BEFORE THE

CALIFORNIA ENERGY COMMISSION

In the Matter of:	)	Docket No. 14-BSTD-01
	)	
Draft 2016 Building Energy	)	
Efficiency Standards Revisions	)	
For Residential Buildings	)	

STAFF WORKSHOP

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

MONDAY, July 21, 2014
9:30 A.M.

Reported by:
Kent Odell

APPEARANCES

Staff Present

Mazi Shirakh
Peter Stark
Danny Tam
Payam Bozorgchami
Bill Pennington

Presenters

Farhad Farahmand, TRC Companies, Inc. (TRC)
Bruce Wilcox, Support Contractor for Building Energy Efficiency Standards, CEC
Sarah Schneider, Energy Solutions
Heidi Hauenstein, Energy Solutions

Also Present (*Via WebEx)

Cathy Chappell, TRC Companies, Inc. (TRC)
George Nesbitt, HERS Rater
Mike Hodgson, ConSol, representing CBIA
*Khalil Johnson
*Bijit Kundu, Energy Solutions
Dan Lapato, representing the American Public Gas Association
David Goldstein, Natural Resources Defense Council (NRDC)
*Garrett Doss, Bradford White Corporation
*Frank Stanonik
Charlie Snowder, San Diego, General Contractor
Robert Raymer, CBIA
Frank Nunes, Wall and Ceiling Alliance
Matt Christie, TRC, on behalf of California Advanced Homes Program, Utilities Efficiency Incentive Programs
Dave Springer, Davis Energy Group
Andy Wall, AC Home Performance
Abhijeet Pande, TRC
Lawrence Penner, Green Hybrid Roofing
Mike _____, CalCERT
Reed Hitchcock, Asphalt Roofing Manufacturers Association
Tom Kizitsky, APA, the Engineered Wood Association
Gary Talbot, 5 Star Performance Insulation
Ken Graham, Green Hybrid Roofing
*Steve Strawn, JELD-WEN Windows and Doors

I N D E X

P R O C E E D I N G S

JULY 21, 2014 9:35 a.m.

MR. STARK: We're going to be starting in just a few minutes. It's 9:28 a.m. and the meeting starts at 9:30, we're just organizing presenters and getting presentation files uploaded.

Just as a note for those listening in remotely, right now everyone is on mute on entry. I will have opportunities for people that are attending remotely to comment, but at the moment all of your lines should be muted.

MR. SHIRAKH: Good morning. It is 9:30 and I think we're going to get started. I'm Mazi Shirakh and today is going to be our mostly residential topics. Before we get started, just a few notes. I left some sign-in sheets outside, please either write your name and contact information on it, or staple your business card.

Today's workshop is going to be recorded and transcribed, so we ask you when you come to the podium you need to identify yourself and your affiliation, and for the benefit of the Court Reporter, better yet, if you can hand him your business card so he can get the correct spelling

of your name.

On the logistics, you've all been in this -- the closest bathrooms are just outside, we don't have any more snack bar in this building, no more coffee, so just bring your own coffees from here on out. And in case of an emergency, you know, we kind of exit through those main doors and gather in the Roosevelt Park across the street and await further instructions, hopefully nothing will happen.

As far as the schedule, we have two topics this morning and two in the afternoon. If we get done early with the morning topics, we're just going to have to take a long lunch because we're going to start the afternoon topics at 1:00, those are important topics, and some people will be attending the workshop just because of those, so we're going to keep on schedule.

So with that, I'm going to start the workshop. I have a brief introduction that's going to talk about the process for the 2016 Standards, the goals and the visions, and also some of the measures and methodologies that we're contemplating to move toward Zero Net Energy.

The authority for the Energy Commission

to adopt the Standards was given to us in 1974, the Warren-Alquist Act, which was signed by then Governor Ronald Regan, and it covers both Residential and Nonresidential Buildings

The first Standards were adopted in 1978 and we have been updating it every three to four years. Ever since, they're required to be cost-effective, the Standards, and we look at the measures individually, although it's not specified in the Warren-Alquist Act, we look at each measure in isolation, make sure that it is cost-effective, and then we also look at the entire package of the Standards to make sure that both individually and as a package they are cost-effective.

We use various ways of coming up with the costs. We work closely with the builders on these costs and we generally do a pretty good job and a fairly good agreement. I'll talk about the methodologies that we use a little bit later.

And in the Standards, we obviously have the mandatory measures and then we also have two ways of complying, the Prescriptive Measures or the Performance, which is a computer program that allows trade-offs. And we do it in a public

fashion. Next, please.

The policy drivers for the Standards are the Governor's Clean Energy Job Plans, also there are various other policy drivers, the Zero Net Energy Residential by 2020 and Nonresidential by 2030, the California Air Resources Board, and the California Long Term Energy Efficiency Strategic Plan, they all set various goals that have to be met through the Building Standards. Next, please.

Additional benefits of Energy Efficiency Standards and Zero Net Energy is greener jobs, higher paying jobs, investments by entrepreneurs, and it will make California's economy more competitive on the global scene. Next, please.

The goals are, you know, we have established a timeline for the residential building to meet the ZNE. By "we," we mean the Governors, the Legislatures, and the various other State agencies. For the residential buildings, to meet the ZNE goals by 2020 and for non-residential buildings by 2030. And the goal is to make the building envelope and the systems within the building as energy efficient as possible, and then using renewables to meet the

balance of the energy requirements.

We use 2008 Standards as the basis of our calculation on the whole house HERS score, a 2008 residential dwelling will have a score of 100, and then from there we're moving towards basically the ZNE would be a score of zero. And part of that will be met with the energy efficiency and part of it with renewables. And that score of 100 includes all loads in the building, including the regulated loads that are under the Title 24 purview, it's heating, cooling, and water heating, and also it includes other loads that are not directly under our control such as plug loads, appliances, and things like that.

In fact, when you look at the components of what's contributing to that score, the plug loads and appliances actually are becoming a dominant factor because over the years we've done such a good job of addressing the regulated loads that, you know, it's becoming a smaller piece of the pie, whereas the plug loads and things that are outside, you know, more flat screen TVs and all that, which we can't control are dominating. Next, please.

For those of you who were involved in the 2013 Standards, which concluded a while back and went into effect about 21 days ago, to be precise, it was a very open and very public process. We convened more than 45 stakeholder buildings all over the state, sponsored by the California Utilities, and we also held 15 staff workshops here in this building.

By comparison, the 2016 standards are far more compressed, more focused. So we're not going to have nearly as many stakeholder buildings which actually have concluded already, or staff workshops because we are narrowing, focusing on very specific measures. And typically we receive thousands of comments and we respond to all of them in some fashion. Next, please.

So this graph basically tells the story of the impact of the Building Energy Efficiency Standards on our Residential Building Consumption. The graph to the far left that says 70s was basically pre-Building Standards. I had the misfortune of living in one of these homes back in the 70s and I can tell you that that graph is not lying. The house that I lived had

single pane windows, aluminum, had minimal insulation in the walls, very little in the attic, electric resistance heating and water heating, and you name it, and I was not happy when I was paying my bills.

So we've done a pretty good job and currently, you know, when we started based on this graph in the 70s, the energy intensity use was over 100 KBtus per year, per square foot.

MR. STARK: Mazi, hold on one moment. It looks like there might have been a problem with the audio. We lost audio. Just one moment, we're going to try to reconnect.

Hello folks, there was a brief interruption to audio, I apologize for that. We should be back on track. Mazi, if you could?

MR. SHIRAKH: Can people on the Web hear us?

MR. STARK: I have them muted at the moment, so they wouldn't be able to --

MR. SHIRAKH: Okay, so --

MR. STARK: I don't have any comments from folks.

MR. SHIRAKH: If you can't hear us, just raise your hand and we'll try to address it.

Anyway, to continue the story, so we're currently -- the graph points us to 2014, we're at that level which is about 22, so we've come down from about 112 to 22 on the regulated load, part of the energy consumption. And our target is obviously the 2020 is around 12, so we're pretty close to our target, so it's very encouraging.

And the goal of the 2016 Standards and the one after that is obviously to move us from 22 to around 12, and then resort to renewables for the balance. Next, please.

This is the schedule for the 2016 Standards. It started April 4th of this year with the CBIA/CEC Standards Forum over at the SMUD Building where we presented the topics and then it was followed by the IOU Stakeholder Meetings, most of them were web-based, there was on in-person meeting in Davis, California, where the IOUs presented the topics to the public and they asked for comments. They received many and they have tried to address them and incorporate them in their case reports, and they presented those reports to the Commission which has become the basis for these staff workshops. And the

workshops started in June and they will conclude in August. These would be the staff workshops in October of this year. We're going to roll out the Draft 2016 Standards, which would be what the staff is proposing to become the next Part 6 Standards for the State. In January of 2015, the formal rulemaking process will start with the release of the 45-day language and it will probably be followed with 15-day language in April, adoption will be in May of 2015. The effective date will be January 1, 2017. You have about a year and a half between adoption and effective date, and that gives the staff time to develop our compliance software and compliance manuals, and it also gives the industry time for both the builders and manufacturers to basically gear up for the effective date. Next, please.

These were the schedule of our workshops. I can't read it from here, but we're towards the very right, we're in the last from the right which is where we are. We're pretty much done, by the end of the day, with our staff workshops. The only thing that will be upcoming will be -- I'm sorry, we were the third from the right -- on Wednesday, we're going to have probably it's

going to be a brief workshop on our ACM Manuals and some of the compliance options we're proposing. We don't anticipate to take all day, maybe just half of the morning. And then our CalGREEN workshop is going to be on August 6th. Next, please.

The Pre-Rulemaking, we've concluded again, as I mentioned, there were stakeholder meetings that the IOU sponsored, and then the rulemaking will start in January. Next, please.

The Pre-Rulemaking and the Stakeholder Meetings, again, I think I talked about it, the only thing I'm going to say here is that the utility sponsors for these were PG&E, SCE, SDG&E, Southern California Gas, and also we will be receiving assistance from SMUD and LADWP, which basically covers I think 95 percent of the ratepayers in the state. Next, please.

The Pre-Rulemaking, we are in the second phase of it. The staff workshops, which is today and at the Energy Commission. Next, please. The rulemaking will start in January and will be presided by the Lead Commissioner, the 45-day and the 15-day language, and the adoption at the Business Meeting will be attended by the entire

Commission. Next, please.

So this slide basically lays out goals and visions for how to get to ZNE for 2016. It's a little different approach than the past. Instead of focusing on certain measures that would become Prescriptive Standards, which is basically the practice of the past, we are specifying a certain performance level for the building to meet the ZNE goals.

And once you specify the performance level, say, you know, for the high performance attics and the high performance walls, the builders have an array of choices and options to meet those goals. For instance, they can use above deck insulation to meet the ZNE goal, or below deck insulation, they can use sealed attics, they can move the ducts into conditioned space, they can use high reflective tiles, or a combination of those, or many other solutions. And we're going to talk about that. Same thing with the walls. So again, we're not going to be focused on one specific measure, we're going to provide an array.

And then we're also going to provide PV, Photovoltaic tradeoff against the high

performance attics and the high performance walls.

So the goal here is basically to give the marketplace many many choices and let the marketplace sort itself out. Some builders are going to gravitate towards energy efficiency measures and we're going to be providing some financial incentives, too. You know, we're working with the CPUC and the IOUs, and they will gravitate towards some of these energy efficiency measures, some may feel comfortable using the PV at least in the beginning to trade off and meet the Standards requirement that way. And then we will let the market sort itself out.

And we're going to create a Prescriptive Package that will reflect this vision, which is going to basically provide instead of just saying you have to do this to meet the high performance attic, it' going to have the range of choice imbedded. And on top of that, then, we're going to have the Performance Path, obviously, which will provide additional flexibility. So the rest of the day is actually to demonstrate this concept. Next, please.

Again, this reflects upon the same

discussion, you know, the high performance attics, there's going to be many choices: above deck, below deck, sealed attics, they can use a different kind of insulation material, or they can combine reflective roofs with some level of roof deck insulation, or use different products that actually imbeds the insulation within the tile itself, and I think we're going to show that today. And again, we're also open to other solutions and suggestions by manufacturers and builders. Or, if they don't like something that is under Option A, they can go to Option B and move the ducts in the conditioned space and, again, moving ducts into conditioned space can take several forms. They can build chases in the attic, basically move the air barrier to above the ducts, or they can literally move the ducts into the conditioned space, and there are clever ways of doing it. Or they can used sealed attics, they can use ductless systems, or, again, you know, the other solutions that we may not have thought about, but as long as it performs at the same level, we're open to it. Next, please.

And then they also have to for the walls choose one of these strategies. You know, we're

going to specify a U-Factor, and I'm using .048 here, it's an approximation and this could change, it may be a little bit higher or lower, but this .048 is based on 2 X 4, 16" on center, and R-9 continuous insulation, which is a 2" foam, but it can also be met with a 2 X 6 at 16" with an R=5 continuous insulation, or it can also be met with staggered studs, double walls, SIPs, or other strategies. Next, please.

Or they can use one of these compliance options. They can use a photovoltaic compliance option to try to trade away the high performance attics or walls, or they can use some of the other more traditional compliance options like the advanced whole house fans, the Night Breeze and other compliance options that are available through the performance pack to trade away some or all of the measures that I mentioned. Next, please.

Besides the high performance attics and the walls, there are two other major measures which is actually the topic for this morning, one of them is the tankless water heater, which actually we call that instantaneous water heater with an energy factor of .82, and the other one

is going to be high efficacy lighting. The lighting market products manufacturing has moved a long way and we finally think it's ready for primetime, the LED sources that are out there, the kitchen that you see in there is all lit with LED lights. And so I think it's time for us to move to all high efficacy lighting using LEDs. And this was actually presented in a separate workshop a couple weeks back, so the presentations are online if you wish to go back and look at them. Next, please.

The Standards use lifecycle costing analysis to analyze each measure individually. This kind of cash flow method that looks at the cost of energy and the savings, maintenance costs, over the life of the building which is 30 years for residential, we discount all those back to the present value, and we assume a three percent real discount rate, 30 years life, and we try to be very thorough in our analysis by including all the markups that the builders have, all the little factors that go in there. And then we look at the present cost of the measure versus the present benefits, and if the benefits are higher than costs, we consider that measure

to be cost effective.

What feeds into the lifecycle cost analysis is the concept of Time Dependent Valuation (TDV) which is basically a measure that captures the variable nature of energy, that unit of energy that is produced on peak on a summer afternoon, is worth more or costs more to the utilities than an off-peak because of generation requirements and the constraints on transmission distribution and other factors. So TDV captures that variability. In a sense, then, the measures that save energy on peak are favored over measures that save energy off peak. Next.

So the challenge of ZNE is that, you know, what is our business practice? Actually, this picture was taken 45 years ago to the date yesterday, it was the 45th anniversary. So the challenge is the way we build our buildings is what is keeping us from our ZNE goal. We put our ducts which contain 50 degree supply air in the summertime in the hottest part of the house, which is our attic, which could be up to 140 degrees. And we do the exact same thing in the winter, we put our hottest ducts with the 140 degree air in an attic that has a 30 degree

ambient. So, I mean, that's totally backwards. So the goal here is to do something about our attic environment. We either need to temper our attic environment, or move the ducts entirely out of the attic space. So all of those are viable options and we think we have solutions for all of them. So that is the challenge of the 2016 standards, which we are going to try to meet. Next, please.

And just to add a little fun to an otherwise serious day, here's a trivia which is based on the same concept of space travel. On November 19, 1969, Apollo 12's astronauts landed and you can see the lunar lander up in the distance, Yankee Clipper, made a bull's eye landing within 500 feet of Surveyor 3's spacecraft, which was sent to the moon three years earlier.

In this picture of Astronaut Pete Conrad, he's removing a TV camera and some other equipment from the Surveyor spacecraft and they brought it back to earth. That camera contained a big surprise. So the question is what is that big surprise? I'll give you the answer after the public comment period, or you can -- well, got to

give you something so you come back. You can Google it yourself, too. So that's the mystery. Next, please.

So that's it for me, so unless you have any questions we're going to go back to the real stuff and it starts with the HVAC Field Verification and Diagnostics. And the person who is going to be presenting this is Farhad Farahmand, and he is not in the room, he's going to do it remotely. And Cathy Chappell is going to be here to help Farhad and me with this presentation. Thank you.

MR. STARK: Who do I need to unmute? I apologize.

MS. CHAPPELL: Farhad.

MR. STARK: Farhad, this one right here?

MS. CHAPPELL: Yes.

MR. STARK: All right, Farhad, you should be live. Can you hear us?

MR. FARAHMAND: Yes, I can. Can you hear me?

MR. START: Yes, we can hear you. I'll go ahead and start your presentation.

MR. FARAHMAND: All right, thank you. Hi everyone, my name is Farhad Farahmand and I'm

with TRC. And alongside Cathy Chappell, we worked on the Residential HVAC Field Verification and Diagnostics Case Study. This was a proposal that is largely intended to be clarifications, other than be far reaching measures; as a result, we don't do any energy savings or cost-effectiveness analysis. This is because the 2013 Code change made some significant improvements and we wanted to give some time for those changes to breathe and have the market and industry adjust accordingly. However, as part of the Case Report that we'll be submitting a draft of to the CEC, we do recommend some field studies that would attain data so that further progress can be made as part of the 2019 Code Cycle. Next slide, please.

There are four measures contained within this case study, and they all relate to refrigerant charge. The first one is that we would require liquid line filter driers. A liquid line filter drier is basically a device that you install on the refrigerant line that would remove debris and moisture. These are elements that may affect the efficiency of the overall system by impacting the state of the

refrigerants.

The next measure would rename Charge Indicator Displays (CIDs) to Fault Indicator Displays, (FIDs), instead. And this is largely a signal to the market that devices beyond those that just can detect charger-related faults can possibly be approved by the Energy Commission as part of a compliance credit that Charge Indicator Displays currently receive.

The third measure is that manufacturer specifications be clarified to be used as the basis for charge verification. This is a relatively simple measure and the Residential Appendices already point to manufacturer specifications throughout when directing Installers and HERS Raters to verify charge. We just specify it further in a couple of places.

And lastly, we would in the Residential Appendices and some clients forms require that Installers notify homeowners that their units have not been verified of charge. And there is an option that an Installer could exercise where they would delay charger verification for air-conditioning units until after the dwelling is occupied. And in that case, we just want to make

sure that homeowners realize that that's the case. Next slide, please.

The typical residential HVAC system is a split system. It has an outdoor condensing unit that connects to an indoor fan and the coil via a refrigerant line. Because of the different geometries of houses, there's different lengths of refrigerant line and different amounts of refrigerant charge that are necessary for these systems. And a 2012 study has shown that, because these systems are getting installed far away from the production line quality control, that there are testing, diagnosing, and repairing of faults that are done improperly by technicians who service these systems.

So this measure as a whole is trying to clarify and mitigate as much as possible charge-related faults. Next slide, please.

Throughout the Case Study, the Case Team has worked closely with the Western HVAC Performance Alliance, which is an advisory group composed of manufacturers, consultants, researchers, distributors, and contractors. We've been in close discussion with them since at least November of 2013 until now and it's helped

a lot in developing and refining these Code measures.

Closely related to the CID and FID measure, its ASHRAE Standard Project Committee 207. CIDs and FIDs both fall under a category of equipment known as Fault Detection Diagnostic tools, or FDD. The Committee 207 is discharged with providing a method to test the performance of fault detection and diagnostic tools because there's not really a standard way to test their performance, it's very difficult to include these types of systems into Code language. So hopefully the committee would be able to kind of standardize that. Right now it's focused more so on commercial equipment, but there's a large amount of overlap with the residential tools available and we wouldn't postulate. They were launched in 2012 and their goal is to have a public review draft just around the corner in January. Next slide, please.

So we're just going to dive right into the Code changes. The first one is to require Require Liquid Line Filter Driers. As I mentioned, they remove debris and moisture that's been introduced into the refrigerant line as a

result of improper installation. These are typically installed with the units as they're often shipped by manufacturers with air-conditioning system; however, we have reason to believe that they are sometimes omitted. Stakeholders have mentioned that they are sometimes omitted by Installers. And because it's an easily verifiable piece of equipment, it's just a cylindrical device that goes onto the refrigerant line outside of the condensing unit, we believe that it's an easy Code addition. Next slide, please.

The Code language is relatively simple that we'll be adding. It's going to be relevant to space heating and cooling systems that have charge, specifically air-cooled conditioners and air source heat pumps. We require that they be supplied with a liquid line filter drier if they're required per a manufacturer's instructions. And that's pretty much it. Next slide, please.

And as a result of this, we'll be adding some steps in the Residential Appendix under both the Standard Charge and the Weigh-In charging procedures. Basically the Installer would look

at their instrumentation specifications, if they need to do a whole specification, then they would look at that, calibrate their equipment, and then make sure that the liquid line filter drier is installed before they go ahead and charge the system. And a similar procedure would follow for the Weigh-In charging procedure if they elect to use that procedure. Next slide, please.

This is the language that we would be adding to the procedure. Under the Standard Charge Verification Procedure, it's simply that the Installer would verify that the liquid line filter driers are installed per manufacturer's instructions and installed with a proper orientation with respect to refrigerant flow, if applicable.

The orientation issue is important if the refrigerant only travels in one direction on a particular system, meaning that the system only provides cooling or heating. The orientation of the liquid line filter may be such that it only allows refrigerant to go in one direction. And heat pump systems that can switch back and forth between heating and cooling, it's likely that the liquid line filter dries omnidirectional, in

which case the orientation is not as important. Next slide, please.

The same language would be added to the Weigh-in Charging Procedure under 3.2.3.1.5, and then we're adding for the HERS Rater observation of the Weigh-In Charging procedure that they include the liquid line filter drier in the line set correction calculation, and that's what HERS Raters use to verify, it's one of the steps that the HERS Rater must complete, is this line set correction, so we just tuck the liquid line filter drier in with that calculation to make sure it's installed.

The next measure is to rename CIDs to FIDs, it's basically just only a name change from Fault Indicator Display to Charge Indicator Display, so the Charge Indicator Display, again as I mentioned, is a unit that is mounted onto an air-conditioning system that notifies the homeowner when there's improper charge in the air-conditioning system. It's one of two compliance methods that are currently allowed in the Standards, the first being charge verification by a HERS Rater, and the second being installation of a CID, and then the

installation is then approved by a HERS Rater, as well.

The CEC basically allows the devices -- there is a set of generic criteria in the Joint Appendices on what a Charge Indicator Display must be able to measure and calculate, and this is kind of a generic set of criteria, but it also has language that other devices that don't necessarily work in this way, the current criterion in the Appendix, can also be submitted to the CEC for approval. And those types of devices may be ones that don't just measure charge-related faults, they could be airflow faults and other types of faults, as well. So changing this name is more so a signal to the industry that a broad range of devices may be in compliance with this Charging Indicator Display, a compliance option. There is a variety of equipment that is possible for application, those that use the compressor operation to detect faults, those that use service temperature vibrations, and those that provide other types of faults, for example, performance degradation as a whole.

The Appendix does stipulate that the

equipment must still detect charge and airflow performance-related faults. Next slide, please.

So this is a very simple change, just changing the name from Charging Indicator Display to Fault Indicator Display, and this is in the Prescriptive Standards here on the next slide.

This is in the table that shows that FIDs would only be required in Climate Zones 2 and 8 through 15, also in the prescriptive section. Next slide, please.

And then the Alterations is also mentioned of these equipment. Next slide, please.

In the Joint Appendixes where the generic criteria for FIDs is currently houses, in this portion of the language, as I had mentioned, basically says that FIDs other than what is described in this section are possible, as long as they detect refrigerant charge, metering device, or airflow related faults, and these technologies must be submitted to the CEC for approval. And that's it for that measure.

The third measure is to specify that manufacturer charging specifications are adhered to. The Appendix currently houses a set of

generic tables that can be used by Installers and HERS Raters to determine whether the refrigerant has been accurately charged. These are typically less accurate than the tables and temperature specifications provided by manufacturers specific to their units, and basically the appendix does already say that when manufacturing instructions are available, use those because they're going to provide more accurate results. And we're just going to be reiterating that in a couple of places.

Installation Manuals for Manufactures are typically left with the condenser and they're available online, as well. And Manufacturers have an option to submit to the CEC a special case protocol which installers could adhere to, and this special case protocol is basically saying that it's a protocol that must be followed that's not the standard charge verification protocol, or the weigh-in charging procedure, it's an alternative to those. And we're saying that this measure would say that Installers must adhere to that special case protocol when submitted, given the appropriate outdoor conditions. Next slide, please.

So we add a sentence under the Purpose and Scope of the Verification Diagnostic Testing section that says, “In the case where the Manufacturer has certified to the Commission a ‘Special Case Refrigerant Charge Verification Protocol’ meeting the requirements of RA1.1.1,” which is the outline of what the Special Case must provide, “…the HERS Rater Refrigerant Charge Verification Procedure shall adhere to that protocol.” We also clarify later in that same section that HERS Rater verification is required for compliance using that Special Case protocol, rather than just kind of just generic language and applicable alternative procedure. That applicable alternative procedure would be the special case protocol housed in RA1. So we just specify that.

And then lastly, in RA3.2.1.2, we remove in Section E the language that says that the HVAC Installer can use the Standard Charger Verification Procedure as an alternative to any applicable Special Case Refrigerant Protocol. Basically if the outdoor air conditions are such that require that Special Case Refrigerant Charge Protocol, then the Installer is going to be using

that anyway. So we don't want that option to go away. Next slide, please.

And the last measure is to require homeowners to be notified of Delayed Charge Verification. Again, so basically when an Installer charges a system, it's highly dependent on the outdoor air temperature. If it's below 55 degrees, in many cases it impacts the accuracy of the charge verification measurements. Some Manufacturers may stipulate that they don't want their units charged when it's too cold outside. So in that case, the installer might delay the verification because in cases where a house may be very well ready to be occupied, they may request the enforcement agency approve that dwelling for occupancy, and then when the weather is warmer later, a HERS Rater would come back and then verify the system of the charge. The current system that is in place that helps track all of these verification procedures is the HERS Provider Data Registry. We're not aware exactly how often Installers exercise this option and, if they do, how often they actually come back and correct the charge if a HERS Rater deems it necessary. And the Case Team is one of the

recommendations for 2019, recommends that further data is gathered to understand the prevalence of this option for 2019. Next slide, please.

A relatively minor Code change, we would add to RA2.4 that the Installer must also notify homeowners that their system has not been verified of charge. This is primarily because a homeowner, say the weather turns warm within the next week, as it often might in California, and the homeowner turns on their air-conditioning system and finds that it's not working properly, we want them to be aware that if it isn't working properly, that further servicing is needed and they may wait to call a technician or try to pursue the process further. Or, if the HERS Rater suddenly knocks at their door, you know, three months after they've moved in, they're not surprised or unwilling to let the HERS Rater go into their backyard and verify the charge of that system. Next slide, please.

We'll be adding an additional requirement to the compliance form related to Weigh-In Charge, the only way that the Installer could exercise this delayed verification option is by using the Weigh-In Procedure. We would be adding

a third requirement to that form that would say that if a HERS Rater Charge Verification is being delayed, then notice must be provided to homeowners that it has been delayed, essentially. Next slide, please.

We're not requiring any particular form to be submitted to the homeowner, but we are providing an example in the Compliance Manual. This one would say basically "congratulations on your new AC system. The process is not complete, you need to cooperate if you want your unit to be working as designed." So that's basically what it covers. And that's all the measures. Next slide, please.

We had the stakeholder meeting a couple months ago, the notes are available at the Title 24 website. The nature of the measures changed slightly after the stakeholder meeting due to further research and discussion between the IOUs and CEC, but the feedback that we generally received during that meeting was supportive of these measures and we received the following feedback: that Liquid Line Filter Driers are typically not installed inside of the condensing unit by the Manufacturer because they want to

make sure the technicians can easily access that equipment if they need to replace it. We received support from at least a couple Manufacturers that they are willing to submit FID products for approval to the CEC, and we're encouraging them to do that for the 2013 Code cycle.

And lastly, the delaying of charge verification, we received feedback that this may in fact increase costs for installers and HERS Raters because it increases the likelihood of failure, charge verification failure for these systems because the HERS Rater would be operating a different charge verification procedure several months removed from when the Installer did it. And this would in turn increase cost. And that's my last slide. I would be very happy to take any questions you may have.

MR. STARK: All right, are there any questions on this presentation in the room?

MR. SHIRAKH: George.

MR. NESBITT: George Nesbitt, HERS Rater. A couple things. Liquid Line Filter Drier, if they're such a good idea, and most Manufacturers either recommend them, provide them, and/or

install them, why not make it a required item unless the Manufacturer does not recommend it? That's one thought.

MS. CHAPPELL: Could you clarify what you mean?

MR. NESBITT: So make it required unless the Manufacturer does not recommend the installation.

MR. FARAHMAND: In the mandatory section of the language, you mean?

MR. NESBITT: Well, yes. And honestly I think this belongs in the mandatory measure just as the duct size and air flow requirement is mandatory for all air-conditioning systems in all climate zones.

MR. FARAHMAND: Okay.

MR. NESBITT: Then on the CID/FID, I guess I'm not totally clear whether this is a required features as part of the package.

MR. FARAHMAND: It's one of two compliance options. They can either -- it's a prescriptive requirement. Installers either have the unit verified of charge, or they install a CID/FID system. And that is then -- instead of the charge being verified by the HERS Rater, the

proper installation and operation of that device.

MR. NESBITT: Okay, just as the CID is currently, even though it doesn't exist, okay. That wasn't totally clear to me reading through things on the train this morning. That could be a lack of sleep, too. So, let's see, on the Weigh-In method, I believe if I read it right, one change is that if the Installer uses the Weigh-In Method, the HERS Rater cannot sample, they have to do 100 percent testing. And is that a change from 2013?

MR. SHIRAKH: I don't think so, no.

MR. NESBITT: Okay.

MR. FARAHMAND: No, it's not a change, it's part of the 2013 language.

MR. NESBITT: Okay, I mean, I certainly agree with it. As a Rater, I will not observe a weigh-in, I don't think I would want to do that. I would want to actually test the system under more normal operating conditions because your weigh-in charge will ultimately be affected by your air flows. So I just, as a Rater, I think I will decline to take the observation option. So I guess that pretty much -- I guess then the other question is, if the CID/FID is part of the

Prescriptive Package requirement, if you're doing performance, is that then -- how is that referenced as far as doing the charge or the CID/FID?

MR. FARAHMAND: Well, my understanding is you would either indicate that you've installed the system, the device, under the performance method, and the energy benefits of that device are not part of your energy summary.

MR. NESBITT: I'll have to go back and look to see whether the performance, well, the performance method may reference back to this section in the Prescriptive Path, but I think in a way this requirement could actually be part of a mandatory, saying if you have a conditioning system, if it requires refrigerant charge, this is an exception or an equivalent to having the charge tested, as opposed to, in theory, you could think -- because when you go to performance method, you wouldn't have to do refrigerant charge, you can opt out. So, I don't know, that's my only thought there.

MR. SHIRAKH: We will look at it. Thank you, George.

MR. FARAHMAND: I'll go back and look at

that.

MR. SHIRAKH: Any other questions on this? Mike Hodgson.

MR. HODGSON: Thanks, Mazi. Mike Hodgson from ConSol representing CBIA. Mostly questions. On the Liquid Line Filter Device, and you want it required only if the Manufacturer's instructions or specifications require it. What percentage of the market uses third-party coils? I know it's going to be different single-family than multi-family. So I would guess it's a larger percentage of multi-family, a smaller percentage of single-family. I honestly don't know the answer, but my concern, then, is who is the manufacturer and what recommendation do you follow, if any? And if a third-party coil is introduced to a standard system, and the subcontractor does that, which is typically the motivation, then if the subcontractors says it's not required, does that mean it's not required?

MR. FARAHMAND: That's a great question.

MR. HODGSON: Then on the CIDs becoming FIDs, the name change sounds interesting. What devices are out there that actually get this credit there in the market?

MR. FARAHMAND: Well, that's the thing, no devices have yet, I believe, gotten this credit and we're trying to encourage more application. We know of a product from Emerson that recently got rolled out, that they're planning on submitting their device for approval, also a product from EcoFactor. These are both residential products that are going to be applying at the CEC hopefully under 2013 Code.

MR. HODGSON: And I apologize, I'm also part of the sleep deprived group that's following this testimony today. Was it required or going to be proposed to be required in Climate Zone 2 and 8 through 15?

MR. FARAHMAND: It's prescriptively required under the 2013 Code and we're not changing that.

MR. HODGSON: Okay, but there it means refrigerant charge, not CID.

MR. FARAHMAND: Either/or.

MR. HODGSON: Okay. So if you use refrigerant charge, you don't need to use an FID in the 2016 Standards. Okay, great. Thank you.

MR. FARAHMAND: Correct.

MR. HODGSON: Yeah, because we've had

that requirement in the 2013 Standards and no one has stepped forward with their product, so I'm not anticipating anyone coming to the market soon, I'd just love to hear it, but I don't know of anybody. We strongly support anybody using charging specifications, they should use the Manufacturer's procedures, I mean, that's who warrants the system and if that needs to be spelled out stronger, there's no problem with that. We have some issues in the field with delayed charge verification and I'm not really sure if this is the right forum to talk about all of them, and I'm not sure if the language that you're inserting accentuates the problems in the field, or helps them, so I think we need to give you some feedback and ask some questions of some Raters, and also of both of the Registries, and to find out exactly what's going on. But one of the issues that comes from the Building industry is, when you delay verifying the charge because of temperature, which I agree with George, that's really the way to do it, not to weigh in, but when you do that and theoretically you notify the homeowner of that, then what happens when the homeowner does not allow you back into the job

site? They own it, we have no legal right as a Rater, assuming I'm a Rater, to get back on the job site. And that's an issue that we need to play through, which is kind of a separate issue than what you guys are talking about proposing today, but I think this language may be the opportunity to work on it. So we'd like to add comments to your presentation. Thank you.

MR. SHIRAKH: Thank you, Mike.

MR. FARAHMAND: Thank you.

MR. SHIRAKH: Any other questions on fault detection in the room?

MR. STARK: If anyone would like to comment online, there is a raise your hand button, I see one person has done so. And then after these folks have had a chance to comment, we'll open the lines to the people who are attending solely by phone. So is there anyone remaining in the room with a comment? All right, I'm going to unmute the line of Khalil Johnson who has raised their hand. Khalil, you are live.

MR. JOHNSON: How are you doing? I was just wondering, would the Manufacturer have to provide the liquid line filter?

MR. STARK: Yes, the Manufacturer would

be required to provide the liquid line filter.

MR. FARAHMAND: So our understanding is that if it's required by the Manufacturer in their instruction manual, they do provide it.

MR. JOHNSON: And as far as the term CIDs on the market, the speaker earlier said there are none? Or there are proposed to be some? CIDs and FIDs?

MR. FARAHMAND: They are currently -- so, I'm sorry, were you asking if there are CIDs in the market, or whether it's currently required?

MR. JOHNSON: I'm under the impression that it is required, either that, or you can have it verified by a HERS Rater, but are there any devices currently able to do this task that you guys are requiring?

MS. CHAPPELL: Excuse me, this is Cathy Chappell. Nobody in the room can hear what Khalil is saying.

MR. STARK: Yeah, you're very faint.

MR. JOHNSON: Oh, so are there any devices that are capable of performing this task that you require?

MR. FARAHMAND: Right. So there are a

couple systems that have this capability. There are none yet to my knowledge that have been submitted and approved for that requirement.

MR. JOHNSON: Okay.

MR. FARAHMAND: But there are actually several devices from Manufacturers that do -- they claim to be able to do this requirement.

MR. JOHNSON: Do you have any names?

MR. FARAHMAND: There's a couple Manufacturers that we have recently spoken with, Emerson and EcoFactor. I can send you a couple -- I can distribute a couple other ones that we're aware of in the meeting notes or something.

MR. JOHNSON: That would be beneficial. I would appreciate that. And that's it, thank you.

MR. SHIRAKH: Any other questions in the room or online on this measure? Nothing online, Peter?

MR. STARK: I'm not seeing any other raised hands. I'll go ahead and unmute the phone only callers.

MR. SHIRAKH: Okay, if you have a question online, please raise your hand, otherwise we're going to move to the next topic.

And I don't see any, so we're going to go to Instantaneous Water Heating and, again, the Case Teams, Sarah Schneider and Heidi (Hauenstein) are going to present.

MR. STARK: Just one moment.

MR. SHIRAKH: Yes.

MR. STARK: Just as a note to those calling in, someone asked if we are going to be posting these presentations and two of them, I believe, are already posted. We will be posting the remainder after the workshop.

MS. HAUENSTEIN: Can you unmute Bijit?

MR. STARK: I believe that person is unmuted, but let me confirm. Yes, Bijit, you should be live.

MR. KUNDU: Can you hear me?

MR. STARK: Yes, we can hear you.

MR. KUNDU: Okay, thanks.

MS. HAUENSTEIN: Great. So thank you. I am Heidi Hauenstein, the primary Case Authors on this measure are Sarah Schneider and Bijit Kundu. Sarah is in the room and Bijit is on the line. I'm going to give the first couple of slides, and then hand it over to Sarah. We also have Danny Tam on the mic up front to answer questions about

the heat pump water heating prescriptive alternative.

So Mazi mentioned this briefly in his remarks, but the way that Title 24 works is that you have your mandatory measures that are required -- oh, sorry, next slide, Peter –- you have the mandatory measures that are required for all buildings, and then on top of the mandatory measures, you can choose either the Prescriptive Path, or the Performance Path. And the Prescriptive Path is an additional list of discrete measures that you would comply with. The Performance Path is you would model your building and verify that the energy performance of your modeled building or the proposed building performs just as well as if you had implemented the Prescriptive Path.

So the way it works is that you have all of your prescriptive measures and, if you want to comply using the Performance Path, you model essentially two buildings, one building that you apply all the prescriptive measures to and you figure out what that energy budget is, and then you model your building that you actually want to build that, you know, has possibly different

measures than is in the Prescriptive Path, and then after you're done modeling the building you want to build you compare the energy performance of the prescriptive with the performance. And if the match or if the performance approach is better, then you comply. And what we know is that 90 percent of the residential buildings comply using the Performance Path.

So on top of both the mandatory and either the prescriptive or the performance, you have certification of acceptance requirements and that doesn't apply to all measures, but it applies to some. Next slide.

So what's in the Code now for water heating is that there are mandatory requirements that in the 2013 cycle we added requirements that all residential buildings have to be built so that they're ready for a high efficiency water heater? So what that means is that you have an electricity outlet near your water heater so you can plug in your instantaneous water heater. You have the right ventilation requirements for a tankless water heater, you have a condensate drain, and then you also have a gas supply that has the appropriate capacity for an instantaneous

water heater. So that's already a requirement in the Code and that is required for all buildings. On top of that mandatory requirement we also have mandatory tank insulation and pipe insulation requirements.

So the prescriptive requirement that is in the Code now is, if you have a natural gas service in your site, then you have to install a gas water heater. And you can install either instantaneous water or a storage water heater, as long as that water heater complies with the minimum federal efficiency levels. If your site doesn't have gas availability, then you're allowed to install an electric water heater and that electric water heater can be electric storage or an electric instantaneous water heater. On top of the electric water heater, you also have to install a solar water heating system that is able to achieve a minimum solar fraction of 0.5.

If you decide to comply using the Performance Path, you can do any number of things with your water heating system as long as you meet the energy budget that is defined by the Prescriptive Path. And the energy budget that is

used in the Performance Path assumes that you have gas availability and it uses a 50-gallon storage water heater to come up with the energy budget, and that storage water heater meets the minimum federal requirements. If you don't have access to gas on your site, then the Performance Path uses a propane water heater to come up with your energy budget.

So the next slide here shows what the Federal Appliance Efficiency Standards are, so what is in effect now is shown on the top and those Standards are being updated in 2015. So I think we're more focused on what is effective in 2015, so for a storage water heater that is gas, the energy factor has to be -- oh, I guess it is a gas instantaneous water heater is an energy factor of 0.82. And for a gas storage water heater it's essentially .6, because we're assuming a 50-gallon tank.

So Sarah is going to go into more detail on what we're actually proposing for this measure, but what it would do is it would update the energy budget that you use for the performance approach by way of using an instantaneous water heater in the energy budget

calculations.

And then I also wanted to say that this proposal is a work in progress, and we've received comments both from the internal IOU Team and from external stakeholders already on the case report that is posted, and we're going to be working in the next couple of weeks and months to update the analysis and update potentially the proposal if it's warranted based on the stakeholder comments that we've received.

MS. SCHNEIDER: So just to reiterate -- oh, I'm Sarah Schneider, I'm with Energy Solutions and I'm one of the co-authors of this Case Report. So to reiterate, this measure proposes to modify the prescriptive requirements for domestic hot water systems in new residential construction. As Heidi said, that in essence it will just update the energy budget for folks that want to go the Performance Path to meet Title 24 compliance.

Again, the primary prescriptive option would become a gas instantaneous water heater that meets minimum federal requirements for gas instantaneous, that's an energy factor rating of .82.

MR. STARK: Quickly, could you move the microphone a little bit closer?

MS. SCHNEIDER: I'm a loud talker, so I feel like I can't have it too close. Okay, is that better?

MR. STARK: Since you're facing away from it, it tends to -- yeah.

MS. SCHNEIDER: Sorry, I'm an amateur with microphones. So in addition to the proposed prescriptive requirement, the Case Team is in the process of developing a prescriptive alternative, so this would allow folks to go the prescriptive route by installing, for example, a gas storage water heater that meets the federal minimum requirements, along with a solar hot water system with a certain solar savings fraction of maybe .55. Of course, it does depend on what climate zone you're in, and I'll get into that a little bit later in the presentation.

So I just wanted to restate that we are in the process of developing the prescriptive alternative. So we propose things throughout this presentation, but it's not set in stone, so I just wanted to clarify that right now. Next slide, please.

So as Heidi had mentioned earlier, about 90 percent of new residential construction that meets Title 24 compliance goes the Performance Path, so you still have that option of complying with the State requirements, you don't have to go the Prescriptive Path of installing either a gas instantaneous that meets federal minimum requirements, or a gas storage combined with something like, say, a solar savings fraction of .55.

And I believe you mentioned it earlier, that CEC staff is considering including a prescriptive alternative to the electric-only scenario which most likely will be a heat pump water heater that also meets minimum federal requirements, and we'll go into this a little bit later in the presentation. Next slide, please.

So in summary, the proposed Code change applies to newly constructed, low-rise residential buildings, newly constructed multi-family buildings, where there is a dedicated water heater for each individual dwelling unit. It doesn't apply to centralized water heating systems, this proposal is only for individual water heaters per dwelling unit. In addition,

the proposed Code change does apply to additions, it does not apply to alterations, i.e., retrofits. Just to add on to this, I do want to state that not every addition is going to warrant an installation of a water heater; in fact, probably most additions don't actually need to install a water heater. So the proposed Code change wouldn't apply in every single additions case, only for water heating. Okay, next slide please.

So this touches back on what Heidi presented a little bit ago, so this is a schematic of possible Code compliance methods for Title 24, mandatory measures required for all buildings, everybody has to use this, go this way, but you also have two other sets of requirements, so you have the Prescriptive Path, and here we have two options here, the first one is installing a gas instantaneous water heater that meets federal minimum requirements, or potentially installing a gas storage water heater that complies with minimum federal requirements and a solar hot water system with a minimal solar savings fraction. In this case, we're seeing possibly a .55. Again, you can still go the

Performance Path and that could be deploying any number of strategies that has to meet the energy budget that is set by the primary prescriptive requirement, which is that gas instantaneous water heater with an EF rating of .82.

I also want to take a moment to state that the Case Team is in the process --

MR. STARK: Hold on. I'm not sure who's that is, let me -- normally I have a mute all button, but I have to exit this in order to get to that button, so just a moment. Okay, there we go. All right, that should be better.

MS. SCHNEIDER: Great, thank you.

MR. STARK: Sorry about that.

MS. SCHNEIDER: Probably not your fault. Okay, so as I was saying, the Case Team is in the process of coming up with a definition for what natural gas availability means. Right now in the Standards, it's pretty ambiguous; does it mean natural gas connected to the building physically? Or does it mean that the utility can provide you natural gas in that service territory? So one of those things so far has been reaching back into previous Code language and seeing how that was defined in the past, and up here we have an

attempt at defining that from, I think, the 2001 or 2005 Standards. Dan, you can --

MR. TAM: It goes before that, 1995.

MS. SCHNEIDER: Oh, a really old definition. That might still apply.

MR. SHIRAKH: Just one second. Could you introduce yourself so he knows who you are, the Court Reporter?

MR. TAM: Yes, this is Danny Tam from CEC. So that language came from old Standards that I found way back from ’95, and it was basically about the old Package C for the electric, so when Package C went away, that’s when the language kind of dies out, so we kind of try to bring it back, we define it.

MS. SCHNEIDER: Twentieth anniversary language. I’ll just read the quote, so it may be crafted based on this: “Natural gas is currently not available and an extension of natural gas is impractical as determined by the natural gas utility.” That last part of this phrase is the key here, and that’s what the Case Team will probably be proposing is that the determination needs to be made by the gas utility that’s working in that service territory. Right now, I

think the compliance manual and possibly the ACM Reference Manual and the Standards all have kind of conflicting references, where the Compliance Manual says, you know, the local Building Department can determine whether or not natural gas is available. So we need to tighten that up and we're working on that right now, and like I said most likely will be proposing that that determination for natural gas availability must be made by the gas utility in that area.

Okay, and as I stated earlier, the Case Team is in the process of developing that alternative prescriptive option for gas water heating, and right now this task entails developing a package of measures that have similar energy performance as gas instantaneous water heaters at the Federal minimum efficiency level, which is .82. And this alternative prescriptive option needs to perform better basically in each of the Climate Zones across California. So basically that's going to be a gas storage water heater that meets minimum Federal requirements plus a solar savings fraction. Danny Tam, CEC staff, has done some runs with the Compliance software, finding out

which combination of measures for this proposed prescriptive alternative path could perform similarly or better than gas instantaneous water heating, and so in Climate Zones 1 through --

MR. TAM: One through 14.

MS. SCHNEIDER: -- 14 and Climate Zone 16, a gas storage water heater with an energy factor, a minimum Federal energy factor rating of .62, plus a solar savings fraction of .55 performs just as good as gas instantaneous. Climate Zone 15, that solar savings fraction would have to be increased.

And as I stated earlier, the cases where natural gas is not available, CEC staff is working on developing a prescriptive option or alternative for that electric-only scenario, most likely it will be a heat pump water heater that meets minimum Federal efficiency requirements.

Again, sorry this is a lot of repeating, so going the performance approach, this proposal has no changes to the performance approach. As we stated earlier, you can meet the energy budget that is going to be updated and based on the energy performance of a gas instantaneous water heater with an EF of .82 or higher. You can

install a condensing gas storage water heater that has an energy factor rating of .82 or higher to meet the energy budget, or any other combination of upgrades, that will still need to meet the energy budget that is set by the prescriptive requirement.

So there are several reasons for the proposed Code change, one being that gas instantaneous water -- all instantaneous water heaters typically are more energy efficient than their storage counterparts, aside from condensing. And also, probably one of the largest reasons is that natural gas consumption is one of the largest -- let me back up -- water heating accounts for the largest share of natural gas energy usage in the California home, the RASS, Residential Appliance Saturation Survey, estimated about 49 percent of energy use in the home comes from heating water. Also, recently instantaneous water heaters have taken up a larger market share, so hence they're becoming more popular, which in turn decreases how much they cost, so they're becoming more affordable.

And as Heidi said earlier, this measure builds upon the 2013 Title 24 --

MR. STARK: Folks can go ahead and ignore that, that just means somebody left using the door without badging through. The fire alarm sounds different, it's a lot more obnoxious.

MS. SCHNEIDER: So right now, Title 24 Code requires the installation of components for high efficiency water heaters such as gas instantaneous, or condensing gas storage, so in essence by the time that 2016 Title 24 Standards go into effect in 2017, Builders theoretically, realistically should be accustomed to designing for gas instantaneous water heaters.

As I was saying earlier, there is a trend, an increasing growth on the market share of instantaneous water heaters. We did some market research looking into qualifying instantaneous water heaters that apply to this proposed Code change, and according to the Energy Commission's Appliance Database, there are 12 different manufacturers that produce 30 different brands of gas instantaneous water heaters with approximately 8,017 different models, so there is a lot of selection for consumers. And also, the Energy Star qualified products list has substantially more models available, about 1,200

different types of qualifying gas instantaneous water heaters that are available on the market today. Some of the drivers for this trend, one being the updated Federal Standards for residential water heaters, which will increase the market penetration for gas instantaneous, those standards go into effect in 2015. Also, the success of the Energy Star and other rebate programs, utility rebate programs mainly that help propel the gas instantaneous water heaters into the market, also the Title 24 Compliance Credits have done a lot. Anecdotal evidence has revealed that up to 50 percent of design plans are now incorporating gas instantaneous in place of gas storage, particularly in Southern California, they're becoming more popular.

Again, as I said earlier, the equipment costs are coming down for gas instantaneous. And then there's other benefits that consumers are paying attention to which is lower utility bills each month for heating water. Again, you could still go the Performance Path, there's also the alternative Prescriptive Path, we're not advocating only for gas instantaneous, it's just where the market is going, it's what people are

asking for, and it establishes a more efficient energy use for a building, at least in terms of water heating.

So this slide lists the key inputs, or key functions into the energy analysis that the Case Team conducted. Before I dive into those inputs, I wanted to just reiterate what Heidi said, this is a work in progress. The Case Report has been submitted for public viewing, however, we'll be updating our analyses based on a number of things, some have been recent comments from stakeholders regarding the proposal, and others are the updated TDV values, the updated prototype building sizes, etc. So I just wanted to point that out.

The Case Team is also going to include in our energy analysis the electricity consumption of gas instantaneous water heaters. Our research so far has indicated that it's about 29 KWH per year for a gas instantaneous unit. We think this might be a little bit high of an estimate, so further research is going to reveal hopefully a more accurate number, or confirm this number. So that will be coming out in the next version of the Case Report in the next couple months.

So moving on to this slide, still, so what went into the energy analysis was comparing the natural gas used of the base case, which was a 50-gallon storage water heater that meets minimum Federal requirements, that's the .60 energy factor based on what will go into effect next year. And then, of course, the Standards case which is a gas instantaneous water heater that meets minimum federal requirements. The prototype building that was used in the energy analysis will be updated; right now we use a 2,500 square foot two-story residential building, and that will be updated in the analysis to include two different prototypical buildings, a 2,100 square foot and a 2,700 square foot. Also incorporated into the analysis of the daily hot water usage per household, the Case Team went with 56.5 gallons of hot water use per day largely because of research done by the Davis Energy Group and what was used in the 2013 -- what was used for the current water heating requirements, mandatory requirements for Title 24.

In addition, just the distribution loss multipliers were included, and those came

straight out of the residential ECM Reference Manual, and then also we used the new construction forecasts that were developed by the Energy Commission for developing the statewide energy savings from the proposed Code change.

So going a little bit deeper into hot water use, the Hot Water Draw Schedule that the Department of Energy used to develop the Energy Factor ratings for all residential water heaters is considered inaccurate and it slightly inflates the Energy Factor rating for gas instantaneous water heaters in this case. So to account for that, the Case Team de-rated or discounted the Energy Factor rating by about eight percent to adjust for the inflated values based on the Department of Energy's test procedure for water heaters. The rationale for doing so is, 1) to address those concerns about inaccurate Energy Factor ratings set by the Federal Government, but also that this is the methodology that's in the current Residential ACM Manual in Appendix E. Also, field tests have indicated that using the eight percent de-rating factor is accurate, and so we went with that. And I wanted to point out that DOE just recently released the updated test

procedure, which one of the reasons for that was to address the concerns about the Hot Water Draw Schedule being inaccurate and hence the inflated Energy Factor ratings for gas instantaneous. The Case Team is currently reviewing the final rule, which was just released two weeks ago.

The CEC could consider reviewing the discounting assumptions that are used in the ACM Rules to respond to the changes that are in the updated DOE -- you might already -- you're shaking your head, Danny, so maybe you already are considering, so I just wanted to put that out there. Moving on to the next slide, please.

So getting to the results of the Case Team's Energy Analysis, this table is for energy savings per unit. So in the first year that the Standards go into effect, across all 16 Climate Zones, it's about an average 50 therms of natural gas -- well, natural gas savings of about 50 therms per year across all the Climate Zones, and then the TDV natural gas savings range from about 6,700 up to over 9,000 KBTU in the first year that the Standards go into effect. I do want to point out that we use the 2013 TDV values because the 2016 weren't available just yet, so this

would be updated. But we don't anticipate a negative impact from the updated values, significantly.

In addition, sorry Peter, can you go back to that? Thank you. In addition, the next version of this table and the next version of the Case Report will also include not the savings per se, but electricity usage of gas instantaneous. So this table shows the first year savings across the State from the proposed Code change. For natural gas savings, it's approximately 5.4 million therms in the first year the Standards go into effect. The TDV, again 2013 TDV, natural gas savings were approximately 862 million KBTU.

So the cost analysis, this slide contains both our assumptions and the results of the cost analysis. I wanted to point out that the incremental cost difference between moving from a storage gas water heater to a gas instantaneous includes the initial equipment cost, as well as our assumptions based on the replacement costs. We could not find any definitive maintenance cost data. If you have it up there, we would love to see it. The next version of the Case Report and the updated analysis hopefully will have some

definitive cost data regarding maintenance for both storage and for instantaneous. So to summarize, the incremental cost is about $446.00. The replacement cost, we base this on equipment lifetime for both gas storage and gas instantaneous, so we make the assumption based on the fact that gas storage typically lasts about 13 years before replacement, whereas gas instantaneous typically lasts about 20 years before replacement is needed. So in the 30-year period of analysis, we're looking at one replacement of an instantaneous water heater and two replacements of the gas, so that's how we came up with the incremental gas storage, how we came up with the incremental cost, and what informed our cost analysis for this proposed Code change.

MS. HAUENSTEIN: This is Heidi. Let me just jump in here for a second. So, Peter, could you go back one slide? So what we have here is the initial equipment cost is the cost at new construction, so if you install an instantaneous water heater as opposed to a storage water heater, it's going to cost you $446.00. So the incremental present value of maintenance cost is

actually more representative of the replacement cost, so the assumptions that are listed on this slide, one replacement of an instantaneous water heater and two replacements of a storage water heater, that that cost is reflected in the maintenance cost column. And our assumption for now, which is subject to change, and we've actually received some good information from some of our utility contacts just recently, but our assumption right now is that there is no incremental maintenance cost, so actually flushing your tank is the same cost for a storage and instantaneous. And what we think we're going to do is base our maintenance cost on manufacturer recommended maintenance, but we are looking for additional data. We already have some, but we're looking for additional. Oh, the other point here is Sarah also mentioned previously that the electricity use is not included in the analysis, so actually that's the next slide, but --

MR. STARK: Should I go to the next slide?

MS. HAUENSTEIN: Sure. So in this cost benefit analysis, it doesn't include the impact

of electricity use. And so that 29 KWH per year amounts to about $110.00 over the life of the product. So what that essentially means is that we're going to need to update the benefits column so it's going to be reduced by about $110.00 or $120.00. So overall the benefit to cost ratio is still pretty high because you see here on this table, you know, the incremental cost is $446, the benefit is around $2,000, and the benefit to cost ratio is incredibly high of, you know, 5:1, or 5.6.

MS. SCHNEIDER: Thank you. You pretty much summarized the slide. Thanks, Heidi. Yeah, so just to go off of what Heidi was describing right now, based on the cost of electricity use related to the operation of the a gas instantaneous, the second to the left column here is the benefits column, so based on the 29 KWH per year of electricity usage, it comes out to between $100 and $120 of electricity cost over the lifetime of the equipment, so over the 30-year period of analysis. And that would be just a very slight decrease in the benefits column here, but not substantial. And I think you pretty much summarized it.

As we mentioned earlier, there is a potential for the inclusion of a prescriptive alternative option for the electric only or no natural gas available scenario. Currently the prescriptive water heating option for electric only is an electric resistance water heater or an electric instantaneous water heater with a solar savings fraction of .5. So based on some of the runs that Danny Tam had done using the CBECC-Res compliance software, he found that atypical minimum efficiency heat pump water heater, which has an energy factor of about 2.0 is actually more efficient in all but one Climate Zone, more efficient than the current prescriptive option. So CEC staff is currently looking into including that as part of the proposed Code change.

And moving on to the next slide, you could see Danny's results here. So the first column is the existing prescriptive option for when no natural gas is available, and then the two columns on the right pertain to the possibly proposed option which is heat pump water heaters that meet the minimum federal efficiency requirements.

As you can see, they perform better for

both the prototypical building, the 2,100 square foot and 2,700 square foot, for Climate Zones 1 through 15; however, the heat pump water heater option does not perform better than the existing Prescriptive Standards for electric only scenarios in Climate 16. So we would probably have to add a solar savings fraction or, Danny, I don't know if you want to --

MR. TAM: I think just leave it from Climate Zone 1-15, that they can just, you know, use the heat pump.

MS. SCHNEIDER: Okay, great. Thank you. Next slide, please. You could peruse these slides at your own leisure, it's pretty much just the proposed Code language for the relevant sections of the Standards and the Compliance and ACM Reference Manuals.

To summarize, Section 150.1(C)(8) are the prescriptive and performance water heating requirements, so here what would change would be that the primary Prescriptive Path would be the gas instantaneous water heater, which again sets the energy budget going the Performance Path. The Energy Factor has to meet the minimum federal requirements.

I've been instructed not to go through the rest of the slides, so we can go quickly through, keep going, keep going --

MR. STARK: So similar language which looks like --

MS. SCHNEIDER: Yeah, so this is the proposed Code language for the Standards.

MR. START: Sure, and I'll just state for the record, these will be posted to our website following this workshop, so people will be able to read these and provide comment on them. And I can go back to them if anyone has a comment that's relevant to this, I can always go back to that slide when that person is commenting.

MS. SCHNEIDER: Great. Thank you. Okay, so this is the last thing I'm going to talk about. So as Mazi mentioned earlier, the IOUs hosted a stakeholder meeting/workshop on May 20th to present the proposed measure, the gas instantaneous water heaters measure, and also to seek input, primarily to seek input from stakeholders. So a few comments were raised, it was a very good discussion that took place. The two key comments, however, that stakeholders had, two concern that they had were the implications

of the updated test procedure, that federal test procedure for residential water heaters had not come out yet. And so stakeholders were concerned about how that would affect the proposed Code change. So since the DOE just released the updated test procedure, the Case Team is currently reviewing this and trying to assess if and how this affects our analyses and the proposed Code change.

Another concern or comment that was raised was that the CEC should consider -- the State should consider a prescription option for heat pump water heaters, and as I stated earlier CEC staff is currently evaluating or exploring heat pump water heaters as a viable option, prescriptive alternative option, to the prescriptive requirements for events where natural gas is not available. And that is it.

MR. SHIRAKH: Thank you, Sarah, Heidi. Any questions in the room?

MR. STARK: I want to say we did get one blue card that I'm not sure is relevant to this issue, they didn't put which item number this was on, this is from Dan Lapato. Is this in relation to the water heating concern?

MR. LAPATO: Yeah. I wasn't sure if I was supposed to put --

MR. STARK: Oh, yeah, the item number tells us which, so if you want you can speak now or we can --

MR. LAPATO: Thank you. Good morning, my name is Dan Lapato. I'm here representing the American Public Gas Association. I'd like to begin today by thanking California Energy Commission for this opportunity to present testimony on the proposed 2016 Energy Efficiency Standards for hot water heaters. APGA is a national association for publicly-owned natural gas distribution systems. There are approximately 1,000 publicly-owned systems located in 37 states. California alone has seven publicly-owned natural gas systems serving nearly 200,000 customers.

Publicly-owned natural gas systems are not for profit retail distribution systems that are owned by and, most importantly, accountable to the citizens they serve. A public gas system's primary focus is to provide safe, reliable, affordable services to their customers.

As we review this proposal, our objective

is to offer constructive comments that will help the Commission ensure the program goals; unfortunately we were only able to review the prescriptive portion of the proposed water heater standard. For the public to truly understand what the Standard offers, we need to be able to review the proposal in its entirety and not through the piecemeal approach. We cannot effectively offer comprehensive comments on the Prescriptive Standards without also being able to review any proposed alternative compliance options.

We would recommend the Commission postpone any decision on the Standard until the public has adequate time to review, comment and discuss the entire proposal in a public forum.

APGA and our research foundation continue to further develop and promote the safe effective way to beneficially use natural gas in the home. The tankless water heater is one great example of this effort. However, like any appliance found in a home, a one size fits standard should not apply here. We believe the proposed Standard set by using the site-based energy analysis of 0.82 would create an unnecessary burden on the

California homeowners.

We agree, there's a long term dollar savings associated with instantaneous water heaters and the industry not only supports these appliances, but many times offers incentives for their installation. However, this is done on a voluntary basis where the homeowner is able to choose the best option for their use and their budget.

Unfortunately, the installation price difference between an IWH in the current Standards would become a deterrent for many homeowners, especially homeowners in situations where their budget may be in flux.

We believe the current Standards, coupled with the new Piping Standards that are now in effect will provide the citizens of California the greatest energy savings while offering the homeowner installation options either at the time of construction, or at the time of a retrofit.

The IWH market is still relatively young and with the homeowners now just beginning to construct homes that can accommodate these systems. We believe it is premature to salvage a standard based on IWH when water storage units

are still a great option.

Through the years, California has been on the forefront of recognizing the need for energy efficiency and a need for energy conservation, not only as a mechanism to save their citizens money, but also as a way to protect the environment. That is why we are concerned the Prescriptive Standard of 0.82 is based on an antiquated site-based energy analysis. The current site-based measurement is used to calculate the energy consumed at the end point, and hence does not properly account for the total energy consumed and their associated emissions. A source or full fuel cycle analysis examines all impacts associated with energy use, including those from extraction production, conversion and generation transmission distribution, and the ultimate energy consumption.

DOE itself has recognized the shortcomings of the site-based analysis, as well as the National Academy of Sciences in a 2009 Report. The EPA's Energy Star Portfolio Manager Program already utilizes and promotes the use of source-based energy analysis. When Standards are established using the source-based analysis, the

Commission will be able to fully identify the emissions reductions through the entire energy cycle. There is nothing preventing the California Energy Commission from adopting a superior, more comprehensive source-based methodology.

APGA strongly encourages the California Energy Commission to begin utilizing the full fuel cycle analysis when establishing standards for appliances referenced in their Building Energy Efficiency Standards. As the Commission continue to develop and implement their Energy Codes, we encourage you to reach out to the publicly-owned natural gas utilities within California to solicit their recommendations. Long Beach Gas and Oil is an example of a publicly-owned utility that can offer insight on how to best serve the community.

Again, on behalf of APGA and our members, I would like to thank you for this opportunity to offer comments and I'm available to answer any questions. Thank you.

MR. SHIRAKH: Any responses to Dan's comments at this point? Jon McHugh.

MS. HAUENSTEIN: I just wanted to say

thank you for your comments and they are definitely heard. We will be releasing the alternative prescriptive approach as soon as we can, probably in the next month, and it will be available for review before the Energy Commission's rulemaking process, or official rulemaking process; again, we're in the pre-rulemaking stage now, so we aim to have those options available as soon as we can.

In terms of using an analysis that uses source-based instead of site-based, the Case Team is using the methodology that the Energy Commission told us to use, so I think that's more a comment --

MR. SHIRAKH: The TDV?

MS. HAUENSTEIN: -- yes -- to the Energy Commission and the TDV methodology does account for the societal benefits of an energy savings measure. And Mazi, do you want to speak more to the TDV?

MR. SHIRAKH: So I don't know if you heard my introductory remarks when I was talking about cost-effectiveness, we use lifecycle costing methodology which includes the initial cost of the equipment versus existing equipment,

the price difference between tankless and storage water heater. We also look at the gas savings over the life of the building, which is 30 years, we look at the replacement cost of the equipment based on their time for both storage and tankless, and the maintenance costs, and these all brought back into the present value. Now, for the cost of energy, we don't use either site or source energy anymore, it's been about 10 years since we've switched to time dependent valuation for both gas and electricity, and although the differences are more pronounced for electricity, it's also true for gas that the unit cost of energy varies with the season and time of the day that it is used. So I know we've basically abandoned the site or source energy over the past 10 years and we rely on TDV which we use for both to determine cost-effectiveness of various methods.

I was a little bit confused about your comment about using .82 Energy Factor. What is exactly the objection to using --

MR. LAPATO: Well, we think the .82 is still a DOE-based site-based analysis and I think we could look at the TDVs, and this is something

quite frankly we would need more time to analyze because, as I referenced earlier, our members and ourselves were not aware of the procedures going on until Thursday of last week. So that's why we're at the point right now where we're now constructing comments and, once again, we do have seven members within the California state here that have some interest in these measures, as well as others, I know. And that's our primary concern is, you know, we didn't believe the .82 -- we don't believe we're at the point right now where the market is prepared and the system is prepared right now to support only IWH systems, regardless without seeing the Prescriptive Standards.

MR. SHIRAKH: Is that a production issue? What do you mean by the market --?

MR. LAVATO: I think right now, just July 2014, now you have to understand I had a 48 hours crash course in the California Construction Code, so I apologize here. The Standards for new construction just came in effect in, what, this month? Am I correct? So as of this month, construction is only required to start constructing those, so you're only at best, you

said, giving a three-year lead time. And I think the market is not right there. We haven't done extensive research, but we believe there are some errors and perhaps different math, if you will, between unit prices for storage, or instantaneous hot water. But I would like to go on record, I mean, we obviously through our own research foundation have been developing and working with manufacturers to develop these higher efficiency appliances, so we absolutely are not in the position of discouraging these by any means, we simply are in the position where we want to ensure the homeowner has the best option available to purchase the equipment they see fit, in this case, natural gas or otherwise, so that's really our position when we want to maintain an open market and let the homeowner decide.

MS. HAUENSTEIN: So this Code change is not requiring the use of instantaneous water heaters. And what we think, 90 percent of the buildings comply using the Performance Path, so in effect what we think is going to happen is that builders are going to still comply using the Performance Path, and that the homeowners are still going to have the opportunity to -- or not

the homeowners, it's going to be the builders -- have the option of looking at their energy budget and saying, all right, how are we going to get there? And they still have the option of installing a minimally compliant storage water heater plus maybe a more efficient HVAC system, more insulation, you know, there's any number of things that they can do to meet that energy budget. So we think that the practical implication here is that there is still going to be a lot of choice and that even though the instantaneous water heater is setting the energy budget, that doesn't mean that the you have to do an instantaneous water --

MR. SHIRAKH: You can use a condensing water heater, storage water heater --

MR. LAPATO: But you're still in a position of artificially moving the market because you simply are forcing –- you have now someone to make up the difference. And if at 90 percent performance compliance rate is right now I think within the Draft Report itself, I mean, it would be very beneficial to our membership if you were to outline some of these other additional standards because, once again, within

the Draft Report itself, and I understand we're still in the pre-rulemaking process, that we're still very much in the data gathering stage, where I think it would be beneficial to our members to include a lot of this information as background, as well as if 90 percent of the builders are currently meeting these standards, the performance measures, that perhaps it would be something you would want to include in the report is some of the measures that they are using to meet these additional standards, because you are having a significant increase in Energy Factor, was it by .2?

MR. SHIRAKH: Uh-huh.

MR. LAPATO: And, you know, once again, it's measured at the residence, itself.

MR. SHIRAKH: Okay, now, the Case Teams will modify the reports to reflect the various alternatives and the background, and that the builders use to comply, which is performance. What I also urge you is to work with us and the Case Teams over the next, I think, couple of weeks, three weeks or a month, so we can make sure to address your concerns, but again they're setting the performance at .82. It doesn't mean

people have to use tankless, there's many different options in using a solar fraction, using heat pump, using condensing water heaters, or using tradeoffs within the Performance Path to meet that.

MR. LAPATO: And I think, once again, with these multiple avenues of compliance, it would be beneficial to our members, as well as the clients of our members, to understand completely what the alternative compliance paths have been in the past and what is common. And I think that would help facilitate the conversation moving forward between APGA, our members, and CEC, as well as the CASE, I think that would be actually instrumental to that discussion.

MR. SHIRAKH: Thank you.

MR. LAPATO: Thank you.

MR. SHIRAKH: Any other questions in the room? David Goldstein.

MR. GOLDSTEIN: Good morning, this is David Goldstein and I work for NRDC. I've been involved in this process -- yes, since 1975 when the Commission first did this. I want to make one major point to start off with, and that is we really support the basic thrust of this proposal

to set the Prescriptive Standard in the reference house based on the instantaneous water heater at a .82. Your analysis showed a benefit cost ratio of, even after the correction, way better than 4:1, that's a lot of energy savings, it's very cost-effective, it takes us a lot closer to the Net Zero goal and helps with the climate goals of AB 32. So we commend the CASE Study authors and the staff for putting this forward as a potential proposal.

Second, and this may address some of the previous comment, it seems to me that you could probably set a Prescriptive Standard based on the Federal Standard for over 55-gallon water heaters, and that probably comes out pretty close to equal to the instantaneous water heater. We did a couple of runs for the IECC 2015 proceeding where we looked at both instantaneous and condensing in non-California areas and the difference was pretty darn small.

Second major point I want to make is that I think we can actually go farther with this proposal in a way that serves State Policy needs and provides more flexibilities for the Builder. And that is to say that we should look at heat

pump water heaters as a universal opportunity available whether or not gas is available onsite and available as the basis for the Performance Standard. Maybe you don't have to change, I mean, the issue of how does a heat pump water heater comply using the Performance method is going to be crucially depending on what assumptions you make about the time of use of the water heater. So if you have a water heater that won't come on during peak hours, that's going to affect the TDV a lot differently than if it comes out unconstrainedly. So given a proper usage schedule, and maybe this requires some controls on the water heater, maybe it implies the tank has to be big enough to get through peak draw periods, you know, we can see whether heat pump water heaters are available as a compliance option under the current system, and see where that goes. If they are not, if it turns out that a heat pump water heater is not competitive with the instantaneous gas water heater, we ought to look at some way to address that so that this is available as a tradeoff option, as well as a prescriptive option throughout the state.

Why is this important? Forty years ago,

the Commission led the country and the world in recognizing that resistance water heaters were a dumb way of making hot water in terms of consumer cost and in terms of the impact on the environment. And we set up a really good system for the time which says gas water heating is the base case for the Performance method. But the times are different now because heat pump water heaters looked at globally are a real factor in the marketplace and their performance is a lot better than it used to be. So in the old days, we talked about an electric water heater drawing its electricity from old-fashioned coal, or nature gas power plants, two-thirds of the energy is lost by the time it gets to the home. Now in California we're talking about combined cycle gas turbines that will transmit more than 50 percent of the energy to the home, and we're talking about a heavily renewable electricity supply. So just looking at the simple numbers, if you had 50 percent efficient provision of electricity to the house, and an energy factor of three, which under California conditions is my guess of what you would actually get, although you have to do the work and figure that out, that's a source-based

efficiency meaning an emissions-based efficiency of 150 percent. That's better than gas.

If you look at the California energy future report, and I don't want to put too much stock in that report because it makes lots and lots and lots of assumptions, but it suggests that a climate goal is best met by replacing end uses of gas for low temperature heating with heat pump electric. Now, I think it's way premature to show a preference for electric water heating compared to gas, but I don't think it's premature to say you shouldn't bias it the other way either, we should have a system where it's about equally beneficial to install electric heat pumps compared to gas instantaneous.

So there are a number of different ways that this can be done, I don't want to suggest any particular one over the others, but I do think that keeping the option of electric heat pump water heating available, given that it is preferable from an emissions point of view based on the data that we're aware of, is something we'd want to do for the next round as we're trying to move to Net Zero on a societal basis for California. Thanks.

MR. SHIRAKH: Thank you, David.

MR. TAM: So this is Danny Tam from CEC. I actually did some analysis for heat pumps while we're developing the Prescriptive alternative, I actually went a size 3, and I think it's because of TDV it just couldn't match the performance of instantaneous by itself.

MR. GOLDSTEIN: What did you assume about the use during the peak hours?

MR. TAM: Currently in our analysis, we don't take account of that, so it's just straight as you factor.

MR. GOLDSTEIN: Okay, and so that would be -- the one way you could correct that potentially, and you'd have to continue with this analysis and see, but if the heat pump shut off during any hour where the TDV is high, would that still be the case?

MR. TAM: So that's something we have to look into. I mean, currently, according to the water heating budget, most of the use is during the morning when people get up and go to shower, and then when they come back from work, so that's how the --

MR. GOLDSTEIN: But the opportunity, the

problem with that and the opportunity in the heat pump water heater is, because the heat pump component is so expensive, they generally put in a much larger storage tank than they would for gas. And so there should be no reason to actually turn on the heat pump or the electric back-up during the hours that you don't want a water heater to be running. You could also actually make that a condition: in order for a heat pump water heater to get use of the value, assuming it's off during all the peak hours, it has to have the capability of interacting with demand response programs of the utilities, otherwise you're going to just assume what you're currently assuming.

MR. SHIRAKH: So we got similar comments from the utilities, too, you know, we're looking at them. I just don't know if that's going to be part of the 2016 or 2019 Standards because the 2016, you know, we have a very condensed schedule. But SMUD and some other utilities are definitely interested in the same topic.

MR. GOLDSTEIN: Well, Mazi, one easy way to do it, maybe not the best way, would be to say that if you are using electricity for water

heating, the reference home has a heat pump water heater at the NECA efficiency. So then whatever -- you wouldn't have to adjust the time of use, you could just model that in the reference house, and then tradeoff on that basis. There may be other creative ways of doing it, as well. But the goal, I think, for California policy at this point should be that we are not pushing people towards gas or towards electric, we're pushing people towards the most efficient options within each of those two choices.

MR. SHIRAKH: I agree. We'll consider it.

MR. GOLDSTEIN: Thank you.

MR. SHIRAKH: Thank you. Any other -- Mike?

MR. HODGSON: Mike Hodgson, ConSol, representing CBIA. And I want to follow-up on what David was just talking about on heat pump water heaters, but for a different reason. Builders who are trying to determine Zero Energy packages are also looking at the option of not bringing natural gas to the house at all, there's substantial savings in doing so. And so looking at some of the language proposed, which is the

first time I've seen some of this language, I'm not really sure, it sounds like you're saying "if natural gas is available," right, then you need to default in one particular direction. And I would support David's contention, I think, is let the playing field be as level as possible and whatever the best solution for the consumer is, that's what happens. The caveat I put into that, or actually the additional information, is to plumb black black pipe to a job site costs money, and to plumb it throughout the house costs money, and so if you could eliminate that it may be a $1,200 to $2,000 savings, and that may be helping drive the person towards an all-electric home, which may also be hopefully a very efficient home for Zero Energy. So I know we're exploring that with some builders right now and I do not want to be pushed into other alternatives.

MR. SHIRAKH: Okay. Thank you.

MR. HODGSON: So kind of general statements. We're very interested in what the impact of the DOE test method is on the energy factor and if it's similar to what I think the software assumes now is, what, nine percent degradation on tankless water heaters? Eight or

nine percent? Eight percent? Assuming it's similar, the question is to move by eight percent or not? And we don't know, and that was one of the questions that the Manufacturers brought up at the CBIE/CEC Forum back at the beginning of the year. So that's going to be interesting to understand. I don't have an opinion, just would like to know what happens. But what we do want to kind of focus on is the effective date. I believe the effective date is April of 2015 and if the final rule came out, and I believe it was the final proposed test method came out on July 1st, I presume there's a 60- and 90-day comment period, and then there's probably other impacts of that. So my question is, and I don't know if we know the answer to this, is when is the final test method going to be adopted so we know what impact it has? Do we know that? No, okay. So I'm assuming it's going to be fall, if not later, and if it is in the fall, then manufacturers cannot be ready by April of 2015, so we want to kind of make sure, and that's a national issue, not a CEC issue, but I would just like to follow it so -- we don't like turmoil, all right?

The other issue is, when we had the

recent NECA Standards that came in for air-conditioners, there was a caveat maybe put in by someone in the audience, not sure, on whether there was an installation date or manufacturing date, and we would like to be very clear on these standards, too, if we could ask those questions, is this installation date or manufacturing date mandated? And my presumption is, which is not safe, is that it's a manufacturing date.

So let's assume that we know all these things and this comes into effect sometime in late 2015, or it could be April 2015, the question that CBIA would have to the CEC would be, what happens then to the 2013 Standards? NECA has changed to 0.67 for a storage water heater, does that mean the Standards now change and we have new software in April of 2015?

MR. TAM: That's correct.

MR. HODGSON: Okay. Does anyone know that?

MR. SHIRAKH: Bill, do you have any ideas?

MR. WILCOX: Mike, I don't think the DOE has figured out what they're doing yet and I don't think there's a schedule like that that's

even been established. I might be wrong, but that's just my understanding.

MR. HODGSON: Well this is what we really would like to know because April 2015 is like tomorrow to us, right? We have a nine-month build schedule and, you know, we need to understand that. But according to the original rulemaking, the effective date was April 1, 2015. And I assume, and I don't know, that it was a manufacturing date. If it's an installation date, that's a whole different ballgame. Okay? So I would hope that the water heating experts here would let us know that and keep us informed as best as possible, okay?

The other recommendations I would make for your case study is you're talking about prototype buildings; I would really hope that you would use the same prototype building that the CEC and CBIA are using for standard analysis, which is around 2123 if I am correct. I don't care about the 2,700 square foot house, but 2,123 is kind of the guts of what we're doing on cost-effectiveness, so that's a very helpful, if you use the same prototype, okay? So we know what costs are and we also know what energy savings

are.

The incremental costs you're using, $446, we have a robust tankless -- what I would call a tankless market, you would call an instantaneous market now, so we know what these costs are and you're low. So my request is that you follow also what the CEC and CBI has done for not only pricing differential, but overhead and profit, which I don't know what you've done. So as long as you're similar, then we can comment. My assumption is, if you left off overhead and profit, which builders do charge, then we're probably close, within 10 percent, right? If you haven't, then we're off by 40 --

MR. SHIRAKH: All right, I mean, I gave them that cost that was based on our discussions at the end of 2013 --

MR. HODGSON: Okay.

MR. SHIRAKH: -- now, if it's different, then we can -- but it was basically I used the spreadsheets that we use to reconcile our differences.

MR. HODGSON: Great. Well, that's not the number that's on the spreadsheet, Mazi.

MR. SHIRAKH: Okay, well --

MR. HODGSON: Well, it could be the raw equipment cost number, but it's not after you multiply it by overhead and profit.

MR. SHIRAKH: Okay, we were probably off by like 30 percent or something.

MR. HODGSON: Yeah, it's amazing you are off by 30 percent.

MR. SHIRAKH: Okay.

MR. HODGSON: Okay, so that's really my comments, is really try to be as similar as what we've already done so that we can analyze it on a level playing field, and also any information about the impact of when these Standards come into effect, especially on the industry, and that's really directed at your team, and then at the CEC it's directed at how does that affect 2013 Standards because we're not anticipating this at all.

MR. SHIRAKH: Okay. George.

MR. NESBITT: George Nesbitt, HERS Rater. Water heating is an important one and it's one that has been kind of messed up, and not enforced. In fact, I have installed numerous water heaters on projects that did not comply with the Prescriptive Requirements. I may not be

the only one in this room and there's probably about every plumber out there is installing commercial water heaters that are not rated with Energy Factors, every day, prescriptively, in alternations and change-outs, when they would actually have to go to the Performance method, as well as electric heat pumps, solar hot water systems that may or may not comply with the Solar fraction, and I don't expect the 2013 language that basically prohibits electric to change that.

But let me step back for a second and understand conceptually, this would be part of a package or multiple packages that would also include high performance attics, or ducts in conditioned space, or high performance walls? Would it be part of any or all packages?

UNIDENTIFIED SPEAKER: Are you asking Mazi?

MR. NESBITT: I'm asking a question to the Energy Gods who may have an idea because it, I mean, because in 2013 we went to one package, we went from three to one to simplify, so are we going to still have one package, or are we going to have multiple packages so you have some options if you do choose to go prescriptively?

And prescriptively is really important when we get to alterations, less so in new construction. Additions, yeah, you're probably actually going performance most of the time, but alterations is where packages become very important.

MR. SHIRAKH: So the proposal we have to this point is we're just going to have one Prescriptive Package, it's the same Package A, but within that we're going to have multiple choices, say for high performance attics. For instance, it's going to say you can do R-13 below deck insulation, vented attic, or you can have a sealed attic, or you can do ducts in conditioned space, so those are all going to be equivalent alternatives within that same package. And the other way of doing it would be adding like footnotes, like instead of having R-13, and this is a discussion for this afternoon, R-13 below deck insulation, you can have above deck equivalent which is R-6. So we're going to try to keep it within the same package, but at some point it may become unwieldy, it might be better to --

MR. NESBITT: So this would be one of your options, so you could do high performance

attic, ducts in conditioned space, high performance walls, or water heater?

MS. HAUENSTEIN: No, it's not an either/or. You have to do –- within water heating you can either do the instantaneous water heater or the storage --

MR. SHIRAKH: For water heater your choices would be instantaneous water heater or you can do storage water heater with a .5 solar fraction.

MR. NESBITT: Okay.

MR. SHIRAKH: But you know, each subcategory will have some flexibility, some options.

MR. NESBITT: So I don't think you've mentioned it too well, but the federal preemption? So by going to a .28 Energy Factor, you're getting around it by also allowing a minimum efficiency with a solar fraction. Is that the --

MR. SHIRAKH: Yes.

MR. NESBITT: Okay. Even though you're actually requiring a more efficient water heater by having a solar fraction?

MR. SHIRAKH: We looked at the preemption

issues and we think we're okay with federal preemption with this approach.

MR. NESBITT: Okay.

MS. HAUENSTEIN: I was just going to comment, you said that the prescriptive approach really matters for alterations.

MR. NESBITT: Yes.

MS. HAUENSTEIN: And so the way that this would work for alterations is, if you are going to be replacing your water heater, then all you need to do is install a water heater that complies with the federal minimum efficiency standards.

MR. NESBITT: Which I just said I've violated multiple times, personally. And I'm a Special Inspector to all the local jurisdictions.

MS. HAUENSTEIN: But in other words, like if you're going to replace your electric water heater, you don't have to go put a solar thermal system on.

MR. NESBITT: Okay, because I did not see mention of that in the Case Report, or I did not note. So currently, or even 2008, prior, or even 2013, and I think going forward, I would agree with multiple commenters that having an electric

option because they're going in, they're going in today, they're going in on new construction, heat pump water heaters. I think we should have a prescriptive option for it. Obviously you have the option to do performance and, in general, I've found heat pump water heaters to be a penalty. Typically it's because the TDV, it is still a penalty. So are you requiring that we put in a tankless instantaneous water heater? Or do you care about the .28 Energy Factor?

MR. SHIRAKH: Point .82, it's the other way around.

MR. NESBITT: Like I said, sleep deprivation. I chose not to wake up the extra hour and a half early to get here at 8:15 and walk.

MR. SHIRAKH: It's .82 and that's what's important is the Energy Factor, however you get there.

MR. NESBITT: Although in your analysis and then in the software, the intention is to still use that .92 reduction factor, which turns it to a .75 even though we'll be saying it needs to be rated. So I am not aware of a single storage water heater on the market that has a .82

Energy Factor, although if we look back at the Energy Commission's database, there's Voyager and a few others that are quite old at this point, that have Energy Factor ratings for combined hydronic, as well as other sources and I think we know that most of the condensing water heaters would probably, or should, rate at higher than a .82 Energy Factor, but they're not rated that way because they all have a 76,000 KBTU input rating, or higher. And this is one of the ways I've violated the Code currently is by putting in a commercial water heater, which under Code I couldn't do without going to the performance method. So I think we need to either allow condensing storage water heaters as a Prescriptive. The other thing, and I've brought this up before, is in the Performance method, you would think that this high performance expensive water heater would be better than your .58 water heater, it's not, depending on the standby loss. So the software in 2008 -- I haven't really played with it in 2013 because it's so slow -- but I don't expect it to be much different, you know, these are water heaters that contractor cost is anywhere from $1,500 plus tax up -- I've

paid six and a half thousand dollars for, okay? And it gets me anything from a penalty compared to a .58 to a slight improvement, yet I think we have enough data that shows it should be equivalent to the tankless instantaneous water heater of at least the .82. So that's something that needs to be seriously addressed in the software and performance method, as well as I think allow a Prescriptive option.

MR. SHIRAKH: Thank you. Any other comments in the room? How about online?

MR. STARK: I'm trying to see if anyone has raised their hand. We did receive some questions by chat including one question on a previous presentation regarding geothermal heat pumps and refrigerant charge rating. I'll get to that after the questions that pertain to this one. To read the questions that we received, first we have someone asking where they can obtain the PDS and PowerPoints for this presentation, we'll share that at the end of the workshop. They can be navigated to on our website, but we'll share those links.

Phil Henry asks, "Please provide the Code citation for gas water heating requirement when

natural gas is available onsite." Is that something that we can do? It's 150.1. And I believe that's in those proposed change language that we went through, so I think that's in the presentation.

MR. SHIRAKH: It was in the presentation.

MR. STARK: Okay. Paul Bony asks, "New generation water source heat pumps can deliver domestic hot water for less than 1,000 KWH per year, saving more CO_2 than natural gas instantaneous water heating. When combined with solar water heating storage, even less electricity is needed. Why force the use of natural gas when this option is available, or in other words, why not allow an easy method for builders/homeowners to use a totally renewable thermal option for domestic water heating?"

MR. SHIRAKH: It's the same comment, and we'll be looking at seeing if we can come up with a heat pump Prescriptive option.

MR. STARK: Sure. And the previous question about closed refrigerant loops, this was: "What are the rules for closed refrigerant systems that are factory charged such as geothermal heat pumps?" And this goes to the

previous presentation regarding weigh-in and coolant charge verification.

MR. SHIRAKH: Okay, if there are no more comments, there is a request here for this afternoon, you know, we have two measures to present, the first one --

MR. STARK: We have two people that have raised their hands since we were looking at the chat questions. Can we address these before we move on?

MR. SHIRAKH: Okay.

MR. STARK: The first is Garrett Doss. Garrett, you are now live.

MR. DOSS: Hello?

MR. STARK: Hello, we can hear you. Did you have a comment to make on the presentation?

MR. DOSS: Yes, I do. This is Garrett Doss from Bradford White Corporation. Now I've got two things that I'd like to comment on. First, as far as the study or the evaluation on cost, I'm trying to understand where the 20-year life for tankless comes from when there aren't any independent studies to say that, and there's quite a bit, depending on longer length for instantaneous water heaters, but there aren't any

independent studies to verify that. And this was pointed previously in the U.S., it's a very young market, so I don't see how a life could be established for them that is that long. I think that's still very much an unknown. There are some studies that indicate that they have less life than that, than the storage product.

Secondly, I know there are some questions, there were some comments about the fact that the new DOE Final Rule -- that the new DOE Final Rule will do away with Energy Factor that is referred to here in the Standard. The new descriptor is going to be the UED, Unified Energy Descriptor. And that .82 probably is going to move for tankless products. The new test method has tried to address some of that eight percent difference that is shown in the studies, and I believe it goes part of the way. If .82 remains, if they go to .82 UED instead of .82 EF, because UED will be in effect when the Standard comes in effect, that will be pushing everybody to go to the very expensive condensing instantaneous product, that would throw all these costs down because it's quite a ways out. And if we're really after energy savings, why wouldn't

it say -- I would suggest that the new Prescriptive method should say gas water heater with a UED of X, and X needs to be determined yet based on what the DOE determines the UED level be because the DOE right now is in the process of determining what conversion factors there are, determine what the UED requirements will be. And so I would suggest that we look at the prescriptive for the gas water heater with the UED of X and I suggest that you're going to need to wait some time to see what the DOE comes out with.

MR. SHIRAKH: Thank you. Any other online questions? There's one more, it seems like.

MR. STARK: Yes, Frank Stanonik is the next one. Frank, you are live.

MR. STANONIK: Okay. I guess it's still morning on your side of the country. Good morning. Let me explain, the previous workshop where this was first introduced really didn't provide a good opportunity for discussion and analysis, in fact, we didn't see the Case Report until after. Having said that, we see a number of problems. First of all, I don't think you

solved the preemption issue, we do not agree that your 50-gallon option with a solar fraction is going to avoid preemption. We think you really need to make sure you've got something that really is going to solve it in accordance with what federal law requires, otherwise this whole discussion is a waste of time if you can't solve that. The cost estimates and the savings in the case study we think have some really questionable numbers, and just as an example, and granted this was some years ago, but back when those of you that maybe remember the SEGWHA project, Super Efficiency Gas Water Heating Appliance Initiative, they did do a survey of installed costs and the difference in installed costs between an instantaneous and a gas storage water heater was $1,400, and the case study sampled a couple of big box retail outlets, that's totally inadequate to get a good sense of what the average true cost difference will be to that homeowner who buys this new home with the instantaneous water heater.

I'm really not clear why you picked the 50-gallon as the baseline when most people have a 40-gallon gas model, which can meet their needs.

The adjustment on the Energy Factor does use this 8.8 adjustment, de-rating that comes from the Alternative Compliance Manual, which was based on some work, some studies done more than a few years ago. But then on top of that, in the case study, there's a further adjustment that in essence indicates that the instantaneous water heater is going to use more hot water and somehow it's not clear whether that is the reason for the 8.8, or in fact we think it should be actually additive if that's the case, if that's actually the case, but it's not really clear in the study.

I don't understand why the distribution loss multiplier is being applied. Most studies for hot water use, I can't tell you all of them, but many of the historical studies certainly on hot water use looked at hot water as it left the water heater. It's incredibly difficult to do a study where you're actually going to measure hot water use at every point of use, and so many of the historical studies that determined what was the average daily use were looking at hot water as it left the water heater and, in fact, if you look at, again, some of the information in that SEGWHA study, information from the California

Utilities indicated that the average California home, their annual hot water energy use was about 201 therms; if you run that backwards, it comes out to about 55,000 BTUs per day, if you run that backwards assuming a 135 setting and a 77 degree rise, it's about a total daily use of about 52 gallons. And yet, again, in the analysis, in the case study, you end up using something on the order of 67 gallons for the cost-effectiveness analysis. It doesn't make sense to us. But in any case, I think one other point, I'm looking at the cost benefit, this cost increase you're looking at, okay, this is a new home, so it's not like the consumer is just going to pay another whatever, five, or six, or $1,000 more, okay? It's going to end up being added in the cost of the new home, and it's going to be added into their mortgage. So in fact they're paying not only that cost straightforward, but also let's say the interest value of that money, which I didn't see being considered.

And the last point is this 30-year analysis cycle is -- it's a fantasy, okay? If in fact people are going to replace either their storage water heater in 10 years, or their

instantaneous water heater in 12-15 years, okay, I can guarantee you in 10 years there will be a new Federal minimum efficiency requirement for water heaters. More importantly, you will have a homeowner at that time who will decide what water heater they want in their home, as opposed to what's the water heater that's going to come with the new home. So to presume that whenever that water heater is replaced, that for your analysis it's going to be the same water heater, that's the least likely thing. And so it just seems like this 30-year analysis is just some period chosen to make the numbers look good. Again, it doesn't relate to what will happen when that water heater, whatever it looks like, dies and now the present homeowner decides what am I going to put in to replace it? It won't be the same water heater, and yet that's what the assumption is. We've got serious concerns with the whole Case Study, which seems to support that, oh, this is all cost-effective, it's all well and good, and we think you really don't have a solid analysis to say that is a correct conclusion.

MR. SHIRAKH: Just the only comment I have, that the 30-year life is what we used to

evaluate cost-effectiveness for all measures in the home, not just water heating, that's for air-conditioning, it's for lighting, it's for insulation, and it's been done the same way, you know, for the previous cycles of Standards, it wasn't cooked up to make this one measure look cost-effective.

Are there any other comments online?

MR. STARK: Bijit Kundu wanted to address the topic of lifetime. So I'll go ahead and unmute him. Bijit, you should be live.

MR. KUNDU: Yeah, this was just in response to, I believe, Garrett Doss, his question about the 20-year lifetime. Bijit Kundu with Energy Solutions, I'm part of the Case Report Team. We used the 20-year lifetime and it's in the Case Report, the reference for that was the DOE Final Rule, the 2010 Final Rule, which is a 20-year lifetime.

MR. SHIRAKH: Okay, thank you. Any other comments in the room or online?

MR. STARK: Yeah, it looks like Garrett Doss has raised their hand again, so they want to add something to this conversation. I will unmute them. Garrett, you're live.

MR. DOSS: Oh, thank you. Yeah, the same number was brought up when the DOE Final Rule was made and the same concerns were raised, and when they were pushed, it all went back to information provided by the instantaneous water heater manufacturers, they took that as fact, as Gospel, and it went in the Rule, but there isn't an independent study that verifies that, or shows that. That's real concern. That's where if you repeat something long enough and people see it in writing, it doesn't matter whether it is based on fact or theory, it becomes assumed fact, and that's what's happened here.

MR. SHIRAKH: Okay.

MR. STARK: It looks like Frank Stanonik would like to additionally make another response. Frank, did you raise your hand a second time?

MR. STANONIK: Yes, yes I did. And just a quick -- Garrett triggered me on something. Someone had raised a question about the DOE Final Rule on the revised test procedures. It is final, it is final and it will go into effect on July 13, 2015. Somebody had raised the question about whether there would be a chance for discussion, comments, whatever. No, as far as

DOE is concerned, that test procedure is done, there is going to be a significant transition period as we go from the current to that new test procedure, but on July 13, 2015, that test procedure becomes the one and only test procedure. I just wanted to get that clear.

MR. STARK: Sure. Thank you.

MR. SHIRAKH: Mike Hodgson.

MR. HODGSON: Hey, Frank, this is Mike Hodgson. When will the manufacturers need to meet the new efficiency of this rulemaking in their manufacturing date? You say that test procedures are effective July 13th, does that mean the equipment must be manufactured on July 13th to meet this?

MR. STANONIK: No, okay, so I'll try and keep this as simple as it can be explained. The revised minimums are going into effect in April 2015, okay? For the sake of discussion, and for a lot of reasons, you should expect most manufacturers are going to establish compliance of their models to those minimums with the current Standard, okay? DOE between now and let's say July of 2015 is going to have to take the requirements that go into effect in April

2015, and essentially translate them to the new test procedure. So the test procedure in theory will not increase the stringency of the new standards that are the April 2015 standards, but they're going to have to be rewritten to reflect the new test procedure. And up until July 2015, manufacturers can establish compliance to revised minimums, but say whichever version using whichever procedure fits that requirement, okay? After July 2015, well, really then what's called the translated minimums will be the only ones on the books and they'll have to use the new test procedure. It's going to be an incredibly complicated convoluted next 12 to 15 months for the water heater industry and anybody else involved.

MR. HODGSON: This is Mike again, Frank. What is the latest date a manufacturer can manufacture a water heater under the old Standards?

MR. STANONIK: The latest date will be July 12, 2015.

MR. HODGSON: Okay. So I'm trying to determine implementation date here.

MR. STANONIK: Right.

MR. HODGSON: But that's a manufacturing date, not necessarily an installation date.

MR. STANONIK: Oh, yeah, as far as water heater rules are considered, everything is still date of manufacture, without question.

MR. HODGSON: Okay, so the question to the Commission is when do the Standards change based on the new test procedure? When do your 2013 Standards change based on the test procedure?

MR. STANONIK: Right, well --

MR. STARK: That's not for you, Frank, don't answer that.

MR. STANONIK: Okay, all right, I gotcha.

MR. STARK: That's for CEC staff. You can answer it, but I don't know --

MR. STANONIK: It's complicated enough.

MR. SHIRAKH: We'll look into it, Mike.

MR. HODGSON: Could you keep us informed?

MR. SHIRAKH: Yeah, we don't have an answer for you now.

MR. STARK: All right. Once more, Garrett Doss has something to mention. You are now live.

MR. DOSS: Yeah, the answer to the last

question, I don't think it was understood, the effective date for the new Standards, the last date that we can make them to the current Standard is April 14, 2015. We'll have a period of time, a short period of time, where water heaters we're going to meet to the new 2015 levels, and be under either test method. So stuff that is complying to date with the DOE minimum, we will be able to manufacture up until April -- and Frank, correct me, April 14, 2015. I think that was the question.

MR. STARK: Yeah --

MR. DOSS: When does the current level go away?

MR. STARK: Yeah, I can contribute, I have some knowledge of this circumstance. The U.S. Department of Energy tends to stagger when they consider updates to their Regulations, they'll consider test procedure updates separately from updates to the Efficiency Standards for things they're held to. So in this case, there's a little bit of a mismatch between the effective date for these Standards as when the units are required to be more efficient and when they are required to use a newer version of

the test procedure. What DOE has done recently is, when there is a new version of the test procedure, they'll allow an early compliance period, and sometimes they'll do the same thing for their Standards. DOE has yet to explicitly address the circumstance where these dates are off by a few months, but I believe Garrett is correct, that the efficiency has to be at that higher level beginning on the April effective date, and the newer test procedure must be used beginning on the July effective date. And the newer test procedure, as mentioned, should not change the stringency, so something that met the Standard based on the old test procedure should be able to meet it based on the new test procedure. So it is going to be an interesting circumstance, and my sympathies certainly for people in the water heating industry that are trying to detangle that.

MR. DOSS: Yeah, and now we're going to add further tangling with this.

MR. STARK: Well, hopefully we'll bring some conditioner, I guess.

MR. SHIRAKH: Thank you, Peter, for the explanation. I'm going to have to cut off the

discussion on this topic. If stakeholders have further comments, please send it via email to the Docket, the information is there, submit comments to the Docket. We're about 15 minutes late, so I'm going to suggest coming back at 1:15 to give everybody an hour for their lunch. But there is a suggestion here. For the afternoon, I have the High Performance Attics as the first topic, and then the High Performance Walls as the second topic, some stakeholders have suggested that they want to switch the order, that we present the walls first and then the attics. I was going to ask if there's any objection in the room or online if we switch the order of the topics.

MR. STARK: For those online, we'll say if you object to switching the order, please raise your hand.

MR. SHIRAKH: I don't see any objections in the room. Is there any online?

MR. STARK: I do not see anyone who has clicked the raise their hand button.

MR. SHIRAKH: Okay, so why don't we come back at 1:15 and we'll start with High Performance Walls. We'll start at 1:15 sharp. Thank you.

(Recess at 12:16 p.m.)

(Reconvene at 1:20 p.m.)

MR. SHIRAKH: So one thing I forgot to mention this morning is the comments, you know, you're welcome to submit comments even after this workshop on any of these topics, and I'm going to look on the calendar here for one second. So today is the 21st, if you can give us your written comments by August 18th, that would be appreciated, that will give us enough chance to consider your comments and incorporate them. Again, August 18th. And you should submit your comments to the Docket and instructions for submitting comments to the Docket is on the Notice of Meeting, which is on our website.

I'm going to wait just a couple more minutes to see if Bob Raymer and Mike Hodgson are coming back and then we'll start. We changed the schedule slightly; instead of presenting the High Performance Attics as the first topic in the afternoon, we're going to present the High Performance Walls.

Okay, we're going to go ahead and get started. Before people walked into the meeting, I asked if everybody can submit their written

comments to us by August 18th, which is Monday, and comments need to go to the Docket, instructions for the Docket is on our Notice website.

So we have two topics to present, High Performance Walls and High Performance Attics for this afternoon, and Bruce Wilcox will be presenting both of them and the Case Teams are also here to try to help with the questions. Take it away.

MR. WILCOX: Thank you, Mazi. My name is Bruce Wilcox and I'm a Support Contractor for the Building Energy Efficiency Standards project for 2016. And what I'm presenting here is a Draft Proposal from the staff for Residential Wall requirements for the 2016 Standards. Next slide.

So a sort of simple preview of the proposed Code change is that we're proposing that there be a Prescriptive U-factor somewhere around 0.05 for exterior walls that would apply to low-rise residential buildings in all of the California climates except Climate Zone 7. And so that's the simple thing and then I'm going to talk about the background for that and the calculations, and what some of the approaches are

that you can use to meet that requirement, and all the way through and then we'll have questions and comments at the end. So next slide.

One thing I'd like to say here is that this presentation, this proposal benefits from a large amount of work that was done by a different Case Topic Team led by Cathy Chappell and her crew, and so very grateful for their help here, even though they don't agree with all of the numbers that are on these slides.

So the context here is that, so we're talking about the California Energy Code Prescriptive Requirements. The context here is that we require, at least for some measures, different things in different Climate Zones, and the Climate Zones we're talking about in that context are the California specific Climate Zones, they're shown on that little colored map up in the upper right corner of this slide, and we're sitting here in Climate Zone 12 which is where Sacramento is and the Central Valley, and so keep that in mind when we start talking about Climate Zones, so we're not talking IEC Climate Zones, or whatever.

The background here is that for the 2008

Prescriptive Standards, the requirements for wood framed walls, R-13 insulation, and 2 X 4 -- well, any wall actually, R-13 insulation in milder Climate Zones, R-19 insulation in the Central Valley 11, 12 and 13, and R-21 insulation in the more extreme desert and mountain Climate Zones 1, 14, 15, and 16.

For the 2013 Prescriptive Standards, which finally went into effect July 1st, three weeks ago, we changed those Prescriptive requirements and the new Prescriptive 2013 requirement is a U-factor of 0.65 in all the Climate Zones for all of the low-rise residential buildings. And that was the basic approach for achieving that 0.65, at least in terms of the Energy Commission analysis, was that it would be a 2 X 4 wall with studs at 16 inches on center with R-15 insulation in the cavity and R-4 insulation continuous sheathing. Or you could do the same thing with R-13 cavity insulation and R-5 continuous sheathing.

And there's lots of different compliance options, ways if you use performance method and so forth, or if you just do U-factors, there are lots of different ways to meet that requirement.

Next slide.

So starting with that 2013 requirement, there was a study done that looked at the Energy and Lifecycle costs of changing those requirements and the basic approach was to use the Energy Commission's new simulation software that is used for Code compliance in the 2013 Standards called CBECC-Res. And CBECC-Res was run to get the energy savings estimates. This analysis in this set of slides was discussed this morning, was all done using the 2013 time dependent evaluation factors because the 2016 TDV values are not completely set yet. And we used the same two prototype buildings that were discussed this morning, I believe, there's a two-story, 2,700 square foot building, and a one-story, 2,100 square foot single family house, and in getting the overall statewide results, we weight those 55 percent to the two-story, and 45 percent to the one-story, assuming that that's the statewide distribution of building styles. And then the baseline, where we're starting from is minimally compliant with that 2013 Prescriptive requirements we just talked about, 2 X 4 studs, and R-15 cavity with R-4 continuous.

No quality installation requirements in effect. Next slide.

So the Case Team developed a set of incremental cost scenarios, and so the first line there in the black box is the 2016 Prescriptive baseline, D-factor 0.065, and we assume that that's where we're starting, so the incremental cost of that is zero. And then there was a large number of different cases looked at and, you know, it's just sort of a condensed list of the relevant cases and I'm not going to read all of these here, but you can see there's different combinations of the framing, which is the left column labeled "stud," it's either 2 X 4 or 2 X 6, and then there's the cavity insulation that goes in the cavities between the studs, and then there's exterior which is continuous sheathing or a one coat stucco layer and its R value. And then the U-factor represents the combination of those using a parallel path calculation. And you can see that there are U-factors up there that range from 0.065 down to .044 down at the bottom. And then the incremental cost is based on a calculation of what the extra costs are to achieve the wall in question compared to that

Prescriptive baseline wall. So as you can see, the 2 X 6, R-21, R-4, .051 case, the second row down is the initial incremental cost of $463 or $.26 per square foot of wall area. And I'm not going to go through the details of all of those walls, but they're there in the Case Report, which documents in greater detail.

So one important note here is that all these scenarios assume 16 inches on center framing. This has been a topic of spirited and wonderfully intellectual debate in the past couple rounds of the Standards, and maybe there's an attempt here to avoid having to redo that wonderfully spirited debate again. So the proposal here is based on 16 inches on center framing. If you go to 24 inches on center, you can save money, and improve the U-factor a bit, but that's not in these calculations and not in this proposal. Next slide.

So again, I'm not going to go through the details here, but this is a cost basis for various measures involved in these walls that was used in doing that incremental cost calculation. For example, the two top lines have to do with the exterior siding finish on the wall and the

first line is three-coast stucco, the traditional cement stucco that's 7/8" thick and requires a lot of work with trowels and things. And the second line is an alternative approach which uses one coat stucco usually over expanded polystyrene insulation. And you can see the cost per square foot and the cost per home for the average of those two prototype houses shown for each of these things, and that's followed by the cost of insulation batts for the cavities and the continuous expanded polystyrene EPS and extruded polystyrene XBS and various other kinds of insulation layers. And spray foam, loose fill, gypsum board, OSB, etc.

So these numbers are integral to the analysis, although none of them are individually, I think, overwhelmingly significant. Next slide.

So this is a table that shows the results. And this is the present value of energy savings, Mazi talked about this this morning in various different ways. And this is a pretty busy slide, but on the left-hand side we have CZ 1 through CZ 16, these are the 16 California Climate Zones, and each Climate Zone row represents the analysis for that particular

climate and the results, as you can see, vary significantly between, you know, in Climate Zone 7 which is a 1,200 heating degree day climate, or 1,400 heating degree day climate, one of the mildest places in the United States, all the way up to Climate Zone 16 which is Blue Canyon up in the Sierras where it's a 7,000 heating degree day climate. So there's a big range. Climate Zone 15 is Palm Springs, where it is one of the hottest places in the world. So we have a big climate range, and that affects the cost-effectiveness of these insulation measures. And then the columns represent the nine different walls, I think it's the same nine that were shown on that first table of alternates. And so for each column, each cell in there in the table, it represents the energy savings compared to the base case, or the overall lifecycle cost savings compared to the base case, including the first cost and the value of energy saved over the 30-year life of the analysis. The green tinted cells are ones where that is cost-effective -- I'm sorry, this is not the lifecycle cost, this is the present value of the energy cost, and so it doesn't include the first cost, which comes in

the next slide.

And so you can see the ones that are in green show the cells where it's lifecycle cost-effective to do this measure, and the ones that are in white, the first cost is higher than the present value of the energy savings. So the one outlined in dashed red there is an R-19 cavity insulation with R-6 exterior insulation case that gives you a U-factor of .049 and costs $477 initial first incremental cost, and as you can see that one is cost-effective in all but Climate Zone 7, and that's more or less the basis for the .05 proposed Prescriptive Standard. You can do other walls here which will have a lower first cost, or a lower U-factor and more energy savings, but actually this particular case is the one that's most cost-effective in most of the climate zones. So, next slide.

And here is the same information for that wall, a bar graph just showing the energy savings and the value of the energy savings according to the analysis versus -- and that's the blue bars -- versus the green line which is the incremental cost per house. And same information two ways. Next slide.

So again, the proposed prescriptive standard here is a U-factor of .05 everywhere but San Diego, the San Diego Coast Climate Zone 7, it's cost-effective to do this using that 2 X 6 16" on center, R-19 plus R-6 continuous sheathing assembly, which is .048 or .049, I think it was actually .049 on the previous slide. But there are many other wood frame options that will achieve that same U-factor and can be more or less advantageous for a builder in a particular circumstance, 2 X 4 at 16" on center with R-15 plus R-8 sheathing makes the .05. It's interesting because there's been some indication that it's possible to get a one-inch, or maybe slightly over one-inch polystyrene insulation board using -- it would be a new product with a different set of characteristics than the typical stuff, but that you could actually make this wall with a one-inch polystyrene sheathing layer, which means that it's basically the same construction assembly as we have right now, substituting just a better insulation layer on the outside, and it would achieve the .05. You could also get the same performance, more or less, with 2 X 6s at 16" on center and R-5, R-21

in the cavities, and R-5 sheathing. And then we have a system that is described in the Standards and in the software called “Advanced Wood Framing” using 2 X 6s that are done with an engineered approach that minimizes the amount of wood and the bridging and so forth. You can achieve the .05 with R-19 insulation in the cavities plus R-4 sheathing and achieve the same effect. Next slide.

So I also wanted to describe some of the alternative approaches to meeting this standard either prescriptively or in the performance method. And I’m going to show pictures of and talk about a variety of things, but structural insulated panels is one, insulated concrete form walls is another, advanced wood framing which I just described, and I’ll show you a picture, there are systems out that people are using that have staggered studs so there’s no studs penetrating through the wall that reduces the thermal bridging, there’s double wall systems that take that to an even greater extent, and then systems using thicker external insulation and that’s one of the big areas of interest and research is what’s involved in going to thicker,

and how thick can you go without it being a major change in the system from the builder point of view. Next slide.

So Structural Insulated Panels are an industrial product, they're made in the factory, and they consist of two layers of oriented strand board with foam glued in between those two layers, so you get essentially this panel that is structurally very strong and you don't need any other framing typically, and because there's a very low level of penetrations, typically you have solid wood around the edges of the panel, but not much more than that, so they have reduced bridging and they can achieve higher U-factors and so forth. They come in 3.5" thick things that fit into a 2 X 4 wood frame system, or 6.5" or even thicker that do 2 X 6s or even thicker frame members. So this is an approach that is possible to do significant tradeoffs. Next slide.

The ICFs, they're called, Insulated Concrete Forms system uses two layers of insulation board, typically expanded polystyrene, or extruded polystyrene that are connected by some kind of a reinforcement system, and you

stack them up like Legos and build your wall system, and then when you get the wall built up, you fill the cavity in between with concrete onsite, and you end up with a system that has an integrated insulation system and a structural concrete wall, and it's airtight and it has a pretty high R value, and so it's a super duper system for building energy efficient houses. It's also not commonly done in California and there are some cost issues, I believe. Next slide.

Here is the better framing from the point of view of energy performance. You can do things where the studs are staggered and you have a reduced thermal bridge through the wall. Next slide.

Advanced Framing, essentially this is defined in the Standards. It involves lining up the studs in the wall with the rafters and the joists so that the point loads are all carried down through the studs efficiently, and you don't need much in the way of rim joists and you can have way less wood in the wall than you would with a normal wall. This was one of the cases that I referred to with the U-factor, AWF,

Advanced Wood Framing. Next slide.

Here is another discussion of the benefits of Advanced Wood Framing and this is all described in various publications from the Commission's -- this is defined as an option in the 2013 Standards, and then there's also an APA document and so forth. Next slide.

So that's the presentation of the Prescriptive proposal. So now we can open for questions.

MR. SHIRAKH: Any questions on Advanced Walls from the audience in the room?

MR. STARK: We did get a blue card from a Charlie Snowder and his comment is on high performance attics or walls. Would you like to speak now, or would you like to wait until after the following discussion?

MR. SNOWDER: I can talk to this one now. My name is Charlie Snowder from San Diego. I'm a 40-year General Contractor and I have a C2 License, Lead AP, and I've tried to work towards understanding the envelopes at energy efficiency. I also represent a reflective insulation product. And I believe one thing missing out of our conversation today is just that, as we talked

earlier today, providing more options and opportunities for the end user to make decisions as to what systems and forms they would like to take, I believe it all borrows down to the one primary thing from the California Energy Commission, and that is satisfying the requirements that we set, and so I believe there are additional ways to take care of some very important things that your presentation very correctly talked about. And mainly it's cost value to systems and thermal bridging. And we all know that the only way we've taken care of thermal bridging over the last 40 years is to build a 2 x 6 wall and stuff a piece of R-19 in it. And so with the reflective insulation products, they give us multiple ways of changing that system. For instance, there's a certified house wrap that's been approved, ICC approved, that by U-value configurations will satisfy the current Code and the new Code that we're striving for, that you listed today. It also under certain applications can create an R-4 by itself as a standalone.

But as importantly to that, it also takes care of that one thing that we've been striving

for in the new Code when we talk about insulated headers. I've been a contractor for 40 years and I have yet to see a lumber company sell me an insulated header. The best we're doing is taking form boards, stick them together with a piece of rigid insulation, and Building Departments are accepting that as an insulated header. The benefit of using a reflective insulation within the system is it does provide a continuous insulation, does substitute a wrap for the exterior of a building, and most important it's cost-effective. So, as with some of your systems you have here, there are cost advantages in different parts of the countries, we're seeing more of those type systems being used, cold climates, hot climates, but here in California the benefit of using a combination of systems, instead of building a 2 X 6 wall and putting a piece of R-19 in it, or high density in there and foam board on the outside, we could physically build a 2 X 4 assembly, which is our standard construction, put a piece of R-13 in it, and use two pieces, two products of a reflective insulation and create an R-22 system. So not only would you generate cost savings, value of

dollars to the homeowner, choices of alternatives, but as importantly we would be able to put that space back into the structure, into the footprint, and so there's cost-effectiveness from the actual construction, the labor and materials, and also advantages to the end user by having more square footage within the same dollar values.

So I just feel that as we process and go through this that we look at the alternatives. I know the California Energy Commission over the last few years have had the conversations that, if our Code right now is all based off our value, and when we get to talking about the other systems, I'd like to share a little more on that. But there is a differential between R value and Reflective values and energy performance outcome. I think those are probably the most important words that I've heard in the last five years that pertains to the California Energy Commission, and I believe the whole intent of this is to take energy, offload energy that doesn't cause our air-conditioners to function as high as they are now, create cost savings, along with all the other additional financial benefits of livability

within the houses. So I would just encourage our Energy Commission to look at reflective insulations, look at the data, I'd be happy to supply some, I know REMA would be happy to supply that type of information, and I believe we could qualify it again, expand on what we're doing and that's adding alternatives and choices to the end users here in California.

MR. SHIRAKH: Yeah, I appreciate it. I will make a brief comment. I don't know if you were here when I was making my introductory comments this morning for the sake of keeping everyone awake, I don't want to repeat it twice, including myself, but we emphasized was that, and this is a great example, you know, we are specifying a performance level which is a U-factor of .05 and, you know, during my remarks I kept mentioning that any other solutions that the manufacturers and the builders can come up together, you know, we're open to that, as long as the product has verifiable performance, has been subject to third party verification, has been through the Bureau of Home Furnishing, you know, we can and we will consider, we welcome it. And I don't know if Payam has any additional

comment.

MR. BOZORGCHAMI: What the U-factors assume is based on R-19 and R-6 continuous. Now, how you get that U-factor, as long as it is certified with the Bureau of Home Furnishing, go ahead and use it. If it's installed per the manufacturer's criteria --

MR. SNOWDER: Exactly. And just the reason for bringing it up is so that we allow the opportunity for reflective insulations to be part of our conversation because, as we all know, once we write this document and it becomes what we're using, we don't get to backtrack and so our intent is to at least bring it forward and ask if there's knowledge or information that we can supply to you, or to staff, to further expand knowledge and the opportunity of creating better systems, or alternatives systems, we just want to make sure that opportunity is available to us and the public.

MR. SHIRAKH: Yeah, we appreciate that. Again, we're interested in the performance, verifiable performance, and once that's in there, it's really between you and the builders what they want to use.

MR. SNOWDER: And the whole key, and I'll say this again when I speak again, is the reality, the bottom line is, is energy performance outcome, so as long as we can set what that performance level is that we're trying to achieve, any product or any system that can achieve that performance should do it, just like in our performance system where you can take something out and put something else in, as long as it qualifies under the performance package then it's acceptable.

MR. SHIRAKH: And that's exactly where we're going, in fact we're looking at the whole house HERS Rating, and for this round of Standards it varies with Climate Zones, but we're talking about a total HERS score between .7 and .75, but again, it's in line with what you're saying, we're looking at the performance, not specific measures.

MR. SNOWDER: Thank you.

MR. SHIRAKH: Any other comments from the audience? Cathy then David.

MS. CHAPPELL: Cathy Chappell, TRC, speaking on behalf of the Utility Codes and Standards Statewide Team. And as Bruce

mentioned, the presentation here is based on the analysis that we have done in our case proposal, the Codes and Standards Enhancement that I believe is posted on the Energy Commission website. And I just wanted to draw your attention to a couple of differences in what the Case Team proposed versus what is presented here, number one, to represent the IOU's perspective, and number two, to avoid any confusion when somebody goes back to review that and compared to today's presentation.

The first one being that the Case Team makes a recommendation that the column to the right of the red dotted column is what we are recommending as a cost-effective option, which is a U-factor of 0.046 for all Climate Zones, except for 6, 7 and 8, which are the Southern California Coastal Climate Zones, and when we look at the analysis on a statewide basis, as you can see it cuts out a couple climate zones, but on a statewide basis results in further savings. And there are ways to achieve that .046 U-factor using both 2 X 6 construction and 2 X 4 construction. So we wanted to point that out, the incremental measure cost of $783.

The other one is that the case proposal recommends a mandatory requirement for QII HERS verification for Batt insulation, and the analysis that was done earlier this spring, May-June timeframe, shows that QII is cost-effective in Climate Zones 1-5 and 9-16, again, all Climate Zones but 6, 7 and 8, using the 2013 cost information provided by CBIA of $843 per house. And the interviews that we have conducted with builders, contractors and program implementers have found that that fiberglass batt insulation is the most commonly used wall insulation in California by far, and requiring QII for batt insulation would ensure that the majority of insulation installations are properly implemented, increasing the effective U-factor of these wall assemblies.

And with the implementation of the 2013 Title 24 Standards on July 1st of this year, there has been a lot of recent discussion and comments from builders and HERS Raters that the cost of meeting these 2013 requirements will increase significantly. And while we acknowledge that there will likely be increases in cost, we also expect that the initial reaction to the

changes and the impacts on the construction and the costs and the HERS costs, as well as construction costs, will settle down and stabilize. The Case Analysis shows that QII is cost-effective, again, in 1-5 and 9-16, even if the cost estimates are $1,000 per house. The Case Team will engage builders and HERS Raters between now and the beginning of the official rulemaking to understand the long term and stabilized cost implications of the 2013 QII requirement, but at this point in time we still recommend that it is a mandatory requirement, again, for batt insulation.

We've also proposed that builders may use loose fill bone in or spray foam insulation as an alternative to the QII requirement. Thank you.

MR. SHIRAKH: Thank you, Cathy. Again, Cathy and the Case Team have done a wonderful job providing us with all the background and the information. For this Case Report, you know, we've deviated from the recommendations in a couple of areas, you know, for reasons that we had, we thought that providing that .049 or .05 provides additional flexibility to the builders at this stage, which is probably important, at a

very very modest loss in energy efficiency. On the question of the QII, we agree with the Case Team that it is a good thing to do, but we have this lightly different take on it, one of them I know we discussed is the possibility of using photovoltaics as a tradeoff for these measures, and we are suggesting, and this will be presented on Wednesday for the ACM workshop, is a Builder wants to take advantage of the PV tradeoff, they have to do a QII throughout the house on all the insulation. So, you know, it is still there, but slightly different than what the Case Team, what they're saying makes sense, but at this stage we've settled where we are. So thank you, Cathy. Any other comment? David?

MR. GOLDSTEIN: David Goldstein, NRDC. I wanted to thank the two previous speakers because my comments will build on theirs. This was a very detailed and high quality presentation. I would encourage you and staff not to get too hung up about the cost-effectiveness of individual measures when the law only requires cost-effectiveness for the entire package. Sure, you want to look at it, and that's an important piece of the decision making, but as the first

gentleman pointed out, the measures that you put here aren't necessarily the cheapest ones that get installed in the field, in fact, often in these cases, necessity is the mother of invention, and when you require something that looks expensive, you come back and look at it retrospectively, which we haven't really done much for Title 24, and it looks better. We have done it for Appliance Standards where the DOE estimates consistently overestimated the cost of compliance as demonstrated in the field later. In fact, by so much that it was difficult for the ACEEE study to get an average figure because, in fact, the total net incremental cost of all the products they looked at were negative.

The second thing is we've got to be consistent with the goal of Net Zero and the policy of loading order, and so if we're leaving efficiency opportunities on the table, we are forcing ourselves later on to go with renewables options that are likely to be more expensive than the costs used for cost-effectiveness. Furthermore, for envelope measures such as this, there are net energy benefits in terms of comfort that don't enter the cost-effectiveness

calculation, but mean something to the people living in the house. Like if you have poor quality insulation, and there's cold spots on the wall in the winter, that's going to be a comfort issue and so requiring quality insulation will help with that, and similarly with U-value, if you went with the utility's .046, you will get slightly better surface temperatures and more comfort from that. So again, people can trade it off later on in terms of how a house is built, but it seems like in justifying the prescriptive level, there would be good reason in this case to not worry about a few $500, $600 errors and go with the utility recommendation that Cathy presented. Thanks.

MR. SHIRAKH: Thank you, David. Just one comment on cost-effectiveness, you are correct that Warren-Alquist Act requires us to consider the cost-effectiveness of the measure in its entirety, but historically we've used both that and individual measures because it gives us a tool to basically screen out the measures that are obviously not cost-effective, otherwise we will be really hard pressed to come up with a package that makes sense with all the options

that are out there. So that's why we use it. And on the question of the QII and comfort, we agree that it is -- the proposal that we have on the table for the PV tradeoff, again, we'll be talking about this on Wednesday in a little bit more detail, but it would be the 2013 Standards, they cannot trade away any of the features of the 2013 Standards, plus QII, plus tankless water heater. So, you know, those measures will not be subjected to a PV tradeoff, it will be just the additional measures that are part of the 2016 package, which is the wall and the attic measures.

MR. GOLDSTEIN: Well, I agree that this level of detail of individual measure cost-effectiveness is good to have, this kind of chart guides decision making, I'm just recommending that we use it as a guide and not as a rigid decision making rule that can never be overturned by judgment.

MR. SHIRAKH: Thank you. Bob, then that gentleman there.

MR. RAYMER: Yes, Bob Raymer with the California Building Industry Association. And this will be somewhat repetitive of comments I've

made in two or three previous workshops. First off, we appreciate and support the direction that the staff is taking here by listing a U-value goal, but making it clear either in the Standards or the Manual, you know, eight or nine different ways that compliance can be reached, particularly with the 2 X 6 construction that's out there. Having said all that, there is still the reality that in the field we're talking about sort of a quantum leap in common construction design, and that can certainly be made, the question is how soon we can incorporate it on a statewide basis and in a quality fashion. Namely, we don't want to instigate something sooner than it should be to the extent that it could result in construction defect litigation. And there's a number of things that can be done to help that, 1) whether it's through the utility CAF program or whether it's through funding of EPIC for market transformation, or what have you, to the extent that we can establish yesterday programs that could help in particular large production builder members, effectively give them design assistance in field application to help framing crews on all of this now, so that as we hit 2017

and 2020, the massive humanity that's out there, that's now coming back to work, and we're looking at probably anywhere from 300,000 to 500,000 people being hired back into the construction industry over the next four to five years to bring us back up to that peak level we were at in 2004. This could be very helpful. And so I realize that the Commissioners are sort of gung ho to do these utility incentive programs and EPIC, the question is how soon can we get this established. I believe that the CAF utility program is already taking this into account and will be providing financial assistance. We're also looking for design and filled application assistance, as well, because as we do this we're sort of simultaneously training the bodies, the mass of humanity that's going to be implementing these down the road.

And sort of in general, along with high performance attics, lighting, and the instantaneous water heater, we're going to be looking at what all this does together, in essence the total cost and the feasibility of doing the entire package now rather than later. And so that will be how we sort of judge our

position on this. Right now, I've got to say, I have a very positive attitude heading into this because you're giving us a whole lot of options to get from Point A to Point B, and that's going to be very helpful. But once again, I don't want to discount the fact that we're making a quantum leap here, that by 2020 at the latest, you know, we're not going to be doing standard 2 X 4 construction, and we're going to be doing some type of advanced wall system, the question is how can we get as much of that done by 2017 as possible in a quality way.

And lastly, in recent weeks I've heard about a new product, a one-inch rigid board that can give you up to an R-8 value and I've heard today about the reflective insulation product; to the extent that we can find out a whole lot more about those very quickly, particularly the R-8 one-inch board, that could be fantastic because, at a minimum, let's face it, that could get you 2 X 4 construction with that, you're not going to have to be changing a lot of your window framing techniques.

MR. SHIRAKH: Yeah, I think that manufacturer is in the room and they're going to

come up and --

MR. BOZORGCHAMI: Actually, the manufacturer had to run to another appointment real quick, but I think, Frank, could you talk about the product real quick?

MR. NUNES: I'm Frank Nunes, I'm Executive Director of the Wall and Ceiling Alliance. We've been installing exterior wall systems, our contractors, for decades. And Bob is right on many aspects of these new wall systems in the sense that there are some quantum leaps in the detail more than in the wall system, itself, one coat wall systems, or California one coat-type systems have been around for several decades and their inception came about for Title 24, a 2 X 4 framed building could achieve an R value with an inch of foam on the exterior. The systems were quite robust and effective in the beginning of their application, but over time they have eroded in both detail and application to the point where construction defect have become prevalent with those systems. And that kind of falls in line with all of these more complex systems, the field of the wall, putting foam up, a thin coat of plaster 3/8" thick,

cementitious plaster, or full 7/8" plaster is nothing new, been doing it actually for many many decades in all types of construction. The challenge is the detail. And that's where the systems need to be brought up, that's where the builders need to be really assisted in achieving a minimum kind of performance value so that cost doesn't become the overriding factor to performance. And I think if that balance can be maintained and achieved, I think we'll have good success. And as Bob was saying, the workforce in housing, as well as commercial, we're seeing many people who are qualified in housing now coming over into commercial because the work is so active, they're running out of a workforce on the commercial side, so that's even sucking more out of the residential. The perception has been, I think with all of us, that anybody can build a house, it may not look good, but it will perform, and that's not the case, particularly with these systems.

MR. BOZORGCHAMI: Do you want to talk about the one-inch R --

MR. NUNES: Oh, yeah, so I looked over that system -- so I looked over that system, it's

an assembly as all of these are, and that's what they really need to be looked at, as assemblies, so the details I saw were quite common, there was nothing unusual about it, quite applicable and able to perform. So I think you'll see more of them. And we're seeing more of it as these systems have been brought into the commercial steel frame side already, so quite applicable.

MR. BOZORGCHAMI: Yeah, I was talking to the manufacturer before lunch and one question he asked was how soon do we want it into the marketplace, and I told him within a month. He said they can do it, so that product could be in the marketplace, and it's manufactured in California out of Dixon -- it's InsulFoam, a product at R-8.

MR. SHIRAKH: So the gentleman that we talked to, his name was Rick Canaday?

MR. BOZORGCHAMI: Yeah.

MR. SHIRAKH: He came to the Commission and he demonstrated the product. Payam, can you tell us where his product is in terms of testing and certification and the Bureau of Home Furnishing?

MR. BOZORGCHAMI: They've done the

testing and it's completed. They've just received their, what do you call it, the certification from the third party verifier --

MR. NUNES: They did a --

MR. BOZORGCHAMI: SGM C1363 test.

MR. NUNES: Yeah. They had a testing agency test and validate in a full scale assembly, and that's what we're starting to see now where manufacturers aren't just throwing their products into these systems, they're testing the whole assembly. And so it's already been validated and it will work quite well. It's going to be much higher performance than the typical one coat now. Again, the detail with the wall penetrations and all that will be a continuing challenge.

MR. BOZORGCHAMI: And hopefully within the week we'll get it listed at the Bureau and it's ready to go.

MR. SHIRAKH: And do you or Payam, have you had any conversation with the manufacturers about the cost of this insulation product? Have they given you guys any indication?

MR. BOZORGCHAMI: The indication I've received is 30 percent more than your standard R-

4 one-inch insulation. That's a cost to the contractor.

MR. NUNES: Material cost.

MR. BOZORGCHAMI: Material cost.

MR. SHIRAKH: Presumably the labor cost is the same because it says the one-inch product.

MR. BOZORGCHAMI: Yeah, your nailing scheduling is probably the same, or if not better because it's gone from one and a half pounds to two pounds.

MR. NUNES: Two pounds, right. So there's more cost in that. Also, the two pound is a lot more durable to handle in the field. And I think once they, from what I saw the components in the system, I think once they get it in full production and in use and application, I think the cost will come down.

MR. SHIRAKH: Is this a product that's only unique to this manufacturer? Or can anyone make this? We want to make sure we're not --

MR. NUNES: I don't think it's rocket science. They've got, you know, it's a proprietary product, but it's EPS Board and, you know, in particular assembly. So I don't think it's going to be restrictive to other products.

The rigid extruded foam companies will be able to -- they have their own values and I don't see anything extremely unique about it.

MR. SHIRAKH: Well, when I met the representative, I asked him how come nobody has made this product up to this point, and his answer was simply that nobody has asked for it.

MR. NUNES: Well, it got so cost-driven, even the one coat systems, you know, the energy efficiency almost became a secondary aspect to it and so if you can get the high performance if you ask for it, and want it, it's available.

MR. SHIRAKH: Well, thank you. I mean, this is exactly what we want is for people to innovate and come up with new solutions. Please.

MR. CHRISTIE: I'm Matt Christie with TRC speaking on behalf of the California Advanced Homes Program, the Utilities Efficiency Incentive Programs. We're in complete agreement with the CBIA's perspective that we want to have a lot of options on the table and be fairly measure agnostic, and that the cap program does intend on incenting builders in this next Code cycle, you know, prior to the 2016 Code cycle for installing high R value walls, both as a direct incentive

and as part of the performance modeling that would be commensurate directly with the energy savings of each homes for having installed the high performing walls, but also as a bonus incentive for installing high performance walls plus some other items in a package of whole building measures, as a fairly large sort of high end bonus for those builders that are really pushing the envelope and getting it deep into savings.

And then on top of that, the program also does offer and supply design assistance and trade training, and we're intending on stepping up our efforts because we are also well aware that this is a quantum leap, that this is a big difference, and that the builders that we're talking to, whom I talk to everyday, need more help and need more assistance on this. So we recognize that and are already putting in place work to up the ante in terms of what we're able to offer the market in terms of design assistance and workshops and teachings and product sheets, and I can work with Frank and anyone else who has wall assembly systems that meet these criteria that we can help educate the building community on and bring into

the marketplace.

MR. SHIRAKH: Thank you so much. Again, we recognize that CAF, the incentives education, these are all a very important part of this, we're working with various stakeholders. Dave.

MR. SPRINGER: Dave Springer, Davis Energy Group. We're working on a couple projects, one funded by Building America Program, a DOE Program to help builders build more efficient walls. And one of the things we're running into is that the devil is in the details when it comes to advanced wall framing and I think we need to be very careful if we're providing that as a measure in the Standards that we're very specific about what that measure includes. And for example, you know, a two stud corner requires dry wall clips which increases the cost to the dry wall, and there's ways to get around that that need to be accommodated, I think.

And finally, on the issue of insulated headers, my house was built 14 years ago with commercially available headers, insulated headers, and I think if we set the standard, the manufacturers will rise to the occasion. Thanks.

MR. SHIRAKH: Thank you. George.

MR. NESBITT: George Nesbitt, HERS Rater. So the current requirement of .065 for walls, in theory you could do it with a wall without continuous insulation, although the .05 would require continuous insulation. We also have to remember that with new construction most of it is complied with in the performance method, so you don't have to go to continuous insulation. You're just going to get penalized. Do you want to correct me?

MR. BOZORGCHAMI: No, you're right, as long as you don't go below the mandatory minimum, you can do performance.

MR. NESBITT: Right. So although I think, honestly, I would rather see people go to continuous than go to thicker walls. For one, it makes framing factor less important, even QII becomes a little less important, although I do need to note QII is an all or nothing, so it's all insulation or nothing, plus we don't have any at least written Standards or training in how to look at rigid continuous insulation. So that needs to be addressed. Then because this is a prescriptive, it also then hits additions. With

additions, it would certainly be harder to then prescriptively comply. And then what thought have you given to alterations in the sense -- to what extent have you considered any impact. I think we have in 2013 a little more explicit as to filling cavities and mandatory minimums, 2 X 4 versus 2 X 6, but how might this impact alterations?

MR. SHIRAKH: Well, in general these requirements will go probably in Section 150.1, which is the Prescriptive requirement for new construction. For Alterations, in Section 150.2, we do two things, we either refer back to 150.1 and adopt them the way it is, or we have total different requirements, or we have 150.1 requirements with modifications. I fully recognize that what we're proposing here, most of them are not going to be practical or cost-effective for Alterations, so we have to have a different approach, and I'm not going to get beyond that at this point because I haven't really looked into it. But we know, for instance, if your existing wall is a 2 X 4 and you're doing an addition to that wall, extending it out, you know, you can't have a wall that's a

wholly different thickness and all that. So we'll consider those things when we work on 150.2.

MR. NESBITT: Okay. Yeah, I mean, because 2013 has taken out some of the things that make alterations and additions easier and at some point we're going to hit a level where it's going to be really hard, I mean, and it seems like maybe we're going to have to split new construction from alterations a little more explicitly and not make the package the basis of everything.

MR. BOZORGCHAMI: Additions, not alterations, because alterations has a set criteria already which works.

MR. NESBITT: Well, I mean, yeah, additions are typically the package with some modifications, but then depending on size. But, yes, even alterations often -- your requirements for an alteration are either the package requirement, or often a mandatory minimum, and there are some exceptions. But what I see is, on the one hand, 2013 one of the goals was simplification, yet on the other hand we're perhaps going to have to go back to more

exceptions.

And then, well, the proposal to make just wall batt insulation QII, I can't tell you how many projects we have failed blow-in attic insulation multiple times. Okay, I went through 10 whole buildings on a project twice, had to fail them twice, and had to get up there and help drag the hose around to make sure it got done right the third time. And on a current project, we've probably failed them half a dozen times. So I think in the big picture, building the building enclosure right the first time is a very important goal, as someone who has spent lots of quality time crawling under houses and attics, fixing them. So not only, you know, pushing lower U-values, or the extent we can make a mandatory minimum higher and almost force continuous insulation, but requiring QII. Because with QII, we also get some benefit on air tightness, and since the Air Resource Board doesn't believe in blower door testing, you know, that's off the table, totally eliminated from multi-family at this point.

MR. SHIRAKH: Where do you come up with that?

MR. NESBITT: Where do I come up with that?

MR. SHIRAKH: The Air Resources Board don't -- you can't slander our sister agencies.

MR. NESBITT: That's not slander, that's truth. So getting that building right because it's a lot more expensive to go back later and fix them. And, of course, I think the reality is there's still plenty of ways high efficiency furnaces, you know, things that people can get credit for, but as we move towards more mandatory and HERS, and less compliance credit, you know, we're going to reach a point where we just need to require the right thing.

MR. SHIRAKH: Okay, thank you George. You had a comment.

MR. WALL: I'm Andy Wall, AC Home Performance. And I want to thank you for the opportunity to speak a little bit today. I hung out here all day just deciding what I was going to say, and maybe this is an appropriate area for me. I've actually been in this industry about 34 years now, so I've seen a lot of things happen. I do think we need to make the quantum leap, I mean, we have the technology, we have the

knowledge we need, there's no reason we can't get there, we just need to do things like educate people. The QII, especially for batts, I feel that should be mandatory and there should be no tradeoffs. I see insulation put in, particularly there's a multi-million dollar house being built right now I know of that's on a 2008, and the insulation they put in over the header was like why did they even bother to put it in there, they should have saved their money for it. So I think it should be mandatory and maybe even on all insulations. I think George kind of hit it on that, regardless of what it is it needs to be installed correctly. It is one of the few opportunities we're going to get when that building is open. Once it's closed, major major problems. And I live in a 27-year-old house that's been retrofitted to Net Zero, and the insulation was a big problem in the walls, and it's crazy expensive to retrofit to Net Zero. I could have put PV on and done it Net Zero, but we chose to fix the envelope as well as PV, so kind of leading to that is PV will give you Net Zero, but no comfort, or maybe no comfort. When we fix the envelope, we can have two-story houses with

very little Delta T between the ceiling of the second floor and the bottom of the first floor, as low as two to three degrees or less sometimes, and you can't get that with PV. As far as education, there are some real great classes out there, maybe they need to do more, but they're still great classes. PG&E -- I don't know what Southern California Ed does, but the PG&E classes, if I may ask who in this room has been to those. Can I ask that? Not many of you. They're free classes, high performance building is being taught at those, so I think you should all pick up the phone, go to the Web, find out what classes you have. I don't know what Southern California Ed is doing, some of you are from the southern part of the state. Performance in walls, there was nothing said about air tightness, I don't think, in the walls, so we can put all the batts we want in the wall, all kind of insulation, it don't stop air flow, and that wall still isn't going to work.

And this is a little thing I heard at a Passive House Conference not too long ago, about a year ago, apparently this is done over in Europe, one of the countries took this on, they

educated the contractors, they educated the consumer, then they made sure there was product available, and then they mandated it. And I think we're doing it backwards. Thank you very much.

MR. SHIRAKH: Thank you for the comments. Any other comments inside the room? How about online?

MR. STARK: Anyone that would like to make a comment that's online, please raise your hand. At present, I'm not seeing that anyone's hands are raised, but I'll give it a couple moments. Let me check the chat.

MR. SHIRAKH: I just want to make a brief comment on one of George's comments, you know, extra continuous insulation, if we end up going to R-8, will actually help with a lot of stuff including any defects that may be present in a building, the result of insulation defects, so going to that extra level of insulation will help with that, it will also help with the framing factor that is not going to be as important, thermal bridging. So hopefully that would help us with some of those problems. Anybody online?

MR. STARK: I'm not seeing anyone's hands

raised.

MR. SHIRAKH: Okay, if there's no other question on this, we're going to move to the last topic of the day, which is High Performance Attics, and Bruce Wilcox is going to present that one, too.

MR. WILCOX: Okay. So this presentation is another Draft Proposal from the Energy Commission staff for High Performance Attics or Ducts in Conditioned Space. And again, this proposal is heavily based on work from the Codes and Standards Team for the California Utilities, and so I'd like to thank them for great work in this area. Next slide.

So there's a little interesting background here on why we are doing this measure and somebody already mentioned the loading order and the emphasis in the State policy on reducing loads by using envelope measures, and so forth, first before you go into the more esoteric measures. And so this measure is intended to reduce the cooling efficiency impacts of cold ducts and attics, as Mazi mentioned earlier, and reduce the space cooling and heating loads that are also increased by having low efficiency attic

systems. And so this is the first two steps in the loading order here that we're talking about with this set of measures. Next slide.

So the overview of the proposed change here is that, for the Prescriptive Packages for envelopes in the cooling Climate Zones, I mentioned climate zones earlier, this is intended to apply to Climate Zone 1, 2, 4, and 8 through 16. So these are mostly cooling Climate Zones. Climate Zone 1 is a heating Climate Zone, as well as 16. But the intent here is to define two alternate paths that you could use in this area of the Prescriptive Package. The first one is that you would provide a High Performance Vented Attic, acronym HPA, and the proposal here is that that would involve having R-13 insulation below the roof deck in the attic, in the ventilated attic, and in addition to R-38 ceiling insulation on the floor of the attic, as is typically done currently, so you're basically adding an R-13 insulation layer at the bottom of the attic roof deck. Because of the assumption here is that you're using some kind of an insulation system that doesn't lend itself to having radiant barrier supplied that you wouldn't have a radiant

barrier on the bottom of that insulation.

And then as a possibility, although that's not included in the current numbers we're presenting here, is possibly the Commission will investigate increasing the duct insulation in the Zones where it's not already required to be all right and possibly lowering the duct leakage value from its current requirement. So that's the High Performance Ventilated Attic Prescriptive Standard.

And the alternate is that, for your house, instead of doing that you could put Ducts in Conditioned Space, acronym DCS. And so a straightforward way of doing that is you put the ducts and the air handler of your split system gas furnace air-conditioner in the conditioned space so that there's -- none of those system components are located in that hot attic, thus avoiding the problem of the duct in the hot attic and obviating the need for that R-13 insulation below roof deck. Or, you know, there are variants on the ducts in conditioned space that give you equivalent performance such as ductless systems.

The ducts in conditioned space is

proposed here as using the criteria that's in the current 2013 standards for verifying that you actually have ducts in conditioned space, which is to measure the duct leakage to outdoors and verify that it's close to zero. So this is a serious ducts in conditioned space where you're actually verifying that the ducts are really in the conditioned space and/or, of course, you can achieve that same performance level by just having duct leakage be zero total. But one way or the other, verifying that you're not leaking air to and from the attic with your duct system. So that's the overview. Next slide.

So the background here is that the current requirements in this area of the Standards, we have a mandatory duct leakage test of six percent leakage or less, verified post-construction in every house if the ducts are located outside the conditioned space, and we have a mandatory minimum R-30 ceiling insulation currently. The current Prescriptive requirements are that ceiling insulation is R-30 in Climate Zones 2 through 10, and R-38 in Climate Zones 1 and 11 to 16, again referring to the California Climate Zone Maps on the left. And if you look

at that, you'll note that Climate Zones 2 through 10 are the Coastal Climate Zones running down the Coast from two up in the north to 10 down in sort of modestly inland, Los Angeles and south, and the rest of those zones are mostly the inland hotter and more extreme zones.

The current requirements for duct insulation Prescriptive are 6 insulation in Climate Zones 1 through 10, 12 and 13, and R-8 in Climate Zones 11 and 14 through 16. So that's where we're starting from with this set of proposals. Next.

So the analysis that's behind this Prescriptive proposal is making use of the 2013 Performance approach assumptions, the Standard design assumptions, so these are the rules that are used for showing compliance using the Performance method under the current Standards and they're being applied to analyze the energy savings of these proposed Prescriptive Standards. And so the standard design assumptions are your ducts and your air handler are located in an unconditioned space, and if you have a single-story house that's 100 percent in the attic, is the default assumption, because that's the most

typical current California construction approach, if it's a two-story house and you have 65 percent of the ducts in the attic and 35 percent in the conditioned space, if you have two more stories, as I said. And that's because in a two-story house, you have ducts that run inside the conditioned space, bringing the conditioned air from the attic down to the first floor, and those typically run in chases in wall spaces and so forth.

The supply duct surface area is assumed to be 27 percent of the conditioned floor area, and we are assuming that you have an attic that has 1-300 free ventilation area, but in the 2013 Standards in many of those cooling climates, we require a whole house fan for cooling ventilation, and when you have a whole house fan you end up with more than 1-300 attic ventilation, so it depends on the Climate Zone you're in. Next.

So in the 2013 Performance Standards for the Performance approach, there are a bunch of compliance options for improving the performance of this situation with ducts and air-conditioning systems located in attics. You can show that

you're going to install those ducts not in the attic, and there are several flavors of that and we don't need to go into the details of that, but you can get a credit for that in complying with the Standards and trade that off against other things like your water heater efficiency, or vice versa.

So roof deck insulation is a Performance compliance option, both above and below decks, so we've been working with the concepts involved in this HPA, High Performance Attic System for the last three or four years. They're using instead of a ventilated attic using a sealed attic in which you attempt to make the attic space at least indirectly conditioned and change the environment for the ducts and the HVAC system. You can use a low absorptivity cool roof, low solar absorptivity cool roof, so instead of insulating the roof deck to keep the solar gain on the roof from getting into the attic, you simply keep the roof from absorbing solar gain, and you achieve basically the same end by doing that. That roof deck insulation and low solar absorptivity cool roofs kind of are a one for one tradeoff in terms of the way they work.

We have measures now for using verified low leakage air handlers and reduced duct leakage. There's a new Standard for manufacturers to certify that their air handlers have low leakage of attic air into and out of the air handler, and that coupled with a better job of duct sealing, you can significantly reduce the impact of the ducts in the attic. You can also use a higher duct insulation such as R-8 or even R-11 or higher. We have provisions for burying the ducts underneath the blown insulation in the attic, and that can have a major impact on the efficiency of the system. And then there's a whole approach called verified duct design where people who make a commitment doing this and working out all the details can design duct systems that have shorter duct runs and a better layout and so forth, that end up with a much less than 27 percent of the conditioned floor area and duct surface. And when you get that duct surface area down to zero, then that's exactly the same as having ducts in conditioned space. So you know, there's a whole range of options, all the way from what we assume is sort of the worst case now down to stuff that's very close to ducts in

conditioned space by using the duct design and especially in combination with buried ducts.

And there's also measures for increasing the attic insulation and using raised heel trusses to make the whole ceiling insulation system work better, and the roof deck's insulation system work better. And these are all implemented in the CBECC software that's used for performance analysis under the 2013 Standards. And so they're essentially in play here either as components of this Prescriptive proposal for 2016, or as alternate approaches that could be used. Next slide.

So just for comparison with other approaches to minimum standards for energy conservation, the IECC, the International Energy Conservation Code, which is produced by the International Code Council, the IECC, which is building inspection industry consensus group, they have a Code that prescribes efficiency measures for houses based on climate, and if you look at what their prescriptions are for these areas, you'll find that in most of California the IECC requires R-38 insulation. There is a tradeoff that you can do R-30 if you use the

raised heel truss and the insulation is not compressed. So the IECC is essentially either the same or requires more insulation in the ceiling than we currently do in the 2013 Standards. The supply duct insulation in attic is R-8 in all those Climate Zones, so IECC requires more duct insulation in the attic. The IECC requires duct sealing and they use unfortunately a different approach than we do, so it's a little hard to compare, but their criteria is 4 CFM25 per 100 square feet of floor area. And if you have a 2,100 square foot home with a 3.5 ton system, that's more or less equivalent to what our criteria is of six percent of the fan flow. If your 2,100 square foot home has more than 3.5 tons of air-conditioning, then our standard is looser, and if you have less, it's tighter. So our system essentially depends on the size of the air-conditioning system and the IECC just depends on the size of the house.

And the IECC requires that all air handlers are low leakage air handlers, so all in all the IECC requirements are more strict than what is in the 2013 Standards, I think, not radically but somewhat. Next slide.

So the current California Standard practice, and we've talked about this a little, but just to review here, the standard house in California has the ducts and the air handler and the furnace and all of that stuff in the vented attic, there's insulation at the ceiling, and I tend to agree with George that that insulation is often not very well done. The measured duct leakage, we've made great progress in California at getting people trained and understanding the importance of duct leakage, and builders are now, I think, passing that six percent criteria pretty consistently without much trouble, and it has to do with learning how to do it right and what to focus on, and what's important.

Duct insulation, you know, we've increased the R value over the last couple of Code cycles and there's still a mix of R-4, R-6, and R-8. We've made very little progress in getting people to design compact duct systems and I think that's partly because of the overhead and cost of doing the design and documenting it; hopefully we'll make some progress in the near future with more automated systems that are easier to use, that people can use for compliance

by doing duct design, but that's I think a rare thing to see in California production housing, using a duct design. Next.

So I have several pages of the results of the Case Team's research into what people are doing in terms of ducts in conditioned space in homes in California and around the country. And there are several builders here that deserve great credit for having pushed things out and done work in areas that are very important, and you can see their names up there, some of the biggest guys that we've seen around in California, Elliott and Pulte, etc., Meritage, so I'm not going to go through this and read all these cases, but you can look at these slides online if you would like. There's also a little table here that shows how aggressive the California utilities are in their incentive programs, along with the Department of Energy and Building America, and so forth in working at various approaches to this problem. Next slide.

And here are some specific examples of high performance buildings that have been built using these kind of systems in California, and I'm sure you'll all want to go and visit all

these houses and see what they're like and, again, for the details here in the case report and in the slides. Next.

And then if you want to get outside of California and travel around, here are some places you can go in Texas and Seattle and Portland and Aztec, New Mexico. Next.

So the modeling assumptions for doing the lifecycle cost analysis here are basically the same as what we talked about for the walls, it's using the same two prototypes that we've been using for Standards development work for the last eight or 10 years now, a one-story 2,100 square foot prototype, and a two-story 2,700 square foot prototype. For the last code cycle or two, we've been assuming that about half of the new houses being built are the one-story and half are the two-story, it's actually 45 percent one-story and 55 percent two-story, and the analysis assumption here assumes a tile roof and 20 percent window area equally distributed.

One of the things to note in both the walls case, but more in particular here in this attic case, looking at attic measures, a two-story house has half the attic area per square

foot of floor area that a one-story house does, and so it matters quite a bit how much it costs and what the energy impact is, depending on what the house design is. And so this 2,100 square foot house actually has a larger attic than the 2,700 square foot house, and so that matters in terms of the energy impact and also in terms of the cost.

And there's some assumptions down here in the bottom part of that table about ducts in conditioned space, what that means in terms of the CBECC software for those of you who, none like George, are willing to actually do runs in spite of how long it takes, the particular case that we're talking about for the DCS here is the verified low leakage ducts in conditioned space which is a name of a system that you pick the input and that gives you no conduction loss, no duct leakage to outside, and that's the assumption in the modeling for the DCS. The HPA case is using the R-13 below deck, R-38 in the vented attic ceiling, and prescriptive ducts in the attic. Next slide.

So the Case Team provided the cost estimates here and they talked to everybody and

found out everything there was to know, but of course, and everyone of course will agree with that! Next.

Okay, so what they found out, and that's where the disagreements will start, is these are the costs of the measures we're talking about here, insulation at the roof deck in the 2,100 square foot prototype is $1,058; in the 2,700 square foot prototype it's $730, and this is using a system with R-13 blown in -- it says cellulose, but I think it might be fiberglass, actually using a netted system, I believe this is the system that Owens Corning Fiberglass described at the CBIA sponsored stakeholders meeting, or some version of that anyway. And there's this little detail that the Building Code requires that if you do that system in Climate Zones 14 and 16 because of their winter climates you have to provide a vapor barrier, so there's some extra costs in those two Climate Zones for a vapor barrier.

The ceiling insulation is increasing here from R-30 to R-38 in some of the Climate Zones, and for a cost of, as you can see, there are $292 or $201, depending on which attic you're talking

about. Taking the radiant barrier which is required in maybe all of these Climate Zones, but in any case, the 2013 Standards require a radiant insulation on the bottom of the attic roof deck, and because we're going to insulate there instead, that actually saves money. The weighted total cost of the R-13 below deck is $589, $670, or $831, depending on which Climate Zone you're in. And then the per square foot cost of this, for those that are interested in that approach, the below deck roof insulation is $.29 per square foot of roof, you've got netting at $.13 per square foot, and vapor retarders at $.04, and so the total cost is $.40 to $.46 per square foot. They didn't say in that case whether it was -- I assume it's per square foot of floor area, but it doesn't say. Close, anyway. Next slide.

All right, so the concept here is you're going to reduce the attic, the temperature in the attic and you're going to have your ducts and your air-conditioner and your air handler up there, and reducing that attic temperature will reduce the losses from your system. And the package of measures here is roof deck insulation, potentially a lower duct leakage rate, and then

potentially other things such as raised heel trusses, or reduced surface areas. Next slide.

So what do these things look like? Here is a picture of the netted blown fiberglass system installed in a California house, so you get this fabric system that goes up, hanging from the roof trusses at the top, and then you blow that space that you make with the fabric, you blow it full of insulation. And then the space below, which is -- we're in the attic here -- is now insulated from the outside. And you can see those low efficiency ducts are there running around in that nice cool spot. Next slide.

So sort of schematically, what's involved here, what we're talking about is conceptually you are insulating the roof deck and it's the light blue part at the top of the attic is where the roof deck goes, you know, new thick insulation right up there, and you still have the same basic insulated envelope for the conditioned space, that's the magenta box down below. So you know, we're taking a conventional house and adding insulation at the roof deck to control the solar heat gain, basically, so it's an anti-solar measure, controlling the solar heat gain into the

attic and therefore reducing the losses on that little HVAC system up there. And there are many ways to do this roof deck insulation. The system on the right there is sort of like the one that's got the blown in fiberglass below roof deck.

MR. SHIRAKH: Bruce, is this vented or unvented attic?

MR. WILCOX: We're talking in an HPA, it's a vented attic.

MR. SHIRAKH: That's an important note because you can achieve ZNE level performance with vented attics, it doesn't have to be a sealed or unvented attic. And many of the strategies we're presenting here aim towards vented attics. Mike?

MR. WILCOX: No, the picture before was the system. It's probably not a vented attic, but that doesn't -- the insulation system is the same thing.

MR. HODGSON: But there's no insulation on the --

MR. SHIRAKH: Right. The difference is for vented attics there's going to be insulation in two places, one at the roof deck, and then you're probably going to have your normal R-38 or

R-30 at the ceiling. In this case, this is a sealed attic where all the insulation is located at the roof deck and nothing at the ceiling. Abhijeet, did you want to make a clarification?

MR. PANDE: Yeah, Abhijeet Pande, TRC. You are right, this particular photograph is of a sealed attic where all the insulation, the R-30, is at the roof deck, but the point is you can do the same construction technique with the vented attic by putting some insulation, R-13, below the roof deck and still have the R-38 at the ceiling, which you normally do.

MR. SHIRAKH: And with some of the builders we talked to, they were under the impression the only way you can reach the ZNE level was with the sealed attic or unvented attic, we're just making the point that that's not necessarily true, it is an option, but you can do it with vented attic, too.

MR. WILCOX: Next slide. So there are many different ways to do the roof deck insulation, which is the critical thing with this HPA proposal. You can put insulation above the roof deck using rigid boards, polyisocyanurate, polyurethane, or EPS or XPS, and that's a system

that I've had some experience with and tested and I think it works very well. There are some issues these days with fire ratings and fire testing and potentially some moisture management issues, etc., but there's lots of options there. Next slide.

This is one of the systems that I've done some testing with, which is a system that we use spray polyurethane on top of the roof deck and it's actually used to glue down the roof tiles, and it provides a level of insulation with just using the glue down system or in combination with the rigid board stock underneath the whole thing so you can get a range of R values and provide a significant impact. Next slide.

This is a new product that the manufacturer was showing to the Energy Commission last week, I think that's where these pictures came from, it's an expanded polystyrene insulation roof tile with some sort of a concrete coating so that it looks and performs like a concrete roof tile, but it's got a significant R value, so that it provide integrated insulation. I believe the manufacturers of this system may be here and may want to say something about this

later. Next slide.

MR. SHIRAKH: There will be time.

MR. WILCOX: There will be time, yes. There are also many different kinds of systems for below deck insulation and we looked at that picture of the system that's being used as the basis for the costing on this proposal, but you can use batt insulation that's suspended on wires, you can use spray foam insulation, and there are issues in all of those with costs and so forth. You can even do combination systems like the one on the picture on the lower right which has got spray foam plus fiberglass batts or some form of batt insulation combined with the spray foam. So there's lots of activities in industry guys working on how to do this in the best and lowest cost way. Next slide.

So there's also in terms of increased duct insulation one of the things about going from R-6 to R-8 is that it's not a revolutionary change, it increases the cost slightly, it offers some challenges when you've got big ducts in small attics, but it's kind of a minimal change in practice, really, and some of it seems like it's a pretty straightforward thing to do. Next

slide.

A lower duct leakage rate is also another practical approach here. All of my macho building performance friends now belong to the zero duct leakage club where you don't build duct systems that have any measurable leakage. And so this is something that, the more we get the building industry accustomed to building like that, the lower the impact of these hot attics we'll have. But I think one of the great success stories in California Energy Efficiency Standards is having gone from probably 15 years ago where the measured average duct leakage in the field in new houses was 22 percent. We've gone now to where people are routinely getting six percent, and that's really a transformational thing in terms of energy efficiency. Next slide.

And then there's the issue of raised heel extension trusses. This is, as far as I know, very uncommon in California houses, and it actually is much more common in the northern tier of the Midwest and so forth where they're worried about severe cold weather and all the issues with ice dams and things like that, that we really don't have to deal with much in California. I

know some architects in California who say that those guys don't care what their houses look like, either, so that's how they can do that. But that's definitely an option and it really does reduce the effective heat loss from the house to the outside, which in the case of that lower system on the right, the standard roof truss, you have this place where there's only three and a half inches of insulation between the ceiling and the roof deck, and where there's a truss, there's in fact solid wood all the way between the ceiling and the roof deck, so it's a pretty severe bridging circumstance and the sun shining on the outside of the roof deck right there. Next slide.

So the concept of doing compact duct system design is not a new concept and we've been talking about it for a long time. It's a relatively complicated thing to do because it requires some coordination and it requires people doing things that are -- if you do the current approach in California, which is you build the duct system in a factory and put it in a big bag and take it out, and stretch it out in the attic, if you make the ducts long, then you've got lots

of flexibility, you can just run them all over the place. If you try to really do a minimalist duct system, I think that requires a higher level of coordination and a higher level of installation effort, and what happens if the duct is six inches too short? That's a whole big problem and you don't have it if you just have very long ducts. But it clearly wins. I'm doing a research project for the Energy Commission with retrofitting older houses and we've done two of the systems that we've done we've used very aggressive duct surface minimalization techniques, and basically you can get down very close to the same performances as putting the ducts inside if you insulate them very well and make the surface area really small, and make sure they don't leak. Next slide.

All right, so these are the advantages of HPA for a vented attic, it reduces the attic temperature, it's only an incremental change to standard practice, you still have your system and your ducts, and all that stuff in the attic just the way you've been doing it all along, and as I said, no change to the duct and air handler location, and the big advantage is that the

package of measures we're talking about here will provide similar savings to what you would get if you actually physically moved that whole system into the conditioned space. Next slide.

All right, now the incremental costs for doing ducts in conditioned space. Similar to the lifecycle costs that I showed you earlier, this is for the ducts in conditioned space alternative. And I'm not going to go into all the details here, well, okay, the material costs are straightforward, you need to use more lumber, more sheetrock and so forth to make a place to put the ducts that's inside the conditioned space, and I'm going to show you some examples of how you do that. You probably need a seal combustion furnace, you probably need to build a mechanical closet inside that house someplace to put the air handler and the furnace. You need to add a HERS test to ensure that the ducts are indoors, and then the total weighted cost comes out in the 2,100 square foot prototype at about $1,100 and in the 2,700 square foot prototype at $900 for a weighted total cost of $990. And the materials cost and so forth are all shown here if you want to get into the details of that. And,

you know, nobody's costs except the Case Team's are perfect, so…. Next slide.

So this is the energy savings results if you analyze those prototype buildings. Now, compared to the 2013 Prescriptive Standards, this is the HPA package with R-13 below roof deck, R-38 at the ceiling, etc., as we described earlier, and you know, the savings vary again widely by Climate Zone, Climate Zone 15 in Palm Springs, which is the hottest by far Climate Zone in the state, has the biggest savings because this is basically a cooling measure, and so it saves in heating, but the big benefit here is in the TDV world is on peak cooling, as it gets to be in Palm Springs 115 outside and bright sun. Next slide.

So now we look at the other alternative, the ducts in conditioned space alternative. For that, we're moving the ducts scenario similar to the conditioned space and maybe the slides are a little out of order here, but anyway, next slide.

So conceptually here what we're doing is we're leaving the attic alone, leaving the roof deck alone, we're leaving the building envelope, the magenta box there, that section alone, but

we're moving all that HVAC stuff out of the attic and putting it down into the conditioned space in the house. And this conceptual drawing here actually shows one of the more successful ways to do that, one of the more straightforward ways to do that for a small simple house which is, if you have a central hallway, you fir down the hallway, put the mechanical equipment in the ducts up there, and then you distribute air from high side wall registers in each room. And it's a relatively straightforward system and it's not very expensive to do it, and it works really well for these simple little houses. Remember when we had the 1384 house, the little three-bedroom slab on grade, one-story house, works great in those houses. So if you guys want to go back to building those, this is a great system. Next slide.

And here is an example of what it looks like, this is the hallway with the ceiling dropped in the hallway, people don't notice that as much, you can have an acceptable lower ceiling there, and the ducts are in there and you're distributing air at high side wall registers in each room. Next slide.

Another alternative for the ducts in conditioned space is to use ductless systems and traditionally we've used hydronic heating systems in Climate Zones where you don't need cooling, but they're possible hydronic cooling and heating both. The big story these days is using mini-splits which you have no ducts, you essentially do the distribution from the outdoor air-conditioning units, shown on the lower right picture there, to each room in the house using refrigerant line instead of ducts. And in this simple straightforward approach, you have an air handler hanging on the wall in the room, it's basically a fan coil, but it's a special kind of fan coil, and there's a refrigerant to air heat exchanger built into the fan coil and a fan that runs, and you have a heat pump and you do heating and cooling and you have no duct losses. These systems have in theory a very high -- some of them have a very high system efficiency, you don't need to worry about HPA measures because none of this equipment is in the attic, but the observations and findings here, the current situation is that there is pretty limited design installation and maintenance experience in

California and the Commission is actually beginning to work with industry to try and develop modeling and installation verification procedures for these systems in the new buildings standards. So there is clearly some big potential here and, you know, to put this in perspective I believe that this is, these days, the most common air-conditioning system in the world, is a mini-split, because they're widely used outside of the United States. And so the question is how do they fit into our construction practices and our Energy Codes, and so forth. Next slide.

So another ducts in conditioned space option is to actually expand the conditioned space, and the one on the left there you basically build a little box into the attic and then put the ducts up there, in the HVAC system up there, and that can either be a little space or, on the right there, the spaces are bigger and more complicated. And one of the challenges for these approaches is can you actually seal up that protrusion into the attic and make it as tight as the ceiling would have been if it just went across there. And one of the traditional problem

areas with this kind of system is that you build that box, you put the stuff up there, and it turns out that when they leak, they really leak to the attic and not to the house, so that's one of the issues with implementing these systems. But it certainly can be done. Next slide.

And using a system like that, you can have a much larger furred down space for the plenum, for the mechanical systems and equipment. And it's shown here in red in the middle of the house. Next slide.

Another approach that's been used some, and people doing more advanced and aggressive systems have used a non-standard framing system for the intermediate floor and two-story house, and you can put all the systems into that space. And you don't otherwise have to make much of a change at all, so that system has definite possibilities, but it does require relatively significant change in the system because you have to go to a truss system for the floor and the floor is no longer a foot thick, it's now two and a half feet thick to get enough space in there to work with. Next slide.

And here's a system using a mechanical

closet in the middle of the house, connected to one of these fir door created spaces in the center, cut out with the attic, and that's kind of a whole system that you'd use on a slab on grade single story California house to do this kind of approach. Next slide.

So benefits. DCS vented attics. The benefits are incremental changes to standard practice, it still uses a vented attic, there's multiple buildable options, you're moving ducts out of the hot attics, you're achieving that overall goal. You can downsize the equipment if you think that way. And there's a bunch of details to be worked out, as I mentioned, the soffit, plenum floor, truss perimeters, etc. And you probably need a mechanical closet to put the furnace that used to be in the attic, you've got to put it someplace because it's not in the attic. Next slide.

All right, so if we go to a third approach here, is to do what's called, well, we don't have a very good name actually, but it's a conditioned attic, a sealed attic, unvented attic, and in that one, as is shown on the left, you expand the magenta box, the insulated

exterior of the conditioned space up to the roof deck and so that the ceiling no longer is an insulated layer. And so the result of this is that attic space becomes largely conditioned due to just being next to the big conditioned space and because the ducts and system up there leak to and from that space, and so it's sort of indirectly conditioned. And there are a bunch of systems that have been developed and are being used to achieve this. There's a relatively significant construction change in that the builder has to learn to seal up that attic ceiling corner there on the upper right and left of the house that, you know, used to be the place you put all the vents, the soffit vents in, and now you want to seal it all up and make it airtight. And it's not a trivial thing to do, necessarily, although it's certainly achievable. Next slide.

So the benefits of a conditioned attic, you get your lower attic temperature because you're no longer allowing the sun to get in there, I guess, is really -- and you're conditioning it partially, and you don't need to insulate or seal the ceiling plane anymore, so

you can save some money on the ceiling. But there are some design and construction impacts, you need to address moisture management, you need to, well, it's similar to the high performance attic, but it's more of an issue because now you have conditioned air that's right next to this attic roof deck insulation system where you potentially have winter moisture problems with cold surfaces on the roof deck. There is sealed combustion equipment issues probably because that attic is no longer ventilated, so you have to have a way of getting combustion air and dealing with all of those issues.

The insulated envelope area of the house increases by some, you know, not insignificant amount, 10 or 20 percent because you're moving the insulated area up and you're putting it on the roof deck instead of the ceiling. And for the California Standards, an interesting and complicated interactive issue here is that you can't put a normal whole house fan in a sealed attic because the whole house fan, normal ones that we started requiring in the 2013 Standards, the old-fashioned whole house fan is installed in the ceiling and blows air from the house to the

attic, and that just goes out through the vents, right? So it's an easy way to make that system work. Well, the sealed attic is sealed, so it doesn't work. And we're going to look at some energy impacts here in a little bit, and that actually turns out to be one of the big issues for the comparative performance areas, that unless you come up with a different way of doing cooling ventilation, that's a big negative. Everyone who wants to do these should be hiring Dave Springer to put in a Night Breeze system.

So observations here are: done correctly, attic temperatures are within a few degrees of directly conditioned space; and there are no documented moisture issues in California. That's not my observation, I don't know enough to say that, myself. Next slide.

And here is one that is one of my own personal issues that I've been paying attention to for a long time, which affects the conditioned attic case maybe more than anything else, which is that a little known characteristic of insulation is that almost every insulation, the conductivity varies with temperature. And traditionally we have ignored this and we

typically use the insulation conductivity at the rated temperature, which for most insulations is 70 degrees Fahrenheit, which is normal room temperature. And we just ignore the fact that when the insulation is colder, it has a higher R value and works better, and when it's hotter, it has a lower R value and works worse. And what's plotted on here is the impact of temperature on conductivity of a variety of materials. The one at the top is -- I can't read it here -- I think it's sheetrock, yeah, drywall, so it doesn't affect it very much. The purple one in the middle is wood framing and it actually is, you know, a pretty significant change, and then down at the bottom we have insulation materials and that's a pretty significant effect if you look at the range of temperatures if you're talking about roof deck insulation in a sealed attic, or even in a vented attic, that the mean temperature of that roof deck insulation will certainly get up close to 140 degrees, which is what the upper right-hand end is there.

And this is a factor that I personally got involved with because Art Rosenfeld, when we were working on cool roof stuff maybe three Code

cycles ago made a big speech about how we couldn't assume that this roof deck insulation stuff was going to work the way we thought without including this effect. And so we've been doing it in the attic modeling since and we're not using these factors in the new CBECC software, so that's behind all these analyses, includes this effect. Next slide.

Okay, so here is the HPA cost-effectiveness. This is now lifecycle cost-effectiveness, which includes the first cost and the energy savings, the value of the energy savings, and it's for the 16 Climate Zones down the left side, the first column is the cost savings for TDV energy savings, less other cost savings, and the second column is the total incremental cost, and the third column is the net of those, and then you have a benefit to cost ratio on the right. So the ones that are in red, the numbers that are change in lifecycle cost that are in red, that means the lifecycle costs to the homeowner was reduced, that means it's cost-effective. So this R-13 below roof deck HPA package that's being proposed here is cost-effective in Zones where the red numbers appear,

and you can see, again, there's a wide range of cost-effectiveness. The benefit to cost ratio in Climate Zone 15 is close to eight, and the benefit to cost ratio is negative in the mild climate zones on the coast. The costs are quite similar, but the savings are wildly different, is what causes that. Next slide.

So one of the things we wanted to do here was to lay out how does this proposal compare to other options and this isn't a very precise analysis at this point, and we'll improve this as we go along, but just to sort of demonstrate where we are here, we've looked at three cases, one is the proposed prescriptive HPA case with R-13 insulation below deck and no radiant barrier, and that's Case 1 in the second column. And we're showing here the results for all the climates where we're proposing to require this in the Prescriptive Standards, so all the ones that were cost-effective for the HPA case. And then Case 2 is a similar high performance attic, except it's using R-6 insulation above the roof deck under the title instead of the fiberglass below deck. And then the third case here is a sealed attic using the prescriptive insulation

levels below deck with no radiant barrier, no wall pull out span, and ducts in the attic. And, you know, on a sort of weighted average across those zones where we're proposing this, you know, they're similar, 10 percent, nine percent, nine percent savings. Here we're looking at the savings compared to the 2013 Standard, the current Standards. So we're talking about round number as 10 percent overall TDV savings.

But you can see that the differences on a Climate Zone by Climate Zone basis are pretty significant and in Case 3, the sealed attic case, it looks not so great in places like Sacramento where we are, where it gets seven percent, where the other two get 12 percent savings. And really, that savings has to do with the whole house fan more than anything else, I think. But otherwise, for most climates, or from any Climate Zones, you know, things are comparable, the sealed attics work pretty good in Climate Zone 15 where there's no whole house fan requirements and things are really hot, so there's lots of options here in terms of tradeoffs. Mike.

MR. SHIRAKH: Could you come -- so the question is how come in Climate Zone 8 it's an

outlier where the sealed attic is not saving any energy, but the other vented attics are up to around 13 percent?

MR. WILCOX: We would have to look at that, Mike. I don't exactly know what the explanation is.

MR. STARK: Would it help if I went back to the Climate Zone map?

MR. SHIRAKH: No, we know where the Climate Zone is, it's just --

MR. WILCOX: Climate Zone 8 is the coast of Southern California.

MR. SHIRAKH: Yeah, I'm surprised that the sealed attic doesn't save any energy, but the vented attic does. We have to look into that.

MR. WILCOX: Yeah, we'll look into that.

MR. HODGSON: Especially the sealed attic.

MR. WILCOX: The sealed attic, the assumption here is that the prescriptive ceiling insulation gets moved up to the roof deck. That's just, you know, it's not necessarily a perfect assumption, but that's what was done. Okay, I don't want to dwell on this because we're not claiming that this is a definitive comparison

of which of these measures is better or worse, it's kind of like where are they related to each other. Next slide.

Okay, that's it. Oh, wait a minute, go to the last slide, actually. Both these presentations have the address for where you send your comments.

MR. SHIRAKH: Again, comments to the Docket by August 18th. This is the instruction.

So moving to the comments, similar to the wall situation, there are manufacturers out there who are thinking about this and they are innovating, and I think one of them, or two of them are in the room, so I was going to ask, do you want to make any comments about your product?

MR. PENNER: I'm Lawrence Penner, I'm with Green Hybrid Roofing. As I've listened to this presentation, there were some thoughts that I would like to just touch basis and also talk a little bit about the product. I'm really thinking that we need to really consider, in conjunction with our R value, we need to really look at the solar heat gain coefficient as another option to meet the requirements for Title 24, in the reducing of the energy being brought

into the attic, so that's one thing, really stressing the reduction of heat transfer, the thermal insulation value. This way we've stopped the energy from even getting into the attic to have any effect upon the duct work, or anything like that. And so I think that's another thing that we ought to consider, the Commission ought to consider as an option to see if a builder is going to qualify for that prescriptive requirement.

Also another thing you haven't touched on very much when it comes to the roof is the U-factor. I know there are some cold areas in California and the U-factor might be something we need to look at as another qualification for the roof structure and to reduce the amount of energy that's escaping during the cold time to keep the cold out, so these are some things that I think would be beneficial and also provide for other options on how to meet the requirement. One of the things that I also see is that, when you start adding insulation to the bottom of the roof deck, you also are now hiding the potential of trouble shooting leaks and problems that happen on the roof. When you put the insulation on top

of the deck, now you're going to raise -- the fascia board is going to have to be bigger now because you're going to have to raise it to cover any insulation that raises up before you start putting the roof on top of the roof, the deck. So these are some things to consider. Obviously, Green Hybrid Roofing has a project that looks like tile, it installs like tile, it's conventional installation so nothing changes, and obviously you've seen this already, but anybody could hold it or touch it. And what we have found with this particular product is that it carries a high thermal insulation value and it stops the penetration of heat coming into the roof plenum, if you want to call it, whatever. Some of the testing, we have done some studies against concrete tile, and when you put 140 degrees onto the face of this tile, only 11 degrees penetrates it. If you take concrete tile 47 degrees, it penetrates it. You can see that's a wide difference of the amount of energy that's going into the attic. All the studies that we have done in the field and just recently, we've just had a report come back from Los Angeles, when the temperature was 85 degrees on a comp

roof, the attic temperature was gunned in at 130 degrees Fahrenheit. Our roof, it was 78 degrees in the attic. So we're finding that at least 50, 60 plus degrees difference in the attic temperature just by stopping the energy before it even goes through the roof deck, and removing it and getting it into the attic. So this particular product, again, as some of you are touching it and feeling it, you'll find out it is extremely light weight. Most of the roofs that we have put on have all been retrofit, so you can see it weighs from 3.8 to 5.8 pounds per square foot, so there's no need for reengineering in the installation, it installs just like regular tile, and if somebody wants, I know the people on the phone won't get to see it, you can stand on it and it won't break. And so, anyway, I just think we ought to consider some additional things added besides R-value, and a better way of applying product to the roof that gives the conventional installation, the conventional look of a concrete tile, and plus it is extremely light weight and it reduces the energy that has gone into the plenum of the attic.

MR. SHIRAKH: Thank you. So you talked

about the weight, a third of the weight of --

MR. PENNER: Of a heavy weight concrete tile, correct.

MR. SHIRAKH: How does that impact the installation time and --

MR. PENNER: Well, it speeds up the install time almost 50 percent because -- and plus we have fewer pieces to put down, so most concrete tile is around 88 pieces per square, ours is 63. So your installation time is -- you almost cut your installation time in half.

MR. SHIRAKH: So you think it's fair to say, then, the labor –

MR. PENNER: Obviously the labor is going to be reduced. Now, another thing I wanted to touch on that, most of the figuring we have done have all been retrofit, not new construction, so we've been dealing with a lot of residential recover-type roofs.

MR. SHIRAKH: Has this product been fire rated?

MR. PENNER: Yes, it's a Class AE 108.

MR. SHIRAKH: And what kind of testing have you done to ascertain the U-factor, the R-value?

MR. PENNER: We've done the C 1363 and we've done the NFRC 201 for the thermal insulation value and the solar heat gain.

MR. SHIRAKH: And are you going to be going through the Bureau of Home Furnishing –

MR. PENNER: Yes, I talked to Steve Fisher this week, we're going to be applying that and finishing that application up this week and we'll be with the Home Bureau of Furnishings.

MR. SHIRAKH: And let's say 2017 rolls around and 10-20 percent of the builders want to use their product, are they going to be in any shape to meet that?

MR. PENNER: No, we wouldn't, we've already -- we can gear our production and double our production within three to four months, it's just a matter of -- the answer is yes, that's a better way of saying that.

MR. SHIRAKH: Yeah, saying yes is better than starting by saying no.

MR. PENNER: There you go, a three letter word.

MR. SHIRAKH: And so what would your overall cost of this system be, including labor and all that?

MR. PENNER: For the 2017, right now, again, all our figuring has been done against residential recover, not in production. So if I was to take light weight concrete in 2017 to meet your requirements that you're proposing, on a 35 square house, we would be a thousand dollars cheaper to install it than light weight concrete. That's on a residential retrofit. Okay? As far as new construction is concerned, we're about 20-30 percent higher at this particular time, however, when we get into full production we'll be able to bring that down within 10 percent of the current install price of a concrete tile.

MR. SHIRAKH: Okay. You need to come up to the podium.

MR. PENNINGTON: This is Bill Pennington. So you said a substantial reduction in labor costs --

MR. STARK: Please speak into the microphone. We are recording.

MR. PENNINGTON: I'll try it again. So you said significant reduction in labor cost. Could you talk about that? Why would this reduce labor cost?

MR. PENNER: Several things. First of

all, as I mentioned a little bit earlier, the installed amount of pieces that you put down to cover 100 square feet is cut down about a third of what is currently, so that speeds up your production because the tile is made a little bit larger than standard concrete tile. The other thing is you don't have to stack the tile and work above yourself, and when you're roofing, I can't explain it, you're actually roofing above your work so you don't break the tile. This, you can walk on so you can work below.

MR. PENNINGTON: So this does not break when you walk on it?

MR. PENNER: That's correct.

MR. PENNINGTON: So you can walk on it and you don't have to be ginger with it?

MR. PENNER: That's right, and you can stack it almost like a composition roof rather than a tile roof, so the material is readily available to you, and you just lay it up.

MR. PENNINGTON: Yes. And does the weight have any effect on like transportation costs or anything like that?

MR. PENNER: Yes, that is true. You can ship twice as much material per truckload with

this because of the weight factor, therefore you're cutting down on the carbon emissions that are going into and you're helping the environment by shipping more for less, shipping more compared to standard.

MR. PENNINGTON: Compared to standard concrete tile.

MR. SHIRAKH: So we are having a lot of side conversations and we're not capturing it for the record.

MR. PENNINGTON: So what about warranty? What's your warranty like?

MR. PENNER: We carry a lifetime warranty on the product, transferrable one time. The reason we can do that, first of all, the oldest roofs we have installed are from 2006 currently, we are now just actually entering into production as far as going into the market wholesale. You've got to understand this product, the way it is manufactured, if you take a look at it you'll see that it is very comparable to a NIFA system, and all the pop-outs that you have on your homes and on the Las Vegas casinos and everything that's been on there 30-40 years, okay, now that is similar in nature of how this is constructed,

however, we wrap this product, this foam with a non-alkali fiberglass mesh which they don't do on conventional pop-outs and stuff like that, and plus our polymer concrete mix is totally different than what is used up there, it's much more durable and much harder, so we're very confident in the longevity of this product.

MR. PENNINGTON: And is that like a prorated warranty where you're --

MR. PENNER: At this time, it is not prorated.

MR. PENNINGTON: It's 100 percent?

MR. PENNER: Uh-huh.

MR. PENNINGTON: So one other question, so do you know what the reflectance is of your product?

MR. PENNER: Currently the best reflectant we have is 34 percent. Most of our colors are not extremely light because people like darker colors, but there's no problem with this designing a 40 percent or better reflectant color for this tile.

MR. PENNINGTON: Thanks.

MR. MIKE: It's Mike at CalCERTS. I just wanted to know about -- you were talking about

the warranty, and so I want to know if the concrete is through color. There was a real effervescence problem with concrete title.

MR. PENNER: I may have to defer this a little bit. First of all, it is color through, we do put an additive in there to reduce the effervescence of any sort, and so effervescence has not been an issue in the field at this time and plus the thickness of the concrete, as you can see, it's very durable and stuff, so it really cuts back on the effervescence.

MR. SHIRAKH: Okay, well thank you. It's good to see that manufacturers are innovating. I appreciate your presentation. Any other comments from people in the room?

MR. NESBITT: George Nesbitt, HERS Rater. Bruce, I'm paying to be here today. No one pays me well enough to do what Ken does and go out and buy multiple computers and slit the calculations between them and reassemble it, and I wouldn't even know how the hell to do that. I mean, obviously putting cold or hot ducts in hot and cold places is stupid, but I'm wondering to what extent, we currently have a radiant barrier requirement in Zone 2 through 15 and a cool roof

requirement in Zone 10 through 15 prescriptive, which do reduce attic temperatures. And I'm wondering to what extent you've looked at HPA in the sense of attic temperatures and different strategies because that's what you're talking about is a reduction in attic temperature. And you mentioned deeply buried ducts, which is another potential method for improving, although one problem is you do have to do QII and they say your insulation has to be the same depth, which is stupid, I mean, ideally we could build structures to bury ducts around the ducts and not everywhere because of other problems. And I just want to sort of illustrate kind of, in following up on the roofing a little bit, my own house I painted my roof and my attic temperature went from 135 degrees, I don't know on what kind of day, to not breaking 100 degrees on a day it was 95 degrees in the shade in Oakland. Now, Rick Chitwood didn't believe me when I said it made my house more comfortable or reduced the cooling load, and suggested I put a black tarp on it, which I wasn't going to do because that's what I started with was a black tarp on my roof, tar and gravel roof, you know, just by painting it white,

so highly reflective roof can drastically reduce attic temperature. I mean, I've worked in some attics that had radiant barriers and definitely they're more comfortable than one without. So I guess that's sort of one question in that sense of strategies of reducing attic temperature if the ducts are there.

MR. WILCOX: Yeah. Well, I've had experience with experimental projects doing these insulated roof tech systems, and where we achieved a case where the attic temperature never goes above the outdoor temperature, I think that's kind of the limiting case because if it's a ventilated attic you really can't keep it much cooler than the outdoor temperature and still have the ventilation operating. So I think as sort of an ultimate goal, that that's what you're going to achieve with an HVA case is, when it's 95 outside, it's 95 in the attic and no hotter.

MR. NESBITT: Right. So, I mean, potentially cool roof, highly reflective roof could be better?

MR. WILCOX: Well, it's hard to imagine being much better because, again, if you're ventilating the attic and it's pretty hard to

keep the attic full of cold air when it's hot outside.

MR. NESBITT: Yeah, well, my attic was also poorly ventilated, so that probably helped. So I guess, I think the thought is that the HPA and the DCS would be part of the same package and it would be either/or?

MR. WILCOX: Well, that's the proposal here, is that you either do HPA or you get the ducts out of the attic, one or the other.

MR. NESBITT: And when we get to the performance path which becomes the basis for the standard design --

MR. WILCOX: We haven't specified that in detail, but I assume it would be the HPA case.

MR. NESBITT: Okay.

MR. WILCOX: It could be either one.

MR. NESBITT: Okay. I think sealed combustion furnaces would not necessarily be -- they would be best if you had a furnace in a conditioned space going to the -- there is no, I don't think there is -- we shouldn't call them unvented attics, for sure. They're no longer attics if it's conditioned space, maybe we should just call it conditioned space.

MR. WILCOX: Well, it really isn't conditioned space.

MR. NESBITT: It's like a large drop soffit.

MR. WILCOX: That isn't conditioned space either because, you know, I remember when John Liebert put in the Standards that if you wanted to have a conditioned attic, you had to have registers up there, so it was conditioned.

MR. NESBITT: Well, Joe Stiebert wrote something about that recently on humidity control and whether you do purposely in duct leakage, but the – what is my point now --

MR. SHIRAKH: George, can you just ask the question?

MR. NESBITT: Yeah. Well, I was just saying power vented furnace is probably an option because you have a large enough volume plus if you have enough leaks to the rest of the house, you have the volume of air for combustion air. So I don't see that a sealed combustion furnace is absolutely required. Going to duct leakage just to the outside is something I'm not too hot on, I really prefer to keep my duct test simple, just get it tight, if the ducts are in

conditioned space we can pretty much, well, hopefully assume that it's also the inside and not outside, it just makes it a lot more complicated having to drag a blower door and a duct blaster at the same time, especially when we get to production. I did 24 blower door tests on Thursday.

MR. WILCOX: Yeah, the criteria is that CFM 25, less than 25. Then you're okay.

MR. NESBITT: Or less than six percent.

MR. WILCOX: No, if you want to be ducts in conditioned space, it's got to be less than 25 total. That's what the Standard says right now. So you might want to propose to change that, George.

MR. NESBITT: I certainly would, well, I thought we had the option to do either/or in 2008. We did?

MR. WILCOX: Not if you want to claim ducts in conditioned space. Six percent is the criteria for the ducts in the attic.

MR. NESBITT: Okay. Well, I've always understood it to be either/or, and I would prefer to have the option. It's just a lot simpler and I think if they are in conditioned space, I mean,

the truth is, and this is a problem when we get to whole house ratings, the whole duct leakage to the outside, well, most of the ducts are outside, so most of the leakage would be the outside whereas if they're inside, anyway. So one of the -- for ducts in conditioned space was to go to ductless. Under 2008 Energy Code, a ductless mini-split was a penalty. And my understanding is, under 2013, it's essentially a penalty, too. And I think in the case report it seemed to say that something like a ductless system would only get credit for minimum efficiency. And this doesn't make sense to me because we certainly give radiant floors a large credit. Consider that most heated radiant floors still don't have slab insulation because people don't want to put it and termites and all that, we have wall furnaces that get credit, although --

MR. SHIRAKH: We're well aware of this issue and Martha Brook is working with the ductless system manufacturers, we're trying to work with them to come up with a proper credit under 2016 Standards. And we know that and we're working on it.

MR. NESBITT: Because it's a severe

disadvantage. On the one hand you're saying get ducts out of attic, and then we don't give you credit if you're going to a ductless system.

MR. SHIRAKH: Thank you. Reed.

MR. HITCHCOCK: Reed Hitchcock, Asphalt Roofing Manufacturers Association. Just a couple things. I'm encouraged and, Bruce, thank you for the presentation, I'm encouraged with the consideration of the numerous items that are in the 2013 as performance alternatives and the consideration of that looking at the Prescriptive. As you know, we commented recently on the deck insulation and some concerns around that and, first off, the gentleman with the fabulous concrete tile, I think I'm going to buy some. The concerns he raised, both on the underside insulation in terms of spotting leakage from the roof system, what have you, that's a real concern, as is the additional work that has to be done if you're installing above the deck. On top of that, with asphalt shingles, just given the nature of the product, you do have a potential premature degradation issue, basically cooking the shingles at the deck, and that's something that we don't have as much research on

as we'd like to, but I think it's something that we do need to consider as we're looking at different ways to comply and to achieve the energy goals. That's all.

MR. SHIRAKH: Thank you.

MR. WALL: Andy Wall, AC Home Performance. I want to support the lower duct leakage rate. I would like to see it lower than what you're asking, but I would like to support that. The higher duct R value, or getting it all inside, very very important. The air handlers, again, I support that coming inside the building. I've done enough thermography on those units when they've been running and they're pretty disastrous when they're in the attic. And I'm kind of wondering, I haven't seen this, but if there's some study that really shows what the real duct leakage is compared to the six percent at 25 Pascals because most duct systems run higher than 25, so when we do a six percent it's actually way understating what they likely are. Buried ducts, I teach home performance and I get some of my contractors in classes that tell me that their local jurisdictions will not allow buried ducts, so I would like to propose that the

CEC send a letter out to the jurisdictions that says that is a credit, apparently, for bringing those inside or reduced leakage, that they should be able to do that.

MR. BOZORGCHAMI: What is the reason for?

MR. WALL: The reasoning that I heard is because when someone crawls around the attic later on, they don't know where they are and they'll step on them. So, I don't know, I can see that, but I also see the severe reduction in AC load and heating load by burying them. And George's comment on the duct leakage outside, I think all houses should have a blower door test anyway, so they're going to have a blower door and a duct tester there anyway, so it takes about two more minutes to do that test, if that.

The Right 4 Club for those that don't know about it, is to load a measure at Ring 3, which is less than 10 CFM, we have some companies that actually exceed that on every duct job they've ever done -- up in Redding -- and then there's a Ring 5 club coming, which will be to load a measure at Ring 4, which is less than 2.4 CFM, and the Europeans have actually pushed that much much further than that, it's less than .25

CFM, I think, on the system. I could be wrong with that number, but it's less than one. And again, I thank you for your time. Oh, I wanted to ask, the R-13 in the attic on the roof deck, is it R-13 for anybody's product? And the reason I ask is because I have R-6.5 on my roof deck and my attic, my vented attic, follows outside ambient no more than two degrees higher, about a two or three time lag from it. But that's a complete sheet on top of the roof deck.

MR. SHIRAKH: So the R-13 is for below roof deck, equivalent for above deck is roughly around R-6.

MR. WALL: Okay, cool. Thank you very much.

MR. SHIRAKH: Bob.

MR. RAYMER: Thank you, Mazi. Bob Raymer with California Building Industry Association. A couple points, just to sort of update you on an issue that was raised at the May 21st workshop regarding the Department of Toxic Substances Control and their proceeding on safer consumer products, namely the three initial priority products that were part of their proceeding and will be for the next year or so. One of those

products was spray foam insulation with Unreacted Diisocyanates. On a positive note, and with a whole lot of pleading from industry, they have now made it clear on their website that they will only be looking at the application of the product in essence from a worker safety standpoint and/or the do it yourself, or maybe using some of these products. They will not be looking at it from an installed product standpoint. You can go to their website, unfortunately it's sort of buried, you have to click into the Safer Consumer Product and then you have to click in to their Question and Answer page. They've added a point on the second page of their Question and Answer, but they make it very clear, they are not the least bit interested in the installed product, they're looking at it from the application standpoint.

Another point that I'd like to raise, I think we discussed this in the past, and that is the assumptions that are being used for the cost-effectiveness analysis, namely the weighted assumption that you've got 45 percent that is one-story and 55 percent that's two-story. We have done a rather large amount of review over the last, I would say, five to 10 years and I

would say 15 years ago, 45 percent would be a very safe figure for single-story construction in the single-family market. I don't think it is all that way anymore. I think it is probably as low as 20 percent, but it would be very safe to do a 25 percent, and from your High Performance Attic, that would help your cost-effective analysis when you do the weighted standpoint. Furthermore, this figure is probably going to drop from the 25 percent largely because of the larger infill projects that are now being planned, we're going to see a very distinct emergence of three-story single-family construction with six-foot separations. All of these homes, the State of California has required sprinklers in all of these homes now and under the rules of the IRC and the CRC as adopted by ECD and the Fire Marshal, we can now move to a six-foot separation from one home to the site of the adjacent home, you can have a zero lawn line, six feet away you can have the next home. And that gives rise to, of course, very high density, two- and three-story construction, particularly in infill projects. There are a number of these in the Bay Area where the first floor is

effectively the garage and a family room, maybe a half bath, and then you've got stairway up to everything else that's located, you know, the kitchen and living room on the second floor, and maybe one or two bedrooms, and then the bedrooms and bathrooms on the third floor. And that's becoming very common, so I'm hoping that, 1) the modeling programs for 2017 can handle the three-story single-family separation homes.

Let's see, also we're hoping that this product that was demonstrated here earlier, I don't need an answer now from Ken, he doesn't mind getting up and talking about this, but we'd like to know, can it be modeled now and will it be able to be modeled for the 2017 Regs?

MR. SHIRAKH: So what we're going to do is --

MR. RAYMER: Are you saying yes, it would be good to have it modeled, or yes, it can be modeled?

MR. SHIRAKH: It can be modeled and we have modeled some, and another thing that Dave told us today, they can actually change the product if we come up with like a different R value or a different reflectance, they can

probably accommodate. So we will be working with them and we'll share the results with you.

MR. RAYMER: One of the things I find attractive about this and also the product that was discussed during the Advanced Wall System, was the fact that, 1) you can walk on this, and so there's a labor, a benefit there that provides a level of simplicity that maybe you wouldn't have to go through some significant amount of design change to incorporate this and get us to that Point B that we want to get to. So even though it may cost a little bit more, there is a benefit in design standards. And to the extent, once again, we try with what you're doing, give us as many compliance options as possible to get to Point B that would be great. So thank you.

MR. SHIRAKH: Thank you. Please go ahead.

MR. KIZITSKY: Tom Kizitsky with APA, the Engineered Wood Association. I just had a quick question looking for some clarification on the use that above deck continuous insulation for a High Performance Attic. This morning one of the slides showed that it was an R-6 continuous insulation, or thereabouts, with radiant barrier?

So it would be tied to that? Okay. And then just another question regarding radiant barrier, and I believe Bruce, you just mentioned that there was the goal would be something to tie an attic temperature to outside air, and that would be kind of the target that you'd be shooting for? Best case scenario?

MR. WILCOX: I think that's kind of an upper limit to what you can expect to get. But, you know, I'm not sure that it's practical to shoot for that as a goal.

MR. KIZITSKY: Would radiant barrier by itself with a cool roof potentially get you to that point?

MR. WILCOX: Well, you can get there with a cool roof all by itself, so a combination with radiant barrier and cool roof would probably do that.

MR. SHIRAKH: But then you're talking about like a .55 reflectance or higher, which is essentially white roofs, and most builders and homeowners don't like white roofs.

MR. KIZITSKY: Okay, thanks.

MR. SHIRAKH: Unless Mike disagrees with me.

MR. BOZORGCHAMI: You can do a lower R value with a higher solar reflectance, also.

MR. WILCOX: There's a tradeoff.

MR. BOZORGCHAMI: Yeah, there would be a tradeoff.

MR. SNOWDER: Thank you. I know it's running late and I'll try to be brief. Again, Charlie Snowder talking about reflective insulations, and the thing I just want to bring in front of the Committee for the California Energy Commission to consider again is that, in our goal, in our zest to create energy performance outcomes, we're looking at all the R values and all the increased values there, but it seems to me that if we're truly looking at cutting energy usage, adding temperatures to reduce usage on air-conditioners and to reduce temperatures in conditioned air spaces, that there are other approaches to get it like this new roof system that was just brought out. So a reflective insulation, right now currently just laid on a roof system can generate up to an R-6, and we're consistently cutting 30 plus degrees from a roof system to the underside of plywood. So my question is, as we set our criteria and we

look at what we're looking for that new performance value to be, it seems to me there needs to be an offset, a performance value that can be set. So are we looking at 15 degrees out of a dead air space, 30 degrees out of a dead air space, 20 degrees off conditioned air space? Because reflective insulations create different values that can excel more than what you get out of a regular insulation, and so it's apples and oranges trying to compare it to R values.

MR. SHIRAKH: Well, the way at least I've been doing it, using the CBECC-Res -- I detect a 2013 Standards Building?

MR. SNOWDER: Uh-huh.

MR. SHIRAKH: Then I move all the duct system and the air handler system into the conditioned space, and then you get some BTU per square foot per year. So that's my benchmark now. And then I go back and put the ducts into the unvented or vented attic, and then I add insulation above the roof deck or below the roof deck until I get the same performance out of it. And then any other alternative would have to follow the same. So if you use your product, again, I know what my benchmark is, it's ducts in

conditioned space and the EOI that comes out of CBECC-Res, and if I can get the same performance using your product, so be it. If it's cost-effective, they're going to use it.

MR. SNOWDER: So as long as it meets the performance outcome --

MR. SHIRAKH: Exactly.

MR. SNOWDER: -- is the criteria of it.

MR. SHIRAKH: Right.

MR. SNOWDER: All right, that's what I just wanted to ask. Thank you.

MR. SHIRAKH: Go ahead, sir.

MR. TALBOT: Gary Talbot, 5 Star Performance Insulation. I had a quick question on the vented attics and, Bruce, this would be directed to you. In order to comply with that option, you have to have R-13 to the underside of the roof deck? Is that correct?

MR. WILCOX: Yes, basically.

MR. TALBOT: Okay, well, then my next question would be --

MR. WILCOX: There may be an alternate for above deck insulation --

MR. TALBOT: Okay, above deck, too.

MR. WILCOX: But the basic system is R-13

fibrous insulation below the deck.

MR. TALBOT: Okay. Well, according to one of the diagrams or illustrations that you presented this afternoon, you did make reference to the fact that all insulations at different temperatures operate differently. So how can we really effectively have this system when we don't call out a specific requirement that an R-13 really is an R-13 at 100 degrees or at freezing?

MR. WILCOX: I think the assumption here is that R-13 -- that it's rated R-13, and the assumption in the current CBECC is the insulation is all basically fiberglass in terms of its temperature --

MR. TALBOT: Okay, so we're not really addressing a performance issue, we're just basically a stated R value, then?

MR. WILCOX: Well, I think the pragmatic thing at the moment is to do it that way because what we know is rated R values and I think what's important from my point of view is to account for the impact to that temperature variation so that you're making the right tradeoffs between different systems.

MR. TALBOT: Okay. Also in these

calculations, when we're doing a netting system up against the roof deck, all right, we have a lot of areas that aren't going to be insulated. Say, for instance, a top chord of a manufactured truss is typically a 2 X 6, or 2 X 4, and we're hanging netting off of these members up there, so we've got, again, we've got these every 24 inches on center, we've got a 2 X 4.

MR. WILCOX: That's what the program, you know, the program is modeling it that way with the parallel path with those two areas.

MR. TALBOT: Okay. I do know in the past that there were a lot of houses done this way and, for instance, in Las Vegas.

MR. WILCOX: I've heard that, too.

MR. TALBOT: Okay, all right. I've been there, seen that. And another thing that we haven't addressed in all these new updates on these new 2016 is air infiltration and how that really affects the R value on these products. So my concern is that we're not taking this major influence on how insulation really works by not addressing air infiltration. I mean, I use an old example that was taught to me by somebody that is older than me, actually, and they came up

and we were talking about some temperatures and one time I was in Chicago, it was in the middle of winter, and they brought up the weather man was saying, well, today it's going to be sunny and 25 degrees, but guess what? With the wind blowing at about 15 miles an hour, it's going to feel like about -2. So I'll leave this with this question: when you walk outside, is it 25 degrees or is it -2? Thank you.

MR. SHIRAKH: Well, never experienced -2 in Sacramento, so….

MR. WILCOX: I use the stay inside on those days.

MR. SHIRAKH: Stay home inside and watch football. Any other comments inside the room? Anyone --

MR. SNOWDER: One quick one.

MR. SHIRAKH: Go ahead, please.

MR. SNOWDER: A really good point that relates right back to reflective insulation, and that is while I was sitting at lunch I read a report regarding ASHRAE 90.1, and it talked about the reduction of R value when it comes to thermal bridging. And so we could lose 35 to 76 percent of R value by bridging, by energy bridging down

through the joist members, or the trusses, or the wood studs coming into the house. And so if you base everything in our new calculations off R value, it's truly not true R because, as we --

MR. SHIRAKH: We actually captured that and if you noticed when we say it's below deck it's R-13, if it's above deck it's R-6, it is capturing that effect because when you have below deck, you have the thermal bridging because the framing members are there. When we run our CBECC models, it's actually sophisticated enough it captures all those effects.

MR. SNOWDER: And so is that -- and maybe I'm using the wrong terminology -- so when you're talking about Delta Ts coming into that thermal mass, that's the down Delta T or the upper Delta T that you're basing your R value off of in mass insulation? Because R value in mass insulation is R-13, it doesn't say on the back if you crush it into a tiny corner, it's nothing, or if it's wet, or it's dirty, or dusty, or it's sagged, and there's no R like when you do a netting, if you blow netting in insulation and it's not done correctly, in five years it slides 60 percent or 20 percent down the shaft, how much R value do

you have where it's exposed? So just talking about R value doesn't truly give, at least from me looking at it, the ability to say, "I can equate equal to that" because R value on a piece of mass insulation, R-13 is R-13 no matter where you stuff it. Different R values, for instance, reflective insulations, can vary 20 R depending on where it's installed in the project. So it seems to me if we're going to allow the ability to have differentials, or different choices of products and applications, we somehow have to be able to correlate reflective values to R values and find out what they're compatible equalities are because it may be an R-19 is equated to a 3/16 inch piece of material if the performance outcome is the same. And I think that's the hard part I'm having, is if we had a performance outcome and you said if you can lower the temperature in a non-conditioned air space by 30 degrees, 10 degrees, 20 degrees, you're there. Lower the temperature in a house by 15 degrees, we can calculate the energy savings on the air-conditioner pretty easily in either one of those performances. But the way I'm reading everything, we're increasing R value, but I don't

see any way to take these other alternatives and create a comparable system other than being able to run it through the performance package.

MR. SHIRAKH: Well, the way we've come with these alternatives is basically we use that performance software and we ran a series of simulations in different climate zones, and we looked at the total savings like Bruce showed earlier and you say, okay, well, this system like below deck with R-13 performs equally as well compared to ducts in conditioned space. And, you know, for above deck insulation, we ran another series of methods and the model can capture the framing effects and thermal bridging and all of that, and then we said, okay, for above deck, then it's R-16. That gives us three different scenarios in there. We can do the same thing for your product, if it goes above deck, you know, we can look at the stated R value, but whatever it's verified, confirmed --

MR. SNOWDER: No, no, I'm not just talking about --

MR. SHIRAKH: -- reflectance.

MR. SNOWDER: -- my product, I'm talking about reflective insulation because I think

whenever we talk about anything, it should be the whole sum of the package.

MR. SHIRAKH: We are, we have to use the tools that we have and we think what we have is a very robust tool that we've been working on it for years and we have pretty good simulation results, so I don't know, Bruce, do you want to add something to that?

MR. WILCOX: I think you are underestimating the effort that we've already been putting into --

MR. SNOWDER: Oh, absolutely not.

MR. WILCOX: -- the insulation quality and --

MR. SNOWDER: I'm just asking because looking into it and trying to read into it, read into what you've done, I haven't been able to find that data. That's what I was trying to understand, how far you've taken it backwards, so, thank you.

MR. SHIRAKH: Thank you. Any other questions in the room? Sir? Do we have any online?

MR. STARK: Yes, we have one person with their hand raised.

MR. SHIRAKH: Go ahead, please.

MR. STARK: We'll wait until the comments in the room are --

MR. GRAHAM: Yeah, my name is Ken Graham and I'm with Green Hybrid Roofing, and there was a couple items that, when you were asking the benefits of the product, in addition to the thermal reduction in heat in the attic space, there is a safety issue because the people are handling less than 50 percent if they were using conventional tile, and the fact that they're able to work below the roof line that they're putting on instead of above, this reduces the chances of State Comp injuries because the people naturally, when you're working with your head downhill, that's a problem. The second one is less fatigue for the workers, so that they're not in a state of shock at the end of an eight-hour day. And third, and one of the biggest things, is on our product we've experienced less than a two percent loss during the installation, as opposed to 10-15 percent with conventional tile. So those are a couple more things that we need to give thought for.

MR. SHIRAKH: Thank you, I can appreciate

the tile that weighs a lot less is going to be easier on the workers. That's a valid point. Any other comments from within the room? Why don't we go to --?

MR. STARK: All right, this is Steve Strawn. Steve, you are now live.

MR. STRAWN: Thank you. My name is Steve Strawn and I'm with JELD-WEN Windows and Doors. I just wanted to remind the Committee of some discussion we had back in May as we look at adding continuous insulation to the walls and how that will affect the installation of windows and doors. Certainly as an industry we're not opposed to the continuous insulation, recognizing that it will increase the cost of installing windows, but likely offset by better overall thermal performance. But the points that should be considered, strongly considered, are ensuring that there's adequate structural support of these products. Some of the paths that we've seen showed just installing or nailing over the foam sheathing that will not likely support some of the heavier products. We also want to make sure that there's strong consideration for the adequacy of sealing these products into the walls

to prevent air and water infiltration. The last is, of course, making sure that there's adequate drainage so that we don't end up trapping any moisture in the wall, resulting in some of the issues we saw a dozen years or so ago of rotting walls. That's my point. I don't have anything other than that. The industry is working on standard practice, providing some recommendations for these installations methods, so we hope to have that out sometime maybe in the fall, well ahead of the adoption of this Code. That's what I have.

MR. SHIRAKH: Thank you so much. Any other questions online?

MR. STARK: It does not appear that anyone else has their hand raised. There are a few people that are calling in that aren't on the computer. I can unmute their lines in case they have any comments. Everyone, I'm adjusting these four lines, do not speak yet because if there's background noise, I might need to mute someone. All right, if you are calling over the phone and are not on your computer, or you cannot raise your hand, you are now unmuted if you have a comment. Not hearing any comments, I'm going to

re-mute the lines.

MR. SHIRAKH: I'm not hearing any comments online or in the room. So now we're in the public comment period.

MR. STARK: Well, let me check the chat line, there's someone named Rich Walker who was asking if he could raise his hand for the previous presentation, like if he could go back and comment, but it looks like he has left the conference call. So yes, this is now the public comment period where if you have comments about anything that we've spoken about today, you can feel free to raise your hand and we can acknowledge you. We're going to start with the folks in the room, however.

MR. NESBITT: George Nesbitt, HERS Rater. I'd like to make a point about I think how people perceive the Code. I think they often take especially the package requirements quite literal. I mean, I think we see that sometimes in this room, you know, we're proposing you have an R-13 wall with R-4, and that's what we're going to have to do. And so I'd like to make a couple -- illustrate a couple stories. Last fall in prep for the 2013 Code, an architect I've

worked with went to a presentation and he calls me and says, “So we’re going to have to build 2 X 4 walls and put R-4 insulation on the outside?” I’m all, “No, you’re not. Yes, that’s the prescriptive requirement, but you can build an equivalent U-value or through the performance path you can do something else.” So I think it’s sort of like the package, people almost take it like a mandatory requirement even though often you have other options.

Another story is just last week I went to get some estimate on some windows for a project and I said I want this glazing with this solar heat gain coefficient, and they said, “Oh, well, you can’t have that. That doesn’t meet Title 24.” I go, “Uh, sorry, excuse me, it does.” I said, “There’s no solar heat gain coefficient requirement in Zone 3 where I want to use it prescriptively. I can use anything I want.” Yet here is a major window, a lumber yard that distributes a lot of windows, and they somehow think that this project doesn’t meet Code. And so people take, like I say, prescriptive requirements and often somehow think that’s actually a mandatory. Another example would be

supply houses, we went to R-6 ducts, so they no longer carry R-4, but I can choose R-4 in performance, or if I'm in conditioned space I can use R-4, so we sort of have an issue with how we communicate and how people perceive and learn the Code and actually understand what it means.

MR. SHIRAKH: Thank you. Any other public comments? So did anybody note an answer to my trivia question that I asked this morning? No? So if you remember, if you can bring up the slide, I think it's towards the very end right before the questions. Right after that one.

MR. STARK: All right.

MR. SHIRAKH: So again, on November 29, 1969, Apollo 12 Astronauts Pete Conrad and Alan Bean made a bull's eye landing and they landed Yankee Clipper within 500 feet of Surveyor 3, which had arrived there about three years earlier. They removed Surveyor 3's cameras and some of the equipment and brought it to earth, and that camera contained a surprise. So if you can advance it two slides? A scientist on earth found that a small colony of common bacteria, I can't pronounce it, but I think that's related to the staph infection, the spores, when they came

back to earth they actually became alive. I mean, they were not dead yet. So after being on the moon for three years and exposed to the vacuum of space, ultraviolet, temperature swings of about 500 degrees, apparently they survived. However, there is a controversy related to that, there are other scientists who think that it was contaminated when it was returned to earth, but both camps are very strong in their beliefs. The result of that was NASA went through massive change of procedures related to sterilizing equipment that was going to other planets and sealing the samples that were returning. So the controversy is continuing, but I've also heard that the Myth Busters from the Science Center, they're going to test this. No, I mean, they're going to create a chamber that has vacuum, with temperature swings and ultraviolet, so we may know the answer sooner than later. So with that, I'm going to close the workshop. The last of the series is going to be on Wednesday, it's going to be, I think, a brief, maybe an hour or two, workshop on ACM rules and some of the compliance credits, and the last one is going to be on August 6th on CALGreen. And we'll be in touch

with many of you over the summer because, as we work through these issues we may have questions that we need to get the larger group involved. PV credit will be on Wednesday. So if there are no other questions or comments, thank you for coming, this was a great workshop, and we will be in touch. Thank you.

MR. STARK: Thank you, everyone.

(Whereupon, at 4:28 p.m., the workshop was adjourned.)

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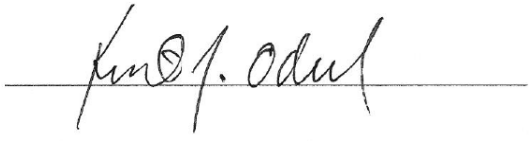

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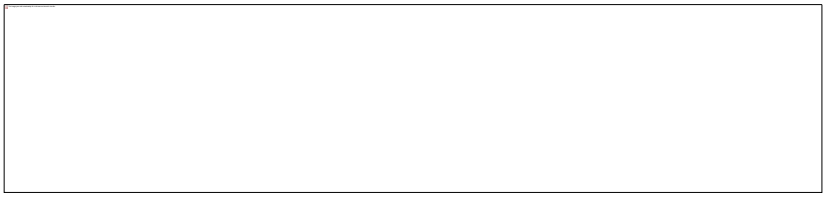

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