the 2015 Federal

Standard, assuming that there's minimum compliance with the Federal Standard. And therefore builders can get credit for the actual efficiency of their dishwasher, which should be at least equal to the Federal Standard and probably greater than that.

This slide summarizes for all the individually modeled plug loads, our default efficiency assumptions and whether or not we can override them with an energy guide label. On the left is actually our assumptions about the age of the devices and that's a necessary precursor to then making an efficiency assumption.

We assume that the ovens and ranges and dishwashers are going to be new in a new home. The televisions, computers and computer monitors are assumed to be as old as those devices in existing homes. Or another way of thinking about that is we're assuming that they tend to be brought over from the existing home. And then everything else is assumed to be a mix of ages and we generally determine that mixed, based on looking at the RASS data for only new homes and looking at the distribution of device ages.

So once we have those age assumptions we're able to determine the energy efficiency default assumption. We can do that by asking what Federal Standard would have been in effect when this device was manufactured. So, for example, for dishwashers we assume it's new, and so the 2015 Federal Standard would have been in effect when it's manufactured during the 2015 Energy Code Cycle. For those products that have a distribution of ages we're using a blended average of the Federal Efficiency Standards, because some products will have -- for example, for refrigerators some products are new enough that they will be compliant with the 2014 Federal Standards. But some of them are older and thus will meet the 2001 Federal Standards.

And then all of the light pink cells there are the end uses that we assumed meets Federal Standards, those are the ones that have DOE Standards applying to them. The others are capturing a market average for the 2015 Energy Code Cycle. And those are generally based on the ENERGY STAR specification that most of the market will meet during those years.

The final column there on the right is the energy guide override. And again if the energy guide label is available, we would use information from the label to more accurately estimate the AEC of the device and to give builders credit for installing devices that are more efficient than the federal minimum. We have energy guide override for all of the end uses that are required to bear the energy guide label. So that's the dishwasher, the primary refrigerator, and the clothes washer.

Or I suppose more specifically we don't have it for the other refrigerators and freezers, but the non-primary refrigerator and freezer -- those things may bear an energy guide label -- but the way that we've treated the secondary refrigerators and freezers is as something that residents may bring over without necessarily the knowledge of the builder, might be installing it in a garage, and we're capturing a weighted average tendency for people to bring those things. So for example, in a three-bedroom home, it seems that about 25 percent of people will have a secondary refrigerator. And then maybe something happened after the fact of construction, so there's no energy guide over ride.

Here's the proposed methodology for estimating the AEC of lighting. In some ways it's quite similar to the individually-modeled plug loads although there are some necessary differences. We're not using the RASS data, because people can't really self-report with the necessary detail of full inventory of all the lights in their homes. So we're using CLASS 2012, which is an onsite lighting audit of 2,000 California households in which we get a full picture of all of the different lights that were in all of the different rooms in homes of varying sizes.

And then our efficiency assumptions are -- again it's the idea of applying modern efficiency assumptions to older inventory data in order to determine what would be the energy consumption of these devices in a home built during the 2015 Energy Code Cycle. So we begin with the CLASS 2012 data, which tells us about the number of lights and the type of lights in each room of the home. And then that allows us to determine how much light output was in those homes in 2012, in each room.

We're assuming that the light output was going to stay relatively constant from 2012 to the 2015 Energy Code Cycle. And what's going to change is that the light sources will become more efficient. And I'll go more into our efficiency assumptions in the next slide.

So we have that lay output calculated. And we then have to determine the assessed lumens. Then we have to determine the lumens per watt of lighting and I'll go into that next. And from that, we can figure out the 2017 or the 2016 Energy Code Cycle wattage that we'd expect in each room. We'll multiply that wattage by the hours of use in each room type, coming from KEMA 2010 Light Logging Study. And that gives us the kWh for each room in the home, which is the AEC or Annual Energy Consumption.

Then we do the same thing that we did for the individually-modeled plug loads, which is to relate that AEC to home size. Here we're using conditioned floor area instead of bedrooms. That's the data that's available in class and also the number of light fixtures tends to vary more directly with the area that you need to light rather than the number of bedrooms. And that gives us an equation that predicts the AEC for lighting as a function of the floor area.

We have three separate equations. We have one for interior lighting, one for exterior lighting and one for garage lighting. So this slide provides more detail on the efficiency assumptions. We have separate efficiency assumptions depending on the luminaire type and on the location. Luminaire type being portable or hard-wired luminaire, and the location would be those three space types we model for the interior, the exterior and the garage.

There's probably more detail on this slide than is worth going over right now, but this is here for your reference. Basically what we're doing is we're estimating, for each of these luminaire types, in each of these locations, what would be the fraction of different light technologies: that's LEDs, CFLs, Halogen, linear florescent. And then what would be the efficacy of those light sources during the 2016 Energy Code Cycle. And then a weighted average of those two gives us the average efficacy of lights of that luminaire type in that location.

And one of the most significant assumptions that we've made in these models in terms of the results, which I'll get to later, is that we're assuming that hard-wired lighting will all be high efficacy during the 2016 Energy Code Cycle. And that's because Title 24 Residential Lighting Requirements will mandate just that, that all hard-wired luminaires be high efficacy. And that's what yields about that 80 lumens per watt assumption that's in for all the hard-wired rows there.

In addition to the individually-modeled plug loads, we have everything else. The remainder is a really diverse set of end uses that ranges from tablets, to microwaves, to vacuum cleaners, electric razors, etcetera. So we have sort of a different methodology for this by necessity, because it's such a unique set of end uses, and can basically be distilled down into three steps.

The first is that we estimate the AEC of the so-called residual MELs in 2013. And here we're doing a bottom up estimate, so we're estimating AEC as the sum of all the constituent end uses. We can never estimate based on every single end use there is, but we're looking at the 98 most prominent of these remaining MELs.

Our two main data sources here are a 2014 net analysis led by SCE that looked at the energy consumption of residential residual MELs and major consumer electronics. And that has a list of the top 20 of these end uses that constitute what the authors thought was the majority of AEC for this category. And then we add to that the AEC from the DOE technical support document for battery chargers, external power supplies. And use some subtraction to avoid double counting, but we're essentially now adding all of those smaller end uses to fill out and we now have this 98 of the most prominent MELs.

Because those data sourced pertain to 2013, we need to account for growth in residual MELs from 2013 to 2017. To do that we applied a 4.3 percent annual growth rate, which comes from the 2013 CEC Demand Forecast for the miscellaneous category. So now we have an estimate of the average AEC for residual MELs in 2017. We need to determine how does that scale with home size or specifically how does that scale with number of bedrooms?

And unfortunately, there is no reliable method for doing this, based on the currently available data. So the assumption that we made was that residual MELs scaled in a way that's similar to scaling of major consumer electronics: the TVs, the set-top boxes, the computers and the monitors.

Unfortunately, when we did some bench marking of this against other major models we see that not only is the magnitude of the result very similar to the others, but the scaling with number of bedrooms is also surprisingly similar. And so specifically, we were benchmarking against the RASS 2009 CDA, the existing 2013 algorithms, the Building America 2014 House Simulation Protocol, and the RESNET 2013 equations. And there we're looking at the residual MELs, plus the consumer electronics, in order to standardize and make sure we're looking at the same uses. Because everyone has a different interpretation of what's residual.

Okay, here are some results. We've got the ho-hum home results now for an average three-bedroom home, with all electric appliances. So it's got an oven range, clothes washer, clothes dryer to an electric clothes dryer and electric oven and a dishwasher, all those different appliances. On the right we have our proposed rulesets. In the middle is the current 2013 ACM Rulesets. And on the left is the RASS 2009 CDA, that Statistically Adjusted, Engineering Analysis.

And so one thing to note is that we have more individually modeled end uses than in the previous -- the existing 2013 ACM -- and one benefit of this is it should allow for an easier update of the models, because we'll be able to -- lets say if we got new data on televisions we can apply that to the televisions model whereas before there was no televisions model.

This is another thing that will allow us to more easily update, and it pertains to a slide a bit earlier, is if you recall that flow chart that has all the different constituent components connected together to result in our final AEC equation? Any of those components can be updated to reflect new data, so for examples if we get new information on average usage, on efficiency, on device characteristics, or saturation number of devices per household, we can adjust each of those components to keep this as a living model that updates with changes to the technology.

Back to the results, it's interesting to note the plug load energy use actually has not changed that much. If you look up to the top of the large blue bar, which is the residual MELs, a fairly similar height there, the biggest difference between the proposed 2016 Rulesets and the existing 2013 Rulesets is the interior lighting.

There's a number of reasons why interior lighting AEC is going to be much less during the 2016 Energy Code Cycle. I'd mentioned the Title 24 Residential Lighting Requirements for Hard-Wired Lighting. There's also Title 20 requirements that will affect small diameter directional lamps, LED lamp quality, and general service lamps. And all of those will also reduce energy consumption for interior lighting.

This slide's really similar to the previous slide, however it's showing a three-bedroom home that has a gas oven, gas range and gas clothes dryer. The difference between the kWh estimated in the proposed model and the existing model is slightly less here.

The difference between the therms is proportionately more than the difference between the kWh. That difference comes from a decrease in oven therms and also in clothes dryer therms. The clothes dryer therms is more significant than the difference in oven therms. For clothes dryers the model assumes that clothes dryers will be minimally compliant with the Federal Standard in effect at the time of manufacture. And so based on the age distribution of clothes dryers for new homes in RASS that means that we're assuming that 28 percent of dryers will meet the 2015 Federal Standard and 72 percent will meet the 1994 Standard.

Here we see the whole home results and how it scales with number of bedrooms, again looking at homes with all the electric appliances. So for smaller homes, and like a studio is a zero bedroom all the way through about two bedrooms, the proposed 2016 ACM and the current 2013 ACM Rulesets have a very similar type of kWh. We see the divergence more for the larger home sizes.

It sort of speaks to that earlier motivation, which is that there are concerns that the current equations overestimate's AEC for the large home sizes, so this appears to correct that.

One thing you may note is that in our proposed equation, which is that bottom teal line -- I guess just take a moment -- with the bottom teal lines, the proposed 2016 ACM, the red line just above that is the existing 2013. The orange is just the average AEC results for homes of different bedroom sizes from the RASS 2009 CDA. And the blue at the top is the national RESNET 2013 Algorithm.

So one thing you may notice is that our proposed algorithms, which are at the bottom, a half off at seven bedrooms meaning that an eight-bedroom or a twelve-bedroom home or what have you is assumed to consume no more energy than a seven-bedroom home or at least as much as. And that has a number of reasons behind it. I won't get into all of them here, but one of the chief ones is the lack of data available for these extremely uncommon homes, which represent less than 0.1 percent of California homes.

As before, this is similar to the previous slide but showing a home with gas oven, gas range and gas dryer. The difference in kWh is smaller. And so they're very similar all the way through a three-bedroom home. And then again we see that for larger homes we're not estimating as much AEC as the previous models. Again, that could be correcting for that overestimation that was earlier an issue. And then the therms are lower across the board, but particularly for large homes.

Shifting gears here a little I'm going to talk bit about the updates to the load profile methodology. The 2013 ACM Rulesets have separate hourly schedules for interior lighting, exterior lighting, refrigerators and then all other equipment. And there's one set of seasonal multipliers, which are applied to most end uses: refrigeration and exterior lighting are just assumed to be constant across there, there's no seasonal variation there.

In contrast, the proposed 2016 ACM Rulesets have separate hourly schedules and seasonal multipliers for each end use, most of which are derived from more recent sub-metering studies.

These graphs here show the proposed updates to the hourly schedule on the left or the hourly schedules in the 2013 ACM. And just to be clear, that's how daily energy use is distributed over the course of the day. And you can see there's four different categories there. In contrast for the proposed 2016 ACM we have many more distinct end uses which capture the unique timing of these different loads. There's actually three more lines that will be added to that graph: dishwashers, clothes washers and clothes dryers will be using the hot water heating model (indiscernible) that we just saw in the previous presentation.

In general, the hourly schedules are based on sub-metering or light logging studies generally from 2012-2013, some older studies in there from California, the Pacific Northwest or Florida. In future updates to the model we would like to have as many of the end uses as possible be based on California-specific sub-metering studies that are again as recent as possible.

Here I've actually shown the weekday schedules, but we do have now distinct weekend and weekday schedules, which for some end uses doesn't make a particularly large difference. But for other things, for example cooking, is much more of an evening peak during the week days. And there's less of a peaking nature during the weekends, more middle of the day energy use. And this just shows that same set of load profiles, but it's a little bit more clear for your later review.

And here are the seasonal multipliers. The seasonal multipliers are a way of adjusting the average daily energies during a given month relative to the annual average, which is to say that some months will tend to have a higher average daily energy use than others due to a variety of different factors.

On the left, we have the seasonal multipliers in the 2013 ACM. There's either an assumption of constancy or that smooth U that's shown in blue. On the contrast, we have the seasonal multipliers in the 2016 ACM, or at least what we're proposing. And in general these are using the same sub-metering studies or light logging studies as the corresponding hourly schedule, the hourly schedule for the same end use.

You can see that there's fewer here. And that's because the residual MELs and all of the lighting have an equivalent seasonal multiplier, so they're all shown as one line. It's in black there.

Also, the refrigeration model will operate in a different way. Rather than just having a set of monthly multipliers the refrigeration model is going to be adjusted on an hourly basis in order to capture how the stimulated interior temperature in CBECC-Res will affect the amount of refrigeration energy needed. So in the hours where it's colder there will be less refrigeration energy, in the hours where its hotter there will be more refrigeration energy.

And the emergent result of this is that we will have a pattern of seasonal variation, because in the summer it's generally hotter and so there'll be more refrigeration energy use. In the winter it's colder, so there's less. To the extent that there are more high value TDV hours during the summer this particular factor, if all were equal, will tend to increase the TDV value of refrigeration.

And then as before, it's just a little bit easier to see these shapes for later review.

That's it. Thank you.

MR. FERRIS: Okay. Do we have any questions in the audience for Eric?

MR. HODGSON: Mike Hodgson, ConSol, representing CBIA, very interesting data.

On your Slides 19 and 20, where you're comparing basically the total -- I guess the energy use versus bedrooms there's a really substantial difference between what you're proposing for 2016 and what RESNET has proposed in their 2013 data. Can you explain the differences?

MR. RUBIN: Yeah. Well, not entirely, but I can speak to that some. The RESNET 2013 is based on a 2009 study from Florida Solar Energy Center, which was later updated in 2011. And they actually used a fairly similar methodology to us. Instead of using the RASS data they were using the RECS 2005 data. And they were using some older assumptions about efficiency.

One of the biggest differences between the RESNET and the California-specific models is that there's much, much more lighting energy assumed in the RESNET models.

MR. HODGSON: So that would make up the differences? There's almost twice as much electric use in their loads as --

MR. RUBIN: Yeah, so we actually have already plotted all of the specific end uses and that's going to be in our final case report. We're currently developing a report that will go into full detail on the methodology and the results. And we can benchmark against RESNET and that and show more detail there.

To some extent it's just that each end use is (indiscernible) more energy in the RESNET model, because each of those end uses has older efficiency assumptions, which don't reflect updates of standards, changes in technology. And again, that difference in lighting is one of the largest differences between the models.

MR. HODGSON: Okay. On the gas side it's almost --

UNIDENTIFIED SPEAKER: (Off mic) Can you say which slide?

MR. RUBIN: Sure, yeah it's Slide 20.

MS. BROOKS: This is Martha Brooks, so I'm just going to chime in.

MR. RUBIN: Sure. Thanks, Martha.

MS. BROOKS: So RESNET's goal is that that's a 2006-ish set of assumptions. And that's on purpose and that's okay. And I'll explain why that's okay when we get to the design reading talk.

MR. RUBIN: Okay. So just to be clear what you're talking about if you look at the blue line on top it's much higher, especially for large homes, than the red line which is the 2013 models or what we're proposing. And the question is --

MR. HODGSON: Excuse me, what exactly constitutes the differences?

So for an example, Bill, on the gas use on the right this model is going to predict and looks like 40 therms, 42 therms, something like that on an annual basis. And on the left or excuse me, on the RESNET model, it's over 100, so?

MR. DAKIN: (Off mic) So I think that Michael's comment is really telling that they're trying to reflect 2006. And we're trying to reflect 2017.

MR. HODGSON: Right, but if we go back to the data that Eric presented on appliances and ovens -- I can't remember what you said what the latest data was, but it was like 2006 or '94, or something like that --

MR. RUBIN: Yeah, so if you go one slide up --

MR. HODGSON: So it looks like ovens haven't changed, so if the efficiency of the lightings hasn't changed -- like I buy the lighting's argument. I get that.

I don't get the gas argument, okay?

MR. RUBIN: Okay. Just to talk a little bit more about that, I don't think that we've seen a huge difference in the efficiency of ovens. To some extent there's a question of was the RESNET accurate for what it was capturing? It's not necessarily the case that RESNET represents the state of energy use in 2006. It's one estimate of what that would be.

And so we also have to take into account that there's two sets of potential errors here: there's potential errors in our model and there's also potential errors in the RESNET, and we don't know that that's not overestimating as well.

MR. HODGSON: Yeah, (indiscernible).

So the accuracy of the prediction for 2013 is basically anchored in the RASS data use, the energy use from the RASS data?

MR. RUBIN: Yeah, that's correct.

MR. HODGSON: Okay. And they were using older RASS data in Florida or a Florida-specific study.

MR. RUBIN: Yes. So that the RESNET is based on -- there's two main set of inputs that go into RESNET. It's based on this FSEC Study. And the FSEC Study is combining these efficiency assumptions that are largely from 2006, with usage assumptions that are generally coming from RECS 2001. So that's some of the timeline that's going in here.

MR. HODGSON: Yeah, but still the efficiency of the appliances hasn't changed, so it's really the use or the estimate of use seems to be variable. Okay, thanks.

MR. RUBIN: Okay. That's (indiscernible) logical.

MR. NESBITT: George Nesbitt, HERS Rater.

So CBECC-Res uses the HERS plug load currently. So you're using the 2009 RASS, which appears would actually predict higher plug use than the current HERS method. And then you're using the 2009 RASS in part to say because people think that the current method is overestimating, you're coming up with estimates based off the 2009 and actually reducing the plug use?

MR. RUBIN: One clarification is that CBECC-Res currently uses algorithms that are in the HERS 2008. I've been referring to those in the slides as the 2013 ACM algorithms although I guess they're sort of the same thing.

RASS informs both the proposed 2015 algorithms and those current 2008 algorithms, but in a different way. The older algorithms are informed by the Conditional Demand Analysis that was done using the RASS data. In contrast, our algorithms are based on applying a modern efficiency assumption to the RASS Survey data.

MR. NESBITT: To what extent did you try to break down the RASS between newer homes versus older homes in your analysis? And since that is at least in total real usage I don't know if we've actually seen any evidence that plug use is reducing and has been since 2009?

And I agree with the gas, I mean unless more people are cooking at home more, or something. I don't gas dryers have changed. I think they've all had moisture sensors for some time. An oven is an oven, okay? A gas convection oven may save a little bit, but we're not talking much. And my general experience is gas estimates from software have been fairly good. Certainly, I have high performance homes that the plug loads are definitely overestimated on. But I think on average, and you've got to look at enough data to really is it on average, right?

And certainly some people's experience with HERs Rating, the California HERs Rating System, has been that they've been happy with those estimates. And I think on average we still want to be a slightly high in our estimates than low.

And I think the assumption on lighting is that 2016 code is going to reduce it. I'm not sure, because my experience has been more and more light fixtures -- light fixtures that use a lot more energy, because the light doesn't get out of them. I can light my house with much lower wattage bulbs than any code compliant fixture I could buy today.

Kitchens, yeah a 50 percent high efficacy rule in the past, which just meant you've got to throw in 1,000 watts of high efficacy to use your low efficacy.

We have failed to regulate how much lighting wattage we can put in a house. We do it in the non-res. So until we -- we can say, "Oh, yeah. You've got to put in high efficacy," but we're not saying how much you can't put in. And so I'm not sure that's a valid assumption yet.

MR. RUBIN: Okay. So can you stay at the mic, because I want to go through your questions one at a time. But I might need your help remembering.

MR. NESBITT: I left my hard hat at home.

MR. RUBIN: Yeah, okay. The first question, I think, was about to what extent did we look at the old versus new homes RASS?

The only time we were only looking at the new homes is when we're trying to figure out how old devices will be in new homes. In general, we're looking at all of the RASS homes. And because we're making the assumption that that whole pool of RASS homes is useful for informing us about how the number of devices in a household, the usage of devices tends to change with number of bedrooms. That's really what we're using RASS for.

Can you remind me of some of the bullet points and I can skip ahead. I know that one of them was about lighting.

It's true that we're assuming that the number of fixtures -- we're talking exactly that we're assuming that the number of fixtures is constant from 2012 to the 2015 Energy Code Cycle. We're looking at the fixtures in the CLASS data. We're then going from that to figure out what the light output was in 2012 and we're assuming that the light output is constant. So I think some of the point that you made might be addressed by the fact that perhaps people aren't over-lighting their homes more than they used to.

MR. NESBITT: But my point is, I mean you can't walk in a modern kitchen remodel or a lot of newly built kitchens that don't have 20, 30, 40 recessed can lights. I mean the designer must get paid by the number of fixtures, so this has been my observation.

But just one last point on this: I think when we get to the design rating also we need greater ability to specify a lot of appliances and fixtures. There's a different between front load washer and top load washers in efficiency.

And if we're talking about accuracy in making estimates, so if a builder provides -- and not every builder provides in the context of a new home -- provides certain equipment. The homeowner may bring it in. But if you're going to have a design rating, you have a default. But if the builder provides it and provides something better, they should be rewarded for it.

MR. RUBIN: And then to some extent we do have the energy guide and an override for that, which is you can take a credit for the actual kWh (indiscernible).

MR. NESBITT: Yeah, because we have very limited in the HERS Rating System to tweak any of those kind of things. We have a little bit, but not enough.

MR. FERRIS: Okay, any other public comments?

(No audible response.)

So I kind of want to take a poll, because I was hoping we would be actually finished with the morning topics by now. And I think there was some heavy interest in the existing PV Compliance Credit. So do we want to leave that to after lunch and go take some lunch, or do we want to address that now and take a late lunch?

(Colloquy regarding schedule.)

So Larry's presentation on the PV Compliance Credit is actually quite short, so why don't we take care of that and then agree that we'll talk to Bob's group offline. And we'll kind of start catching back up on schedule.

MR. FROESS: Okay. So my name is Larry Froess and I will speed through in a quick recap on the PV Compliance Credit that was previously approved last year for the 2016 Standards.

I just want to also iterate that the point of this presentation is to iterate the difference that this is for Part 6 compliance and not as part of the EDR scores on there.

It starts off during the 2016 Standards development cycle CEC staff worked with the building industry to develop some sort of a PV Compliance Credit to help transition the construction methods to the new prescriptive requirements of the envelope, which are known as high performance attic and high performance wall.

The PV Compliance Credit is equivalent in magnitude to the average TDV energy savings from the installation of high performance walls and high performance attics. But it's based on the average of a California home, so most homes aren't an average home. There may be more credit given to some homes and less to others than the exact equivalent to having high performance walls and high performance attics.

The PV Compliance Credit is not based on renewable generation. It's more or less based on the climate zone, square footage of the house, and the -- it's a particular credit not based on anything else. The minimum PV size required is 2kW to qualify for the credit. And it can be more if the house is more than 2,000 square feet, and the climate zone.

The PV Compliance Credit is only available for homes that are in climate zones where the high performance walls and the high performance attics are prescriptively required. Again, it is an all or nothing credit. Once you achieve the minimum requirement you get that credit. And if you've got more PV installed it doesn't matter. Once you've taken it and met that threshold, you get the credit.

The PV Compliance Credit is also flexible. I mean, you can use it to offset other building measures such as a tank-type water heater when you compare it against an instantaneous, or if you have more windows facing the west of south direction.

The PV Compliance Credit is also going to be in effect for the entire 2016 Code Cycle. There won't be any early sun setting on it. There will be training provided to builders on a regular basis throughout the state and that's through an EPIC program. And then it is anticipated that the insulation industry will develop new and cost effective ways to help the builders incorporate the high performance attics and walls into their buildings before the end of the 2016 Cycle.

And this next tab, Bruce will get into the actual input of the PV when he does his presentation on the PV credits, but this is just a quick screenshot of the PV Compliance Credit. We've changed it to just a checkbox now, so it's all automatically calculated. Initially, it's going to say you need a minimum size of 2kW. And you click that checkbox and then it has to run through the simulation first before you know that actual requirement based on size and climate zone.

And then after the simulation this is the result screen. It'll say at the top there what is actually required to be the minimum size, based on the square footage and climate zone. And it'll also report on the CF1R as a special feature just as it does now. And that's the recap of the Compliance Credit.

MR. RAYMER: Bob Raymer with the California Building Industry Association. We concur with everything you just said. Our only concern right now is that we began using the CBECC beta version. Our consultants are getting some curious results. And so there seems to be not a huge variation, but a noticeable variation whether you go with high performance attics and walls, or with PV you're not getting the same result when you max out.

And so what we'd like to do is very quickly get the two parties together and find out what is Megan doing wrong? (Laughter.) Or not wrong.

MR. FROESS: Yeah, definitely.

MR. RAYMER: Okay, thanks.

MR. NESBITT: George Nesbitt. If I remember right the amount of credit is dependent on the difference between the tradeoff and the prescriptive requirement. So its --

MR. FROESS: Yeah, during sample runs they determine the equivalence of it.

MR. NESBITT: Well, what if a 2kW system is too large, and what about multifamily in smaller units, because the project I'm working on -- I think multifamily we've done Net Zero with 2kW or actually even less in multifamily.

UNIDENTIFIED SPEAKER: How many?

MR. FROESS: It's a minimum size.

UNIDENTIFIED SPEAKER: (Off mic colloquy) Yeah, the regular size is smaller (indiscernible)

MR. FROESS: I think it's one for multifamily, one for dwelling.

MR. NESBITT: Okay.

MR. HODGSON: Mike Hodgson, ConSol, representing CBIA.

Just to kind of give you a flavor, we have a lot of people doing runs in 2016 actually trying to figure out whether they're using high performance attics or not or using walls or not. And I think we have a fairly good feel for the software, but we need to sit down and talk to you guys.

But in one of the climate zones, which is 4, you actually get 1.8 percent more credit for solar than you do for attics and walls, but when you get to 5, 9, 10, there's about a 2 to 3 percent difference between attics and walls. When you get to -- actually 10 is 4 percent -- and then it gets a little bit less in 13 and 15.

So we need to understand we're using the 2,700 square foot house that -- we agreed to a two-story home that we looked at, 20 percent glazing, east facing, it's the same house we've run hundreds if not thousands of runs on. So we're expecting that to be within two-tenths of a percent. And we're getting maybe 2, and in extreme Climate Zone 10 a 4 percent difference. So there's a difference and we need to figure out what it is, okay?

And then we need to publish a blueprint on how to really use the software. Thanks.

MR. FERRIS: Okay, so why don't we break for lunch and we'll meet back here at 1:45. And we'll move in to the CALGreen topics

(Break for Lunch.)

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MR. FERRIS: Okay, let's get started. If you can all take your seats.

Okay. We'd like to welcome Martha Brook to talk about the history of Energy Design Rating s.

MS. BROOK: Hi, this is Martha Brook and we're going to try and get the room quieted down before we start. Be quiet!

Okay. Marth Brook, I'm with the Existing Buildings Unit in the Efficiency Division. And I am not going to give you the history of Energy Design Rating s, because I didn't prepare to do that. But I am going to talk about the background in terms of what we are planning to do for 2016 Energy Design Rating s as implemented in CALGreen. And then Larry is going to talk about some early results.

Okay, so what's an EDR and what's an EDR? So any kind of asset rating has this sort of general form or the proposed design, the rated home on the numerator. And the reference design is in the denominator. And so it's a unit-less number that's, for our purposes, multiplied by 100, so you get a score from 0 to 100 for a new building. And then most likely higher than a 100 score for an existing home.

For our purposes the units in the numerator and the denominator are kTDV per square foot per year and the whole building energy use is used in the calculation. So not just the compliance total, if you're familiar with the output from CBECC-Res, but in addition to space heating and cooling, ventilation and water heating, we also have interior and exterior lighting, appliances, plug loads and most recently PV. It's all included in the numerator and the denominator of the National Reference ((phonetic) in the design rating, but for our purposes there's no PV in the denominator.

So what I'm trying to cover today is to sort of the talk about these sort of high-level objectives for the 2016 Energy Design Rating . So what we embarked on was to make sure that whatever we came up with for the 2016 Rating was consistent with the HERS Whole House asset ratings for existing buildings. Not necessarily the current HERS Whole House methodology, but what we intend to have in the updated HERS Whole House asset rating methodology.

We also embarked on an effort to better align the Energy Design Rating with the National HERS Ratings, otherwise known as the RESNET HERS Ratings.

And then finally everything that we do in terms of calculations, modeling, etcetera, we expect to be consistent with the Code Compliance Software. So we're intending to implement the calculations of the Energy Design Rating s in the CBECC Software.

So even though we're going to be moving to -- and I'll talk about this next -- a national reference we're not using national modeling rules or assumptions; we're using California modeling, California TDV. But there is quite a bit of movement we have made or are intending to make in terms of aligning with that National Reference and I'll talk about that next.

So just a little bit, this is the only slide I have on this topic: Energy Design Rating s and the HERS Whole House Program, we do intend to update the HERS Whole House Regulations. I don't have a schedule for you on that, but the positive news from the staff perspective is that our management has asked for a staff to be assigned as the project manager. And then that means that that person will develop a schedule and begin to do pre-rulemaking activities with you and other stakeholders.

We do expect the HERS Whole House updates to be consistent with the changes for the 2016 Energy Design Rating s. It's super-important for the ratings that the California Energy Commission promulgates to be consistent between new construction and existing buildings. It's a residential asset rating scheme and the market looks at that as one thing, looks at new construction as just the most recent existing buildings, right? So it's really important that we don't bifurcate and have two separate rating schemes.

We also intend, in our update, to reduce the costs and increase the quality of existing building asset ratings. Again, staying consistent with the approach that we'll talk about today, but all of the detail on how we will do that and when we will do it will come up in a separate HERS Whole House set of proceedings and pre-rulemaking activities. So hopefully many of you will be able to participate in that with us, going forward.

Okay, so Energy Design Rating s and RESNET HERS, we've been collaborating with RESNET for the last year to find areas where rating a minus can happen. And as a result of that effort we are recommending several important changes to the calculation scheme for the Energy Design Rating . Most importantly, the efficiency level of the reference design, the denominator in the rating calculation, will be at the International Energy Conservation Code 2006 as interpreted by RESNET.

So there's some gray areas in that international standard in terms of assumptions about, let's say, insulation installation quality. RESNET interpreted it a specific way and we are aiming to use that interpretation to better align with the RESNET ratings, so that's just an example of, and an interpretation of the Standard as made by RESNET. And everything that they've made in terms of an interpretation is published in their RESNET Standard, which I think I have referenced later on.

A second component that is dealt with in the RESNET Rating Scheme that we're also intending to make in the Energy Design Rating Scheme is to implement an approach that normalizes the impacts of using electricity versus gas equipment in the reference design. And this turns out to be really, really important and I'll talk about it more later. But when you think about it an asset rating is supposed to be a relative performance of homes in the marketplace.

And traditionally what we do for a code compliance is if there is an electric –- you know, it depends, but what RESNET does and what we've done traditionally in the past with design ratings, is if there is an electric water heater in the proposed design there's also electric water heater in the reference design. And that has a lot of benefits from a rating calculation scheme. But the problem is if you're comparing the rating of that home to the same home efficiency level-wise, except there is a gas water heater in the proposed design and then a gas water heater in the reference design, the performance of those two reference water heaters -- the electric water heater reference and the gas water heater reference -- are very, very different in terms of the metric we're using for the rating, which is TDV.

So it's inappropriate to have a different rating in the marketplace for homes just because the reference, the denominator in the rating scheme, is different. And so the RESNET has traditionally always dealt with this by their scheme they call "normalized and modified end-use loads." They deal with this to some extent. And so we're proposing to also deal with this, but our methodology will not be normalized, modified end-use loads it will be a way to normalize this impact based on the TDV ratios of electric and gas equipment.

MR. MCHUGH: I have a question.

MS. BROOK: Yes?

MR. MCHUGH: Jon McHugh, McHugh Energy. So are you proposing that right now if you have an electric water heater you still have a gas tankless water heater as the base case? Are you proposing that if you have an electric water heater that then the base case also has an electric water heater?

MS. BROOK: That's right, because this isn't Code Compliance, all right? So this isn't the standard design in the denominator, it's a reference design, which is completely different. And we are proposing to, for appliances –- space heating, space cooling and water heating –- to have the fuel be the same in the numerator and the denominator.

MR. MCHUGH: So this is good for 2016, but I was sort of presuming that EDR was potentially the vehicle for adopting a Zero Net Energy Standard for 2019. And so it seems like there might be some sort of confusion in the market if for your 2016 EDR you have something that essentially weakens the base case.

MS. BROOK: It won't, it won't, it won't.

MR. MCHUGH: I mean, I get that it's just a denominator, but in terms of a base case that you're looking at for setting your efficiency, potentially your efficiency standard, I could see that -- are you're going to talk about that later? Okay.

MS. BROOK: Yeah, when I talk about how we're going to do it I think, hopefully, your concern will be alleviated. But if not then come back up, okay?

Okay. So again, those lower two bullets in blue, that's by and large what we're doing to align with the RESNET National Ratings. We're not using their normalized, modified end-use load scheme, we're not using their rating metric, we're using energy costs. They use this kind of modified end-use load metric. But we are adopting these two principles: the efficiency level of the reference design and normalization of fuel pipe, basically. And that's really important when you start to look at why you do an asset rating and the impact in the marketplace of asset ratings.

Okay. So the reference design, again as specified by RESNET, is 2006 levels of energy efficiency, basically. Walls have 2x4 R13 in most climate zones, 2x6 and R19 in the most extreme climate zones in the state; roofs and ceilings, R30 and R38, and no radiant barriers or cool roofs. And you can look at the slide to get all of the details in terms of which climate zones have which levels of efficiency. But I think they're pretty typical of our standard differentiations in terms of climate zones.

Floors have a 2x10 construction with either R19 for Climate Zones 2 through 15, or R30 for Climate Zones 1 and 16. Slab edge has R10 insulation only and 24 inches deep only in Climate Zones 1 and 16. As I mentioned before the insulation installation quality is modeled as improved in CBECC-Res, which means it actually meets manufacturer specifications in terms of you get the full credit for that insulation level in the envelopes.

Air infiltration rate is 7.2 air changes per hour. And windows are a 0.65 U-factor, except in the most extreme climates where that drops to 0.35 and then it has a 0.4 solar heat gain coefficient in all climate zones.

The heating, ventilation, air conditioning equipment reference design that follows the NAECA requirements, in effect in 2006, is generally a 78 percent AFUE for gas furnace, 13 SEER for air conditioning, and a 7.7 HSPF for heat pump heating.

And the cooling airflow and fan power is not code-worthy right, because our current code is 350 and 0.58 for CFM per ton and watts per CFM. But again, this is back -- assume that it hasn't been field verified. And therefore you're not getting the full performance of the airflow and fan power again, because it's supposed to be representing a 2006 Vintage and also an unverified condition. So it's 300 CFM per ton and 0.8 watts per CFM.

The Duct R-value and leakage is R8 and a 20 percent leakage. And the Reference design uses a constant heating and cooling setpoint schedule.

MR. HODGSON: Mike Hodgson, ConSol.

So the air conditioning on this slide is unverified through using 300 CFM per ton, but the previous slide you're using QII as the base case of insulation?

MS. BROOK: Right.

MR. HODGSON: So you're saying the insulation is perfect, but the air conditioner is not?

MS. BROOK: So the reason that we felt okay about the insulation installation being manufacturer specifications is because we give credit on the rated home side for field verifying QII in California. And they also, in the National RESNET HERS, also have a field verification credit for the rated home for insulation installation verification.

MR. HODGSON: Actually, they have a degradation. So RESNET assumed Grade 1, which is our QII.

MS. BROOK: So they differentiate the rated home whether or not you field verify the insulation, right?

MR. HODGSON: Right, so what they do is de-rate the home after verification. What we do is de-rate the homes before verification.

MS. BROOK: Right. But we're using the same reference and that's so our ratings are going to be similar.

MR. HODGSON: Okay.

MS. BROOK: But on –- and this is a very recent path -- the next thing I'm going to say is very recent for RESNET. They're in the process of adding a credit on the rated home side for AC, heating, and air conditioning verification. And because they haven't done it yet and there's lots of homes already rated they don't want the actual rating numbers to change significantly. So that's why they're moving to de-grading the air conditioning and heating airflow and fan power.

So that if you get the credit on the rated home side then overall ratings of the same homes that have already been rated in the marketplace don't change significantly.

So this is not what they do now. They don't have any way to credit verified HVAC now. They're proposing to do that and to get it in like within the next year or so. And so what we're trying to do is we're trying to, in our alignment, find a place where we're comfortable with our reference knowing what they intend to do on their end in terms of a reference specification.

And this is one area that they are planning to change. So they don't do it now, but they are going to do it as soon as they get the HVAC Verification Standard Update fully through the RESNET process.

MR. HODGSON: Right. But this is the reference design that you're planning or proposing for the EDR, right?

MS. BROOK: Uh-huh.

MR. HODGSON: So the EDR goes into CALGreen, so CALGreen now is going to assume that QII is a required feature?

MS. BROOK: Yes. And it turns out that you get more credit on the rated home side by having QII in the denominator. It's just the law of fractions. So we think that is 1) exactly aligned with RESNET and 2) that there's no loss to the rated home, because you're going to get all of the differentiation you could possibly want in terms of the difference between a field verified and un-field verified rated home in terms of the difference in the rating number.

So you're not losing anything in terms of whether you as a builder decide to do QII, because you're going to see the difference in the rating.

MR. HODGSON: It seems like that portion of the rating just gets washed out?

MS. BROOK: It does not. It does not get washed out.

MR. HODGSON: Okay.

MS. BROOK: Especially for -- I mean, I know a lot of people think that. And I think it's because they're thinking of it like as a standard, like as a compliance thing where you're trying to get to 100 or something like that?

MR. HODGSON: That's right. Well I'm thinking of it as a compliance tool because EDR becomes a number, it becomes part of a code process in CALGreen.

MS. BROOK: Right, that's right.

MR. HODGSON: So it is a compliance number that we have to be concerned about.

MS. BROOK: But the number we pick is still going to be a number that has –- well I don't know what you're going to pick in terms of whether QII is in the number or not on the rated home side. That's not my job, right?

But whatever that number is you're still completely differentiating two rated homes, one with field verification and one without. So there's really no issue in terms of you not getting credit for QII, because the rating will give you that credit. So whether or not you want QII in the Standard, that's a standard rulemaking process.

MR. HODGSON: Right, but you're putting it in the EDR.

MS. BROOK: But what I'm saying is that whatever number you come up with you're not losing anything.

MR. HODGSON: Let me bring my cohort here.

Bill, you're needed.

MR. DAKIN: So it's simple, it's a really simple idea here. If RESNET has a field verified measure that they include to qualify for their reference we're agreeing with that. And that's what's happening with QII and Grade 1. This new thing, to put refrigerant charge into their mix, they're going to have a degraded efficiency related to refrigerant charge in the Reference. We agree, so that's as simple as you can say it.

MR. HODGSON: I have no concern about RESNET. My concern is about how it gets implemented in the EDR, because EDR becomes CALGreen and that's the California Reference. I don't care about RESNET. I am trying to harmonize. That's, to me, a separate topic.

MS. BROOK: Yeah, but what I think --

MR. HODGSON: I agree with you 100 percent on the RESNET side. I think it's great and they're making movement. We need movement from that. Now you put QII into the EDR Reference Home. To me that changes that rating, that number score. It's more difficult to achieve, because the QII is in the base case.

MS. BROOK: So it really depends on the numbers, right? And really, what --

MR. HODGSON: I know what the numbers are.

MS. BROOK: But what I'm trying to tell you is that the number that gets picked that gets implemented in the Standard is going to be based on what characteristics are in the rated home. So the rated home will get a number and it will be a different number. Maybe it will be a 65 with QII and maybe it'll be a 68 without QII. The standard rulemaking process will decide whether the standard is set at 68 or 65.

Having QII in the reference doesn't change the fact that you've got to pick what the characteristics of the rated home is going to be that sets the number for the rating.

MR. HODGSON: So we're going to have a rulemaking to decide the CALGreen EDR numbers; is that correct?

MR. DAKIN: I don't know, 2019?

MR. HODGSON: No, for 2016, because it's in the 2016 Code.

MS. BROOK: Is there a number?

MR. HODGSON: No. You're making up numbers and it's already in the Code. You can't do that.

MS. BROOK: Well, so I don't know what you mean that I'm making up numbers. You just told me there is no numbers in the Code?

MR. HODGSON: Okay, so that's --

UNIDENTIFIED SPEAKER: (Off mic) A side bar conversation, I think, would be better (indiscernible) --

MR. HODGSON: Yeah. I mean, you guys are now messing with CALGreen, which you already adopted. You have not gotten the numbers into the Code, because you didn't have the work done, right? Not being criticism, this is straightforward.

Now you're saying, "Oh, we're going to make up the numbers." Okay, by which process?

MS. BROOK: No, no, we're not making them up.

MR. HODGSON: You were going to pick them, you had just told me that you --

MS. BROOK: No, I was talking about 2019.

MR. HODGSON: Well, I'm talking about 2016 now. You don't know what those numbers are, so you're now going to have to pick them. If you're going to pick them and you don't know the stringency of the standard then you have to have a public process. You do not have time for a public process for 2016, so what are you doing?

That's my concern, all right?

MS. BROOK: Okay. I don't even know what's in CALGreen, is it 15 and 30?

MR. HODGSON: Yeah.

MS. BROOK: So then what I'm saying is that the number that is required to get to 15 percent, that's just math, right?

MR. HODGSON: Percent over what?

MS. BROOK: Of the standard design not the reference, not the reference. Not the reference, the standard design. It's not the same, it's not the same. It's not 15 percent better than 2006; it's 15 percent better than 2016.

MR. NITTLER: So Ken Nittler with ENERCOMP, so I'd like to try and shed some light. And I'm sure Larry here is going to have something that sheds some light on it too.

First of all, CALGreen as a prerequisite has QII. So if you're going to go for Tier 1, Tier 2 or Zero Net

Energy QII is a requirement in CALGreen. If it's adopted that way it's a requirement, it's a stated requirement.

In terms of what you will see during Larry's presentation I think is that the determination of the tier is done using our Title 24 basis. So it's 15 percent above the 2016 or 30 percent and then the ZNE Tier has to meet one of those two tiers, plus also has to have enough PV to take the 2016 budget down to zero.

And so the reference point doesn't affect, at least in the 2016 Standard, doesn't affect what builders would have to do to get to zero. And it doesn't affect what the builder would have to do to get a Tier 1 or Tier 2, because that's being defined off the Compliance Calc.

MR. HODGSON: Okay.

MS. BROOK: All right. We went all the way through this, right?

Okay, so now finally to wrap up the Reference Design Spec for water heating, it's again the NAECA minimum in 2006. So it's 0.59 energy factor for a 40 gallon gas storage water heater and 0.92 energy factor for a 40 gallon electric resistance storage water heater.

And that's actually the biggest deal when we get to the fuel, how to neutralize for fuel pipe. The fact that those are completely different beasts in term of energy costs, the 0.59 gas storage and the 0.92 electric resistance, is why we have to do the normalization which I'll talk about soon.

And then finally for appliance and plug loads the energy use and internal gains are modeled in the Reference Design only as specified by the RESNET Standard.

Okay, so normalization of gas and electric equipment energy costs in the Reference Design.

UNIDENTIFIED SPEAKER: On (indiscernible), just on the previous slide? So if I understand this correctly on the DHW side let's take two homes and let's say they are otherwise built as a reference home. One of them has gas, one of them has electric. Will they get different scores? They have the same efficiency as this. What is the baseline?

MS. BROOK: Yeah, they will get different scores, because TDV will say that they are valued differently in California.

Okay. Now, to talk more about that, so what we're intending to do is to adjust the proposed design TDV that goes into the numerator or the ratings by the ratio of the difference between the TDV for the electric equipment divided the TDV of the reference gas equipment. So for space heating, space cooling, water heating and appliances where there could either be electric or gas we're going to make an adjustment to the TDV of the proposed design to normalize for electricity.

So if you start out with electricity you don't have any adjustment your ratings stay the same as they would otherwise be. But for gas you're basically getting your rating adjusted by the ratio of the reference design TDV between space heating, electric versus space heating gas; space cooling electric versus space cooling gas, etcetera, etcetera.

Space heating and space cooling, those ratios are very, very close to 1. But for water heating and appliance, which is the reason I bolded those, they're not 1. So the TDV of that electric reference water heater is very big compared to the same TDV for the reference gas water heater. So the ratio is not 1, it's greater than 1.

And then also for appliances, because this is a whole building rating we can't have an artificial rating that makes a house look better just because the reference TDV of a gas appliance is different than the reference TDV of an electric appliance. So we have to do that also for appliances. And that also is significantly not 1.

So this is the impact of using energy costs as a metric, right? That we have to be really careful that when we're producing ratings that go into the marketplace that we're communicating the rating as the relative energy cost of that home. So let me show you with some numbers what the impact of this adjustment is.

So this is really hard to see, but at least here in the room, maybe it's a little better on the Web.

UNIDENTIFIED FEMALE: Should I zoom in?

MS. BROOK: No, that's all right. I mean whatever you want to do, I don't care.

So the gray bars on the left is the RESNET ratings as calculated by EnergyGuage, which is a RESNET certified rating calculation tool. So this is just a comparison of what a California Energy Design Rating would look like compared to RESNET for a high-efficiency home, which is a little bit worse but pretty close to a 2016 home. It has a little bit higher air leakage, but otherwise very, very typical of a new home.

And our ratings using the scheme I just explained are in those sort of brownish-green columns. And you can see what that does, because you have a really big TDV number for electric water heater. Where in Oakland and San Diego where water heating is a big component of the total rating you actually have gas homes that look worse than electric homes, because the denominator in the reference on the electric side is way bigger than the denominator of the same home with the gas water heater. And so those are the greenish-brown columns.

The blue columns are what the ratings look like with the adjustment I just described on the previous slide. So the electric ratings stay the same and the gas ratings get adjusted downward to reflect the relative difference in energy costs of electric and gas equipment.

So basically the adjustment basically gives you a single reference instead of a dual reference. And this is, I think, very understandable in terms of how we know about kind of an evaluation cost in California. So we don't necessarily get the same rating, because the TDV of gas is so much lower than the TDV of electricity that it doesn't all normalize out. So there's still some influence of those high TDV electricity costs in the ratings. But I think that's what we intend by using an energy cost metric.

So this slide is just meant to illustrate the impact of the adjustment that we think is needed to neutralize the fuel type in the Reference Design.

So the next thing, just to clarify everything that I've talked about today up to this point was really the denominator of the ratings, of what's in the Reference Design. Just to clarify we're not using constant setpoint schedules in the rated home or the proposed design. We're intending to use the same setpoint schedules we use for Code Compliance, which is a constant setpoint for heat pump heating, but a setback for gas furnace heating or a setup for air conditioning.

And this will give a very, very slight rating bump for California homes, because we have Standards and we have had Standards in a long time for California about setback thermostats.

And in addition to that it's very, very reflective of surveys and other studies of how people actually operate their equipment in California. So we think it's appropriate that Californians get a little bit of a rating credit for how they operate their equipment and the type of thermostats that are in their homes.

And then finally, we're not intending to blow off all the good work that the team and staff have done over the last year on appliance and plug load updates to energy use and internal gain assumptions. So all of the benefit of that work will go into the numerator and go into the proposed design for the rated home side of the rating equation. And that will make California home ratings look better than they otherwise would if they just stuck with that sort of RESNET 2006 Vintage set of appliance and plug load assumptions.

So this final chart just sort of shows some of the impact of that. So the first two sets of gray and blue columns in this chart are the same ones you saw in the previous slide, the RESNET Rating next to the California Rating using the normalization of fuel type in the

Reference Design Scheme. Those are the first set for the first four columns.

And the next four columns are the same homes with reduced appliance and plug loads. So this is just intended to show that RESNET has a scheme for getting credit for better appliances. So this set of gray bars with the red highlights just is what the ratings are in the RESNET scheme if you reduce your appliance usage.

And then what I did is just to illustrate that we also are going to see these lower ratings in California based on assumptions of appliance and plug load use. I just used the current set of California appliance and plug loads, so what did Eric call them, the 2013 ACM assumptions.

I don't know where the new ones as implemented in CBECC-Res are going to land, but you'll certainly know in a month or so what those look like. But the important part is that you're going to get credit for the average set of assumptions that we're going to assume that's going to help your rating out.

And then there may also be schemes that where if you verify you have better ENERGY STAR appliances or such you could get additional ratings depending, again, on the use case whether that's going to go into a future Energy Design Rating Scheme or a future California HERS Whole

House Scheme. But certainly to lower the ratings below 50 you're going to need to have methodologies to give credit for better appliances, because they're a dominant part of the whole building end use, energy use.

And that's all I have.

MR. MCHUGH: Hi, this is Jon McHugh.

So I'm trying to understand how in RESNET right now for a new building, let's say built in Florida or something like that, that building is going to have a determined appliance load that is the same as in that 2006 IEEC base case, is that right?

MS. BROOK: Unless they do -- there's a methodology in RESNET to get credit for better appliances. If they follow that methodology then they -- that's what I showed in the red outline is a RESNET score -- a RESNET home scored in the RESNET approach when they have better appliances.

MR. MCHUGH: Okay, I see. And we're looking at, it's in the earlier presentation, of when you have an energy guide and the builders can provide that you can get credit for those things. But for all the other plug loads it seems to me that the plug loads that you can't change, and the defaults that you would use if you didn't enter the energy gauge or energy guide numbers, that then there would be a disconnect between our rating as an EDR and someone in

Florida.

So let's say we're building that building, we're not putting any appliances in and you do the same thing in Florida. And that Florida house is identical to this house that we built in California, the California house would have a lower score. And it doesn't seem like that's appropriate.

It seems to me that you'd want to actually put that appliance number, even though it's a different number, but that it's actually balancing out our revised assumptions with appliances, so that the scores are comparable. Not that the number and the denominator is comparable, but that the scores for that identically built house are comparable, I think.

MS. BROOK: Well, I think that there is definitely a struggle between that objective and the objective that -- I think where staff ended up is we need to figure out a way to give California homes the credit for the 30 years of Appliance Standards and Building Standards and Energy Efficiency Incentive Programs that have changed the lighting and appliances in their homes. And basically that's what your case team did is these are updated assumptions. This is what we expect for California homes. Why wouldn't we want to give the rating credit for that that we think is deserved?

MR. MCHUGH: So for the lighting sure, right? But for the plug loads, which are not regulated by Title 24, they're regulated by Title 20 and --

MS. BROOK: Yeah. If you recall, I said Appliance and Building Standards, most of its Appliance Standards, all right? I mean, we've been waving our flag here in the Energy Commission pretty high over our Appliance Standards.

MR. MCHUGH: And our Appliance Standards have done a fantastic benefit, not just for California, but for the rest of the country.

MS. BROOK: No, but the other objective and then the challenge is when do you give up and ignore better information? And that's kind of where we're at. So hopefully RESNET will - - but see RESNET's approach is they want to give credit for better appliances too. And they think they have the scheme to do that.

They think their appliance and plug load assumptions are a 2006 Vintage. They want to see lower ratings for better appliances, but they want to put that on the rated home side, not changing the reference. They want the reference to be as solid as possible, so that the ratings go down over time and the builders get credit for those ratings going down over time.

MR. MCHUGH: So, they're getting credit for the appliances, okay.

MS. BROOK: Yeah.

MR. MCHUGH: All right, thank you.

MR. NESBITT: George Nesbitt, HERS Rater. What is he going to say?

MS. BROOK: You're going to answer that question. Right, George?

MR. NESBITT: Would you like me to turn myself off? (Chuckling) Tower of Babel.

So the Public Resources Code required the Energy Commission to develop a rating system. And we were in this room nine years ago and we developed it and it was approved. And yet Build It Green came out with their GreenPoint Rated Index, which was the HERS system, although they modified it for older homes. 2013 we came up with the Energy Design Rating , here we are at 2016, an Energy Design Rating . And we've got the CAP score, this is all HERS Rating software, this is all HERS System, even though most of it does not follow the Title 20 Regulations.

So let's talk about harmonizing with RESNET. RESNET requires a HERS Rater to do an Energy Design Rating , to do a HERS Rating.

The other difference, I think major difference between our methodology and RESNET, is the standard design. It has the same geometry and the same surface areas as the proposed design whereas in our methodology we've created a box.

MS. BROOK: That's not true. Actually, RESNET changes their denominator, they changed their glass in their denominator.

MR. NESBITT: In the IECC it's the same, at least. But anyway, minor differences there. I'm not completely sure about some of what you want to do with the Standard Design and where the numbers come out. It's just that what I proposed nine years ago is that we'd have software that would calculate a RESNET HERS score.

I mean, why can't RemRATE give the Energy Commission a $1,000 and we could have a software with the same input that would give us a HERS score that would be consistent with the RESNET? And we could have a HERS score based on California and we could have Code Compliance. I mean, this is what we talked about nine years ago and this is what we did. I mean, this is essentially when we started CBECC-Res. It's essentially we've created a structure that would allow us to do this, but we're not doing it.

As someone who designs mechanical systems, does code compliance, HERS Rating I have to use multiple pieces of software and do inputs. And that creates error, it wastes time. There is no reason we can't have consistency.

MS. BROOK: So thanks, George. Yeah, I think you're voting for us to get an update to our HERS Whole House Regulations, so that's what I'm thanking you for.

MR. NESBITT: Yeah, it's long overdue.

MS. BROOK: Well, I agree, I think we should. And I'm trying to communicate that our management is asking for us to go forward and get started on it.

MR. NESBITT: But we're actually backwards, because we're only creating it. And now we're going to go back and change it.

MS. BROOK: Yeah, so it's definitely a challenge when you see the connections between things and so you want to -- right, so there's an obvious connection between an Energy Design Rating and a HERS Rating; an obvious one, right? That's, to be honest with you, why I participated in this alignment exercise, because I wanted to make sure whatever was going to go into the design rating was going to be consistent with what we wanted to do in the Whole House Upgrade.

And it's just a matter of timing that it makes it very awkward and I apologize for that.

MR. NESBITT: Well, one last point just about the HERS Rating System, it's the only system that is universally compatible: Energy Efficiency (indiscernible), ENERGY STAR homes, LEED for Homes, Zero Energy Ready Homes, utility rebate programs, so on and so forth. And yet, we've fail to use it.

MR. HODGSON: I'll make this real quick, Mike Hodgson, ConSol.

I just want to thank you for all the work you've done. This has really been a big effort that spun for at least two years and we got traction when you got involved, which we really appreciate. And the goal from the building industry was to align the rating systems of California with the national rating systems and to give credit for California's work. And I think you've done a very good job of doing that.

MS. BROOK: Good. Thank you.

MR. HODGSON: You're welcome.

MS. BROOK: And (indiscernible)

MR. FERRIS: So we have one more commenter on the telephone, Nehemiah Stone. Are you there, Nehemiah?

MR. STONE: Can you hear me?

MR. FERRIS: Yeah.

MR. STONE: Can you hear me? Hello?

MR. FERRIS: Okay. You should be good, yeah. Go ahead.

MS. BROOK: Can you hear us?

MR. STONE: Yes, I can. Thank you.

So at the last IECC meetings that I've listened to there was a lot of concern expressed about how the index would apply with multifamily, that the process was not designed for multifamily and it didn't actually work very well for multifamily. The answer I got when I said, "Well, so what do you do?" They said, "Well, you can use it. But it's just not going to give you good answers."

Martha, have you looked into how this process is going to work for multifamily in California?

MS. BROOK: No, I haven't. But maybe we can get your help on that.

MR. STONE: Okay.

MS. BROOK: So yeah, that's kind of where we're at now is we are racing to get to this deadline to have something to present. And so now we need the thump on those things that didn't get considered, so multifamily is at the top of the list.

MR. STONE: So initially then this would only apply to single family? Or you're saying that the process, it's at a point where it's time to start thinking about multifamily and it'll be applicable to both at the same time? Which of those is it?

MS. BROOK: I think so. I mean, I think Larry needs to clarify, but somebody told me that the CALGreen applies to low-rise, multifamily also?

MR. STONE: Correct, yes.

MS. BROOK: So we're intending for this to be used for that, so that's why we need to thump on it now, okay, for multifamily.

MR. STONE: All right. Thank you.

MR. FERRIS: Okay, now we're going to switch to Larry to talk about Energy Design Rating s for CALGreen.

MR. FROESS: Hi, my name is Larry Froess, and I'm an engineer, Mechanical Engineer with the Buildings Standards Office. And I'll talk about the Energy Design Rating and how it relates to the Software CBECC-Res.

An Energy Design Rating is essentially an alternative way to show building performance. It's for use with the Title 24, Part 11, which is the CALGreen Energy Efficiency Section.

There is a scoring method where 100 represents the RESNET Reference Home characteristic that Martha just described. The EDR score of zero would represent a house that has high levels of efficiency measures as well as renewable generation. And it also allows you to include non-regulated energy such as lighting, appliances and plug loads as Martha described.

CALGreen also has two prerequisites that was mentioned previously. 1) is that it has to be done with state-approved software, which is CBECC-Res and the CF1R would do the reporting of the scoring. Also, you have to have the key quality insulation installation verification. And that's required for any of the two tiers and the ZNE Design designation.

Tier 1, basically you have to show a 15 percent better on the compliance margin of the Title 24, so it's strictly based on the Part 6, Title 24 compliance margin. A Tier 2 prerequisite must show 30 percent better on the compliance margin. And the ZNE Design designation must meet one of the tiers below, depending on the climate zone and has to have an EDR score of zero or less.

And so for the single families in Climate Zone 6 and 7 you only have to meet the Tier 1 requirement. And multifamily for Tier 1 would be for Climate Zones 3 and 5 through 7. The rest of the climate zones for single family and multifamily would require the Tier 2 prerequisite.

Martha went through these already, so I can just skip through these five: these are basically the reference home baseline requirements that are in the software.

The EDR also allows a PV System Credit. And Bruce will discuss that in a moment. It actually simulates the actual proposed PV system as proposed on the building. It actually uses the PV System characteristics, which includes the azimuth and the tilt of the array. However, it does not apply the PV Compliance Credit that we previously talked about as part of the EDR scoring.

And when the EDR run is selected it actually will take about one-third longer, because it has to do an extra run, a third run, to establish that EDR baseline. And Bruce will get into the screen inputs of the PV part of it, but I will talk about the results once the PV is put in or not put in; I have a couple of examples.

So this first screen shot is an example of house that was run that has some PV compliance margin in it or PV Credit. This first slide shows how the standard design -- or that will show up -- and that is essentially the Part 6 Standard. When it was rated against the EDR home with a score of 100 the Part 6 Standard home would have a score of 62.1 in this example. And again, the software is still under development. This is a research version of a screen shot, so things may be cleaned up in the future.

The next slide shows the EDR score of a proposed design that had the PV credit in there, but the score for the EDR proposed design that's highlighted is the house with just the efficiency measures only and not the credit of the PV system. We're just breaking it down as a separate item on there.

This next screen shot is the EDR of only the credit that the PV system provides. Again, we're just breaking it down for clarity to show the differences. In this case it has a value of 31.3.

And then this final slide is the final result of the proposed model where it does include the energy efficiency measures of that first proposed design number, 51.6. And then it subtracts the EDR value of the proposed PV only of 31.3, with a final result in EDR of 20.3. And that is the number that the CALGreen would be looking for, for that ZNE Design designation.

And then this is the results of the CF1R, as we look it's very hard to see on the small screens in here. Unfortunately, I don't know if --

UNIDENTIFIED SPEAKER: Are you guys going to make this available online?

MR. FROESS: Yes. All of these slides will be available electronically as well as up for hard copies. Yeah. I mean, I apologize, that's the best that we can do.

But this first slide is meant to show like a progression of a model of going from a Tier 1 to a full ZNE Design Designation.

This first slide shows that Part 6 compliance margin, up there in the right of the highlighted number, is a compliance margin of 24.0. So that is greater than the 15 percent requirement for Tier 1. So the Energy Design Rating Table at the bottom will automatically check the Tier 1 prerequisite checkbox, indicating that it's met the 15 percent above Code Compliance.

(Colloquy regarding the slides.)

So this next slide is the example of a house that the Title 24 compliance margin is 44.5. So that exceeds the 30 percent prerequisite to meet Tier 2. However, now I'll scroll up a little bit to see the EDR table below.

So that first checkbox on the bottom left of that table is not checked. That's the QII prerequisite. This particular run did not have that selected, so that box is not checked. And so even though this met the Tier 2 requirement on the compliance margin for that prerequisite the QII has not been met. So this does not meet the ZNE Design designation even though what's outlined in red, the final EDR is negative. It's a negative 23.4.

UNIDENTIFIED SPEAKER: Can you go over again why that doesn't?

MR. FROESS: Oh, because it doesn't have the QII; there's two prerequisites that are required. And so this is just automatically checking and letting the users and the plan checkers know that this does not meet both the requisites.

And the final slide here is the situation where it does exceed the Tier 2, it's 34.4 percent. And if you scroll down a little bit then in this case it did have the QII verification checked, so that box will get checked automatically. The red box indicates that the final EDR score is a negative, so it's less than zero. And therefore all the four boxes will end up being checked on the left with that bottom box being the ultimate indicator that this design meets the ZNE Design designation requirement of CALGreen.

And so that concludes my portion, if there's any questions?

MR. DAKIN: This is Bill Dakin with Davis Energy Group.

So the third slide, the first slide of the results I was confused, because it looks like you said it meant Tier 1, but didn't have QII. And my reading of the CALGreen language is that QII is required. And I think I saw a slide that says that?

MR. FROESS: It's a prerequisite.

MR. DAKIN: Yeah.

MR. FROESS: Correct.

MR. DAKIN: So it shouldn't check that box.

MR. FROESS: It does not.

MR. DAKIN: Okay, because it looks like it.

MR. FROESS: If you zoom in on that -- it's a very good question, Bill, I mean this is what we're making clear. There's four boxes on the bottom left --

MR. DAKIN: It is checked. It says, "Design meets Tier 1 prerequisite."

MR. FROESS: Prerequisite.

MR. DAKIN: Okay. But all right, it doesn't check the QII box.

MR. FROESS: Right, and then so as it's making clear of that.

MR. DAKIN: So it meets the prerequisites, but it doesn't meet Tier 1 ultimately, because Tier 1 requires QII, correct?

MR. FROESS: Good point, right.

MR. DAKIN: Okay.

MR. FROESS: We're calling it the prerequisite of Tier 1, but we can work on that wording then.

MR. DAKIN: Yeah, it seems a little confusing. Thanks.

MR. FROESS: Okay, good. Thank you.

MR. FERRIS: Okay, well it looks like then we're going to be moving on to Bruce Wilcox's presentation on the Internal PV Calculator in the new CBECC tool.

MR. WILCOX: Okay. Thank you, Todd.

So in order to support this EDR calculation that's just been discussed we need -- in the CBECC-Res Software we need an estimate of the TDV production of the PV system that's supposed to allow you to get down to those low levels and go negative for ZNE.

And so the current or the previous versions of

CBECC-Res we've never actually calculated photovoltaic production, we simply ask people to do that in another program and input numbers. So in order to facilitate this EDR calculation we've now implemented a PV calculation directly in -- I think a very high quality PV calculation directly in CBECC-Res. You know our programming team, I want to give credit here to Chip Barnaby and Neal Kruis for working on that.

So here's what I'm going to talk about here: An overview background. I'll talk about the PVWatts Calculation. What the CBECC-Res PV inputs look like. And compare the PVWatts calculations to the Commission's own homegrown PV calculator, CECPV.

So the overview here is that as I said in order to support the, at this point EDR primarily, we've built in a PV Calculator in CBECC-Res 2016 that does an hourly calculation. It's compatible with making TDV calculations of the benefits of the PV. And it uses the PVWatts algorithms, which are -- PVWatts is a program that's supported by the National Renewable Energy Laboratory. And it's I think a reasonable, simple PV calculation that we think is pretty well suited for the purpose here.

So an important facet to mention here are that this calculation is meant solely for the Energy Design Rating function, CDR. It's not at this point used for any compliance with the basic Title 24 Requirements.

There is a separate PV Credit that was talked about this morning, but that's using a much simpler, more prescriptive approach to performance. As Larry pointed out that PV Credit is actually not generally limited by the performance of the PV system anyway. And so there's no connection really between this new PV Calculator and that Title 24 Compliance Calculation.

And the other thing to emphasize here is that this isn't intended to be a high-end photovoltaic system design tool. It's not a sophisticated engineering tool. It's meant to give a reasonable estimate of PV performance for the kind of the situation we typically find ourselves in for ratings. And compliance kinds of things in the building world, where you usually are doing calculations when the actual design of the building is still a little vague: you may not even know what lot the house is going to get located on. You don't know what the orientation is going to be. I mean, there's huge unknowns.

And you're looking for a reasonable number that fits into the rules for how you get credits. And we think that what we've got here works really good for that.

The other thing to emphasize here is that we've tried to make this flexible to meet the needs of different levels of user input, knowledge and sophistication.

At the simplest level we're importing here the ruleset that's been used for the new Solar Homes Partnership Incentive Program by the Energy Commission and what's called the California Flexible Installations, CFI. And for that you basically sort of can take a stab at how big the PV system is, and put that in there and figure out what the credit's going to be and go forward with that. And maybe that's all you ever need to do to get what you need and that's fine.

But then, also as you'll see in a minute, we've given input so that you can do a much more detailed and sophisticated set of inputs for much more complicated systems of multiple arrays and orientations and components. And we did this all to make Mazi happy so he could do his work more easily. So we're trying to make everybody happy here.

So the New Solar Homes Partnership has been operated by the California Energy Commission as an incentive program for new homes to put in PV systems since 2008, so a pretty long history here. The NSHP uses a calculation tool that was created here at the Energy Commission called "CECPV," which is a pretty sophisticated and interesting photovoltaics calculator.

And to go along with that a whole set of rules for how you could specify a PV system and how you would inspect it and make sure it was installed correctly and make sure that it was functioning and a lot of quality control and so forth.

So the Commission has got a pretty strong background in doing this stuff and what works and what doesn't based on thousands and thousands of homes that have been built under this program. So that was the New Solar Homes Partnership.

The 2013 Standards PV Compliance Credit has already been discussed. I'm not going to talk about that much, but that's a very simple, very limited credit.

And then we have the 2016 PV Compliance Credit, which is similar to the 2013 version. And again we've talked about this. It doesn't have much to do with the PV it mainly has to do with as taking that credit that's kind of a transitional credit in the compliance world to help people get used to the increased performance requirements of the 2016 Standard.

And then now, the fourth thing that's going on is this new PV Calculator for Energy Design Rating s and programs like CALGreen. And this is the context we are operating in here and I guess that's -- if I do it then everybody else is going talk about this first, but I'm probably going to skip this line anyway.

So PVWatts is a program that does a simple, hourly simulation. It's really useful for us in the California Standards, because it fits pretty easily into the stuff we're already doing. It's compatible with our compliance weather files, which have hourly data and hourly solar radiation data in them. The solar radiation data we use for our compliance weather files actually came from NREL and from their solar radiation resource network stuff.

The PVWatts being an hourly simulation works very well with the TDV factors that we use for all of our evaluation of energy stuff. And PVWatts is sort of a public program, it's not open source like what we're trying to do with our software. It's not public domain, but it's available for anyone who wants to use it without any charge as long you give credit to NREL and observe their copyright.

But one of the important things is it's been maintained over the last number of years by the guys at NREL and they keep updating it and fixing bugs. And so the technical calculation is ongoing and current.

So what we've done here actually, I mean there are various ways we could have used PVWatts, but what we've ended up with is we've implemented the PVWatts algorithms in new code and new software inside the California Simulation Engine simulator; that's the guts of the CBECC-Res Program.

We use the publicly available documentation of the PVWatts algorithm, so you can download off the NREL website. We've compared it in detail to the NREL PVWatts version to make sure that it gives exactly the same answers with some minor exceptions like PVWatts doesn't run in daylight savings time and CBECC-Res does. So that changes the answers slightly. Those kinds of differences, big deals like that.

And one of the big issues for us is that this implementation in new software in CSE allows us to meet our goals for this release of software that include having as much as possible on almost I think everything in the CSE simulator in open source by the end of this process. Meaning that we post the software on our website and anybody can download it and use it and so forth.

We can't do that with the -- you can get a copy of PVWatts as a DLL that you can embed in your program and use it. You get that from NREL. It's all free and everything, it's all great. Only you can't say it's open source and give it away to anybody else. It's got an NREL copyright on it. So their approach to distributing the software is unfortunately not compatible with what we're doing with CBECC-Res.

Fortunately PVWatts from a software point of view is a pretty simple program and we were able to duplicate it in a few days time by some sophisticated programmers. And so we've essentially got the best of both possible worlds here, I think.

(Colloquy regarding the slides.)

So anyway, this is the simple PV input screen for the PV Calculation in the current version that you'll all be seeing. I guess maybe this is in the beta version that some of you have already seen; it's mostly like this. So you go to this input screen labeled "EDR" for Energy Design Ratings, which you've already been looking at for the last couple of hours here.

If you check "detailed Energy Design Rating inputs" on that screen then that opens up the idea of doing an EDR rating. And the first thing that you get is the PV system credit inputs as shown in the bottom half of the screen here. And at the simplest level where there's a scroll box there and you can say, "I want to do simplified or detailed."

And if you do simplified, this is the input right here. You say what the DC System size is in kilowatts. And you get the choice of three different module types, standard, improved and thin film, which have very small impacts but are useful to people with somewhat higher performance PV systems.

And then if you check the box that's labeled, CFI, that's it. There's the definition of your system. And this is we think ideal for people who are doing a design and getting ratings on a house that's going to built in numbers of times in a development or maybe in multiple developments. And they're looking for a very simple way to get credit for a PV System.

At this point they probably don't know whose PV System they're going to buy. They don't really know what. As I said they certainly don't know what the orientation of the roof is, so there's big questions about that. So this whole approach of CFI gives them an opportunity to do this in a flexible way.

So here's the rules for CFI here, from which we're proposing to move over from the New Solar Homes Partnership. And so the idea is you get credit in CFI for a PV System that's not optimal, that's sort of a regular performance. And if you meet the criteria that we're talking about here then the program always calculates a specific orientation and tilt and so forth and you don't have to worry about everything else.

So in order to be in CFI your PV array has to face between 150 and 270 degrees, compass orientation. That's from basically southeast to west. Any orientation between southeast and west is fine. The tilt has to be the same as the roof and it has to be between 4 and 12 and 7 and 12, so standard production house roof tilts. And you have to have minimal shading as defined in the New Solar Home Partnership Rules.

Let's see, I'm trying to go down. Can you do that? There it is. Okay, so this a simple of the minimal shading criteria and it applies to things that protrude from the roof like vents, chimneys, architectural features, mechanical equipment and stuff. But it also applies to neighboring trees, next door houses, things like that.

And the rule just says that the distance "D" from the closest point on the array has to be two times greater than the height "H" of whatever obstruction it is above the level of the array.

So it's a relatively simple thing. You can look at the building and sort of see whether it meets this criteria. And it's basically, I think, a pretty straightforward criteria. And if you meet this criteria then from the CFI point of view the array is unshaded. If you don't meet this criteria then you can't use CFI. Then you have to go into specific orientation details and shading and all of that stuff. You can still use the program, but you can't use the simple input.

So then if you're not going to use the simple input you can use the scroll box there where it says, "inputs." You'd pick "detailed" instead of "simple" and then that opens up a whole bunch more inputs on the screen here. You again get the DC system size and the module type. And you've unchecked CFI here, so we're not going to do CFI, we're going to do detailed. But you could do CFI here if you wanted.

But if you uncheck that then, now you have to put in the azimuth of the compass orientation of your array, the pitch of the roof. And you can put that in either in terms of degrees or angle in terms like the builders do roofs 4 and 12 and so forth.

And then you put in the inverter efficiency that you're going to use for the system taken out of the Commission's Inverter Database. So that's the more detailed approach.

If you want to only go down to the next slide, okay?

Okay. Now, if you have a complicated system, you're doing it for Zero Net Energy and you can't get all the panels on one roof slope, you have to put in panels facing more than one direction, all of those kinds of issues that might come up then we allow you to put in, I think, maybe five arrays is the limit here. But at least up to five arrays, each system with its different capacity, in DC kilowatts.

You can different module types on different runs of those systems. If you don't want to do that for some reason some of them can be CFI, others can be not and so you can get into much more complicated and evolved systems with the same calculation built into CBECC-Res.

And there is an example of what appears on your CF1R if you have one of these complicated, detailed system inputs. It echoes all of those inputs and they're all there for it to verified as part of the reporting.

So one issue that we thought people might be interested in, we know people are interested in, is how does the results of PVWatts in this application in CBECC-Res, how does that compare to the CECPV Program that's currently in use for the New Solar Home Partnership? And the answer is that the results are very similar.

This is a comparison of a set of standard panels at a normal pitch and orientation. And the CECPV results here are from a report that Davis Energy Group did for the Energy Commission as part of, I think it was a utility-supported project, where they calculated a bunch of results for different pitches and orientations of standard arrays. And looked at how much they produced in I think this is all in Climate Zone 12, Sacramento.

So we duplicated that same set of runs in the new PVWatts as implemented with the defaults that are in there, etcetera. And you know, the results are within a percent or two for most cases. If you get the orientations all the way to east then you started getting in 4 percent and so forth. But by and large you won't see much different results here than what you would have gotten with CECPV.

Some of the difference here undoubtedly has to do with assumptions about long-term degradation and a balance of system losses and various things like that that are generally dealt within programs at this level with kind of root force rule assumptions. So those could be adjusted to see if you can get closer to the average results if there was a reason to do that.

So that's my presentation. And I'd be happy to take questions if anybody has any.

MR. SELBY: Brian Selby, Selby Energy.

I've done many HERS verifications of NSHP homes and used the PV Calculator many times. I didn't see the ability in the software to model obstructions that may occur on the site. You might have trees or neighboring obstructions. Where the PV Calculator I believe has the ability to model those and take that into consideration. I didn't see that down here.

MR. WILCOX: Yeah. Well and so the question is what can you do if you actually have shading? And I agree this is an interesting problem. When we agreed to put the PVWatts Calculator in the situation, it was somewhat simpler for us because PVWatts couldn't allow shading at that point either. So if it's a simple thing for simple cases that's fine; and it's relatively easy to do.

NREL just released a new PVWatts Program in the last couple of months that now has shading. And so we realize this is an issue and we're going to have to sooner or later do something with it. And we haven't actually tried to figure out yet whether we'll just migrate the PVWatts shading or whether we -- I think we could also migrate the CEC PV shading algorithm.

And if you know about both of those it would be interesting to hear your comments about which one would you like better.

MR. SELBY: The second part of my question would be obviously this is an Energy Design Rating. And on the CF1R that would be part of the documentation that would go to the Building Department for final review, plan check and permit.

Now, once they get a permit on this whose responsibility is it going to be to verify these measures, like a PV system and whether or not there's shading? Or if they took the CFI approach and they did have some issues that didn't meet that when they actually installed, whose responsibility would it be to actually call them on it and say, "You need to go back and change that?"

Along with a lot of the other features to get a rating, several envelope measures: window area, SHGC, U-factor, these types of things, whose responsibility would it be to verify that in order to solidify that that as-built condition is actually met?

And I know that's not your part.

MR. WILCOX: That's not my part of the program. Maybe it's Larry or maybe it's Martha?

MS. BROOK: It's not me, anymore.

MR. WILCOX: It's not you anymore, okay.

MR. SELBY: I mean it really comes down to compliance. That's my biggest question.

MR. FROESS: So what we're anticipating is very similar to how the NSHP field verification is done now. So anything that needs to be verified in the field would be done by a HERS Rater, similar to NSHP.

You're also sort of in a parallel world with the utility and new construction programs who do their own verifications and plan check on the measures that go beyond the Standards. And so it seems logical that you'd have that kind of a backup.

MR. SELBY: All right, thanks.

MR. FROESS: So that's a preliminary answer.

MR. SELBY: And that does bring up one other question about the level of sophistication of the software is increasing. Is there any requirement to have a certified professional prepare that documentation for an EDR rating, similar to a RESNET Rating having a HERS Rater prepare that? Just some thoughts.

MR. WILCOX: Yeah.

MR. HODGSON: Mike Hodgson, ConSol, representing CBIA, two questions.

Bruce, for you on your presentation on the input on the simple method you basically kind of check the box as a standard module type, right?

MR. WILCOX: Uh-huh.

MR. HODGSON: And if you get it more complicated the variations on the module are not manufacturer-specific they are more kind of like, "Good, better, best" or other variations?

MR. WILCOX: Well, and we need to actually do better definitions of what those things mean, but my understanding is that the improved modules have an anti-reflection coating, maybe? I think that might be the difference. But this definition is a PVWatts definition, so it just moves it across. And we need to have some specifics about what that put-through requirement is there.

MR. SELBY: Yeah. But the intent is not to go down to an actual module itself, right? Okay, all right.

So Larry, I think for you on Energy Design

Ratings in general -- I'll stay off QII right now -- so if I wanted to go to Tier 1 and I met 2016 can I do that entirely with solar?

MR. FROESS: It depends on the climate zone. I mean, you have to hit to a Tier 1 as a prerequisite for certain climate zone.

MR. SELBY: Okay, so I'm in Climate Zone 12. I'm not sure what you mean by Tier 1 is a prerequisite in a climate zone. Tier 1 is not a prerequisite in any climate zone right now.

MR. FROESS: Well, for the EDR requirement you have to meet Tier 1 first before you can take it down with PV.

MS. BROOK: Right, you can't do it all with solar is what I'm hearing.

MR. FROESS: Right. You have to hit the 15 percent compliance first.

MS. BROOK: Because the 15 and 30 is the efficiency.

MR. SELBY: Okay, so I'm in 2016. I have a high-performance attic, high-performance wall, I just beat code. And now the local jurisdiction wants me to go Tier 1. I now have to do that with strictly efficiency; is that correct?

MR. FROESS: If you're following CALGreen.

MR. SELBY: I'm trying to follow CALGreen.

MR. FROESS: And Ken wants to say something.

MR. SELBY: Ken, correct me again.

MR. NITTLER: No, no, no. Okay. As I understood it from watching the CALGreen process, so the tiers are based on the Compliance Calc. And the Compliance Calc can have PV in it in most climate zones except 6 and 7, right?

So you could have a case where I think you could get to an EDR of zero with PV, because you've determine the tier by looking at the Compliance Calcs. The Compliance Calcs would have the PV in them, right? So you could meet the Tier 1 or Tier 2 criteria that way.

And then if your PV system is big enough for EDR credit you can get down to zero, so it is possible.

MR. SELBY: It is possible, but let me give you a straightforward example. I am meeting 2016 with attics and walls and the local jurisdiction says they want me to go to Tier 2. Can I now put basically an equivalent of 30 percent of solar on my house and meet Tier 2? I don't know the answer to that.

MR. WILCOX: I think it's no, because Tier 2 is based strictly on compliance margin. And you can only take credit for the PV Compliance Credit.

MR. SELBY: Okay, so how do you --

MR. WILCOX: It's not (indiscernible) PV.

MR. NITTLER: But that PV Compliance Credit is supposed to be the equivalent to walls and attic, right? So that's not so significant.

MR. SELBY: Right, so that gives me 15 percent, roughly. I get that. But I'm saying I'm not using that. And a local jurisdiction comes in and says I need to go to Tier 1, then I have to basically go to 15 percent over code using efficiency measures.

UNIDENTIFIED MALE: But QII solar could be part of that (indiscernible) itself.

MR. WILCOX: In the PV Compliance Credit.

MR. SELBY: Yeah, but I want to use solar. I like solar.

MR. FERRIS: So I think that we need to get back to your question here, Brian. We need to think about it a little bit. I understand your question.

MR. SELBY: Well, I think it should be spelled out.

MR. FERRIS: I understand your question.

MR. SELBY: Okay, you understand the question, because it's not clear in the code. That's my issue, all right? And we get down to CALGreen it doesn't say that. And so I think we're going to have some problems if we don't have flexibility on what we are going to use with solar.

And I'm going to leave Ken out of that argument.

MR. RAYMER: Bob Raymer with California Building Industry Association, this issue did come up at the Green Building Code Advisory Committee.

And at the time we were looking at some draft language from the Commission where it looked like you could use solar to get to a minimum compliance at Part 6, but you could not use any component of solar for either Tier 1 or Tier 2. If a jurisdiction adopted Tier 1 for a time being the way the CEC had the regs written, the Green Building Regs, you couldn't use any solar. And you guys changed that.

So that the question here is how much solar could you ultimately use in Tier 1 and Tier 2? I don't know. I don't have the software, but you can definitely use solar.

MR. SELBY: So Part 11 says you have to use the compliance software to meet Tier 1 and Tier 2?

MR. RAYMER: That's correct.

MR. WILCOX: So you have to use the rules that apply to the compliance situation to get to the 15 or 30 percent. You could include the PV Compliance Credit, because that's in the compliance software to get to 15 or 30.

MR. SELBY: Okay.

MR. WILCOX: I think you probably never can get to 30 with just that. I think you're short by a little bit in some climate zones, but you could get to 15 percent.

MR. MCHUGH: This is Jon McHugh with McHugh Energy. We looked at this in advance of the adoption of CALGreen.

If I remember correctly you can't hit the tiers with solar only in any of the climate zones. So I mean, if you look at the numbers that are in that table that describes it, 5 and 6 there's zero credit because you're not required to have high-performance attics and walls in those climate zones. But what is it, 22 percent is the highest credit that you get?

MR. RAYMER: Well actually I believe like say Climate Zone 12 is just choosing the residence there, next to the residential the PV Compliance Credit and QII you can get to 30 percent, which you need QII to get to Tier 2 anyway.

MR. MCHUGH: So anyways, I think you guys have done a great job here. I looked over Martha's presentation. I understand what you're doing. It looks like you're basically putting a denominator underneath there. And the calculation on top is now you're just calculating what your amount of energy consumption is, it's including the plug load, so I'm pretty good with those comments.

I still have some questions about the electric and gas thing, but I'll talk to you later about that.

In terms of someone who is doing a Cardinal Orientation Rating for their homes, because ideally where this is going to be used at is subdivisions of houses that are complying potentially with the Cardinal Orientation, maybe that's not possible. But I'm not sure what's intended.

But my guess is that out of those 200 buildings or whatever that some of those panels are not going to be able to fall under the QFI. (sic) Is this intended that the solar system that falls outside of that QFI that -- CFI, yes. Is the intent that when someone finds that they're outside of that range that they need to basically go back and recalculate for that? Or is there some sort of way of pre-calculating sort of parametrically some method so they can say, "Look we did all these simulations and therefore for this particular set of -- "

No, but go ahead, Bruce.

MR. WILCOX: Yeah, I mean someone could make such as scheme up, but we don't have anything like that implemented. Whereas CFI allows you more than 90 degrees, right? So if you've got a right angular building you always at least have one roof that's facing within CFI, I believe, right?

MR. MCHUGH: Right. But for detailed you've basically got a fixed angle, right? All right, thank you.

MR. DAKIN: This is Bill Dakin with Davis Energy Group. We have actually used the earlier beta version of this and so I want to compliment the team on the work that was done, the efforts that were done.

We did our comparisons versus PVWatts as well and found really good -- we did see some variances, probably because of this daylight savings and some hour calculations and stuff -- but very similar. There were a couple of things that, well, some I'm not even going to get into because you might have different outputs and different inputs, so it's probably a little premature to talk about.

But a couple things I noticed was that I wanted to emphasize the need to kind of really categorize what's the difference between and standard and premium, because right now I know what the standard and premium version is in PVWatts. And it's a certain efficiency and then a power co-efficient of temperature. The issue is, is how is that verified? How is a building official or a HERS Rater going to go out there?

That information isn't easily available. CEC does have its certified database and I imagine that CEC may actually have that information when they certify their panels. And maybe all that needs to happen is that information needs to be just reported on the online database, so that somebody can go up and say, "I'm using these modules." And then I know which one to use.

Obviously if it's early in the design, you don't know. You might choose both and see what the difference is. Our experience is there's not a huge difference between those two.

The other is that we noticed that thin film is only in the detailed output and not in the simplified. And I'm not quite sure why. And also, that when you run thin film the actual annual TDV output and the kWh output is higher than both standard and premium.

And it does that in PVWatts too, so I'm not quite sure why that is. It's not intuitive to me. And maybe somebody in the solar industry has an explanation?

MR. WILCOX: Well, PVWatts, it's maybe not intuitive, because traditionally thin film modules have had a lower envelope efficiency sync. (phonetic) But the input here is rated in kilowatts, so it's not area. So if you're talking four kilowatts of thin film it's probably of a larger array.

MR. MCHUGH: Certainly, yeah.

MR. WILCOX: But the thin film generally uses diffuse light better.

MR. MCHUGH: Yeah, and they're less susceptible to increases of temperature.

MR. WILCOX: So if you have the same four kilowatt system, and one's thin film and one's not, the thin film one might produce slightly higher output, I think, is the idea.

MR. MCHUGH: I just thought it might be good to just double check with that as reality. And that's not what I'm used to hearing.

MR. WILCOX: And actually there's some new thin film products under development in the world that are actually pretty high efficiency, so it's possible that those will become an issue in the future.

UNIDENTIFIED SPEAKER: (Off mic) How high is their efficiency?

MR. WILCOX: It's pretty high.

MR. MCHUGH: And lastly, I think it's important to try to get some kind of shading in there, because there are going to be cases especially with multifamily and single family with complex roof lines. That you may have a system that you can get it on the roof, but you're not going to meet the ceiling criteria of the CFI.

That's all. Thanks.

MR. NESBITT: George Nesbitt, HERS rater. Why use PVWatts rather than use all the calculations from the CECPV Calculator?

MR. WILCOX: Well, there's a lot of complicated issues behind that, George. I'm not the person who made that decision, but there's a -- so I can't really comment on it.

MR. NESBITT: Okay, because I just see it has relevance with here we have this tool and -- gee, I wanted to save the white-haired men who were here earlier time -- my builder friends, and myself, from having to do the CECPV Calculator as well as in CBECC. And is this something that NSHP could recognize? Having shading I think would be important in that.

Is the CEC equipment database part of this?

MR. WILCOX: Yeah, George. Keep going.

MR. NESBITT: And if it is and even in the CECPV Calculator as a HERS Rater we actually have to use that tool to do a rating on an existing home with solar, I can't find my (indiscernible) PV panels anymore. And I don't have old calculators handy with them, so having the historic database is very, very critical when we get to existing homes in rating.

Multifamily, can we do multiple systems by zone or is it one system per file?

MR. WILCOX: I'm not sure I understand that completely, George, what you're talking about?

MR. NESBITT: Well, in a multifamily building there some inputs that you do by zone, say each zone being an apartment, versus a single-family home or is it input only one place? So could you have different systems on different apartments in a multifamily? It's just a thought. Is your output only in annual TDV? Do you give annual kilowatt hours? Or is it just TDV per square foot? And do you have monthly output?

And do you recognize micro-inverters?   Because the second system on my parent's house, the micro-inverters are definitely producing more than essentially panels in the same orientation until -- with a single inverter.

MR. WILCOX: Right.

MR. NESBITT: And then Bill actually mentioned it, my understanding is that the solar ready in PV systems is installed to meet the solar ready are verified by the Building Department. It's only NSHP that really requires the HERS Rater. I do not believe that you required that a PV System for Code Compliance, let alone Zero Net Energy, be verified by a HERS Rater. I mean, not that I didn't argue for it.

MR. FERRIS: Yeah, Nehemiah Stone on the telephone to ask a question.

MR. STONE: Hi, can you hear me okay?

MR. FERRIS: Yes.

MR. STONE: All right, I have a couple of comments and then one short question.

So this area as both Bill and George have mentioned is one area where it is going to be important to look at it for multifamily differently. And one of the reasons it wasn't mentioned was that you're also going to have a multifamily project that's multiple buildings, but you only have the array on one building. And as you go through and get ratings for buildings the interaction between those is not going to be quite as simple as for a single-family home.

The other comment, Bruce, you asked if anyone had good input on how PVWatts versus CECPV deals with shading, the new PVWatts. I talked to somebody and I wish I could remember who it was, but I talked to somebody recently who has seen the new version of the PVWatts and they believe that the CECPV Calculator still does a better job on shading. I'm not an expert, I can't say myself. But I did get that input from somebody.

The question I have, it goes back to your Slide 8, Bruce, if it would be possible to bring that up again? On the slide it says, "NSHP only" and I am -- or it says, "From New Solar Home Partnerships, NSHP." Does that mean that the CFI details are from that or does that mean -- or yeah, let me just put the question that way, what does it mean "from New Solar Home Partnerships?"

MR. WILCOX: Well, the concept here is to take the rules that were developed and used in the California New Solar Homes Partnership for the CFI and move them over to the EDR. It's essentially use the same rules in EDR. Now, that's the concept.

MR. STONE: Okay. So that brings up the shading issue again, then. But the other question that raises for me does that mean that it's contemplated that the CECPV Calculator would go away once this is implemented? And it affects other things.

MR. WILCOX: I don't think -- the answer to that is no, Nehemiah, I think.

MR. STONE: Okay.

MR. WILCOX: I think what's being proposed here is that the EDR has no connection with the CECPV or the New Solar Home Partnership and it's going to use a new piece of software. And that's basically what's being proposed.

MR. STONE: Okay, all right. Thank you.

MR. FERRIS: Okay. So I want to take just a couple of minutes and talk about our next steps. So we mentioned earlier before we're hoping to have the CBECC-Res 2016 2.0, out in beta by April 15th. We basically have to finish some testing. We don't want to send something out that is giving an incorrect answer.

We'd like -- because of that we've extended out the written comments due date, so we'd like comments back to us by April 22nd by 4:00 p.m. The Workshop Notice basically outlines how you can submit comments to the docket. But if you go to our website you can go to the 2016 Standards Tab, go to the "More Information: Post-adopted Implementation." And if you go to Docket Number 16-BSTD-03, you can submit a comment and that's the open docket for this Residential Update.

And we're going to post the slides as well as any other information. I was going to say we were going to get a written transcript, but the court reporter didn't show up. And supposedly they're going to do it from the recording, but that seems kind of iffy. So we may only have an audio recording of this meeting.

And our plans are to take this to the June 8th Business Meeting, so that we have it approved and ready to go for July.

But thank you all for participating. And we'll be around, so if you want to ask us questions feel free.

(Whereupon, at 2:55 p.m., the workshop was adjourned)

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TRANSCRIBER'S CERTIFICATE

I do hereby certify that the testimony in the foregoing hearing was taken at the time and place therein stated; that the testimony of said witnesses were transcribed by me, a certified transcriber and a disinterested person, and was under my supervision thereafter transcribed into typewriting.

And I further certify that I am not of counsel or attorney for either or any of the parties to said hearing nor in any way interested in the outcome of the cause named in said caption.

IN WITNESS WHEREOF, I have hereunto set my hand this 22nd day of April, 2016.

Myra Severtson
Certified Transcriber
AAERT No. CET**D-852