BEFORE THE

CALIFORNIA ENERGY COMMISSION

STAFF WORKSHOP ON

SCOPING WATER HEATING SYSTEMS FOR FUTURE

BUILDING ENERGY EFFICIENCY STANDARDS

CALIFORNIA ENERGY COMMISSION

HEARING ROOM A

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10:04 A.M.

Reported by:
Peter Petty

APPEARANCES

<u>Staff</u>

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Martha Brook, High Performance Buildings & Standards
Danny Tam, High Performance Buildings & Standards
Eurlyne Geiszler, Office Manager, High Performance Buildings & Standards
Doug Herr, High Performance Buildings & Standards
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<u>Presenters</u>

Amin Delagah, PG&E, Fisher-Nickel, Inc.
Yanda Zhang, TRC Companies, Inc.
Marc Hoeschele, Davis Energy Group

<u>Stakeholders</u>

Larry Weingarten, Water Heater Rescue
Larry Acker, D'MAND Systems
Ahmed Abdullah, So Cal Gas
Nehemiah Stone, Benningfield Group, Inc.
Edward Osann, NRDC
Jim Lutz, PE, LBNL
Phil Pratt, Southern CA Gas Co.(Sempra Energy)
Gary Klein, Affiliated International Management (AIM)
Patrick Splitt, App-Tech
Jonathan Changus, Northern CA Power Agency (NCPA)
Greg Cobabe, Housing Community Development, Codes & Standards
Carl Hiller, AET
Robert Davis, PG&E
Peter Grant, LBNL
Larry Brand, Gas Technology Institute (GTI)
Thomas Enslow, Attorney at Law, Adams, Broadwell, Joseph & Cardozo, rep CA Pipe Trades Union
Gerald Van Decker, RenewABILITY Energy Inc.
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I N D E X

P R O C E E D I N G S

JULY 16, 2013 10:04 A.M.

MR. ASHUCKIAN: ... with the Commission and I want to thank you for coming to our very first of a series of workshops to help develop our next round of building standards for 2016.

Water heating is a major portion of our energy portfolio in buildings, comprising somewhere in the range of between 15 and 30 percent depending on the climate zone. And as you all know we are striving to achieve our goal of zero net energy homes by 2020. We have two rounds of standards between now and that period of time before we achieve that goal. And water heating will be a major factor in trying to reduce the energy consumption of existing -- of new buildings and major retrofits in order to help achieve that zero net goal.

Today we'd like your input on a bunch of areas; essentially what research and development you think might be necessary to help achieve our goal of reducing energy consumption. What standard practices are currently out there that can help reduce the energy consumption as well as other areas that you think might improve the use of energy reduction for water heating. As you all know we are preempted by federal regulations on the actual water heater itself, so we have to achieve energy savings from everything around the water heater that helps consume energy as well.

So with that I will actually turn it over to Martha to talk about the rest of the agenda for today, but again, thank you for attending. And I look forward to your input on this very important subject.

MS. BROOK: Hi, I'm Martha Brook with the Energy Commission. I'm a senior mechanical engineer and one of the technical leads on the standards development efforts here at the Energy Commission. Danny Tam is organizing this workshop for CEC staff. And he's going to be getting us through the agenda.

Danny, is now the right time we want to do introductions?

MR. TAM: What ma'am?

MS. BROOK: Is now the time we want to do introductions?

MR. TAM: Yes, let's do the introductions. All right, I'm Danny Tam from the Energy Commission. I work in the Building

Standard office; if we could just go around the room?

MS. BROOK: Just start here and rotate through.

MR. WEINGARTEN: I'm -- now I'm Larry Weingarten. I've been involved in various ways in hot water.

MR. KLEIN: All right, please sir you've got to move much closer to the microphone.

MR. WEINGARTEN: I'm Larry Weingarten and have been involved in the sort of hot water from the contractors' point of view.

MR. ACKER: I'm Larry Acker with Advanced Conservation Technology, Inc. We've been dealing with hot water issues and products to distribute hot water for over 25 years. And I'm here to hear what's going on.

MR. ABDULLAH: My name is Ahmed, Southern California Gas Company, I'm the emerging technologies program manager.

MR. STONE: Nehemiah Stone with the Benningfield Group

MR. OSANN: I'm Ed Osann, I'm team leader for water efficiency for NRDC's water program, that's Natural Resources Defense

Council.

MR. LUTZ: Jim Lutz, Lawrence Berkeley National Lab.

MR. DELAGAH: Amin Delagah, PG&E Food Service Technology Center and also Fisher-Nickel, Inc.

MR. PRATT: I'm Phil Pratt, Codes and Standards Southern California Gas Company.

MR. KLEIN: Gary Klein, Affiliated International Management. I'm in hot water.

MR. SPLITT: I'm --

MS. BOOK: Why don't you guys come up here, there's more equipment, there you go.

MR. SPLITT: Yeah, are we on? I'm Pat Splitt from App-Tech and Santa Cruz Energy Consultant.

MR. KLEIN: Closer to the mic, Pat?

MR. SPLITT: How about now? Okay, I'm Pat Splitt from App-Tech and Santa Cruz Energy Consultant, and also do a lot of residential hydronic design.

MR. CHANGUS: Jonathan Changus with the Northern California Power Agency.

MR. HELFT: Bruce Helft, CEC staff.

MR. COBABE: Greg Cobabe, Housing

Community Development Codes and Standards.

MR. HILLER: Carl Hiller, Applied Energy Technology and former chair of ASHRAE TC 6.6 Service Water Heating System Committee.

MALE VOICE: (Overlapping) Hello?

MR. DAVIS: Robert Davis, Pacific Gas and Electric Company.

MR. HOESCHELE: Marc Hoeschele, Davis Energy Group

MR. GRANT: Peter Grant, Lawrence Berkeley National Lab

MR. BRAND: Larry Brand with the Gas Technology Institute.

MR. ENSLOW: Tom Enslow with Adams and Broadwell, here today on behalf of the California State Pipe Trades.

MS. GEISZLER: Eurlyne Geiszler, Office Manager, Building Standards Development Office, Energy Commission.

MR. HERR: Doug Herr, CEC staff.

MR. FLAMM: Gary Flamm, Supervisor, Building Standards Development Unit.

MS. MOHNEY: Leah Mohney with the Energy Commission's Research and Development Division.

MR. TAM: Okay, I'm going to go over the

people that are on the WebEx. We actually have a whole bunch of people: Anthony Bradley, Brandon De Young, let's see Charlene Spoor, Christine Tam, David Bixby, Dalia[sic] (Delia) Estrada, Eddie Huestis, Felix Valenzuela [sic] (Villanueva), Gabe Ayala, might as well -- okay, George Nesbitt and Gerald Van Decker, Jeff Miller, Jonah (Schein), Keith, Luke Sires, Matt Fong, Neil McDonald, Payam (Bozorghehami), Peter Mayer, Richard Harris, Sid Abma, Stephen McMurtry.

I'm going to go over the agenda real quick and then we'll have Amin to talk about commercial first.

MS. BROOK: Danny, can you do the little bit of housekeeping we're supposed to do every time before we get underway to (inaudible)

MR. TAM: Okay, yeah. In case of emergency there's an exit to the left of the building and also the main building when you -- the main door where you came in at. Once you exit the building, Roosevelt Park is right across to your corner from our building. Go and meet there and we'll take accountability for everyone who's here in case of emergency, okay?

And so we'll start with Amin talking about commercial buildings and then Yanda will talk about multi-family more closely. We'll talk about single-family. I myself will talk about an overview of the rulemaking process for Title 24 and also how we calculated the energy budget in Title 24. Gary Klein's going to briefly talk about some examples for multi-family and then we'll break for lunch.

In the afternoon we'll have a brainstorming section to talk about all the issues that we have in water heating and hopefully we'll come up with some sort of solutions. And hopefully by 4:30 we'll wrap up the meeting.

Okay, if I can have Amin come up?

MR. STONE: Sorry, I'd like to ask a question, Danny. I couldn't hear all the names you read of who's online. Is Yanda online, because he's not in the room?

MR. TAM: I don't see him online.

MS. BROOK: (Inaudible)

MR. DELAGAH: That's what I was afraid of, how's it going everybody? My name is Amin Delagah, I work at the PG&E Food Service

Technology Center. I also work for Fisher-Nickel, Inc. We operate the FSTC. And I'm a project engineer and I've been working with hot water for the last five years.

So I wanted to talk today about the importance of hot water in commercial buildings in California. And we actually did a couple different research projects. One was a PIER project a couple of years ago characterizing hot water systems in commercial kitchens. And recently we also worked the ENERGY STAR program; with them we were looking at the upcoming commercial water heater specifications and in that process we were able to examine a bunch of commercial segments.

And these are all the lists of the segments we looked at. And we looked at the number of facilities and how much hot water they used and kind of characterized the efficiency and kind of came up with a gas load for each of these segments. So mainly we looked at a bunch of facilities with food service, but it also included facilities like hotels and we also looked at other facilities like office buildings and, you know, the salon sector also uses a significant amount of hot water.

I want to kind of go through a little bit about the gas load and to start with here's the number of facilities, commercial facilities, that use a significant amount of hot water. And as you can see, office buildings, there's a large number of those facilities. About almost 60,000- 55,000 facilities that use hot water. When you actually take a look overall that's about 200,000 facilities in California that have moderate to heavy hot water usage. And about 165,000 of those facilities use natural gas for water heating.

We're going to take a closer look at full-service restaurants, as an example of how we estimate the natural gas usage of the load of that segment. And the way we do it is initially at the PIER Project we look at the recount data, which gave us about 35,000 facilities. And we estimated from a lot of our site survey use that about 33,000 gas water heaters were installed. And from there we have done a lot of field monitoring to show that an average full-service restaurant uses 2,500 gallons per day and it's open almost every day of the year and at about a

80-degree temperature rise.

We kind of did this process for each segment based on our monitoring work and estimates and also work that other consultants had done in actual field projects. And what we saw was that, you know, when you look at 90 percent of the facilities operate standard efficiency water heaters we're able to make an estimate of the average efficiency of water heaters are normally around 65 percent. Most full service restaurants have recirculation systems. That's why the efficiency, the operating efficiencies are a little bit lower.

And this is the equation we used to estimate the gas load for all these types of facilities. Basically to estimate the gas load it's the daily flow rate times the specific heat of water and times of density of water and multiplied by the temperature rise divided by the operating or system efficiency of the water heater. And when you go through the calculations it's about 25 therms a days or a annual facility gas use of 9,300 therms per year. And if you actually multiply it by the number of facilities it's about 288 million therms.

So we did the same process with all the different facilities that we mentioned earlier. And to kind of back up to this annual facility gas use when you plot all the different types of facilities, for example restaurants, full-service restaurants, are not the biggest user per facility as compared to the larger industrial or institutional facilities. But when you actually account for the number of facilities in each of these segments you see that restaurants, especially quick-service or full-service restaurants, account for about half the hot water usage in terms of gas load for the commercial sector. But overall we estimated that there is 620 million therms of gas used annually for these moderate to high hot water load segments.

And to compare the research that we have done to a few other -- a couple other research projects. One in 2000, the California Public Utilities Commission did a study that showed that overall it used data from three major investor-owned utilities. And it showed that commercial facilities use about 2,100 million therms per year. So although this data is dated by 13 years it was really good, because part of the work was that 30 percent of this 2,100 million therms was for water heating, which actually equates to about 800 million therms annually.

So we also looked at another study, this was a 2006 CEUS survey; it was a California Energy Commission Report. And in this study it showed that restaurants used 72 million therms annually and commercial building types 407 million therms. The total gas usage in the commercial sector was submitted at 1,283 million therms. So it's actually a lower estimate than the two studies I just mentioned.

And moving on to kind of the findings of these three studies basically our city, the FSTC, and the CPUC study estimates compared pretty well. You know, we only looked at the medium to large-usage facilities. They looked at all the facilities and that's 680 million to 800 million therms. It's kind of somewhere in that range for hot water use. When you look at the CEUS study, the 72 million therms for food service really appears to be underestimated.

And basically where I'm trying to go with this is that the commercial hot water use is very significant. The hot water load at about

800 million therms is very significant and if you actually throw in the electrical water heater usage at about 70 million therms you're looking at a total commercial load of 870 million therms in commercial facilities. And we really feel that that's a conservative estimate. It could be as high as 1 billion therms.

So really where we go from there is well how can we get the savings? You know, how can we reduce this and our perspective for the road map that is, you know, right now only 20 percent of commercial facilities have condensing water heaters in California. And this is compared to more mature parts of the country where they're used to condensing technology like the Midwest where 60 percent of water heaters are condensing.

And we actually have a really good payback in a lot of commercial facilities, the average payback is about 1.5 years. So there's really no reason why we should, you know -- we have such a low I guess penetration rate. So I know that as mentioned earlier that we can't mandate condensing water heaters, but maybe we can incentivize condensing water heaters in certain segments where the payback is much quicker.

You know another thing is the optimization of distribution systems. Obviously insulating hot water pipes is something that's mandated, but not insulation of all hot water pipes. And that's something that we feel that is really important, especially for improving hot water delivery performance and also really it's just going to improve the efficiency of the system. And there's been some recent laboratory testing done at the PG&E Applied Technology Services that really kind of can shine some light into this area. We definitely feel like things like the recirculation pump timer is definitely a useful thing to mandate with commercial systems. And we definitely want to encourage -- these are all of the existing systems, there's a lot of retro-commissioning we can do. But with the new systems we'd really like to integrate demand circulation.

One thing that we recently learned in a lab is when you have a condensing water heater with a continuous recirculation system you lose almost the entire condensing availability. So you're almost -- when you're putting a condensing water heater in, in a large full-service restaurant for example, it's operating a majority of the time as a standard efficiency water heater. Sure there's less heat losses from the tank, but overall you lose most of that efficiency. And that's something that maybe moving towards demands circulation or other circulation system scenarios away from continuous recirculation we can achieve higher savings. And we also want to promote point of use or decentralized hot water systems.

And finally the biggest bang for the buck is actually really looking at the water using and user implement of. You know, for example in restaurants an old dishwasher can use about 75 percent of the hot water used in a facility. We've seen that in several facilities and we feel like that's a really great place to go after, not just energy savings, but water savings as well.

And let's, you know, we still have some really mature actually technologies out there like refrigerate-heat recovery, which is used currently with supermarkets. But we feel like it has a lot of good applications in laundry and also in food service. And dishwasher waste heat recovery is one of the technologies that's really been coming on strong and we'd really like to support that further.

So that's all really I really had on a commercial perspective. Thank you very much, everybody. Martha?

MS. BROOK: Sure, can you explain a little bit for me --

MR. KLEIN: Microphone.

MS. BROOK: Can you explain a little bit about why in restaurant situations with recirculation that condensing water heater is acting like a standard water heater most of the time?

MR. DELAGAH: Sure, well when you have that incoming -- when you're having continuous recirculation and you're sending out 145-degree water it's usually coming back at about 140 degrees or 135 degrees. When you have that water coming in and mixing inside the tank you no longer have like good separation of the cold water the bottom of the tank, and hot water on top. It's no longer stratified in that way. So having all that warm water at the bottom of the tank you don't get the condensing operation to happen, so if you can't condense the water vapor then you lose that ten percent bump in efficiency. Yes?

MR. OSANN: In one of the studies you pointed to earlier in your presentation, which concluded 38 percent of gas use was for water heating was that in the commercial sector?

MR. DELAGAH: Yes.

MR. OSANN: Specific to the commercial sector, but statewide or --

MR. DELAGAH: Yes, that was the CPUC study from the year 2000. It's available online.

MR. OSANN: Yes.

MR. HILLER: Hi, Carl Hiller, a question and a comment. First of all on office buildings do you have any information on where hot water is used typically in office buildings? Is it easy to collect that kind of information, I kind of think I know but I'd like to hear what you --

MS. BROOK: There's very limited data on our field research on office buildings. Office buildings do vary from very small office buildings to a very large high-rises. We did some of those estimations for the ENERGY STAR

Program. They're very just limited to what was out there. We didn't really look into the specific end uses, it was just more just some general things that we could glean and kind of made some basic estimates.

MR. HILLER: I'm not sure I understood, your pod's a little far from my tired eyes. It seemed to me like that was a pretty large percentage of those office buildings if I remember it correctly.

MS. BROOK: It was because it was a number of water heaters. I think that's why, but he should bring it up again. I (overlapping) yeah.

MR. HILLER: Okay, yeah.

MR. DELAGAH: So there's about 55,000 office buildings, but you've got to remember not every office building has a commercial water heater. They typically have a lot of residential water heaters or even boilers, which boilers would classify under this. But it's the residential water heaters, you know, they're so small that we almost consider them a different aspect.

MR. HILLER: Nothing like business?

MR. DELAGAH: Yeah, it's a number of facilities but when you look at the actual -- let me go up. When you actually look at the gas usage, well let me go one more slide. When you actually look at the overall hot water load over the area there's a number of facilities there, but they don't use that much hot water. So that's why, you know, 50 million therms per year is the estimate that we came up with.

MR. HILLER: Yeah, in the ASHRAE circles we've been planning on proposing a research project to ASHRAE on office building hot water use. And part of the reason for that is we think there's a lot of low-hanging fruit to be had there even, you know, just because there's a large number of such buildings. Even if each building doesn't use all that much hot water there's a lot of buildings that could be substantially improved. That's why we're proposing the research project.

The comment I was going to make is to make everybody aware that I am a research contractor for ASHRAE on monitoring hot water use in a couple of hotels. One of those hotels was here in Sacramento, the Embassy Suites right down by the river. That's been under full monitoring for about a year now and will continue for another year measuring three separate systems there. The main gas room hot water circuit, it's got two full-service restaurants on their own circuit and it's also got a small laundry circuit and we're monitoring that. Eventually that'll all be reported. So far we're finding information consistent with what you've been saying.

It's amazing to me how much hot water restaurants use, it's a significant percentage of the total hotel hot water use is that do full-service restaurants.

MR. DELAGAH: Great, thanks for your comments. Any other questions?

MR. TAM: Amin, there's a question online from Gerald Van Decker.

MR. DELAGAH: Okay.

MR. VAN DECKER: Yes, I have two questions. Is the 1.5 year payback for the condensing water heaters based on upgrading to condensing water heaters when the water heater needs to be replaced, that is based on incremental costs versus savings?

MR. DELAGAH: Yes, it's based on either a burnout or in a new facility, but I think we based it on burnout. So we're taking into account the incremental costs between a standard efficiency and a high efficiency versus a planned replacement where you want to be taking into account the costs of a standard efficiency water heater.

MR. VAN DECKER: Okay, that's fair, a good thing to do. A second question, you have dishwasher waste heat recovery, by that are you talking with drain water heater recovery or are you're talking about flue or both?

MR. DELAGAH: Both.

MR. VAN DECKER: Or I shouldn't say flue, I should say exhaust.

MR. DELAGAH: Yes, exhaust air heat recovery is mature; the manufacturers all integrate that system. Our European dishwashing manufacturers have integrated drain water heat recovery and also heat pump as a secondary exhaust to air heat recovery measured. We have some American manufacturers that are brought on add-on drain water heat recovery devices. Those are all things that we should consider for future, you know, future works, more research.

MR. VAN DECKER: Have there been any research with existing technology -- drain water heat recovery is that on like what's used in residential?

MR. DELAGAH: For commercial facilities I'm aware of some research being done. There's actually a webinar coming up soon on that technology, but there has been work done in laundry and some limited work in food service. And we've done some lab research. But field research is a little bit looser, especially in food service because you have, you know, oils and grease that go down the drain. And that's definitely something that's sometimes difficult to take that research on, because if you do mess it up you might get a call in the middle of the night. So we haven't yet taken that on, but we definitely appreciate if manufacturers want to take on field research in that area.

MR. VAN DECKER: Yes, I've expressed interest with Fish-Nick to do it. We have a number of installations already actually running, so okay I'll end with that, thank you.

MR. DELAGAH: Great, yeah. We'd love to

hear about your results, Gerald.

MR. VAN DECKER: Thank you.

MR. DELAGAH: Yes?

MR. OSANN: It was mentioned earlier that there is a federal preemption on water heaters per se, but I don't believe there are any minimum federal efficiency standards for commercial dishwashers. So presumably that's an option that's still open to the Commission.

MR. DELAGAH: That's really good to know. Of course, ENERGY STAR took the step of revising their standards, which is great to see. We haven't seen any work in recognizing heat recovery yet. Since it something that's viable, but there is some Health Department, I would say, hoops that we have to go through to kind of really highlight the technology, because it's also ventless. You don't require a dedicated ventilation system. That also saves energy, but to get through the Health Department hoops that's going to take, you know, a few more years to really get it accepted we feel like. But it would be definitely nice to do more research and to get more validation of the technology.

MR. GRANT: All right, Peter Grant, LBNL

here. So another question about that 1.5 year payback period, at one point you mentioned that these condensing water heaters typically end up operating as non-condensing, because of the return water temperature in the recirculation loop. So when you calculated that 1.5 years were you taking that effect into account or is that just looking at the rating?

MR. DELAGAH: When we initially did that study and when these slides were initially put together we didn't have that research yet. So that came by in the last month when we just completed our recent PIER Project. It would have -- we would have to go back and really look at that. There are savings over standard storage water heaters, significant savings. It's not as big as we initially estimated, but there's definitely savings and it all really depends on also the amount of hot water use of the facility, because that means you have a lot more cold water coming into the water heater that can affect. You might have more condensing in that situation.

MR. GRANT: Okay, so with you just getting that information in the last month this is probably premature, but do you have like any sort of gut feel of how it all works out at this point?

MR. DELAGAH: In terms of payback?

MR. GRANT: Yeah.

MR. DELAGAH: I would say it might bump the payback to 2, 2 and a half, something like that.

MR. GRANT: That's still quite good.

MR. DELAGAH: Yeah.

MR. GRANT: Thank you.

MR. DELAGAH: Sure.

MR. STONE: This is Nehemiah Stone. So I mean did you take a look at what the schedule is for each of these to figure out if condensing was the right solution or if, you know, a local electric demand water heater or I mean whatever? To what extent did the schedules play into --

MR. DELAGAH: You mean the profiles?

MR. STONE: Yes.

MR. DELAGAH: So for the work that we did on both for the PIER Project, that was the bulk of the work, and also for the ENERGY STAR, it was focused on gas water heaters. And so we really didn't look at other types of water heaters, but yes the profiles do have some significance. The majority of the segments we looked at were moderate to high hot water load facilities. So in terms of standby loss and all those things it's not like a residential facility where that has a big component.

In commercial facilities a standby loss of say a water heater is very small, less than one percent typically of the daily hot water loads, so --

MR. STONE: Does that include the standby losses in the distribution system?

MR. DELAGAH: No.

MR. STONE: Or you're just talking about that water heater?

MR. DELAGAH: Yeah.

MR. STONE: That's kind of what I was trying to get at though was the improving the efficiency of the water heater is one way to go, but as you pointed out at the very beginning a lot of it has to do with the distribution.

MR. DELAGAH: Absolutely.

MR. STONE: And so the selection of what would be the right equipment would take that into account and that would be linked to the profile of the use.

MR. DELAGAH: Yeah, in my closing remarks I didn't just mention condensing water heaters I also mentioned -- oops, let me go back. You know, we really need to look at distribution systems are a huge part. The more we study distribution systems the more we realized that a significant part of the heat loss occurs, especially in the type of facilities you work with: multi-family, supermarkets, any of those facilities.

You know, for example in a supermarket on a day that they're not even open and not using any hot water they still use three quarters of the gas use for water heating versus a day that they were open. So, you know, in any of these large facilities there's definitely a huge role for going to a decentralized type of system. And that's something that we can definitely look at for Title 24. Yes?

MR. OSANN: You mentioned about a universe of about 200,000 facilities with modest to heavy hot water in the state? Did any of your data give you an indication of what the rate of new connections is? I mean, how much is that growing typically?

MR. DELAGAH: From I would say about ten percent, but during the recession probably less than we were going through in the last five years. It's probably is picking back up again.

MR. STONE: Ten percent over what period with that growth?

MR. DELAGAH: Well, I mean like every year you might have nine water heaters going to existing facilities and one water heater going to a new facility or a hot water system. Is that what you mean?

MR. STONE: That's one way of looking at yeah, okay.

MR. HILLER: Yeah, Carl Hiller again. A lot of good points here, I'd like to add some comments. First of all in terms of the amount of energy losses due to recirculation loop I've done some research on that, probably some papers on schools. And we have strong suspicions that office buildings are very similar. In things that tend to be sink-use dominated, hand-washed sink dominated the total energy use that goes to make up the heat loss off the loop, at least in the school that I monitored, was 91 percent of the energy use. And we suspect office buildings are very similar to that, so you're looking at probably 90 percent or more of the total energy use is heat loss off the loop.

So there's a lot of room for improvement in hot water distribution system design and total system design to improve the efficiency. And that also applies to how effective a condensing water heater is. One of the issues is that people apply currently, condensing water heaters like they weren't condensing water heaters. They just stick them in the way they've always stuck a water heater in and that's not the best way to apply a condensing water heater. You need to change your system design to maximize the efficiency of the condensing part of the system. So again it's a matter of teaching people what to do and it's a relatively minor modification. But there are simple things that can be done to maximize the efficiency of a high-efficiency equipment, but you have to do it and we have to teach them how to do it.

And one final comment is something that we should all keep in mind with these discussions is that in commercial, and especially in like hotels, which are highly dependent on their customer satisfaction ratings on hot water adequacy. Over-sizing/redundancy are the norm, so you look at a hotel for example and there's at least 100 percent backup if not more. I wouldn't call that oversizing, but really you've got twice as much capacity as you need. Because if something fails you want to keep your customers having hot water, so the backup system or the lead lag chiller kind of concept will go into effect. So it really impacts the economics, so that we have to keep that in mind.

We've seen some installations where let's call it oversizing is a factor of ten and that's commonplace, because especially with conventional technologies the cost of doubling or quadrupling the heating capacity or the heating rate, is small. And so it's commonly done, but that really impacts both how we calculate the effectiveness of alternatives where you don't want to do that kind of oversizing and just how efficient everything's going to turn out when you've done that oversizing. A lot of cycling losses and that sort of thing, so these are all important things we need to consider in our discussions on what should be done.

MR. DELAGAH: Thank you, Carl. I definitely agree with all those points, and it just really highlights the amount of work that's needed in studying commercial segments. Especially segments that we have not really spent enough time studying and really getting an understanding of efficiencies in all these different commercial segments. I know we've done some work in multi-family or food service, but there's a lot of segments that we haven't covered.

MR. BRAND: Yeah, Amin I just wanted --

MR. DELAGAH: Larry?

MR. BRAND: -- Larry Brand from GTI, I brought the results of the PIER Project with me. And maybe we could just talk about it at the breakout on the commercial side, because it does do a nice chart plot of the effects of different recirculations, just control system approaches and condensing versus noncondensing under different scenarios. So we could share that later.

MR. DELAGAH: Oh.

MR. STONE: Can I suggest that that's not something talked about on the break, but it really should be part of this discussion if you can put the results up?

MR. KLEIN: I think he meant the speaker in the breakout session this afternoon.

MR. BRAND: Yeah, the breakout.

MR. STONE: Breaking out, okay.

MR. BRAND: Yeah, the breakout.

MR. STONE: My hearing aid only works half the time, I didn't catch that.

MR. BRAND: You got the break part.

MR. KLEIN: Okay, Amin this is Gary. How do you think the split is between the restroom areas in terms of the hot water use compared to the kitchen? I'm assuming it's a huge amount in the kitchen compared to the restrooms?

MR. DELAGAH: Good assumption, Gary. The work that we've done, the average hot water use per hand-sink is ten gallons per day. This is like with like a 2 GPM aerator, so the hand sinks are a very small component. A small quick-service restaurant might use 500 gallons a day, so having three or four hand sinks that's ten percent. Now in a full-service restaurant maybe they have eight hand sinks, but they use on average 2,500 gallons per day so that's, you know, a much smaller percentage.

MR. KLEIN: So to follow up on that then, as best I can tell the bathroom facilities are almost never close to the kitchen. Certainly not in terms of the way the pipe typically runs, so it almost makes sense to think about them as completely separate uses with localized water heaters. Is that something you guys have been looking at?

MR. DELAGAH: Yes. Yeah, definitely we've been looking in that direction as well as we're going towards these heat recovery technologies. The dishwasher, for example, used to take in 140-degree water. With the new technologies, with the exhaust air heat recovery you can -- we have dishwashers that only take in cold water. So they can be designed, they don't have to be on a hot water system anymore or the ventilation system, so they're their own appliance now.

When you start taking away a bar dishwasher and a dishwasher in the kitchen you can now turn down the temperatures from 145-150 to 125-130, so there's definitely savings there as well as sizing down the pipes. And going away from continuous recirculation to more just simple piping just for the main hot water uses in the kitchen, like a three-comp sink or mop sink, and then doing some as you said point of use for the small uses like the far-off laboratory sinks.

MR. KLEIN: Or some way of demand priming and good insulation, the same strategies hold.

MR. DELAGAH: Exactly, yep.

MR. KLEIN: So you don't need multiple water heaters, but you do need to rethink the plumbing layout.

MR. DELAGAH: Yeah, and when you look at for the customer they save all that copper piping in new facilities. You know, the paybacks are really good; it's almost a full offset. Depending on the strategy you want to go you can go partially optimize or fully optimize and we can talk about that later on this afternoon officially.

MR. CHANGUS: Just a quick question, Jonathan Changus from the Northern California Power Agency, admittedly the liberal arts major in the room. Do the arguments or the suggestions you have for decentralization and focusing kind of on the distribution systems also apply to electric water heater systems as well, to do?

MR. DELAGAH: Absolutely, yeah. Obviously if you have a centralized electric water heater, there are only savings opportunities when you go to point of use, you know? And it also is with any of these things you always add redundancy when you have multiple water heaters. If the main water heater in your kitchen goes down you might still be able to operate your facility, you know, if your dishwasher is on a separate line or if your hand sink's on a separate line. There's a lot of added value, but definitely any time you remove recirculation or distribution line losses it's a bump in efficiency.

MR. HOWLETT: Owen Howlett from the Energy Commission, just a question about the dishwashers you mentioned. There are more efficient dishwashers, I'm not up to speed on this but do the more efficient dishwashers have any consequences? Like are their run times much longer than the previous generation or are there any consequences for the design and operation of the restaurant?

MR. DELAGAH: For example, the door type dishwasher is the most commonly installed in restaurants: small to medium size, full service and some quick-service facilities. For that after you do a wash and rinse, which is typically a minute to extract all the energy from the water vapor that takes about 30 seconds. So instead of a one-minute cycle you might have a one and a half minute cycle.

Typically it's not a huge issue, because they're usually loading the next rack to be put in there. In your high through quick facilities they usually opt for a conveyor type dishwasher and not a door type dishwasher. So even at one and a half minutes it's just fine. Under the counter in the bar, it's about two minutes versus two and a half minutes; it's not really that much of an issue.

Outside of that there's really no other issues. You are trading a little bit sometimes going from a gas centralized water heater to typically a electric booster, so although you are saving a lot in terms of there's some offsets that are between gas and electric that you've got to look at as well.

Yes?

MR. OSANN: Has it been your experience at the Food Service Technology Center that the franchised restaurants that have a template for the building and the layout and the arrangement and everything, are open to and interested in efficiency improvements of the type that we're talking about here today?

MR. DELAGAH: Several have been. We worked for example, with some quick-service facilities like Subway already is doing it on their own wherever they can go to decentralized heating if the codes allow it or if the Health Department allows it, they do. So they realize they don't use a lot of hot water, they're not very intensive and they'd rather do point of use especially at their far off hand sinks. And they might go to tankless just for the three-compartment sink, so it's better than just having a storage water heater sitting there losing heat all day.

And also you have really poor hot water delivery performance at all these far-off hand sinks. So for them it is an energy savings as well just a improvement of hot water delivery performance. You have other facilities that have taken up -- if you go to a continuous recirculation line you want to make sure you still have hot water at your hand sink. You have hot water in the ceiling, but you still have to get it down to that low water using 0.5 GPM fixture. And so we have seen adaptations of just bringing their recirculation system down a little bit and back up to at least make sure you have hot water.

So there are some strategies that have been taken up. They can be doing more and we have been -- one of the PIER projects that we're proposing, I don't think we're going to get it in this time, was to actually do or work with a California chain and to actually look at their existing system and really do a thorough research project on seeing the end use, energy use kind of like what we're doing in the lab. And also optimize that system using some of these strategies and look at the energy savings of that.

So that's research that we need to do that's going to require a lot more, especially field research. We should kind of do a key study to really demonstrate it for these facilities, I think that's the best strategy.

MS. BROOK: Okay, thank you very much.

MR. DELAGAH: Thank you, Martha.

MR. ABDULLAH: I just want to mention that some of these technologies we are looking at: waste heat recovery from the air-conditioner that's over the kitchen. We are field testing in four different sites using a system developed by RHEEM and RINNAI with the heat recovery from the condenser or the air-conditioner, which is usually on in the kitchen area throughout the year even in the winter months. So the significant heat recovery from the condenser to aid the water heating systems, and the payback, could be anywhere from three to five years. So we're testing it in four different locations.

And the other experience that we have had is that a lot of the restaurants that are not corporate-owned or chain restaurants, they are very difficult to convince them to adopt new technologies because they operate on thin margins of profitability. So they don't have the means nor the resources to adopt new technologies, so that's going to be a big challenge. And I would hope that in this exercise we will prioritize the market segments that we should target, because we can't possibly address all markets. And I would also hope that these strategies would be different for new construction versus existing.

MR. TAM: Okay, next we have Yanda Zhang from TRC.

MR. ZHANG: My name's Yanda Zhang with TRC. Today I'm going to talk about DHW applications in multi-family buildings. Mostly it's a summary of what we did for PIER research in the last couple of years and how we took it to, for example, the 2013-2008 Title 24 development.

So is this automatic or I didn't do anything, just, so let me just go back, okay?

MS. BROOK: (Inaudible)

MR. ZHANG: I see, okay. I get it, so maybe I made some mistake here.

So just a brief history of what we have done in multi-family more or less. I would say it started, was a couple of years. Nehemiah Stone here in the room initiated the research emphasizing the importance of the DHW energy using multi-family residence in special centralized systems. We're also saying we did around PIER research of the area and later on it was also funded IOU's Codes and Standards programs to help us to improve the understandings of the system to have the model of the central DHW systems. And it helped us to, for example, to implement some of the important code in the last run of Title 24 development.

So first of all, in turn with the building type even we say multi-family buildings what we also mean is for example in coding, hotel and motel buildings where you have multiple dwelling units and each one has their kind of independent usage patterns. And a water system is not supplied by, for example, individual water heaters or boilers. It's more being supplied by a central boiler with a complicated distribution system mostly using recirculation loops.

And here also showing on the first graph here, showing the importance of multi-family. As we've seen, you know, the last couple of years the market recession has been really hit hard to the single-family sectors. And then we're seeing actual multi-family construction has remained relatively strong or even picking up more faster than single-family's. So that's something we like to people to pay attention. You know, in a sense when we talk about residential hot water usages, multi-family is a important sector.

So this is a kind of generic overview of the system where we're discussing. And on the top is a schematic of the multi-family building or a hotel building in essence. And usually you have a central boiler room located, could be in a couple different positions in the building. It could be in the top floor or could be on the first floor or basement. And what they usually have are multiple recirculation loops going from the central boiler or storage tank through the building, and then you have branches or risers they often call it, going to different dwelling units.

This is really a very simplified illustration of a recirculation system. What you can find in the field is usually much more complicated, but there's something in common. There's something in common is usually they do not tend and do not try to run the recirculation loop to every floor. In that case some people might think it's a good idea, so that you can have hot water close to each individual unit. But from the energy use point of view having a very complicated, long recirculation loop is really going to lead a loss of energy, a loss.

This kind of energy use breaking down, kind of illustrates the point. And if we start in from the left side showing this is what the total gas supply is to the system you can see roughly, you know, one-third of the energy actually used is lost by the water heater due to inefficiency there.

And another one-third roughly as, you know, we conclude from the field study is losses through recirculation distribution systems. So what's really reached to the end users basically is the other one-third. So the overall wall system efficiencies on average, it's about 30 percent-ish. It really again depends on your usage pattern, for example if you go to a college dormitory building. Especially in summertime or during weekends there's not many people and we see most of the energy is used for or by the heat loss through the distribution system. In that case the old wall system efficiency would be low single digits.

So there's also for example, design impact. If you do design a system with a short recirculation per se and you're going to have, for example, longer rises to individual dwelling units. Now if you study the system you find it out, the heat loss through the distribution is less. But yet it does not mean the system is more efficient, because what's not potentially visible is if you have a long rise or long pipes people will have more, you know, kind of like a dump of the hot water for waiting hot water to reach through the faucet. So just you have different kind of ways to patterning in a sense, something to pay attention.

And what we, the last couple of studies we also focused on new construction buildings that try to understand what is the latest practice. And what we found out for example, at least for new buildings the insulation is relatively good and existing buildings are a different story. So, you know, at least for multi-family hotel or motel buildings I would say from a new construction point of view emphasizing pipes insulation is important, but the savings might be marginal. It's just because they seem to have done quite a lot.

Some of the things I'd like to discuss here were already kind of covered by Amin in his presentation. What I would like to discuss is given the system design we have in multi-family buildings what we can do, what we can do as the next step? And a couple of things we can consider: one, traditionally we can consider using for example high-efficiency boilers and water heaters; that usually means condensing water heaters. That's definitely an area that Amin showed. In many cases especially you would have a large amount of any use, the payback is relatively short.

Another one to consider is, you know, the recirculation system optimizations. For the last Title 24 we did some, in a sense the first step to work. For example, trying to at least ask people to pay attention to the plumbing designs saying this is something not done usually in the field. I mean, the last Title 24 we began to set the baseline such that you can have two circulation loops instead of one. The rationale behind that is that using two allows you to use a smaller size pipes than using one big fat pipe to supply the whole building.

And, you know, this slide I like to discuss is what else we can consider. And in multi-family buildings and we also have space heating systems, so for hotels-motels you also have pool heating. You know, the question for example is how we can possibly in a sense have a integrated design to have your heating system addressing both hot water as well as space heating and pool heating needs.

Something for example, if you're going to use a condensing water heater adding more load as was discussed before can potentially give you shorter payback. And if you're going to use also for example solar water heating system, you know, adding that additional load also -- even your load profile also improve your solar system efficiency. So integrated design is something we need to consider.

Another possible consideration is integration with heat recovery from a HVAC system. You know, we haven't done anything, we haven't noticed anyone doing something in this particular area. And not like, for example, I mean probably taking more steps in that area to consider in commercial kitchens. Or we haven't seen a lot of doing in multi-family buildings.

And part of the challenge I guess is multi-family buildings you could, you don't always have centralized HVAC systems: in hotels, motels maybe and not always, but less common in multi-family buildings. So we probably should conduct more market studies to see where it's applicable. And a hot water drain recovery system is actually constantly discussed. And we also have actually, I forgot the name now, in the proposed possible solutions discussion about especially this might be useful potentially and more potentials in multi-family, because people more tend to think multi-families.

You know, you can have simultaneous hot water usages and the potential is higher, but then again we performed a preliminary analysis to find out there are also challenges we need to consider for example. And in multi-family use you have kind of a -- you basically have kind of, what should I say, a kind of large distance between for example boiler rooms between the actual hot water fixtures. So to bring your recovered heat into the boiler room is a challenge.

And now if you look at the individual dwelling units heat recovery and that more or less might lead to each individual unit's going to have a recovery system, heater recovery system. In that case you're going to have potentially a higher cost, kind of lose some of the advantage of the hot water use of the whole building. So those are the things we don't have an absolute answer, but it's something we should consider.

Just also for reference this diagram we tried to -- again going back to the slides. We're trying to give people a kind of a better sense of what's being implemented in Title 24. So we've talked about in practice you have different -- you know, building types could have different hot water usage. And they're often very scattered, have large variations, but we need to do up in Title 24 something to consider is that we do have assumed or default hot water usage patterns for analyzing hot water savings and also to create potential energy budget for compliance purpose this diagram kind of shows how hot water plays in the overall multi-family energy budget for Title 24 compliance.

The kind of reddish bar here shows from a TDV point of view the percentage of energy used by a DHW system as compared to the whole building energy use. We're talking about DHW regulated energy. And the green bar shows some natural gas in term of therms, the percentage of total energy use represented by DHW system. In both ways you can see the DHW representing a really large chunk of the total energy use, so that gives you a kind of an overview how important DHW is as we compare to other end users such as HVAC and lighting.

And this one we like to summarize what's commonly required for centralized DHW systems for multi-family. So we know in a sense from the Title 24 design point of what is the starting point from now and what we need to achieve further. So from hot water heating equipment point of view the standard is aligned with the DOE user requirement, DOE hot water heater and boiler efficiency requirement.

What we added in the last run is that for centralized system, and we in California began to require solar water heaters to be installed. It's required in a sense, it's not mandatory requirement meaning that it's not -- what we require is you need to achieve the amount of -- at least achieve it on energy savings, that equivalent to install a certain size of solar water heater. And what we call prescheduled requirements for those familiar with the code structure. And you don't have to install solar water, but you have to come up with energy efficiency measures to achieve this equivalent amount of energy savings.

And for distribution systems we began to require the dual loop design as the baseline systems and having demand control recirculation system and as a default a control strategy. Again, those are what we call prescriptive requirements meaning that it's something you don't have to do exactly, but you have to design a system achieve the equivalent performance as defined by those two specifications, those two meaning the dual loop design and demand recirculation.

So the last bullet point we also began to ask builders to pay attention and building officers to check the plumbing designs. It's really a baby step last time, because it's not been a common practice for building officers to check each of those system plumbing designs. So what we began to require is really minimal. And in fact, it's actually a HERS rater measure. Something it's not, again mandatory required. You will get a credit for doing so as a way to encourage people to begin to pay attention to plumbing design.

So going forward what are we saying we can potentially do? And again to help achieve the goals what were set by the State to achieve zero net energy buildings. Similar to what was discussed we can talk about -- separate the discussion for heating equipment, which we would say consider high-efficiency water heaters and boilers usually meaning condensing water heaters.

And then recently we also discussed with different stakeholders and parties who were thinking how we, for example, should consider using distributor designs to take advantage of some of the high efficiency equipment, especially tankless water heaters in multi-family buildings. That's something we should have considered, something already will begin to do some preliminary work hopefully or at least is going to lead to some field demonstrations.

Another one is solar water heater performance. Since we begin to require a solar water heating system in the buildings I think something we need to pay attention to is especially large, centralized solar system. How do we regulate and the efficiency of those systems, how do we better integrate solar systems for the boiler and the water heater systems. Or even going further, there might be applications in terms of how do we integrate solar systems with space heating systems.

These things I think used to be maybe more considered as emerging technologies, but since now we have those into the code we should begin to consider, you know, kind of mandatory requirements in sense of how we can improve the system efficiencies.

Distribution systems, well we did some work in the last run, which is in terms of optimizing distribution recirculation designs, which is dual loop design was mentioned. I think more what can be done is to consider, as we already talked about this, when the recirculation system is applicable. When we should consider more a distributed system meaning, you know, not a centralized system.

And also recirculation control improvement and the demand systems is more or less, I would say it's probably kind of the best system we found from our studies so far. But still from the field research we realize there are certain areas that can be improved. For example, you know, the system particularly for some of the large systems kind of the reliability of the controls, how it can respond to small flows in large systems, can be challenges for those controls. Something, you know, we should consider.

The various designs, this is why I think I touched upon in past discussions, is one is a central recirculation system versus distributor system. Something to consider how do we integrate with other systems space heating, HVAC and solar systems or even solar PV systems. Maybe that's, you know, a little bit of a reach and what I mean is that we begin to see what they call what's the term, a solar PV system, what's the term where they could have it PVT? PV Thermal systems, that's what I mean.

So by for example cooling your thermal PVs actually improve your PV efficiency as well as you can collect hotter waters. Because something at this stage may be small and it's kind of a ET type of technology, emerging technology consideration. But whether it's from PIER research or from PG codes and standards point of view I think this is something we should consider.

I think this slide somewhat summarized what I like to kind of recommend and for both PIER research and I guess also for standard water -- yes, how do we demonstrate new system designs that improve, that has large savings potentials. Meeting new designs again means how do we have integrated designs, how do we have a distributed systems versus centralized systems.

And we also need to collect performance data from those systems and accept some performance rating method especially for new solar applications and do Title 24 performance modeling. As we know one thing is most of the buildings there, at least for multi-family buildings, they are following what they call a performance compliance approach meaning that they try to reach the code requirement by building simulations to demonstrate that building energy use is below the required budget. That implies that we need to have good simulation tools to support new system designs, support new technologies. So that it can be used for code compliance.

One of the examples is for example, the control, the simulation capability of controls. In the past we all recognized the savings from controls, but we kind of lack sophisticated ways to quantify energy savings in different buildings. And one of the key, I will say key elements that help us to achieve the last cost improvement is that it was a model that would be able to calculate, estimate any savings from controls. So going on forward we need similar tools to just new technology and new system performance.

I think that summarizes my presentation, thank you. Nehemiah, please?

MR. STONE: I'm going to monopolize here for a moment, because I've got a bunch of questions Yanda. On I think it was right around slide 4, for central heating systems you were saying that some multi-family buildings have the central heating systems that you could integrate with. And I'm wondering if you're talking about, you know, fan coil systems or you're talking about distributed water source heat pumps. Because the integration would be different depending upon how those things are going to be handled.

MR. ZHANG: Right.

MR. STONE: What have you seen?

MR. ZHANG: I think what was in my mind was more hydraulic heating systems. And especially along the coast and Bay area we see many buildings have those systems. And to a degree they're similar, the hydraulic system and the DHW system both have central boilers and they have hot water pipes to bring hot water throughout the building, to basically distribute the heat throughout the buildings.

MR. STONE: The concern about how they would be handled differently though is more about prioritizing. You know, in other words if there's a demand for hot water versus a demand for heat. I'm sorry, whether there's a demand for hot water or for heat the controls to prioritize in all the different units that's -- but I haven't seen a whole lot of the four-pipe systems that are supporting or two-pipe systems supporting heat pumps. But I did see some in the past, I'm not sure that people are actually going that way today.

MR. ZHANG: Yeah, I would say that I might, what was in my mind is hydraulic systems and not necessarily heat pump systems. And also we don't see many applications that have integrated or what they call combined space and water heater applications. What's in the code, Title 24 recognized is you use the same boiler for both DHW and for space heating or hydronic heating systems.

And what we did see is at one of two sites in Berkeley, and they actually shared at least part of the distribution systems. And it was quite interesting, but actually we didn't study that particular history in our last PIER research, because our scope was related more to the DHW systems. And we didn't have any plan of being able to allow us to understand those systems. So but as I talked to the facility manager he said, "It works fine," and obviously it works and there was no complaints so I -- and he also said he came from the East Coast side and he saw those systems more often.

So that leads me to consider, you know, we should look at it. And what, if any benefit we can have from those systems. Yeah, that's at one of the sites we have.

MR. STONE: Right, the chart on page 5, was that based on nominally typical buildings or was that based on real-world buildings? I know it was all Title 24 runs, but --

MR. ZHANG: Right, this was the eight-unit multi-family prototype, for example, compliance software validation used by Title 24 and so I --

MR. STONE: And have you considered doing the same kind of -- I mean you guys have a larger set of multi-family new construction plan sets or models than anybody else, because of the programs you run. Have you considered doing the same kind of comparison looking at what's happening in the real world?

MR. ZHANG: Well, I use this again as a

summary, so I do recognize and we all understand each building, they all have large variations. And to a degree it's what is the average, you know? It kind of requires large amount of data sets to come up with the average, which we don't have. This one I was just trying to show you for code reference since this workshop is trying to support Title 24. This is what's being currently specified in the code and something to consider.

MR. STONE: But the message here is, I think a lot more important than --

MR. ZHANG: Yes.

MR. STONE: We're trying to get to zero net energy and I'm concerned, I hate to say this in front of you, but I'm concerned about installing all of this gas equipment, because TDV pushes us towards gas when we have this 2050 goal of getting to 80 percent below the 1990 emissions level. And there's no way in blank that we can get there if we now are pushing people and will continue to push people towards installing a bunch of gas infrastructure. And I think if you took a look at real buildings and looked at what's happening rather than the prototype the differences there might be more astonishing and might be even bigger than what you're looking at or what you see from the model.

MR. ZHANG: I say one thing I will just say probably I -- this slide was discussed, they were a couple months of ago when we first planned this meeting. Now you talk about, I think, a small gathering to add other unregulated load heater to compare, for example, the plug load especially. And so what I said here, this is only a comparison of a regulated load and how does DHW compare to the rest end use assumed in Title 24.

And for example, we know we have the HERS tool rating system. There are rating systems that including other end uses, I think including those will be probably more useful and helpful to give people a better picture. And this is just regulated load.

MR. STONE: Last question, in the list of things you thought we should consider I was surprised by a couple of things that weren't on the list. So I want to find out if maybe I missed it and they got included in 2013 or maybe you just didn't see any reason that they might end up in savings.

One is continuous monitoring, being able to see how the system's performing all the time. And EDC stuff showed how much continuous monitoring action makes a difference. Acceptance testing, so that you know that it's actually working the way it's supposed to be working when it's first installed. And a larger tank volume per unit load at least as a credit, you know, if you design so that instead of 150-gallon tank you've got a 600-gallon tank that you get with a very small pump, if you get credit in the standards from savings from that. So I'm wondering are those things not things that you saw in any of your research that might make a difference or did I miss something in 2013 and they're already included?

MR. ZHANG: Some we considered, some say it's still an open question. I agree, because for example the last one, maybe it's just the last one is the large tank size. And what I really would like to add a credit is along that line, is to consider really the system designs. And right now you go to any building or talk to mechanical designers, the default is just that's the way it is. It's that you have one or two boilers to support a storage tank and then run a recirculation loop and how is it run, and as long as somehow it reaches to every different part it will be fine, there was no design. So along that line the first think I like to emphasize yes, is to let's consider how we can design systems differently. And that, we definitely should include how big for example is tank size. How do we size the boilers and especially you're going to integrate it with solar systems and the large tank is more important. I agree with that, but I didn't go into those level of details.

MR. STONE: What about the continuous monitoring?

MR. ZHANG: Continuous monitoring is the first question you had. We are already giving credit to continuous monitoring in the code, yeah.

MR. STONE: Probably discussed like a year and a half ago?

MR. ZHANG: Right, so whether we more or less is the assumption. You know, that's what the EDC's doing is the long-term effect is being able to bring down your hot-water supply temperature. So that's included in the code, so that's recognized. As again what do we talk about, for example the demand control is a prescriptive requirement. It means that that's just used to set the energy budget for compliance purpose. And if you choose to use for example, EDC systems the model is going to come in energy savings and to see maybe what can be compensated, what you lost from --

MR. STONE: Well, so I remember correctly and I may not, but if I remember correctly the only credit given for the continuous monitoring is in conjunction with a temperature modulation system like EDC's. not with a demand control system or is it a -- I mean, can you get that on top of the base case demand control?

MR. ZHANG: I think something -- folks, I've not so sure, talk to Larry and one time EDC discussed with me I certainly talked to them and said, "As we design or as we are starting here what's included in the code is what we see available in the market." And in fact I actually said, "You guys should consider, have different control strategies working together to see what's the best." But what the codes cannot do is to begin to create something that does not exist in the market. That's what we didn't do, so...

MR. STONE: But it doesn't exist, Larry?

MR. ACKER: It does exist.

MR. STONE: There you go.

MR. ZHANG: Okay.

MR. STONE: (Inaudible)

MR. ACKER: The technology is changing all the time. We work constantly to upgrade electronics in all kinds of systems. So the technology is there, it's just a matter of electronics totally being able to control a pumping system.

MR. STONE: That's what it amounts to?

MR. ACKER: Yes, it is and we're about ready to come up with some new things in the next few months.

MR. ABDULLAH: I have comments. Can you go back to your chart where you show the water heating consumption per the percentage of Title 24?

MR. ZHANG: Yes, can just take -- not this?

MR. ABDULLAH: Yeah, that's the one. Yeah, I'm kind of confused about this chart, because if you were to say in some of the bars almost 80 percent of the natural gas use whether it is by therms or TDV is off the -- you know, 80 percent of it is used for total domestic water heating. So are you assuming these are all the space heating is by electric heat pump and that the cooking and the drying is nonexistent?

MR. ZHANG: Yeah.

MS. BROOK: (Inaudible)

MR. KLEIN: Microphone, Ms. Brook?

MS. BROOK: Yes, counting heating, cooling, ventilation.

MR. ABDULLAH: So it has space heating in there?

MR. ZHANG: Yeah.

MR. ABDULLAH: So I don't understand how water heating consumption could be 80 percent or 90 percent of the --

MS. BROOK: Because there's no -- there's very little heating requirements in those model climates and space heating requirements in the model climates. And so that's why it ranges, so that when you look at the most severe climate where there is in the 15, 16 that's where it's down 20 to 30 percent and the most severe climates there is space heating and space cooling. But where there is very little space heating and cooling then water heating bumps up to 80 percent.

MR. ZHANG: Yeah.

MR. ABDULLAH: Well, I'm looking at say climates on 10, which has there a significant amount of space heating requirements. And I don't see that water heating should take 80 percent unless you're assuming, hang on just let me finish, unless you're assuming that it's a central water heater and has a lot of losses and then you're attributing the total water heating consumption on a per unit basis. Then maybe yes, because we know that when you have tank type water heaters and individual units it's about 180 therms for water heating and it's about 200 therms for space heating. And then if you do a central water heating system then the point of consumption goes up to 270 therms for water heating and the space heating still stays at about 200. So that's why I'm looking at those numbers, so I was just curious.

MS. BROOK: Yeah, so it could be that you're thinking about existing buildings and this is a new buildings slide. So that's one thing I would just mention is that the other thing this was sort of pointing to is that we've continued to make significant improvements since space heating and cooling in new construction and we haven't made those same improvements to water heating. So the residual is that water heating is hanging out there, especially in the mild climate zones as the remaining big thing to go after, because we've already done a lot in space heating and cooling in the standards, so for new construction.

MR. ABDULLAH: Okay, I just want to add that from emerging technologies we're looking at solar water as well as combined hydraulic space and water heating for multi-family as well as single-family homes. And in response to Nehemiah's concern about greenhouse gas reductions and etcetera I don't think you can basically achieve it through cost incentives, but we're looking at a number of new technologies that are addressing energy efficiency, after treatment and then advanced combustion technologies. So I think that we should give technology a chance before we legislate any natural gas alternative.

MS. BROOK: Well, I don't think -- this is Martha Brook -- I don't think this is the right place to bring up the rather large and unwieldy discussion about energy versus greenhouse gas. But when we get into Danny's discussion where he talks about and explains how we do the energy budget calculations and what we value in terms of energy costs in the standards. It'll come up again, because we are trying to capture carbon costs in that evaluation of energy.

And, you know, all we can do from the standards perspective is we have a mandate to look at it from the consumer's perspective of energy costs. And so all we can do is make that as comprehensive as possible a evaluation approach. And because we update it every time we update the standards we have the ability to consider everything that stakeholders bring to the table as important in that evaluation and we can discuss it then.

MR. OSANN: I have a few questions. I didn't quite understand the point you made earlier in your presentation about trends in new buildings. You mentioned the insulation is pretty good in new buildings, but there was a "but" of some kind and I didn't quite get that. Were you qualifying your view of --

MR. ZHANG: I'm trying to think what did I say, did I say I was talking about --

MS. BROOK: You were talking about pipe insulation.

MR. OSANN: Yes, pipe insulation.

MS. BROOK: Our new building is already doing that and therefore there's not a lot of benefit in requiring everybody to do it if everybody's already doing it.

MR. OSANN: Yeah, I --

MR. ZHANG: What do I remember I said is that there obviously you can achieve more savings by adding more insulation, no doubt about it. But I guess maybe I said this, that don't think that that will give you a large amount of savings, because at least in new building they already pay attention to that since in the field. So we should consider other things.

MR. OSANN: And is that in response to Title 24 or is that for other reasons?

MR. ZHANG: Multi-family heating has

probably a unique market position in a sense, because of the utility in multi-family programs that there has been such a outreach to view this design and come up with what you can do to improve your systems. And I think that's the effect there, is the because the building industry community have probably better educated in terms of how to do things right along with other things. I think that that, at least compared to any other building sectors, I think the multi-family building program from the utilities has a very large percentage coverage for the total multi-family units to build in the states.

I don't know, Nehemiah probably can give you a better number. I would say at least 50 percent of the units, new construction units, has their participant of utility programs. So I think that's there one of the effect.

MR. OSANN: So those are supporting specific measures. I mean, the relative value of pipe insulation is not incorporated in the modeling as --

MR. ZHANG: It is, for example Title 24 model is a specific -- for DHW system you can specify is it additional insulation added like one-inch insulation added. You do get credit for that.

MR. OSANN: You get a credit?

MR. ZHANG: So I think that maybe that's kind of visibility and had an effect to the market.

MR. OSANN: Yeah, go ahead.

MR. STONE: Yeah, sure. So Yanda, if I'm not mistaken, I mean the biggest issue with the insulation is what you're saying is it's a compliance issue more than anything else?

MR. ZHANG: Right, right.

MR. STONE: So the model may count for the effect of the insulation, but building departments are not very widely enforcing it I guess is the way I would put it. So for those buildings that Yanda is talking about that are going through an IOU program you have a pretty high certainty that the insulation is there. For those that are not, you don't.

MR. KLEIN: A follow-up on the insulation question, it's my understanding that we don't and the standards actually require insulating all of the hot water piping. The only, for research systems we require the loop, what about the branches?

MR. STONE: So for the kitchen, okay so we get some of it. I guess there is an opportunity to pick up things that are not on the loop. And depending on the way that the loop is structured if it's a central corridor loop with long branches then the odds are you'll get a portion of the branch, because it goes to the kitchen. If it's vertical risers they'll tend to be closer and they'll be on the loop, so they're supposed to be insulated anyway. But it seems to me that we ought to be paying attention to the branches that touch the loops. They act like wicks to heat, so we ought to be thinking about it, yeah.

MR. ZHANG: I'm not saying there's nothing to be done, but again my point is that the incremental savings will be small. You know, one of the for example applications you can consider in a branch, branches are not necessarily required to be insulated. However, if you look at the heat loss mechanisms and the big challenge of heat loss is because someone used the hot water and then the hot water is sitting in the pipe for a long time and will slowly dissipated, wasted.

In that case it does not matter how thick your insulation is, it's just going to make it slower. Sure, there are better chance for the person to pick up, but again the point is that the incremental savings you can expect will be smaller than other measures. That's what I mean.

MR. SPLITT: This is Pat Splitt from App-Tech. I just want to make two observations. One, I'm from Santa Cruz where we don't have high-rise buildings, but we do build a lot even through the recession, of multi-family but they're all three-story buildings max and either all three stories are residential or the first floor is a combination of commercial and parking and the upper floors are residential. But in almost all instances these buildings are designed, so that for the first ten years those spaces will be rented out as apartments, but they're all designed with separate equipment.

So that after ten years if the owner wants to convert them to condominiums in that case they all have to have their own water heater and, you know, space heater and air conditioner as far as they're concerned, because they don't want to have to worry about putting in monitoring systems and hiring somebody to do that. And worrying about how to pass that on to a condominium association they don't want to have anything to do with it. So that's just a type of building that you can't just always say well it's always better to have a central system. And, you know, there are other reasons economic other than just energy that drive people to do something else.

And the other point I want to make is your asking for ways of incentivizing this new equipment or new designs. Well one thing that's been a problem currently is that I work a lot on combined hydronic systems. A lot of the new equipment now is actually being installed the covers, because people don't want to have to go through all the rigmarole of getting equipment listed in an appliance directly and tested and everything until they're even sure it's going to work in California.

So I think what would be a great help to a lot of these people who are developing new equipment is if we came up with some sort of program where a certain number of systems, say a company could install 20 experimental systems in California without having it listed, without all this official testing just so they could gather the data. And the tradeoff would be since the Commission allows them to do this that they have to monitor the equipment and give the Commission back the data, so we'll build up a database on this new equipment and get some useful information. And it sounds like that would be a win-win.

MR. ZHANG: I will leave the second, the response to your second question to Martha because that's --

MS. BROOK: Yeah, I'm just going to take it and note it. I think there are kind of probably a lot of issues with that that the Energy Commission isn't responsible for implementing the standards, so it could be up to the local building departments to decide whether or not they want to experiment with, you know, buildings in their jurisdiction. I think that could be problematic, but I think that Pat's on the right track. I think that we do have to establish mechanisms to get manufacturers to provide us with performance data.

And we have been talking about options where we, instead of what Pat suggested what we would do is we would assume a default conservative performance curve or efficiency for this experimental equipment. And then require a performance curve that's justified and kind of self-certified by the product manufacturer if they want us to use that specific efficiency information in the performance calculations. So that's another approach.

MR. ZHANG: Yeah, regarding your first comments individual systems versus centralized systems, the code does not require you have centralized systems. But it basically set the performance level for centralized system if you do have a centralized system. If you decide in a multi-family building use the individual systems in fact you, in the simulation you're going to check something called, you know, the system one or something like that. They will be compared and followed requirements specified for individual systems. So the code allows you to select either system, but then apply different sets of rules for them.

MR. SPLITT: Just an example, the systems I typically do in these buildings are combined hydronics. They'll just have one little boiler and one small storage tank and one fan coil for the space heating. But and that's gas and I might -- and they're combined hydronics. So I might like to want to do an all electric building, so we'd get down to zero net energy. But right now currently I can't model a heat pump combined hydronic system except for one of these integrated tank and really cheap heat pumps sitting on the top that have no capacity. So you don't have enough (inaudible) to do space heating.

MR. ZHANG: Yeah, correct.

MR. SPLITT: So that's a problem with the modeling, yeah.

MR. ZHANG: I agree with you, we say this is actually a modeling issue in new technology and new systems. How do we calculate their performance, I think so yes we need to address that.

MR. OSANN: A quick question, you mentioned a plumbing design check, ACM plumbing design check. What's the acronym mean?

MS. BROOK: Alternative calculation method, it's what we call our performance compliance approach.

MR. OSANN: Okay, all right. And on one of your later slides on potential strategies you had one of your listed bullet points at the bottom were water measures, water efficiency considerations. But you didn't talk about that at all. Did you have some particular thoughts about that?

MR. ZHANG: I think this is limited. This is limited in a sense we, for a central system especially, actually for the single family we'll have the same issues. We often have the situation you wake up in the morning, the pipe's cold and you have to drain water, cold water down to cold water to get hot water. And those kind of things need considered in your overall system performance, because the benefit of a centralized system is trying to reduce that kind of waste by bringing hot water closer to your fixtures.

But individual systems may or may not achieve the same kind of savings or goals. I think so this is more a generic consideration, especially when considering overall system performance and not just the energy efficiency, water efficiency be considered. I don't think I going to specifically discuss a particular measure here, because we strictly speaking will only talk about hot water systems here. We're not talking about, for example, appliances efficiencies like low flow rate showers. I think that's not what I'm trying to discuss here.

MR. OSANN: Right and I did notice there wasn't any reference to end use measures or product selection or anything like that either, clothes washers or dishwashers or anything like that.

MR. ZHANG: That's related to what we can regulate in Title 24. Now potentially there are ways and I think it would be more creative in code design, require more creative code designs. And I have to say here we are not considering that. In general Title 24, I would just say that appliances efficiency has to match with federal efficiencies requirements.

And we have been talking in the past, for instance during the last code cycle to give different compliance passes. For example, in one compliant path you use minimal efficiency appliances, but have to add some level of cost effective renewable technologies. And the other stretch maybe is it allows you to not use renewal technology but to make up the loss you have to voluntarily use high-efficiency appliances.

MR. SPLITT: Correct.

MR. ZHANG: And those are the concept of what we discussed, it was proposed by different people. But in general here we are not trying to -- in my slides I'm not trying to address that issue. I think that can be a much broader topic. Jim please?

MR. LUTZ: Yeah, Jim Lutz, Lawrence Berkeley National Lab. Just a question on whether individual water heaters are more energy saving, water saving than central systems. And do you actually compare or have you just been told to keep them separate and rate them against themselves rather than against each other?

MR. ZHANG: One thing we do know in my slides, previous slides, is this overview of hot water system efficiency. CEC's overall 30 percent, this is average, right?

MR. LUTZ: Right.

MR. ZHANG: There's a huge variety here,

so one third of that is due to a distribution loss. So that definitely leads to consider how you can reduce it. The fact is that in a big building like those you have a couple hundred feet of pipe, recirculation loop running hot. At least the supply pipe you have to keep it hot, at least very lukewarm 24/7 just there present. It is a huge amount of heat loss, so we should consider what are the alternatives in terms of applications and come -- I'm not saying that I have a solution now. But just conceptually say that here is 30 percent versus you have a individual water heater, which if you bring up in apartment settings close to the fixtures and your energy factor is .6 and you add another 10 percent loss, you still achieve maybe overall 50 percent overall system efficiency. Conceptually there is some potential, how are you going to work it out? I think we can talk more details and in the breakout sessions and we probably can discuss in details.

Recently I had some discussion with Gary, you know, similar issues presented in single-family buildings where you do have individual hot water heaters. But you still have large distribution losses. What are the strategies to them, Mike? I think we can talk some more together.

MR. OSANN: Do you have data on the relative share of new construction in multi-family sectors that's served by individual domestic hot water versus central systems. Do you know how that's split?

MR. ZHANG: Actually I did have some data, I don't remember the number I have to say. Nehemiah, do you know that offhand?

MR. STONE: Yeah, I know it offhand, but it's about ten years old now, the data that I have. And that's in Southern California about 40 to 50 percent had central DHW, in Northern California about 15 to 20 percent had central DHW.

One of the issues that was mentioned by Pat was that there's a lot of these other considerations and so people are putting in individual systems also. Well, it turns out there's a number of insurance companies that will give you really, really higher rates if you have individual water heaters compared to having a central water heating system, because obviously if something goes wrong while somebody's on vacation you've ruined a few floors of stuff rather than having it down in your basement and just dealing with the distribution pipes.

So there are a lot of other considerations, some of them tilt one way. And I don't know why the insurance companies in Southern California focus that way whereas Northern California they don't, but that was the data we got. And that was from interviews with the builder, developers and architects and engineers.

MR. ZHANG: Amin, please?

MR. DELAGAH: I had a few broader questions for you. Any idea of estimates of annual gas load in multi-family? And can you also --

MR. ZHANG: What load?

MR. DELAGAH: -- describe what multi-family is as there is some overlap with what I covered with hotels. Does multi-family also, is it concerning nursing homes, you know, just a little bit more overlap of what would be multi-family and what the overall annual gas load would be in the multi-family segment?

MR. ZHANG: I don't think I have that overall like you do, like millions of sums for the whole multi-family buildings. I don't think I've ever done that calculation, it can be done but I don't have the number. As for example, I might assume maybe you have an interest in comparing for example to rest homes and office buildings, for other building types. And yeah, I think it's useful but I don't have the number.

In terms of a building kind of definitions what is defined as multi-family buildings, and that's a very tricky question. Actually sounds by -- I'm not so sure I have all the answers, but in terms of the overlap with hotels and motels we know they're considered separate in the code. However it's just for DHW systems that current Title 24 requires DHW systems in hotels, motels buildings follow the same requirements as those in multi-family buildings. They're still considered two types of buildings, but they just have to follow the same code requirement.

Given that I say you can have mixed-use buildings. And that I think what they need to do is, for example, for compliance purposes, for example, from the simulation you have simulate them separately. So you do have a first floor commercial use restaurants and that part of the space, restaurant space, you have to follow whatever the compliance for restaurants versus the rest of the building to compare to for example, for multi-family buildings compliance.

MR. DELAGAH: Thanks Yanda, I had a couple of comments and one more question, the ACM appliance check thing was something new that I didn't know much about. Something that we struggle in Food Service Technology is insulation is required on the recirc system. You know, sometimes we see it on the actual drawings, but even in new facilities we'll see bare copper pipe. There is really no compliance on that.

And something that we've seen some chain restaurants do is to ask their contractors to send photos of insulation on the piping before they put the sheetrock up. Would that be something that just emailing photos, is that something that you could have some kind of simple compliance to make sure we have insulation on hot water piping? Is that something, you know any comments on that?

MR. ZHANG: I think that what you suggest is what the building department would do for a compliance verification. But one thing I, again going back to the insulation code require I would say is it potentially has a large impact from the utility programs. And I think that if I probably also was to add is the HERS rating systems in California for residential building, which reach into multi-family also had a large impact. Where, you know, in addition to building department inspections you can have HERS raters come to have a further look of the compliance and especially those looking for credit.

And I think the market industry probably sees this as the norm now, as that you can take advantage of those. You can take advantage and implement efficiency measure potentially getting incentives. And you also potentially have HERS raters to enforce. And I think that has a large impact and what you said for example, noncompliance in restaurant buildings, it's not just for pipe insulation. I think it's kind of an overarching issue for lighting, for HVACs, and for many other things. They're not always in compliance I think. It can sometimes be a common issue. I don't have a particular suggestion for that.

This is also, the utility program has been struggling with in how to conduct or carry out what they call compliance enhancement programs, how to effectively do that. That's something they have been struggling with too.

MR. DELAGAH: All right, Yanda. I have one last comment on drain water heat recovery and I've heard of the horizontal drain water heat recovery systems that you can put underneath let's say the shower-tub, that can be used not to send out preheated cold water to the water heater, but just to the --

MR. ZHANG: To the shower?

MR. DELAGAH: -- cold water line to preheat the cold water line with the hot. Would that be more feasible for your multi-family application?

MR. ZHANG: In that case it can be used for single-family or multi-family or anything, because you basically recover heat for a particular fixture, right? I think, the way I see it is if you have longer usage times, more usages, that's always going to help you to improve the recovery efficiency. Because usually those kind of bulky heat -- at least I see today's design heat recover, heat exchanges itself is fairly large heat capacitor. So itself maybe suck a lot of heat first, not maybe a lot.

Now the only thing, that way I say the disadvantage is that then for each shower or each fixture you're going to have a heat recover exchange is in the cost issue. And you kind of lost the advantage you might be thinking in multi-families you can have. You know, one or a couple of heat recovery exchanges to collect where is heat from different apartments in a central save the overall system cost, then you've lost that. So other than that, yeah I'd say --

MR. ZHANG: A

MR. STONE: Can I jump in on that just a little bit? One of the options from all -- I mean, what you described about capturing the heat right at the place where the hot water is being used is exactly the right approach for single-family. And it's kind of like Larry's technology, there was a right approach for using demand control for a single-family, which is not, couldn't be translated directly over to multi-family. With multi-family on something like this John can probably speak to it better than I can.

But what you can do is have the copper pipe that wraps around the drain connected to your return loop in your hot water loop, so it doesn't have to be, you don't have to connect, you know, the heat. Preheating the cold water for the shower, it can be adding heat to the return loop going back to the tank in a central system.

MR. DELAGAH: So it might if the return is going back at a higher temperature you're actually cooling the return, so that'd be a challenge.

MR. STONE: It wouldn't be that hard to put a control that solenoid, so it would sense that.

MR. HOWLETT: Yeah, I have a question. I'm not sure if this question for Yanda, it make be a question for Carl Hiller or somebody else who's here. But when we looked at the code last time I don't think we looked at requiring three-eighths inch pipe to supply some fixtures. And it's my understanding that if we're looking at low flow rate faucets, three-eighths pipe is probably sufficient, but I'm not sure if three-eighths is enough if we're looking at 2 GPM showers or maybe still 2 1/2 GPM showers. Does anybody have information on that and is that related to the pipe run length, is there a certain length of pipe that we can serve with three-eighths but not beyond that length?

MR. ZHANG: He's smiling, Gary?

MR. KLEIN: And the answer is yes, go ahead Jon.

MR. CHANGUS: Oh, you go ahead.

MR. KLEIN: Technically as flow rates have gone down we should be able to use skinnier tubing at least on the branches or twigs that serve individual fixtures. There's nothing wrong with the physics, this is a case of where everyone's from Missouri and no one believes it's going to happen until we show them. Carl's standing up here to talk for a minute, but I think if I remember correctly we never got more than about two gallons per minute ever under any conditions going through three-eighths tubing. And so there's a functional limit due to the friction resistance caused by the water flowing through the pipe in and of itself.

And so there's probably some cases, there are cases where we should be able to use it, we certainly should be able to use it for fixtures that are less than 2 GPM maximum flow rights, which constitutes most lavatories and some showers, but not a tub-shower combo. You'll end up with limits and people complaining probably. But that's based on nothing or very little data and a bunch of mathematics. I think we ought to build a few and test them and see if they do what we're hoping they do or they don't and then we'll know.

MR. VAN DECKER: Okay, it's Gerald Van Decker speaking, I've been given the floor with an unmute and I've been anxiously waiting to talk. I'm calling from Canada, I apologize if I've interrupted any course of flow here. I have several comments, I'll first address adding the heat to the return loop with drain water heat recovery. The simple answer is no, definitely not, never. It will generally remove heat from the return loop ending heat losses and save nothing. Just examining the temperature ranges and whatnot if your return loop was going to be at, for example, 50 Fahrenheit sure maybe you want to consider doing that, but it's not.

A general comment, at 33 percent efficiency the entire hot water system is generally horrendous as people have discussed. And I've been waiting to speak for quite awhile on this, but the whole building recirculating system distribution loss has also increased space cooling loads, which should be a penalty I think in Title 24 in some way. One can mitigate insurance risk with overflow pans with individual water heaters, that is done and it's slows the drain for example.

Echoing earlier comments and some numbers I suggest that there should also be a credit for point of use water heating in multi-residential. And in addition to reducing standby losses you're actually going to get a reduction, because users are now paying for their consumption. They're going to reduce their consumption and I can give you an example of that. Years ago, one of my relatives used to turn on the shower for a half an hour and let it run before thinking about getting in the shower to steam up the washer. That just drove me absolutely crazy and I think that would give you another substantial savings in some cases.

One could also use off-peak electricity to heat water. An electric water heater is a great thermal battery and off-peak is much more environmentally benign and lower cost. And that could be included as a requirement if you're going to do something like that.

Now regarding drain water heat recovery market that's what I'm the expert in. I'll first state that I'm a professional engineer and founder of the company, which manufactures the power pipe drain water heat recovery systems. And I've been in business, started the company 13 years ago actually, I've been doing this for 13 years. It may be new to some of you folks, it's not new to me. Gary knows me quite well, he's laughing, sorry.

Last July two standards were published for drain water heat recovery systems. These cover performance and safety referencing of both has been approved by IECC. And there are at least three manufacturers with performance rated and labeled heat exchangers. And sorry, this is not a commercial, but I've got to bring you guys up to speed a bit here. There are more than

10,000 apartments and hotel suites with our units specifically, if I can speak of what my company's done and running for up to nine years now. And there are more than 25,000 homes with our units installed and that's in North America, Europe and somewhat in Japan.

Building energy code credits are available in Ontario, France and the United Kingdom. I personally participated in the ACEEE Hot Water Forum the last three years. I'll begin this year presenting in the fall. People like Nehemiah know that I'm real. He may think I'm crazy, but he knows I'm real.

There have also been lead energy credits for many years now and I am sorry to say guys, and I'll take part of the blame for this, California's way behind the drain water heat recovery. And the presentation of drain water heat recovery here in this forum is quite incomplete. I'm sorry, take it as it is and nobody contacted me and I'm the main person working in this in the industry plus my 19 employees.

But per preliminary analysis in the presentation of multi -- it was stated that in multi-family the long distances between the boiler room and the hot water fixtures make it very difficult. Well, that -- we just don't install it that way. That's just not the way it's done. The units are normally done for every four washrooms, it could be one for every one, it could be up to one for every six depending upon design constraints and payback requirements. And they're installed in the main drain stacker and separate drain and then it ties in. You don't do central systems for the entire building, it's just not cost effective. And you do preheat the cold water going to the shower and to the washer and fixtures.

And again we have 10,000 apartment suites and hotel suites running this way for many years. We weren't contacted about this. Oh well, that's too bad. I don't feel too bad about it, I should do a better job out there. Falling film drain water heat exchangers typically serve four washrooms as I said and they can have a 100 plus year maintenance life. I mean, it's for your life. They substantially increase effective hot water capacity, which actually can fix problems or will fix problems with heat pump water heaters for example that can't keep up to the load. Or you can reduce tank size and reduce recovery rates.

And they're simple to install during new construction, but they're very difficult to retrofit and that's a shame but that's the reality. But they do become part of the building's infrastructure and I think Gary Klein will echo that very well.

Horizontal drain heat recovery, a comment about that, there are actually shower stall type systems available in Europe. They do not perform very well. They are not double-wall vented, I cannot imagine how they'll ever be approved here for use, because they're not inherently safe. But they are used in Europe somewhat. Not to any big degree, it's usually falling film heat exchangers.

You can put any unit horizontal with falling film. For example, a two-inch unit will have about half the performance being horizontal versus vertical for falling film type. But it's still much more cost effective than solar water hearting.

So I rest my comments, anybody have any

questions for those comments or rebuttals or anything?

MR. STONE: Yeah, this is Nehemiah. It wasn't Gary that laughed, it was me.

MR. VAN DECKER: Thanks for your laugh.

MR. HILLER: Yeah, this is Carl Hiller. One of the comments I stood up to make, your lead in makes it a good segue. First of all let me state I'm a fan of heat recovery of just about any method, you know, drain water is one of many heat recovery methods. One of the things you have to be a little bit careful of when you talk about using your drain water heat recovery. To preheat the cold water that you're going to mix with the hot water to reduce energy is when you think about it, the only reason you're using the cold water to mix with the hot water is because the hot water was hotter than you needed it to be.

So the logical thing to do would be to turn to your hot water temperature down. And when you do that in the limit you use straight hot water and there is no cold water use and so how you integrate a drain water heat recovery system has to take that into account. I personally in my house, set my temperature down so that we take our showers with straight hot water.

And therefore using a drain water heat recovery to preheat the cold water would accomplish nothing. You know, it would have to go to my entering cold water into the tank to accomplish anything. So that's one of the many factors one has to consider when designing a system.

MR. VAN DECKER: But Carl, you cannot legally or I shouldn't say legally, I'll speak in Europe, you cannot do what you do with the water heater, because of Legionella risk. You cannot have the water heater at 105 or 110 Fahrenheit, it's impossible. You have to have at least -- well, in the United Kingdom they're a bit crazy, you have to have it at least at 140. But I understand the standards of the sub-point temperature is 120. That is even considered risky in some countries.

But you are absolutely right, if you do set it down to that point then that's a problem. By the way, that's actually if you do have individual water heating I have to state that I have a conflicting interest with that. But if you do have a individual water heating in multi-res then you don't have that problem, because you are doing equal flow to the cold side of the shower to the water heater. And you will get more performance, you will get more energy savings.

MR. HILLER: Well, just let me comment that I know a lot of Legionella. I'm on the ASHRAE 188 Committee and I have been doing things in Legionella for a long time, so I'm not going to go there. I know what the issue is, you're right it can be a concern. But it's only a concern, you know, to a certain level and one has to trade off the risk factors involved. Especially it has to do with who gets exposed. You know, what you would do in a healthcare facility or an AIDS care facility would be entirely different than what you would do in a place where there are primarily healthy people. So I'm not going to say anything more on that subject. But what you do is different depending on the application.

MR. VAN DECKER: Agreed.

MR. HILLER: The other comment I was

going to make was in regard to the three-eighths inch diameter pipe. Gary's right in that there is some research needed and it varies with pipe type. You know, plastic behaves differently than copper and other things and we really don't know what length at what flow rate we can get out of them.

I know when I did my lab tests on three-eighths inch pipe I made it 160-feet long, so I could measure the Delta-T accurately because it was going to be going through so fast. And then I found I couldn't get it going through that fast. So I could've made it half that length, because at 160 feet I could only get 2 1/2 GPM through it. But I probably could have 4 or 5 GPM I'm thinking at 20 feet. The problem is I couldn't measure the heat loss at 20 feet, because the resident's time traveling through the pipe was 2/10ths of a second or something. So there is some research necessary there.

We know by having the long pipe for the measurement purposes when we can measure accurately the heat loss, but we still need to go back and figure out what's the longest pipe we can use as a function of the flow rate we're trying to get. We don't know that part yet.

MR. VAN ABDULLAH: I just want to add that in the Southern California Gas Company we have done a number of projects for multi-family recirc loops for central water heaters. And as far as we know the health code does not permit the water temperature to go below 120 degrees.

MR. TAM: I have some questions online. George Nesbitt, are you there?

MR. NESBITT: Can you hear me?

MR. TAM: Yes.

MR. NESBITT: Yes, George Nesbitt, I'm a HERS rater. A couple things I want to hit on, looking at the RAS data, the average single-family so this is single -- oh sorry, residence, single-family and multi-family throughout California. Thirty percent of the total energy is gas and electric is water heating as well as space heating. So 30 percent each to 60 percent, so obviously getting reductions in water heating is important.

A couple of things, condensing boilers -- there is a lot of ignorant out there even among manufacturers, manufacturers reps, engineers, contractors. The needs for low return water temperatures, which kills the high efficiency. There is massive heat loss typically in the boiler room, so this is a function of pipe insulation and pumping, missing pipe insulation, poorly attached gaps at turns, unions not insulated, bald out.

Other equipment I've seen: heat exchangers not insulated quite common, also clamping directly to the pipe versus insulating the pipe and clamping over the pipe is another issue. Recirc loops are obviously massive energy use, most of the systems I see no control, temperature control is a lot less frequently. And the end control, I have managed to convince one client to go to demand control. Heat traps is something I don't see a lot of, it's more important if you don't have a loop or well even if you have a loop, if you have demand control. I don't see a lot of heat trapped.

I'm surprised Gary hasn't -- Gary Klein hasn't mentioned low-friction fittings like long-sleeved 90s. I think we require them on pools now, but not on plumbing. Speaking of controls, I see a lot of space heating boiler systems where the pump in the loop is operating year-round even if it's 100 degrees outside. So I don't know if outdoor reset is required, but it's certainly something we need, we should be requiring. As well as rather than just controlling the whole loop controls that would only turn on the loop if there's an individual demand as well as the appropriate outdoor temperature.

Pumps, I know in the code I don't think there's much credit available for say variable speed or pumps that have a little better control. The issue of combined space heating and domestic has come up. I've done a lot of residential combined, but I also convinced one multi-family project to go to a combined system. So rather than having separate water heater space boilers they're using the same boilers and then a tank.

And a heat exchanger, although I have I think seen one space heating that came off the domestic loop on a newer multi-family.

And I think we really need to look at the issue of central boilers versus individual water heaters on multi-family. I still see a fair amount of individual systems. What is the -- at what point does it make sense to go to a central and I think some of what drives it is also, you know, metering each unit. And I've seen it on affordable housing, but that means running gas lines and meters and everything to every unit too. So, you know, they go through a lot of costs and then, of course, upkeep to replace a lot of individual units. So I think more research on that.

Then solar hot water, we really need to create some HERS measure for it, because as part of our job is checking compliance for programs. And a lot of projects, multi-family projects now especially affordable, almost all of them have solar hot water. The CECS chart is limited to a certain amount of square footage, so we might need to work on that.

I've also noticed the solar fraction, even with a high solar fraction on single family you don't get a lot of credit. Whereas I have some multi-family projects where all their savings, you know, they're getting 73 percent solar fraction and condensing boilers. And their compliance margin on the water hearing budget is phenomenal. But I also see a lot of solar hot water tanks that are a long, long, long way from the boiler. And then of course, with all the loop losses they're doing less.

And the last thing I'll hit on is commercial water heaters versus residential water heaters. Currently the only way you can prescriptively put in a water heater on a change-out in residential is if it has an energy factor. Yet there's a lot of commercial water heaters going in that should require a performance calculation, but they're going in any way. So that's something we need to look at is commercial versus residential water heaters.

And that is it. Oh, and last question is the breakout session, can we participate online or is that going to -- are we going to be allowed?

MS. BROOK: This is Martha, George. I don't know, let's -- what are you going to be -- why don't we figure out. We'll figure out during lunch what we're going to do with our breakout sessions and then we'll announce to you and others online. So if you want to participate you can either --

MR. NESBITT: I can be there in my car in an hour and a half, but yeah it'd be nice even if we could, there's a lot of us online. So perhaps we could have a breakout session with just those of us online?

MS. BROOK: Well, yeah you guys could sing "Kum Ba Yah" and get back to us and -- okay, now we'll talk about it seriously. You know, but we need to keep going George, because we're like over an hour late or behind our schedule. So we need to get on to the next topic and we'll let you know right after lunch how those breakout sessions are going to go for the online participants.

MR. ABDULLAH: This is Ahmed, I just want to add something regarding. This road map, hopefully we will be discussing about existing buildings as well. Some of the issues that George raised is a big challenge in implementation as far as energy efficiency programs, because of the baseline comparison for energy efficiency is always assuming a system that is Title 24, so therefore it is in compliance. So we are unable to roll out programs that actually address noncompliant systems.

On the other hand if we come up with a new widget, let's say a better water heater or a control system or whatever, if we have to install that it could appear to be cost effective. But if you install it and then you could bring the system back to compliance it may no longer be cost-effective, because you've got to have the added cost. So those are the challenges we face with the existing market.

MS. BROOK: Well, good think we don't have any acceptance requirements on the water heating system, so compliance will be easier or noncompliance will be easier. Yeah, no I think this is a big issue for existing buildings, existing equipment where we've already raised it with the PUC and we'll be doing more of that in the existing building work that we're doing under 758. The useful life of equipment and the assumptions about you need to baseline, be in code, are huge impediments to existing building retrofits and we know it. And we need to do something about it.

But today we are going to focus mostly on code, but our code does reach into existing buildings. So I think that will be covered there. But if there's no other immediate multi-family questions I'd urge us to move on to single-family and then I would recommend that we break for lunch right after that. And then Danny and I can talk over lunch about getting us back on schedule.

So with that I think we thank you, Yanda. Thank you very much, and we're going to ask for Marc to come up.

MR. HOESCHELE: Hello, I'm Marc Hoeschele, Davis Energy Group and I'll be talking about single-family water heating. And I'll be presenting with Larry Brand, Gas Technology Institute, who's going to talk about combined hydronic and how that fits into the picture.

So with Davis Energy Group I've been involved in water heating activities for 25 years and Codes and Standards. We, Davis Energy Group developed the first detailed water heating methodology back around 1990, still doing water heating research for Codes and Standards as well as through the PIER Program and DOE's Building America program. We're also doing some studies there on, you know, advanced system technologies and modeling opportunities.

So what I'm going to do is provide an overview of the single-family market and present some recent research results that we collected on a GTI-led project that was funded by PIER.

This is a California Residential Appliance Saturation survey or RAS data from 2010 that shows the breakdown of gas energy usage for residential consumption. And the previous version of RAS, which I believe was 2005 showed a roughly equal breakdown of water heating and space heating. And the 2010 survey shows water heating becoming, you know, roughly half of the gas consumption in residences and space heating decreasing with the efficiency efforts and so forth.

From the CEC Energy Almanac 2009 data there's statewide residential consumption estimates, which is presented here in cubic feet. So we have 460 billion cubic feet of gas consumed in the residential sector as of 2009. So what I'm trying to do here is work through some numbers to kind of disaggregate what we're looking at in terms of single and multi-family.

Going back to RAS the average California household is at slightly over 190 therms of water heating per year. The saturation of natural gas water heaters in single-family homes is about 88 percent. You know, very high saturations for various reasons including fuel costs, Title 24, relative fuel costs of gas and electric. But Title 24 is pushing people to gas, so very high saturations.

In terms of census data we're looking at a little over 12 million households in California and roughly 70 percent are single-family. So, you know, breaking that, breaking the residential gas consumption down by the 49 percent for water heating and then 69 percent single family we look at our rough estimate is that about 70 percent of water heating use in California is in single-family homes and the remaining 30 percent in multi-family.

And, you know, the data Yanda was presenting in terms of recent construction characteristics, clearly there has been a lot more multi-family activity. Whether that's likely to remain a trend moving forward, it'll affect this balance. Looking at the single-family load in the data we collected in the recent field monitoring project we're estimating that of 165 billion cubic feet of gas consumed annually, about 34 billion can be associated with the pilot energy and gas storage water heaters, so the continually burning pilot of about 450 Btus an hour. So to keep the tank hot and do a little bit of useful water heating, you know, we're consuming roughly 20 percent of the individual water heater gas consumption.

So I'll talk a little bit about this project, this PIER Project that was just finished the end of last year, the title "Facilitating the Market Transformation to Higher Efficiency Gas Fired Water Heating." And there are several people in the room who worked on this project. It was fairly comprehensive looking at modeling and survey work and field monitoring and a whole range of activities.

I'm going to talk a little bit about the field monitoring, because there are some interesting findings there. We monitored 18 homes statewide, both with their existing water heaters and then after an advanced water heater was installed. So roughly seven or eight months pre-monitoring, four to five, six months post-monitoring of data and very high-resolution data was collected at these sites. We looked and of the sites, 12 were in Southern California, 6 in

San Diego Gas and Electric territory, 6 in So Cal Gas and then 6 up here in Northern California.

A range of advanced technologies were tested in this project including entry level, ENERGY STAR, storage water heaters. So they're at the .67, .7 EF level. And also condensing and hybrid storage water heaters that, you know, A.O. Smith has that hybrid product that's been on the market and there are others coming. And also some condensing storage units were tested and then condensing and non-condensing tankless.

A hybrid system is basically the market's response to take a tankless unit and add a down-sized storage tank to correct some of the delivery issues that part of the market isn't happy with. So it's one of the emerging technologies that's looking to marry the two system types.

So with this monitoring from the 18 households here what I'm plotting is daily hot water recovery load in Btus per day. And the red star shows what the energy factor rating is defined at, which is basically 64.3 gallons per day at a 77-degree Delta-T. So that's where storage and tankless water heaters are rated at or a majority of the residential products.

What I've plotted here then is the observed daily hot water recovery load from our field sites in terms of Btus per day based on the number of occupants. And, you know, this was one of the key findings of the study. I mean, the hot water loads that we see in California are much lower than what the energy factor test is suggesting. And this has implications for performance of both storage and tankless units, but more significantly for storage, because the system is in standby a greater percentage of the time.

So we had three households out of the eighteen that exceeded the energy factor level. But there were many, many that were 20 percent of what that rating level is and its milder cold water temperatures is a big factor and lower hot water set points. So instead of energy factor looking at a 77-degree Delta-T, cold to hot we were more in the 50 to 55 range. So suummer loads in particular are very low, especially in Southern California.

So from the various sites then with each bar representing a site and PG for PG&E, LA for

So Cal Gas and SD for San Diego this is the -- we didn't monitor the base case water heaters for a full year, but we extrapolated based on the data collected. So this is a breakdown of annual pilot energy and projected total energy, including the pilot for that household. Of all these sites there was PG5 was a tankless to begin with; all the rest were storage water heaters of different vintages.

And so several interesting things, there is a noticeable variation on the pilot energy between some of these sites. On average it was 40 therms per year and there is a site or several sites, ST3 and LA4 are both very close to where the -- well the pilot energy is greater than what was required to meet the end use loads and the distribution losses.

MALE VOICE: Increase the pilot.

MR. HOESCHELE: Right.

MALE VOICE: Just make sure nothing runs but the pilot.

MR. HOESCHELE: This graph now is kind of the summary graph looking at all the different product classes and combining the data. On the left axis we have annual delivery efficiency.

You could call it an energy factor even though it's not defined exactly the same, but energy out divided by energy in. And on the right axis is the daily recovery load in Btus instead of gallons per day, primarily because in California we have this situation where we're doing a lot less water heating than certainly in cold climates.

So for each of the product types then we've broken down, you know, generated an efficiency curve. The red dotted line shows where the average household was, which is at about 27,000 Btus per day, about 7800 Btus recovery load per person given the occupancy of the homes we had. And that compares to the 41,000 Btus in the energy factor test.

So with Amin and Yanda's presentations with central systems and highly loaded systems, the reality is you're operating the unit in an environment where the load is much higher than the standby. And what we observed in many applications is, you know, it's kind of the opposite and what that's doing is moving us down these efficiency curves; down to the point where the efficiency, especially the storage water heaters is really dropping off.

The purple lines show the average load for that product class that we observed in the field, so the way that the units were distributed among the households there was different load variations. And the fact that condensing storage was the highest load was a decision made for our bigger households to make sure there weren't going to be any capacity issues in satisfying the loads. As you can see the storage units tend to drop off a lot faster at lower loads. The tankless shows some performance degradation, but it's most severe at the really low levels. Condensing storage and condensing tankless are intersecting at about 45,000. They're right over the energy factor load level. And beyond that the condensing storage started to show an efficiency advantage.

So a key finding here is loads affect the performance and the standards do take that in to account as they handle storage water heaters. They do as the load, the ACM model projected load, decreases with smaller building size. It affects the efficiency of the water heater and that's accounted for.

So for the base storage the existing storage water heaters in the field their average nameplate efficiency was .58 EF. As we found them under observed loads they performed at 8.50, so lower loads is a factor there. There could be performance degradation over time even though Robert Davis tested one of the 10-year-old water heaters that was pulled out and it performed pretty much up to original specs. So loads and degradation over time are two factors at play.

Likewise for the ENERGY STAR water heaters, .67 was average product class rating and they performed slightly under that. Tankless, .82 and they came in at .71. The condensing tankless a little bit over .94, they came in at .77. And condensing storage with a thermal efficiency rating of 92 percent came in at about 75 percent.

If we take all, use those performance curves on the prior graph and move everything to the energy factor rating level, we have this efficiency correction to reflect what the impact is. So if we brought our existing water heaters up to the energy factor level of performance we'd gain 6 EF points bringing them to within 97 percent of rated efficiency. Likewise, Energy Star has a smaller correction, but it's looking right in line too.

Tankless, about 10 percent underrated and that's kind of consistent with the Title 24 degradation, the cycling degradation of 8 percent, which is assumed across the board for tankless units. Condensing tankless showed a little bit bigger degradation, so maybe looking forward there's an opportunity to provide a different correction factor for condensing tankless water heaters.

And condensing storage they're not going to have an energy factor rating, at least the units we tested, so they came in at about 80 percent of their thermal efficiency. And thermal efficiency doesn't take in to account the standby effects, but it is how the units are presented. Nehemiah?

MR. STONE: Clarifying question on this, can you explain the relationship between those first three columns? The way they are labeled I would assume that I could add what's in the third column to what's in the second column and I would get what's in the first column, but it doesn't work out that way. So can you explain the relation?

MR. HOESCHELE: Oh, okay average rated, so that's nameplate efficiency. And so monitored is our aggregated, monitored efficiency for that product class. And then the correction is if we move up or down the efficiency curves that we've defined, that's the correction we would apply. So the base storage would go from .504 to .564, so it's not quite at the .58 nominal class rating. It's at 97 percent of that.

MR. STONE: Okay, so where's efficiency correction coming from? I guess that's --

MS. BROOK: So what, in the field they couldn't replicate ENERGY STAR test conditions, so that's what the efficiency correction is, is to get it back to the ENERGY STAR or not ENERGY STAR, but the federal energy factor test condition.

MR. ABDULLAH: I think it's the recovery amount correction, because in the field the recovery was lower than the test recovery.

MR. HOESCHELE: So using the shape of this graph is how we move from the purple point where it was observed and we adjust it to the energy factor level. So the base storage is coming from here, .504 and we're moving it up to .564, if it had seen the loads it was rated at.

MR. VAN DECKER: This is Gerald Van Decker, how are these curves produced?

MR. HOESCHELE: Well, so we had all this data and we combined, looking at on a daily basis, we looked at the recovery load and the energy input and with that variation we could define these curves and average them across the product class.

MR. VAN DECKER: Okay, so right on topic, it's really cool you've done this actually. I have submitted to ResNet and actually the EPA had a correction factor somewhat years ago. But I've submitted to ResNet and now submitted the document to the Energy Commission, an all-inclusive equation. It's this really nice, big, elegant equation that I presented at ACEEE last year. Gary Klein is quite familiar with it.

And it corrects for the load, it corrects for the temperature, the sub-point temperature water heater, your inlet temperature; you can actually calculate your energy factor for any day if you know the load and all these numbers or for an average day in the month, whatever you want. So I think it's similar to this and it's based on first principles. And my little sneaky thing in there is it adds drain water heat recovery into that, so you get a whole water heating efficiency and it also includes hot water distribution efficiency, which Gary has input into.

MR. HOESCHELE: Right, and the standards do reflect, you know, there is a curve in the standards that adjusts the rated performance of a storage water heater based on the load. A tankless water heater has a straight cycling degradation penalty currently.

MR. ABDULLAH: So Marc, I have a question.

MR. VAN DECKER: I'm sorry, just on that, I'm not familiar with that, so I'm going to need to ask you for that reference later.

MR. HOESCHELE: Okay, yeah there's an appendix.

MR. VAN DECKER: Or if you can provide it to Gary Klein.

MR. HOESCHELE: Yeah, there's an

appendix that documents the full water heating methodology.

MR. VAN DECKER: Is that used in Title 24 now?

MR. HOESCHELE: Yes, it has been since 1990.

MR. VAN DECKER: Okay, thank you.

MR. ABDULLAH: Marc, I just had a question. In this correction are you taking in to consideration the standby losses and somehow or not? I don't know.

MR. HOESCHELE: Well, yeah I mean it's buried in the data, the standby effect, and that's explaining the tailing off of the efficiencies.

MR. STONE: Okay, thanks. I hate to sound stupid, but I do it often. I guess I'm still not clear, that red column there, is this something you developed from your research or is it something that you got from ASHRAE or is it -- I mean where?

MS. BROOK: No, it's from the chart.

MR. HOESCHELE: No, it's from the chart basically.

MR. STONE: I still don't see it, Marc.

I don't --

MR. KLEIN: Microphone, please.

MR. HOESCHELE: Oh, Jim?

MR. LUTZ: What he did was he fit the daily, each day's data for that type of water heater, came up with a curve. That's the curve. And then said the daily recovery load and the energy factor test is 41,132 Btus, so if you go along that curve to 41,132 Btus per day that's what that type of water heater has, sees it from the field if it was operated under energy factor testing conditions. I think I'm just saying this correctly.

MR. HOESCHELE: Yeah, that's correct.

MR. LUTZ: So the difference between -- so go back to the actual table. The difference between what that type was rated by the energy factor from a lab test whenever it was tested versus what they saw if it was operated at energy factor loads in the field is what the efficiency correction is. So what that's saying is the energy factor test is actually pretty accurate relative to the field, if only the field would use that many Btus per day of hot water.

MR. ABDULLAH: And also I think Jim the

numbers are lower for California, because of the way we use water; whereas the other factors are sort of a national average.

MR. LUTZ: Well, that's why actually the efficiency corrector is very small if you look on this column. And that's because if you took it back to what was used in the energy factor, whereas the field efficiency is much slower, and the adjusted and rated is based on the California field versus energy factor.

You're still looking puzzled Nehemiah.

MR. STONE: Yeah, it seems to me that either there's one column in there that is not as necessary or there is a column that is necessary that is not there, because it still doesn't make sense to me, sorry.

MR. HOESCHELE: There could be an additional column added for energy adjusted observed field efficiency.

MS. BROOK: Okay Nehemiah, Jim and Marc are going to take you to lunch and we're going to keep going.

MR. HOESCHELE: So there are implications here too. These were all existing houses in the field study of five to fifty years old. You know, a wide range of -- and we didn't very carefully document all the hot water end uses. We did take some shower flow measurements in the master shower, but looking forward as we go to more water efficiency, better appliances, other technologies that are going to reduce loads we have to keep this in mind where these water heaters are going to end up as loads go down.

In terms of gallons per day we're looking at about 15 gallons per day per person, so compared to the 64.3 in the energy factor test that's about a quarter average household size California nationally 2.9, 3.0. But your single and two-person households, this has implications. So I think that's the last one for me, so Larry is going to talk.

MR. BRAND: You'll sum up later?

MR. HOESCHELE: What's that?

MR. BRAND: You'll sum it up later?

MR. HOESCHELE: Yeah.

MR. BRAND: Okay, I wanted to, I'm Larry Brand with GTI. And I just wanted to touch on combo. It's already been touched on twice, so maybe this won't take that long. And then at the end Marc has some summary comments.

But this is just some of our work on combo systems. Our friends in Minnesota call them combi systems integrated heating and hot water. The work that we are doing in our lab, we're doing tankless technology, but you can do them all: storage tank, tankless, combo and hybrid systems and high efficiency and mid efficiency. It's pretty agnostic to the equipment that you use, but basically these are the components: the hydronic air handler, the coil and the tankless water heater.

There's a lot of research going on on these systems, so we wanted to kind of introduce this in to the Title 24 process, because these things are coming. There are a lot of manufacturers who are producing product and there's some benefit to California. I think we've heard today, already in multi-family some folks are installing these devices with some pretty good success.

And then so here is some of the work that's being done, market analysis all the way through energy efficiency pilot programs that we have a project that we're working with Ahmed on in So Cal Gas territory as well as Nicor, NYSERDA. Building America has a couple of different activities going on in combo systems and then the gas industry itself, through ETD, that's the industry research consortium. So plenty of research going on, so these products are coming and I think one of the things we'd like to do in residential is make sure that they're adequately characterized for Title 24, so that's kind of my bottom line.

So energy savings over typical, we're just comparing here a 94 percent combo systems versus a standard 78 percent AFUE. Make a minimum furnace with a .59 energy factor water heater. So you kind of get the idea that it's not a fair comparison here with different baselines for efficiency, but because you have a single thermal engine the cost associated with the high efficiency tankless water heater and an air handler should be considerably less expensive than a standard furnace and a standard water heater, because you have the single thermal engine, you have that benefit. Right now the market clearing prices don't get you there, but eventually you should get there.

So here's some of the benefits comparing those two devices. Cold climate gives you a little bit better savings than a moderate climate and then you can see the annual cost savings of 238 bucks for cold climate NYSERDA. And then hot climates, which we tend to see more here in California, around in the hundred dollar kind of a neighborhood. So depending on market clearing prices, it could go that way.

Just to mention the utility pilot programs of that 90 percent energy factor, this is NYSERDA and Nicor Gas in Chicago, so 90 EF tankless water heater and a hydronic water handler from various partners now, and then 40 residences were installing these systems with mid-efficiency. We're targeting homes with mid-efficiency furnaces to do the upgrade and doing some data collection sponsored by Building America as well.

So DOE has kind of gotten involved. We're doing some field performance. And one of the larger issues is contractor support installation. And this kind of goes back to getting the return water temperature right in order to get the condensing performance out of it, so we're all saying the same thing here. If you have a combo system it's similar to the loop where you're going to be returning warm water to a water heater, so the performance can vary significantly.

And if you don't get it installed correctly to reduce the return water temperatures it can affect your performance. Amin talked about this as well in the storage water heaters for commercial. The storage tank water heaters tend to work better in commercial where you have a loop without a constant recirculation system. So if you have cold water you get better heat transfer. We're seeing that in the combo system world as well.

There are a lot of barriers and maybe I don't want to get in to these too much, but distribution channels, the existing furnace industry doesn't really care for this product too much. And then some past installation mistakes that were made, you know, poor labeling, those kind of things. So we've seen some poor performance and we have to get over that hurdle, because we know a lot more about these systems. So the package systems where the controllers are designed correctly and then some trade education and training the trades and getting the contractors in line with combo system.

But I guess my point here is that a lot of this is going on right now, so I think now is a good time to start talking about how do we apply combo systems in Title 24 and get the best performance that we can get. And I think that's what's in here -- oh, no this is your summaries. We're going to go back to Marc's summary and I can take questions on combo later, but we're trying to get you back on schedule.

MR. HOESCHELE: So here I just really developed a fully comprehensive list, but just a few thoughts and discussion points in terms of that road map. On the equipment side Title 24 handles storage water heaters pretty well in terms of efficiency versus load and tankless, as we talked about, it looks like based on the field data we collected that non condensing tankless is appropriately handled in Title 24. Condensing tankless, more observed degradation, there may be room for more study there.

New products are coming; hybrid water heaters and so forth need more study, how they work and the controls and all that. Heat pump water heaters is certainly an area that is getting a lot of national activity and is certainly a component in all electric Z&E approaches and so forth. And you know, currently it's pretty challenging how they're handled in Title 24 with the relative TDV rating.

I don't have a lot of experience with the new beta model that's out there, but the one run I did it came out a little bit worse than the standard gas water heater and whether that's where it should be or not is a point of discussion. But how heat pump water heaters are handled and compared to what base case is an issue.

Other emerging products out there, I mean drain heat recovery Gerald has talked about that. And clearly there's interest and a need to get them recognized. Three function heat pumps are limited, but they're also out there and so other technologies like that to make sure that they're handled appropriately in Title 24.

Larry talked about the combined hydronic and there is a lot of research coming out and in process that will inform, optimize design procedures. And, you know, the rating side of the equipment is another problem and I know ASHRAE is looking at that. The compliance method that exists is very simplified and definitely needs work. That's been recognized for awhile, but now since technology is gaining traction it needs to be on the table.

Plumbing design, which we haven't about much yet, but there is a lot of work going on in model development and understanding single-family distribution as well as multi-family is challenging. Single-family more so, because at least the multi-family you have diversity simplifies how you recognize loads and distribution. In our 18 homes you'll see all kinds of patterns.

There was a discussion about insulation and the benefits, and like Yanda said if the time interval between draws, which is a majority or a significant fraction of the draws is small, less than 10 minutes, insulation won't have a significant impact. It'll give you slightly warmer water. If it's over 45 minutes, again, it's not going to have an impact.

So understanding the last bullet point, bringing that up, understanding the load patterns is really important and developing something that is representative and defensible is a challenge. Jim's been working on that for several years. Getting to know what new home load patterns look like and usage quantities, is that going to be 20 percent lower than where we are now? There isn't a lot of data out there, so all that's important.

And then the point right above this compact house design is something that -- this is an idea I'm throwing out there. There is a credit in the upcoming Title 24 that will give a small benefit for a compact plumbing distribution system. But it seems in my mind if we can somehow package an overall compact house design credit that takes in broader benefits, I mean that might be an effective way to get enough savings potential behind it to generate interest. Because right now the way building envelope is handled there's no disincentive to making your house whatever footprint you want. And once you do that, you add more wall area and you also impact the plumbing design and the duct layout, so if we can put all those together it's something to talk about as a potential strategy.

So Larry, I don't know if you have any

final thoughts.

MR. WEINGARTEN: Marc, this is Larry Weingarten. A question about tankless heaters, fairly high degradation, any comment on where that comes from?

MR. HOESCHELE: For the condensing or both?

MR. WEINGARTEN: For both.

MR. HOESCHELE: Well, so the prior work we had done did develop the 8 percent degradation that's in Title 24, it looked at hot starts, cold starts, cycling and applied some generic load profile to come up with a weighted impact. So I mean, that's clearly the factors that are driving the tankless degradation is what is the load pattern, how long are the draws and the time between draws. So the field work done here, you know, I think fairly, reasonably validates that earlier effort.

On the condensing side it probably would have to do, and others might have more information here, but not being able to achieve condensing efficiency as reliable, given the drop off valves that the units are subjected to.

MS. BROOK: Are you starving? Thank you

very much Mark and Larry.

What I think we should do is break for lunch and if we could get back at 1:45 we will resume. And for those of you on the phone when we get back at 1:45 we'll let you know what we're going to do for the rest of the day and how you can participate. So thank you very much.

MR. VAN DECKER: Sorry to interrupt, were there other questions for this presentation permitted or we're closing it off?

MS. BROOK: Yes, but recognize that we're all starving, so we're not going to give you a lot of (inaudible). So yes, if you have a question we can field it.

MR. VAN DECKER: I'm just wondering why, I mean the pilot stuff for the -- I'm just wondering why the non-pilot light tank water heaters weren't studied. In looking in Ontario for example, about 95 percent of our tank water heaters, both retrofit and new construction, our EF267 do not have pilot lights.

MR. HOESCHELE: Well, so they were studied in the advanced case water heaters. So let's back up here. So the orange line here is the efficiency curve for the entry level spark ignition ENERGY STAR water heaters. You know, again, the low loads and the parasitic energy, these about 110 kilowatt hours a year for any of these units that are hooked up to electricity, which is any of the tankless or --

You know, so that, again it's just another parasitic that is degrading the performance. As you get higher loads that impact gets diminished, but as far how common they are I don't think they are that common in California, but at the ENERGY STAR level. Basically on an economic basis Robert Davis had one of those units in his house and he figured he was saving three cents a day I think or something like that between gas savings and the electrical energy increase.

MR. VAN DECKER: In Ontario there's no additional cost for them, because they're just standard. In fact I think you can more for a lower EF water heater, because they're just not available.

I just have a comment too, because I may not be able to attend the session this afternoon. Gary Klein has developed a very good model for the hot water distribution efficiency, for measuring it at two levels as well for what that correction should be. And just another comment on that and drain water heat recovery is there part of it the infrastructure of the house and the both together, they're low loft 5 to 10 primary water heaters. So primary water heaters, tank, tankless whatever, heat pump water heaters will come and go, but these systems will stay and that's why they do need to be very seriously considered.

And drain water heat recovery is not just a cold climate technology; as with all heat recovery technologies the percent savings is about the same, regardless of location. It does depend upon habits in the house without question, but energy savings is proportional to the load. If you have no load you won't save anything of course. So anyway thank you very much and thanks for letting me speak.

MS. BROOK: Thank you.

MR. KLEIN: Oh, Martha too, we won't be able to get back until 2:00 for lunch. We won't be able to get back until 2:00 with lunch. There's 30 of us going out to find food.

MS. BROOK: Okay, 2:00 o'clock we'll

return and that's 15 minutes less of road mapping work, but that's fine and we'll see you then.

(Off the record for lunch 1:06 p.m.)

(On the record at 2:04 p.m.)

MR. KLEIN: Martha, an estimated time for folks on the phone would be between 3:30 and 3:45.

MS. BROOK: Okay, so between 3:30 and 3:45 approximately based on this morning's schedule it might be like 4:15-ish so let's -- anyway ballpark around that time for checking back in with us.

And now we're going to turn it over to Danny Tam, who's going to walk us through some standards information.

MR. TAM: Okay, and welcome back. In the interest of time I'm going to try to go through these slides quickly, so just bear with me. Just a reminder all the slides today and the transcript's going to be available online and we'll post them shortly. So I borrowed this flow chart from the OAL website, so basically it all starts right here at the legislature.

MR. LUTZ: You immediately jumped into an acronym that I did not know.

MR. TAM: Oh, sorry.

MR. LUTZ: And I'm actually pretty up on the acronyms, so there's probably people who need even more help on them than I do.

MS. BROOK: The OAL is the Office of Administrative Law. It's basically how all state agencies develop regulations. And if that's not -- that picture is, you know, pretty much gobbledygook as far as I'm concerned. So it's like that's why the standards that you don't like the other end, because of this picture right here so you can blame it on that slide.

MALE VOICE: (Inaudible)

MS. BROOK: Yeah.

MR. TAM: So it all starts right here at the legislature. In our case the Warren Alquist Act gives the Energy Commission authority to develop energy efficiency regulations.

So a bulk of the work is actually done right here, what we call pre-rulemaking activities. Basically we're getting inputs from everybody: all the stakeholders, the utilities builders, building officials to get an idea what should be included in the next round of standards.

Bear in mind that anything that we consider, any measures, what to look at from the perspective that it needs to be cost effective, it's actually technically feasible and it actually saves energy. So there's quite a lot of negotiating going on in this pre-rulemaking phase and hopefully all the differences will be worked out. Because once after the pre-rulemaking period we've got to place where we call a NOPA, a Notice of Proposed Rulemaking and also Initial Statement of Reason, which is basically to summarize what we're proposing and why we're doing what we're doing. And along with that we've got to propose the proposed standard with what we call the express terms.

Once we publish these documents it immediately starts the official rulemaking process.

So the public have 45 days to comment on anything that we propose and they can respond to a docket. So at the end of the 45-day period we're going to have a business meeting right here in the Commission with the commissioners. And they will consider all staff inputs and comments that we've received to see if the proposed measure should move forward.

So at that point if there's no changes non-substantial, we can move into what we call the Final Statement of Reason. So basically it's again a summary of what we're proposing, why we're doing what we're doing. In addition, any comments that we receive will be part of this Final Statement of Reason. And also any comments then we have to respond to each comment. Now you understand why we would like to work out any differences at this part of the pre-rulemaking phase, because we have to respond to every single comment when we have the actual rulemaking process.

So in the case that there is actually changes in the standard and they're substantial we might move in to this 15-day period. It's similar to the 45-day, but now it's 15 days, so we have 15 days to comment. At the end of that period we have another business meeting and at that point if there's -- if all parties agree we move into the Final Statement of Reason.

And a lot of people don't know this, but the Energy Commission actually doesn't own the entire Title 24 process. The Building Standard

Commission actually owns the whole Title 24, so we developed Part 6 of Title 24. So when we're done we give everything to the Building Standard Commission and they do their rulemaking process and at the end we adopt their regulation.

Okay, I mentioned everything we do has to be cost effective, so at the beginning of any standard we look at our life cycle costs and also to see if we need to update any of our methodology, any weather files, TDV values. And you can see, like I said we get inputs from everybody, so if you want anything to be included in the standard the pre-rulemaking part is where you want to have your voice heard, basically.

MR. LUTZ: Can you explain TDV?

MS. BROOK: Do you want me to do that Danny?

MR. TAM: It's Time Dependent Valuation. I'll briefly talk about it in the next presentation.

MS. BROOK: Okay, so let's wait for Danny to talk about it and then we can talk about it more after that.

MR. TAM: And as far as the life cycle costs effectiveness for residential building we look at a 30-year life cycle. For nonresidential we're looking at 30 years for envelope and 15 years for lighting and mechanical and we're using a 3 percent real discount rate.

So for 2013 we had a lot of support from IOU'. They had a lot of stakeholder meetings in support of the standard, so for 2016 we've probably got go through the same process. So be on the lookout for between now and next year we're going to start having workshops related to Title 24.

MR. HILLER: You say you have a 30-year life cycle --

MR. KLEIN: I can't hear you if you're not on the microphone or I can't record it.

MR. HILLER: Carl Hiller, when you say you do a 30-year life cycle, I hope you're not inherently assuming the life of the equipment is 30 years though, right? Like you wouldn't assume a water heater lasts for 30 years?

MR. TAM: Right, so it's 15 years for lighting and mechanical, for --

MS. BROOK: But just for non-res we don't assume you're replacing your water heater in that 30-year time period.

MR. HILLER: So you're assuming the water heaters and --

MS. BROOK: Everything in the residential structure is lasting for 30 years, that's what our assumption is.

MR. HILLER: So you're looking at water heater lives of 30 years?

MS. BROOK: Well, we're not -- what I'm telling you is that we're not assuming a replacement midstream of the equipment. We're treating the whole residential -- you know, everything in that residential structure over a 30-year time period.

MR. HILLER: So that would tend to over-value products, because they're not really going to last that long. They're going to run 10, 12 years.

MS. BROOK: Yeah or 30, right. I mean how often we replace the equipment -- I mean, I think this is a huge discussion. And certainly one of the good things is that you can participate in our process, because we do update it before we start every standards update. So we make those assumptions, but that's been the way we've done it for many, many years. But the --

and Jon's going to come up here maybe to clarify, but I don't think that we assume a equipment replacement in the middle of residential 30-year time period.

MR. HILLER: So just so I'm clear, if --

MS. BROOK: Wait, wait, wait let me -- let Owen -- Owen's looking at me like I'm crazy, so.

MR. HOWLETT: Sorry about that, was that obvious?

MS. BROOK: Uh-huh..

MR. HOWLETT: I'm sorry, but for some technologies we do, so for the lighting stuff, if they're --

MS. BROOK: For non-res lighting, non-res lighting, right?

MR. HILLER: And res lighting, so if there are things that we know need to be replaced like light bulbs we factor that in on what we think is a reasonable replacement cycle. So I'm not sure what's been done in the past with water heaters, but I don't think there's anything inherently in the TDV methodology or within our constraints that would prevent us from assuming a ten-year life or --

MS. BROOK: That's right. What I'm saying is that we state our assumptions at the beginning of the update and that's when we set it in stone and we want all the analysis to be done the same way. So my understanding was that everything on the residential side had a 30-year life. And if we haven't been doing it that way then you should jump up and correct me, because I don't anything else about that.

MR. ZHANG: Yanda Zhang and I just want to comment. For 2013 code do up, for example, the solar water heating for multi-family buildings?

MS. BROOK: Multi-family is considered non-res.

MR. ZHANG: Well, you have low rise multi-families. And we also had, if you remember, this high efficiency water heater ready measure where we compare if you're going to use high efficiency for condensing water heater versus the conventional water heater during the 30 years. We did assume --

MS. BROOK: One replacement?

MR. ZHANG: Yeah, replacement is routine, so there are incremental costs that occurred at the beginning and somewhere in the middle.

MS. BROOK: Okay, so I think, and we don't have to go in to the details now, but what I'm claiming is that we'll document it. We do document it, it's on our website, and we will update it every code cycle so you could look at what we've documented for the 2013 standards. If you think it's unacceptable or not clear and not thorough we can certainly, and we will certainly at the beginning of the 2016 update, update it again.

MR. TAM: Okay, this is a tentative schedule for 2016. Like I said from between now and next year we'll have this pre-rulemaking process with the goal to have the standard adopted on January 2015 and effective the date of January 1st, 2017. Any questions on rulemaking in general?

MALE VOICE: Can you move back one slide, please?

MS. BROOK: So we're going to publish this slide deck as Danny said too, so you don't have to commit this to memory.

MR. LUTZ: When you, everything's based,

how do you decide what the baseline is for what? So if you adopt something as a standard, then it's relative if the life cycle cost is lower than the baseline?

MS. BROOK: So the baseline is the current standard.

MR. LUTZ: Okay, and --

MS. BROOK: Yeah, because that's what we're assuming is that is actually that we're getting full compliance and that is the baseline in the buildings, right? But that's only true for new -- well it's true for new construction and also additions and alterations. We're assuming that the baseline is you're meeting the current code and --

MR. LUTZ: At the time you do it, yeah.

MS. BROOK: Yeah.

MR. VAN DECKER: Sorry, Gerald Van Decker here. I might have missed that. What is the mandate or the goal for the next, for the 2017 code to be how much more, how much better than current code?

MS. BROOK: Well, there the Energy Commission staff does not want to continue to use a percent better than code metric, because we think it disadvantages us to a significant degree. Because as we get closer and closer to zero net energy performance level the energy that we're actually managing under the Title 24 update is smaller and smaller every code update. So to say that we're going to get 50 percent or 30 percent better sounds very impressive, like we're doing this huge list and it's going to impact the industry in this major way and it's a tiny bit of energy. So we're really trying to move the metric to a whole-building energy use per square foot metric and say that's our target.

We haven't established those targets for the next two code updates, but we're, you know, aiming to do that. We don't want to get in a position where we're claiming we're going to get 50 percent better in a code update. Then everybody starts freaking out then, because that's a major change when it's really a tiny bit of energy. And that's the reality of where we're going and what we've already experienced and we intend to change that.

MR. VAN DECKER: Okay, so to add to that I know the European value is the energy per square foot and I think they inherited it from

California. And there's obviously some risk in that, because it can result in larger houses for the same compliance. And what -- but specifically for hot water or for water heating the loads are not really well modeled or based upon per square foot, but rather bedroom count, for example, like resident does. So I'd just like to see some decoupling of that if you could, if you're going to do it on a per square foot basis.

MS. BROOK: Well, we're not, we wouldn't for loads that don't change per square foot. We're not going to develop a metric per square foot, but they're going to get bundled in to a whole-building energy per square foot number. So we may determine that the target or the goal for water heating, you know, based on the current water heating load metric that everybody agrees to, but when we roll it up in to a whole building Title 24 target it's going to be a whole building, it's basically a kBtu per square foot number. Now having said that, that kBtu was going to be source energy number. We call that TDV, Time Dependent Valuation of Energy. It's basically an hourly source energy multiplier for electricity, propane, gas and other fuels. And Danny is going to get to that in his next presentation.

MR. VAN DECKER: Okay, thank you.

MR. TAM: If there's no more questions I'm going to move into energy budget. Okay, first a couple of definitions. Energy budget is the maximum amount of TDV energy that a proposed building can be designed to consume. And TDV energy is the time dependent value energy. It's a time varying energy used by the building that reflects all the costs of energy at the statewide level. Basically TDV is a hourly value based on the climate zone. It's different for -- depends on which fuel type that you have: electricity, propane, gas. So depending on what it is it has a huge difference. You can see when I show you the runs that I did.

MR. LUTZ: So is there one TDV for the building even though it's using electricity and natural gas?

MS. BROOK: No, there's a different TDV multiplier by hour, by climate zone and by fuel type.

MR. LUTZ: So does a building have a

budget of electricity and a different budget for natural gas and can you trade them off?

MS. BROOK: You can trade off, you can definitely trade off from fuel to fuel, because everything is converted to a TDV metric and at that point it's all tradable.

MR. LUTZ: Okay.

MS. BROOK: I think the important thing to understand about TDV is that it's not a site-energy metric it's a source-energy metric. We're counting the cost of energy all the way back at the power plant for electricity, so it counts the energy that it costs to generate electricity, to transmit it, to distribute it and similarly for natural gas. It doesn't count extraction costs, but it counts transmission and distribution costs for natural gas. And it also attempts to put a value on carbon.

So it's really important, we think for California, because it gives us the right valuation for energy at every time of the year. So we can, and our standard do, take into consideration when energy is being used throughout the day and throughout the year. So that's why buildings in California, at least buildings that comply with our standards, really focus on shifting that cooling peak either reducing it through good envelope design or that really good air conditioning equipment and systems. Because that summer afternoon energy is very, very expensive at least for the foreseeable future; now that all might change.

And what we do also in our TDV methodology is we look at the costs of the current electricity grid and we also look at the costs of what we think the electricity grid is going to be in 30 years. And we kind of bring all that forward in to like a weighted average valuation. So we're not just taking a static of view of what we think the costs are for the systems that provide houses and buildings energy. We're looking at it from today's viewpoint and a future viewpoint.

And you can argue a lot about what that future looks like and that's why we update the TDV every three years, because we want you guys to participate with us in understanding what we're doing and what we need to value. And because all sorts of things are changing in terms of grid costs and grid impacts, you know, with renewable energy and all sorts of other things. We need to update it regularly and understand what we're doing together.

MR. BRAND: One, I'm going to ask a lot of questions, so at some point you'll just have to tell me to shut up. So the TDV is that if you had the time of use water heaters, the ones that shut off during the day, an electric resistance water heater that shut off during the day might actually look pretty good?

MS. BROOK: Right, it would.

MR. BRAND: Okay.

MS. BROOK: And in fact well Danny is going to show you some comparisons he did with our new compliance software just so you can get an order of magnitude of what we're looking at for water heating. Not all the distribution system options, but just some basic water heater types. For the first time in the 2013 standards electricity is more cost effective than propane for water heating, so that forced us to change our comparison baseline. So if natural gas is not available you'll now be compared to electric water heater, not a propane water heater. That's directly related to how we value the energy costs in our TDV methodology.

MR. BRAND: What are the units of measurement of -- what are the units that the time dependent value energy is expressed to?

MS. BROOK: It's basically both dollars and can be converted to kBtus, so we use both depending on how we're communicating it. It's a valuation so it is a cost metric, but when we're bean-counting within the software and looking at loads we're really using it as a kBtu number.

MR. DAVIS: This Robert Davis, PG&E. So you're talking about water heaters here. When you're talking about the ratings of different water heaters you've got electric water heaters and you've got gas water heaters, trouble is a lot of gas water heaters also use electricity for various components. So can you foresee, because of the TDV, requiring or asking for separate accounting for the electric consumption and the gas consumption of these water heaters?

MS. BROOK: Yeah, actually I was just thinking about that at lunchtime. That, you know, Marc mentioned the fact that you weren't going to save any money if you went to an ENERGY STAR water heater. And I started thinking about that and I think our software right now would say that you will save money, because I don't think we're doing that. We're not counting the electric part. So that's certainly something we should talk about in our breakout sessions, and yeah.

MR. LUTZ: Then you'll also to have to talk to the Appliance Standards here at the Energy Commission to get them to make sure that the electricity use and the gas use is reported.

MS. BROOK: Is reported, right. Right, Yeah.

Okay, so let's keep going Danny.

MR. TAM: Okay, so basically there's two ways to comply for Title 24. First is the prescriptive standard. Basically there is a set of measures that if your building has these features, you know, it complies and meets the minimum standard of Title 24. And it's all based on kind of standard and building type.

So let's say you want to do something different or you want to be better than the minimum. In that case you're going to go to a performance standard, which you have to use a Commission certified compliance software in which case it will model the building. So for residential it's looking at the heating, cooling, ventilation and water heating. And for non-residential it's heating, cooling, ventilation, indoor lighting, water heating and sun processed energy system.

So what the software is doing is basically calculating two things: the energy use for the standard design and the proposed design. The standard design is basically using what's in the prescriptive standard and that's what sets the budget: whatever the proposed building meeting of mandatory and prescriptive requirements, that's your energy budget for the standard design. And the proposed design is what your proposed building will look like.

And then when it does a comparison when your proposed design meet or exceeds the standard design; that's when your building complies.

MR. LUTZ: And that budget is in TDV?

MS. BROOK: The budget is in TDV and it's --

MR. LUTZ: And that's total TDV?

MS. BROOK: -- calculated individually for every building that goes through the software, so it's not a static budget. We don't use prototypes, we calculate that specific to each building that's being proposed in the permit situation.

MR. TAM: I want to do a quick overview for this formula. The hourly, it's just that we carefully load together this formula with the TDV multiplier, is how we get the water heating budget. So, the first term, HSEU, is the Hourly Standard Energy Use. It's based on a hourly use schedule, it's different for weekend and weekday.

The conditioned floor area is a maximum at 2500 square feet. I think the idea is that any house bigger than that is not really using additional water. And also the Delta-T of the water inlet and water set point.

Okay, next that term is multiplied by the DLM, the Distribution Loss Multiplier. The big component of that is our distribution system multiplier, which I'll talk about in the next slide. Basically, depending on what kind of system you have, say, you have a point of use system versus a recirculation system with no control. There's going to be a huge difference as you can see in the next slide, so, okay.

And then the second term is what happens if you have solar water heating. So whatever your solar fraction is that percentage of the energy is subtracted from your overall use.

The third term, the HRDL, is the pipe loss in recirculation loops. It only applies to multi-dwelling units with a central system.

And the last term is the sum of all the direct loss of unfired tanks. And this is all described in detail under our Alternate Calculation Method Reference Manual, it's a mouthful, ACM Reference Manual Appendix E. It will actually describe each term in detail of how they're actually calculated.

MR. LUTZ: So, you don't have -- you have an hourly use for each hour of the day, weekdays and weekends, but you don't have the number of draws in each hour. And some of the technologies, like tankless, the number of draws has an impact on the loss and the energy use.

MS. BROOK: Right, so right now we're assuming things about that which gets us to sort of gross adjustment to an efficiency number like we do for tankless. We basically have a degradation factor that takes in to account those other things we're not taking into account, because we're not looking sub-hourly.

MR. ACKER: Larry Acker here, I've got a question. On tankless water heaters several of the manufacturers are coming out with built-in pumps, systems in them, and they're promoting them quite heavily. How are you calculating that on the energy loss factors?

MS. BROOK: Well, we're not. We would have to -- right now I think, and you guys can all correct me because I could be wrong, but we're just using energy factors. So if the energy in the pump isn't embedded in that energy factor somehow we're not capturing it.

MR. ACKER: But it makes the water heater run a lot longer, because you're actually on a timer based system. It's like putting the timer on a tankless water heater

MS. BROOK: Yeah, so we're not counting that extra time that the water heater is running, because we have standard assumptions about the usage.

MR. ACKER: You're basing this on an hourly run? So if it only ran for -- if you had a pump system only ran for minutes a day how would you calculate that?

MS. BROOK: We're not and that's one of the things we should talk about in our breakout session and one of the things that Marc suggested is that now is the time to actually dive into water heating modeling, because this is a very high level model. You know, it's not near the -- we're doing first principles for the rest of the building and this is what we're doing for water heating.

MR. STONE: This is Nehemiah, I just want to give a little bit of perspective on it. Up until the, correct me if I'm wrong, 2008 standards there was no HRDL factor in there at all. And so the fact that we have it there now means now we've had a little chance to learn how that's, you know, whether it's right or not and make some adjustments to it. But there was nothing there before that, so we pretended that the central water heater was right outside the door of every apartment.

MR. HOESCHELE: Marc Hoeschele, so for single family I mean recirculation systems have been available in the code for awhile. And there is a procedure for accounting pumping energy for the different system types and, you know, demand recirc has a much lower --

MR. LUTZ: It gets pulled into the DLM term doesn't it?

MR. HOESCHELE: Exactly yeah, so the HRDL is just for the central systems as Danny was saying.

MS. BROOK: Yeah, so maybe you should move on. Yeah, so here's where Danny is going to walk us through these distribution multipliers. But basically this is where we're saying we'd like this way to do it; we don't like the other way. And so if the numbers are large that's a good thing, if the numbers are -- is that right?

MR. TAM: Yes, so for the standard system trying a branch of a multiplier of one.

MS. BROOK: If the numbers are large it's a bad thing, right?

MR. TAM: Yes.

MS. BROOK: Okay.

MR. TAM: So your standard system has a multiplier of one. For instance, the recirculation system with no control has a 6.4 multiplier, which is really, really bad. So one of the systems that Marc developed, the compact design requires a HERS inspection, it has multipliers .7. So it's a little bit better than standard design. And point of use has a .03, so it's actually a lot better. So it all depends on what kind of system you have and what type of controls that you have with recirculation system, sir?

MR. KLEIN: A question on the volume that's implied by the compact design and the point of use design, is there a volume that's imbedded in that?

MR. TAM: It's based on pipe length and square footage of the house. Marc, you want to talk more about that?

MR. HOESCHELE: Marc Hoeschele, so the only recirculation systems get a ten percent hot water reduction from the standard assumption, but there isn't any differentiation beyond that between all the other system pipes.

MR. KLEIN: Even the compact and the point of use?

MR. HOESCHELE: Right, so yeah, so that --

MR. KLEIN: That needs to be fixed.

MR. HOESCHELE: That needs -- yeah,

right.

MR. KLEIN: I would observe. If we mean point of use, we say by that, what I think we mean is we're saying that it's close. Well, close is a volume metric thing not necessarily a foot thing and so close is that which is inferred here is that the efficiency of the distribution system is 70 percent better than the base case. So we're assuming there is 70 percent less pipe, if you will and less volume, if you will on the plumbing.

MR. HOESCHELE: It's 30 percent, right.

MS. BROOK: Thirty percent for point of use, yeah.

MR. KLEIN: Oh, you're using point of use, okay. It's one's very much smaller. It's a huge difference and so -- but we ought to be able to give some sense of real numbers for that and we ought to be making adjustments based on the volume in the piping. We were discussing at lunch the purge volume, if you will.

MS. BROOK: Okay, well why don't you guys propose a new set of distribution multipliers based on volume. I'd like to see how much they differ from this set.

MR. HOESCHELE: Yeah, I understand.

MS. BROOK: Yeah.

MR. TAM: Okay, we would --

MS. TAM: This is Christine Tam, can you hear me? I'm coming in from the phone.

MS. BROOK: Yeah, we can hear you.

MS. TAM: Hello?

MS. BROOK: Yes, can you hear us?

MS. TAM: Okay, yes. So I'm with City of Palo Alto and we are doing some analysis based on some of our residents who are considering switching from gas water heaters to heat pump water heaters. And, you know, if we look at the COP of some of the very efficiency pump water heaters it looks like they could be more cost effective than electric water heaters. But in the current 2008 Title 24, and I think also in the upcoming 2013 Title 24, there's a requirement for any homeowners switching from gas water heaters to electric water heaters to demonstrate the lower TDV value using the -- like an energy pro or some sort of a energy modeling tool. Is there something that we can demonstrate, you know, as a whole to get some sort of exemption for the city base given that all our residents are in the same climate zone?

MS. BROOK: Oh, so what you want to do is you want to prove once that it's a cost effective thing to do and not have to prove it every time? Is that what you're asking us?

MR. TAM: Right, because just even getting a water heater permit is already a step that the resident has to go through. Having them go through the whole energy mulling exercise I think is just extra tough.

MS. BROOK: Yeah, no I understand that. If you could, could you send your contact information to whoever you have access to on the -- I don't know if you have Danny's email up there or somebody's, so that we have a Compliance and Enforcement branch in the Commission that deals with your kind of questions. And I'd like you to talk with them, because I don't actually have the answer for you. But I think that they can help you.

MS. TAM: Okay, who would be a good contact person?

MS. BROOK: Well, maybe the easiest thing is Danny Tam, dtam@energy.ca.gov, and we'll make sure that we get your question answered.

MS. TAM: Okay, all right. Thank you.

MS. BROOK: Okay, thank you.

MR. OSANN: I've got a couple of questions, this is Ed Osann, about this before we move on. One is what do the distribution multipliers get applied to?

MS. BROOK: Yeah, so go back up to that equation. It's the DLM term, so it's getting -- it's bumping up your hourly standard end use value.

MR. OSANN: Okay.

MS. BROOK: Which is calculated based on square footage and a canned usage schedule that we use for every building.

MR. OSANN: And you say it's bumping it up.

MR. HOESCHELE: So there's one piece missing here, this is Marc Hoeschele, there is a standard distribution loss multiplier, which is floor area dependent. It says for, you know, 1,800 square foot you're going to have 15 percent distribution loss. The DLM is then applied to that, so it's a scaling factor on the standard.

MR. OSANN: And if we're --

MR. HOESCHELE: The standard

distribution? Well the usage is, I think the standard distribution loss multiplier is kept to 2,500 square feet, so yeah.

MR. ABDULLAH: So Marc, if this is a 2,500 square foot that DLM number, does it have to be multiplied by a correction factor right for square footage?

MR. HOESCHELE: If it's more than 2,500?

MR. ABDULLAH: No, if it is a standards calculation for a 2,500 square foot home. So that DLM number, does it have to be corrected for area, does it?

MR. HOESCHELE: The DLM isn't corrected for area, but there's another term that is multiplied.

MR. ABDULLAH: I understand, okay that multiplier could be a one then, unity?

MR. HOESCHELE: The DLM yes, yeah.

MR. ABDULLAH: Yeah.

MS. BROOK: So the way that it's introduced here it sounds like the hourly standard end use already has got that standard multiplier applied to it.

MR. LUTZ: Yeah, because it's got --

MR. TAM: It's actually a combination of

a lot of other formulas too, but this is like embedded in there. So if you want more information look at the ACM Reference Manual Appendix E. It goes in to tremendous detail about how each term is calculated.

MR. OSANN: Okay, and then on the next table then these factors that were developed, are these -- is there a computational basis for these numbers or are these essentially judgment calls?

MR. HOESCHELE: This is Marc Hoeschele. There is a -- you know, for the last several revisions we've used a distribution system model to -- that on sub-hourly levels can model individual draws and actual plumbing layouts and so forth. I mean, the big question is, again, what is the typical draw profile to apply, so we've looked at different floor plans and run different schedules and this is kind of the synthesis of that.

MS. BROOK: So what we've been trying to do historically is not put all of that really detailed nitty-gritty stuff in the compliance software. So instead we've kind of pre-boiled it down to these multipliers. And I think the question on the table is, is that appropriate, is that okay, does it work, or should we actually be doing the individual system level modeling for every building like we do for HVAC systems, for example.

MR. LUTZ: Yeah, like you do for envelope and HVAC.

MR. HOESCHELE: Yeah, and this is Marc, I guess the argument would be as we discover when we do plumbing surveys in the field you have absolutely no idea what you're going to get in the distribution system. It is pretty random what gets installed. So, you know, there's a lot of assumptions here, but it's trying to keep it simple and computationally more streamlined.

MR. TAM: Okay, a new version of our compliance software, CBECS, was released last week. I was able to do some compliance run, but before I do that I want to just go over the climate zones real quick for those of you not familiar. As you know, California is divided into 16 climate zones. For my example I did Climate Zone 3, 9 and 12. Climate Zone 3 is basically coastal, San Francisco bay area. Climate Zone 9 is Southern California, Los Angeles area and Climate Zone 12 is Central

Valley, Sacramento area.

So for my base case I did a 2,100 square feet single-story house. On the very left column is your standard gas storage. It's a standard .6 EF 50-gallon gas tank. And then I compare it to instantaneous gas, it's at .82 EFs. You can see tankless did substantially better.

The next two columns you can see how TDV multiplier has a huge impact on your energy budget, because electric and propane, because of the TDV multiplier is a lot more than your standard design. And in the case of propane like Martha said for 2013 it's actually higher than electric.

Okay, I also did some comparison with heat pump. So it's interesting, because for Climate Zone 3 and 12 it actually did a little worse than standard design. But for Climate Zone 9 it actually did a little better. So it really depends on what climate zone you're in and the climate there.

So for the last two systems I want to look at just how the distribution system has an effect on the overall energy. So I went back to a standard gas storage design, but instead of a standard trunk and branch I used the compact system HERS verified. So it did a little better than standard gas. And then I did a HERS point of view system, which in turn is a little bit better than compact, which is what we expected. Okay, sir?

MR. SPLITT: I'm Pat Splitt, I just have a question about for the heat pump water heater. What was the standard ambient air condition or location for that?

MR. TAM: It's Climate Zone 3, 9 and 12 and I used a 2.33 EF. It's just something I just picked from the appliance database.

MR. SPLITT: But was it in a garage? Was it in a closet? Was it in a forced air space?

MR. TAM: For the compliance software the location of the water heater is not actually part of --

MR. SPLITT: But it makes a huge difference for --

MS. BROOK: I don't actually know. I was looking around to see if Doug was back. Doug should actually come up and tell us, because he actually programmed the water heating algorithms into the software. So maybe you could just tell us how that heat pump water heater is dealing with weather data.

MR. HERR: I'm Doug Herr, the location of the water heater is not considered in the software.

MR. LUTZ: Well, what's the ambient temperature that the heat pump water heater sees?

MR. HERR: I don't know what the ambient temperature is. It's not considered in the software or any algorithms.

MALE VOICE: It was a fixed COP?

MR. HERR: Yes, it's a fixed COP.

MR. LUTZ: Then why is it different in different climates though?

MR. HOESCHELE: This is Marc Hoeschele, so heat pump water heaters haven't changed since the 1990 original detailed water heating methodology. There is, and I can't remember the origins of it, but there is a adjustment by climate zone based on ambient temperature weather file temperature that affects the rated performance, so that's how it's handled. No details as far as where the unit's located: garage, outdoor closet, indoors. So again, it's a very simple, just like the combined hydronic hasn't changed either.

MR. TAM: Also the TDV multiplier has got to be different for each of the climate zones, so that might account for some of the differences.

MR. HILLER: On the heat pump water heaters the real efficiency is going to be a function of both the entering cold water temperature and therefore the average temperature that the heat pump sees during its heat up cycle and also the air temperature. And especially with heat pump water heaters you can play tricks. You don't use attic care for your heat source and you can enhance the temperature of your heat source. So at some point and time it would be useful to have the ability to model that effect, because right now you're just assuming. You pick a number out of the air in it.

MS. BROOK: Well yeah, we're basically using the energy factor, you know, and assuming the test conditions. But we're doing that for every -- I mean, I understand the heat pump water heater is much more sensitive to that, but we are doing the same thing for all the water heaters.

MR. HILLER: Yeah, and for even some of the ones that are on the market today, their real infield efficiency is nothing like their rating, their energy factor rating. Because the GE 50-gallon heat pump water heater uses way more resistance heat, because of the way its controls work in real life than it does under the energy factor test where the electrical resistance almost don't come on at all. So that one's way off, because the real COP of a GE heat pump water heater is like half the energy factor rating.

I also had a question on what's a point of use gas water heater?

MS. BROOK: I have no idea.

MR. TAM: I believe the definition is it's depending on what's the size of the pump; it's like five feet from the source.

MR. KLEIN: It's point of use for whole house water heating. It's the plumbing system that's compact not the water heaters in lots of places.

MR. HILLER: But it's still one water heater then?

MR. KLEIN: Yes, yes.

MR. HILLER: Okay.

MR. TAM: Yeah, the distance from the water heater to any end use point has to be within a certain distance. It's like five feet or something.

Okay, the next case I look at 2,700 square feet, two stories. It's basically you can see the same trend. It's the 2,100 as you can see.

MS. BROOK: Okay, well we asked our questions all the way along. I think what we'd like to do since it's already 10 to 3:00 and we know we haven't even started our breakout sessions yet.

And there's folks on the phone that have been patient with us and maybe calling in from all parts of the nation, we would like you to ask any questions you have now or provide comments now, so that you don't have to wait around for us to get back from our breakout sessions, which is likely going to be 4:00 or 4:30. You're welcome to, but we would like to get your questions and comments on the record now if you're willing to do that.

And so we would give you a few minutes now to ask us questions or provide comments if you can let the chat window in the WebEx thing know that you want to talk. That would be how we would implement that.

MR. VAN DECKER: It's Gerald Van Decker talking first. Sorry, I already it unmuted before I heard that. I've got a really dumb question. The time value TDVs here, is that all for performance path?

MS. BROOK: It's also how we determine the cost effectiveness of the measures for the prescriptive path, so it's both. It's the energy valuation metric we use in the life cycle cost methodology and that's applied to both. Basically that's applied to the prescriptive standard, which is what we set and publish in the Building Code. And then the performance compliance approach is just what Danny explained, it's a compliance approach. It's not a separate standard and so we are using that same TDV metric for that.

MR. VAN DECKER: Okay and the prescriptive path Martha, I'll talk to you offline about it. Gary Klein is aware of a different methodology for doing that that we've developed in Ontario. It's a score card. It's kind of a simplified way of doing it that you might want to consider, so I'll just leave that where it is, but thank you very much everyone.

MS. BROOK: Uh-huh, thank you.

Anybody else, okay?

MR. LUTZ: I have a question that you'll not want to hear, but what would be the process of going back to a first principle's model like you do on HVAC envelopes? What would it take to get Title 24 converted to that? I mean, I agree right now we don't have the models that can handle that and they'd obviously have to be very simplified, but procedurally within Title 24 how would we go from this kludging of fudge factor upon fudge factor upon fudge factor?

MS. BROOK: What are fudge factors?

MR. LUTZ: Okay, coefficients upon coefficients upon coefficients.

MS. BROOK: There you go, yeah.

MR. LUTZ: How would we go from that to a major rework that actually is based on a model?

MS. BROOK: So, first off I would say that the Energy Commission does not have the resources to develop that detailed model, so the very first thing is that there would have to be sponsors either through research emerging technologies or Codes and Standards. You know, anybody who it's in their best interests to make that happen could be sponsors. And then there would have to be, you know, the the other, I guess, requirement that we've just recently enacted is that we are only willing to support open source software, so it could not be a proprietary model. We think that's what it means to provide public domain software, which is what the mandate is for the Energy Commission.

And then I think it's just the due diligence of any good software project. You know, you have to develop it and test it and before that you have to develop the functional requirements for it. I think hooking it in to our compliance software architecture is actually pretty simple. I don't think there's a big lift there. I think the lift is actually developing the model. I think hooking it in to our architecture would be relatively easy.

MR. STONE: I'd like to add something if I could. We actually looked at that when we did PIER project for -- excuse me, the case work for hot water for the 2005, maybe it's the '08 standards. And one of the biggest constraining factors is you can't include anything that the building inspectors can't or won't inspect.

And so when you're talking about first principles you get down to it, you know, you really should know how many feet of three-quarter inch you have and how many feet of half-inch you have and how many feet of one-inch you have and all these other things that we just, you know, there's no way that you're going to get a building inspector up there with a tape measure to measure things. That's just one example, but there's a lot of others. So it's got to be simple enough that it's enforceable.

MR. ZHANG: Yeah, I think I want to concur with Nehemiah and just say actually Owen wants to talk with the same thing. From a code compliance point of view what are we consider is what can be inspected. So we've talked about that compact designs and I remember there was a lot of push-backs from an inspector point of view. "You know, we've never done this thing, how are we going to make sure that what is...?" for example.

You know, speaking in terms of volume

you have to give people a very simple straighter way to find what the volume is that they can accept and take it to the field, can verify it. So I think there's a tradeoff. What we can goes in detail, what can we implement.

But giving that side also when I do comments, for example, we didn't talk too much about the recirculation loop heat loss, which is a term somewhere in that long equation. That we'll still have to base on a kind of engineering a first principle analysis system and added by the field model. So if you read it into it and the ACM detail it is actually slightly basic heat transfer fundamentals. It's kind of like first principle model, so it does exist.

MR. VAN DECKER: I'm Gerald Van Decker here again, sorry. I would encourage you to consider the equation that Gary and I have submitted for the energy factor, because all these models from the very base assume the energy factor. We're talking about single homes here in this case. You're starting with the energy factor and that energy factor is not an accurate representation in any given situation. It's going to vary over the year. So I think that you could really simplify a lot of this stuff, but could also get more accurate results and eliminates a lot of the bias there if you look at that equation that I developed. And it's really available, thank you.

MS. BROOK: Okay if there's nothing else then I think we're ready for some guidance from the group on how we're going to break out into working groups and how long we should take and what we should do there.

MR. TAM: Oh, actually one second, sorry, there's a question from Frank Stanonik.

MS. BROOK: Oh okay, hi Frank.

MR. STANONIK: Hi, good afternoon, can you hear me?

MS. BROOK: Uh-huh.

MR. STANONIK: Okay, well it's not so much a question. I've been I guess waiting, but just a comment, because of what we've dealt with in the past. But in one of the presentations there earlier they were talking about information from I think it was 18 homes. And it seemed to me that it was, well my perspective was it was too easily presented. As well, you know, it's good data I agree, but it was too easily presented as here's some definite information as to what we need to be doing as we go forward here. And I guess I just want to put that caution out there that data points from 18 homes, it wasn't even a full year of use as I understand it. It is useful, but we shouldn't put all that much faith in it to make strong conclusions as to how we need to amend the standards or whatever.

I mean, we had a long debate on some of the things that the Energy Commission came up with relative to tankless water heaters and how much data they had and that's water down the drain so to speak. It's done, but I'm really conscious of okay so we have some good information, but we need to be careful about conclusions that this really tells us what these products are doing in the field, you know? From 18 data points and I don't remember the slides, but I think there's -- not I think, I know, there are millions of residential water heaters installed in California. And so there just needs to be a little perspective there that okay, we have some good data, but let's not assume we have the answers.

MS. BROOK: Yeah, no I think that's a

good point, Frank. But I guess to be completely honest with you beggars can't be choosers and standards development is definitely beggars in terms of good information that we need to, you know, modify the California Building Code.

MR. STANONIK: Yeah, I'd say you have an assignment to do. Yes, I understand.

MS. BROOK: So I think, and to be completely honest with you, this is what will happen if we go all the way through our rulemaking and we're basing all of this stuff on 18 homes. And then you, this is just completely hypothetical, but you come to the Commissioners and you say, “Look, it was only 18 homes, what the heck, you can't base a standard on that." And the Commissioners are going to ask you, “Well, give us those three million or something then.”

I mean, basically, this is the best information that we have and so we really are always asking stakeholders to do whatever you can to bring us more and better data, because we are starved for the data. And we've made decisions on far less information than 18 homes, for good or for bad that's the reality of the standards development. And so I think that that is a challenge and we don't want to do the wrong thing. I mean, these are consumers that have to pay energy bills and we are responsible for that.

And we need to be cautious, but we also are trying to be thinking of the consumers' viewpoint when they're getting products sold to them too. And we want to be conservative in our estimates of the performance of those systems and, you know, we need data to give us judgment in that area.

So I mean, I think that it's also true that that kind of field data collection is very expensive. And it takes a research program like PIER to actually get 18 sample points. And you and your members I think are in a position to help us out, because you have, you reach so many different markets and customers. And, you know, we'd love to work with you on figuring out ways to get more data in to our rulemaking process.

MR. STANONIK: Well, okay. I mean, just I wanted to put that out there. I know I hear you say you got it, I understand your assignment is to get the new standards in. And I think trying to look at the systems approach will certainly open up opportunities and can be some ways to save some energy.

MS. BROOK: Yeah, thanks. And the other thing too is I think that water heating is a really good example where we don't have to necessarily only have California samples, right. We can leverage data from other places, so if you and others know of such data then we would love to bring it in to the discussion.

MR. KLEIN: Just speaking of which, one of the folks here Jim, spent some time looking at national numbers for hot water usage patterns. And if I remember correctly it's like 150 some-odd homes and over 22,000 days of use data. And that would be better than 18.

MS. BROOK: Absolutely, I mean we would love to change our underlying assumptions about usage based on that great data and we should talk about how to get that done.

MR. TAM: Okay, Martha another question from George Nesbitt. Okay, George go ahead.

MR. NESBITT: Yes, can you hear me?

MS. BROOK: Yeah, hi George.

MR. NESBITT: Yeah, George Nesbitt, HERS rater. A couple of things, keeping the calculation simple is a very good idea. The new residential compliance in Engine is probably about a thousand times slower than MicroPas currently. But obviously working on making those modification factors more realistic or better, more accurate is a good thing.

Then I just I want to hit on the prescriptive water heater you can put in a gas, a natural gas or a propane water heater. Your only option is an electric water heater with a 50 percent solar fraction. There is no option, say, for a heat pump and it looks like, you know, heat pumps are just about the same as the gas. And so that would be something we should do, have more prescriptive options for other than just standard gas.

MS. BROOK: Oh, I see. Okay.

MR. NESBITT: Yeah, and that addresses the question for Palo Alto.

Then what I'm trying to figure out, and I've been looking at the standards as we've been talking, the issue of not being able to preempt the national standards, efficiency standards. Yet with multi-family we are using a condensing boiler and a solar fraction. I'm trying to figure out if that is a prescriptive requirement also? I don't see it listed so much as a prescriptive requirement or if we're just doing that in the ACM. And I guess if we can make it a prescriptive requirement, which is not quite the same as mandatory, because you can always go to performance and trade off, why we don't do that with single-family water heaters or furnaces, other equipment as a way around.

MS. BROOK: Well, I think that's a good question. I don't know the answer and I don't know if Yanda knows the answer about why we were able to set that baseline to be condensing boilers for multi-family. I don't know.

MR. ZHANG: This is Yanda. I think George you might want to the check the ACM point. We'd love to set it to be condensing, but I don't think we did that.

MS. BROOK: Okay, so we don't think we did set the baseline to be condensing, so maybe you should point out to where you think we say that and we can get that cleared up between us.

MR. NESBITT: Okay.

MS. BROOK: And don't tell me now, because we haven't even gotten to our breakout session. Just send me an email. That would be better if you're willing to do that.

MR. NESBITT: Yeah, well I think it was even in today's presentation. I mean, it didn't say condensing, but high efficiency.

MS. BROOK: Okay.

MR. NESBITT: Yeah, so.

MR. OSANN: Are the commercial products even federally covered?

MS. BROOK: Well some of them are. I mean, we do follow whatever's in ASHRAE, adopted in ASHRAE.

MR. LUTZ: Yeah, we follow ASHRAE 90.1.

MS. BROOK: Yeah.

MR. STONE: Yeah, it doesn't matter whether they are or not, because if George is right, that it requires condensing basically the minimum efficiency condensing unit would do it. And so you're not asking somebody to put in something higher than the minimum efficiency.

MS. BROOK: Well, see it's only -- this is really getting into the weeds, but it depends on how DOE publishes their standard and how ASHRAE publishes their standard. If it's in the same group then it's the minimum within that group. If they've pulled out condensing as a separate product then the answer's different.

So for example, right now in residential our baseline has to be electric resistance, because there isn't a separate standard, there isn't a separate product category or a standard for heat pump water heater. So we can't. You know, it's not a separate standard set by the feds and so we have to use that electric resistance baseline. At least that's our understanding of it.

Okay, so any other questions?

MR. TAM: No, hang on a second. Let's see, SDG&E has an RFP out that includes water heater recycling technology of how would a device labeled electric resistance water heater recycling be treated as an entry in the model. Right, so in our model it currently, our model doesn't recognize that.

MR. LUTZ: How would you model an off-peak electric resistance water heater?

MS. BROOK: Yeah, so maybe this is an area where you're trying to do something in the Be On Code Program for a utility incentive program? In which case there would need to be a different sort of calculation outside of the compliance software for that off-peak component, because we don't address that component of the equipment in our compliance software. But that's true of many, many technologies. There's lot of technologies we don't give credit for under the compliance software, which are valid and good for incentive programs. They just can't be modeled with the constraints that are embedded in the compliance software.

Shall we move on? So Jim, or Gary I don't see, do you want to explain how we're going to do this breakout session?

MR. LUTZ: Yes, we want to have three parallel breakout sessions: one on commercial buildings, I'm looking at you Amin; one on multi-family and Yanda I'm looking at you to lead that one; and one on single-family, focus on Marc there. And we'd like to go each of these breakouts will run in parallel and go to different parts of the room, so commercial there, single-family here, multi-family down there.

MS. BROOK: We might have to spread out more just because of noise.

MR. LUTZ: Yeah, but spread out.

MR. STONE: Is this room going to be open? I didn't see anything in there earlier.

MR. LUTZ: And take one of the big pieces of paper, take notes. We've got four types of questions we want each group to go through. One is identify the issues and keeping the issues fuzzy. I'm sure that each group will have issues that they want to discuss. We have how long on time-wise?

MS. BROOK: I think like no more than an hour.

MR. LUTZ: No more than an hour, so 15 minutes on each of these. Identify the issues, sort through which issues are the top ones, the most important ones to deal with. Start some discussion on solutions to those issues on how this is, you know, how hot water is treated in Title 24. And then how to get those solutions in to Title 24, what is it going to take, and how is it going to be done. So that's the general idea and I guess, go so multi-family, single-family and commercial.

(Off the record breakout sessions at 3:09 p.m.)

(On the record at 4:22 p.m.)

MR. DELAGAH: So how are we doing this,

are we just going down one two, three, four? Is this like a discussion or am I just kind of --

MS. BROOK: Yeah, just do a summary of what your group talked about and then we can ask you questions. Does that sound good?

MR. DELAGAH: Okay, yeah.

MS. BROOK: And there's M&Ms there afterwards for your little reward.

MR. KLEIN: Don't speak directly in to the mic by the way.

MR. DELAGAH: Don't need to, I won't okay. Can everybody hear me?

MALE VOICE: We hear you now.

MR. DELAGAH: Please help me out if you're in the corner over here and I'm missing something big, please shout it out.

MS. BROOK: It's -- the little light is on.

MALE VOICE: You just have to hold it real high to your mouth

MR. DELAGAH: It's on, I got it yeah.

So we talked about how the commercial sector, especially if you go to like ACEEE Hot Water Forum or you go to any of these places, you know, when they talk about the residential sector of multi-family or commercial every time the takeaway is there's lots of opportunities in the commercial sector. It's a great payback, it's a much better win-win, lots of winging through, but we just haven't done the research either in the different applications or the specific products. So I think for us we really need to focus more on commercial.

You know, there's definitely it's a way to get new technologies in the market that don't have yet a payback in quick service or I mean, sorry, in residential applications. So from our focus is more research, especially in the different applications. We might have an idea on restaurants, but we really don't have an idea in office buildings or hotels or schools and all these different applications then. Focusing our research to characterize systems in the field and their operating efficiencies is really the first step. And we've kind of been talking about it for awhile, but how do we gain some ground?

For example, ASHRAE the handbook, a lot of the information in there is 30 to 50-years old. We really haven't invested in commercial facilities in quite some time and we have an opportunity here to really gain some ground quickly. And the overall kind of thing that we looked at was well if we do some of that characterization, kind of the model that we've used with this current PIER project is to characterize a facility in the field, get a profile from that, and apply that profile in the laboratory with different water heaters and distribution systems. And then we can really see the potential savings of each scenario.

And then when we can do that we can assign in a sense of we can figure out a system delivery efficiency, kind of the stuff Jim is doing in the residential part. Like how efficient is this system at the point of use at every fixture? Aggregate all that and from there we kind of could see that well, in supermarkets a centralized water heater, you know, at 20 percent efficiency is not going to cut it. We need to have a minimum system delivery efficiency for each application in the commercial sector.

And we feel that that could be a good approach for CEC. I don't think we can do anything for right now for the next, 2016 is that? But really, we need to set everything in motion to kind of get there at some point, so broadly that's kind of what we talked about.

MS. BROOK: Well, one of the things that's frustrating to me from a standards perspective is that this road map really needs to get back to the PIER and the ET programs right, because we don't have control over their budgets or their funding. But we really rely on their results like we have in the past. So how do we get them to do things strategically instead of just doing, you know, this demo of a dishwasher heat recovery system and this demo of a tankless water heater? How do we get them to do more of the type of research that you're describing?

MR. DELAGAH: Other aspects of that was you could have for these different applications you could have a minimum, either a prescriptive path or a just a minimum thing, like you cannot put in one centralized water heater in a supermarket. You shouldn't be able to do that. There could be set of criteria of minimum requirements that could also be using say, this calculator for those different applications to figure out how you could come up with that minimum system delivery efficiency. So like it could be -- so we can design that, we can develop that, but we do need a lot of field research and to supplement that with the laboratory research to kind of create those calculators.

MS. BROOK: Okay.

MR. DELAGAH: We talked about issues. You know, some of the issues that we have is there's food safety guidelines for sizing water heaters, there's plumbing code issues. There's all these issues that kind of cloud the picture and we definitely have to work with these different societies. Building departments, they don't want to really do more compliance. They don't want to be looking at these systems. And so those are all major issues in the commercial sector.

Let's see, what else we looked at here. Yeah, I think that really covers it. Any -- yes, okay thanks Larry.

You know, I actually had not noticed that for 2013 insulation is required on all hot water piping, which is great. I see I was referring to 2008, so that is a new thing. I think we covered that, but for in terms of other things we can put in to the upcoming Title 24 we don't really have information. We don't have one thing that works for all these different commercial applications.

I think we really need to take the time and trust this process to get there. I think the current PIER project that we're doing, that we have done, really kind of shows a road map; potentially on a way to get there. We can't think of one measure that we can put in there right now that's just ready to go for the next and that's, you know, will make the process easy.

MR. MCHUGH: I thought you were saying earlier that the dishwasher --

MR. KLEIN: You have to come to a microphone or I won't be able to record your thoughts.

MR. MCHUGH: Hi, this is Jon McHugh, hope it's not too loud? So Amir, I thought that the dishwasher heat recovery was something that was ready for prime time. Are you saying there's something about that technology that has safety issues or feasibility issues or payback issues or application issues, what is it?

MR. DELAGAH: Well, I mean it's a very specific application. You have different sizes of dishwashers from under-counter to a door type to a conveyer to a slide conveyer. And especially when you start getting to these larger dishwashers there are plumbing codes and things of that nature that you have to follow, there's ventilation issues.

The Health Department, in certain jurisdictions in California which goes by the Uniform Mechanical Code, they follow Uniform Mechanical Code, they require exhaust ventilation systems in all dishwashers. And it's really up to the local jurisdictions if they want to follow that. Well the big benefit of these ventless machines, at least the door types, is they are ventless. You pay an extra $3,000 up front, but you don't have to install this ventilation system.

So but if we're getting pushback from these certain localities, they're still requiring you put in these ventilation systems, that's an extra $3,000 that a restaurant has to put in. And at the same time they might be able to gain $500 dollar savings. Their electrical booster heater usage is going to go up somewhat and then they're going to get the same as with the water heater. It's not quite there yet. We first have to get the buy-in from the Health Departments to just all across California allow these systems to go in, because we have proved in a laboratory that they do not emit any more heat load versus a low temperature machine.

So it's really, I think from my standpoint, we've got to have our ducks in a row to really implement something that's really going to stick.

MR. MCHUGH: So is that something though that could be done over the course of, you know, six months to two years? Is that, I mean --

MR. DELAGAH: We've had the conversation with the health departments and the buildings department, that's really where it stands. They're very elusive. The buildings department spoke to me when I went to my first IAPMO meeting, which is just the buildings departments. And we're hoping to have the next regional IAPMO meeting at our facility if we could. But to get that group to agree on something like that, I'm not sure how many years it's going to take.

MR. MCHUGH: I hate to draw this out, because I know we've got limited time, but this is one of the measures that we saw had some promise. My understanding is, is that the savings wouldn't be as great as they possibly could be if we followed what the other 49 states had. But that even in California with the requirements for ventilation instead of having something like a two-year simple payback we'd have a six or seven-year payback, but that's still something that's within sort of the twelve-year payback that California uses as part of their energy standards. I'm just trying to understand why this technology is not ready for prime time.

MR. DELAGAH: Let me get back to, I guess my overall systems perspective of it all, which is really might affect it. The whole idea of this technology say with the door-type machine is the fact that you can size down your hot water system. From a recirc system that covers your whole facility to one that maybe covers just parts of your kitchen that's just a normal trunk, branch and twig system, no recirculation pump.

To get there we have to prove that this way of designing a facility is one, feasible, is one that's cost effective. And we have to quantify the savings to really get everybody on board. Once we can show that this optimized strategy and being that the cold water in the dishwasher you can have heat recovery without a cold -- like only certain machines have a cold water supply only. So there's a lot of things that we have to figure out to get to the point where we can really optimize our entire hot water system.

MR. MCHUGH: Oh, I thought you were pre-heating the hot water that's going in to your water heater. This is just going in to the dishwasher. It's not just being used for the hot water system. Oh, okay, interesting.

MR. DELAGAH: So there's a lot of those aspects. I mean, I think it's promising, but we're just not ready for code language.

MR. MCHUGH: Yeah, okay.

MR. DELAGAH: I'm definitely for the technology I just think we have a ways to go.

MR. MCHUGH: Right, interesting. Okay, thanks.

MR. DELAGAH: I think I used up my time. Who's up next?

MR. HOESCHELE: I'm the least annoying

person left.

MALE VOICE: What did he say?

MR. DELAGAH: He said he's the least annoying, so therefore he can go last.

MALE VOICE: Are you going to take that, Marc?

MR. HOESCHELE: Yeah, okay fine.

MS. BROOK: We need you to leave your notes here, because we're going to volunteer somebody to type them up and get them back to everybody.

MR. DELAGAH: Okay, I'll leave them right here.

MS. BROOK: Okay, thank you very much.

MR. HOESCHELE: For the single family do we going to go through the full brainstorming or however? How much time do we have?

MALE VOICE: I think (inaudible)

MS. BROOK: Yeah, I think you're good.

MR. HOESCHELE: So not 30 seconds or less. So these are the issues we identified and we started with low, medium and high, but then went for three votes as far as what the priority measures are. And also early on we decided to tie enforcement issues, contractor training, higher minimum requirements for contractors as far as installation, you know, demonstrated abilities. Define current practice better is a big problem in knowing exactly what we have out there in terms of hot water loads and even hot water distribution systems. We've looked at 150 over the past 6 years, it's so diverse what we find out there; that's a problem.

MS. BROOK: Uh-huh, you sound like Frank.

MR. HOESCHELE: And then the best practice guidelines needed. So we kind of tied all those four together as one, but then we started getting votes individually. So the plumbing design, building design, requiring plumbing design is a high priority. And you know, there's interrelated with best practice approaches. It seems like maybe this is an iterative process. You know, things are so, in terms of plumbing design, so disorganized now maybe we need a first step. And then as things tighten up a little bit you get a better read on where this can go. I mean, but it's too diffused right now.

MS. BROOK: So the first thing is they

tell you where the water heater is, that's their plumbing design. That's the baby step, is that what you --

MR. HOESCHELE: Right. Right, I mean I know when we tried to, with this go round, tried to put more, you know, limit the big pipe and there's a lot of pushback from the building industry on that. And they just said in this industry the contractors aren't ready to do this. So I think we agreed that it's important to define best practices as we know them now even though they might not be perfect and get that information out there.

So other, oh valuing of water and the whole resource stream. I know this has been a topic that the Commission has been aware of for awhile, but I think it would be beneficial and would help support initiatives that reduce water waste in the distribution system, to get more credit for the embodied energy and water or the sewer impacts. Now what's involved in all that, I don't know if the Commission has made any initial efforts to look at that. You know, how to quantify those.

MS. BROOK: Well, we haven't done

anything yet, but it's been on our list. But it's been on our list.

MR. HOESCHELE: When you say it's been on our list, you --

MS. BROOK: Well, the thing that I imagine is that there's something like TDV for water. That we basically say that there's this societal cost of water use just like well right now we're saying there's societal cost of energy use and that's the metric that we use as determining whether or not we should do anything about water efficiency in the standards. We have the mandate, it's in our legislation that we should do it, that we have the authority to govern water efficiency in the building code. We just haven't had the band width to deal with it yet. Hearing from you guys that it's super important is a good thing.

MR. KLEIN: To give a rough sense of scale for this group the indoor water use, meaning water supply and waste water treatment, the energy of that is on the order of five kilowatt hours per thousand gallons. That's a national number. California has got numbers that are on average like that with a variation from about three to about twenty-five.

MR. STONE: Site or source?

MR. KLEIN: This is the site energy. Yes, this is the --

MR. STONE: So it doesn't include the pumping energy to get that there?

MR. KLEIN: No that is the pumping and treating energy of delivering and treating water on both sides, okay. It's the kilowatt hours attached to the embedded energy in the water, if you will. It doesn't include the source energy of the electric grid to make all that or the water that goes in the electric grid. It's just the energy attached to the water embedded, so five kilowatt hours per a thousand gallons is about right. When we, if you convert, we're talking about hot water in this room. Hot water is around 50 times more energy intensive than that.

MS. BROOK: But I think it's --

MR. KLEIN: We can count it.

MS. BROOK: No, but all I'm saying is that we don't have to limit ourselves to the energy component of water.

MR. KLEIN: Correct, okay.

MS. BROOK: We have the mandate to govern water efficiency and valuing water for water's sake not for energy's sake. So one could assert we should both: count the embedded energy and also count the value of water for the state of California. That's why the mandate was given to us, it was for water efficiency purposes, not because somebody realized that there's some embedded energy in water. It was because we have water issues in the state and buildings consume water, so we should would have water efficiency in our building code.

But having said that valuing water like we now value energy, it's not a trivial exercise, it's a pretty big deal. And it will take, in my opinion, a concerted effort that -- Jon can confirm this, because we've begun to scope out the 2016 standards. And Owen's here too, or at least he was, it's not on the table right now. So having had this workshop and I mean if the stakeholders here and other places think it's super-super important now is the time to say it is, because otherwise it's not going to. You know, the Commission always has limited resources and we always have to pick what we're going to work on. And right now even though it's a mandate it hasn't risen to the top of the list.

MR. MCHUGH: Hi, this is Jon McHugh again. My understanding is that for Title 24 we're not looking at water issues, but I think for CALGreen we are. And to the extent that you guys are involved in CALGreen recommendations?

MS. BROOK: Yeah, there's certainly things in CALGreen for water efficiency, but they haven't done any kind of societal valuation of water to determine those recommendations. They're just gut calls about water efficiency.

MR. MCHUGH: Right, oh and so your question was, is whether or not TDV should explicitly value water?

MS. BROOK: Yeah.

MR. MCHUGH: Yeah, and that makes sense to look it by the various climate sense, because of the whole north-south difference in energy. Thanks.

MR. STONE: Not only that, but elevation and height of the building.

MS. BROOK: Yeah, and to be honest with you one of the issues that we have with resourcing it is with the California utilities, because right now the California investor in utilities -- well LADWP and SMUD are joining in too now, are really supporting our codes work. But they're supporting it from an energy efficiency point of view and that's where their mandate is. And if they can't extend that into water efficiency then our resources will be we need to find those resources from other places.

MR. DELAGAH: Does that put the focus on Title 20 (sic) in terms of reducing hot water use through appliances?

MS. BROOK: No, hot water is we can do it, hot water is not the issue. I mean, hot water we deal with, we deal within the standards, and we'll always deal with hot water in the standards.

MR. DELAGAH: Well, does it put additional priority on reducing hot water use since it carries both the energy and the water aspect? And say as a heater where you're only saving energy you want to save hot water, is that a higher priority than saving just or having a more efficient system? That's just saving energy. Should we really be looking first at saving hot water?

MS. BROOK: Well, in my opinion a lot of the things that you guys want to fix in the distribution system have water efficiency benefits that we're not counting. And if we want to start counting it then we need your help developing a methodology to start counting it. And I don't see that that methodology is going to be funded by investor-owned utilities that are paying for our support with energy rate payer dollars, because we don't have that same source of public funding from water rate payers, right?

MR. KLEIN: I think that we might be able to, if the PUC has allowed it, get the energy utilities to help fund tracking the water so we can track the energy implications of the water savings or the water use. They're not going to be as interested in hot water, because of the relative value. On the other hand there's a lot users of water and so there may be a way of discussing that.

But it seems to me at a minimum we should be, if we're able to as we're moving through our work over the next several years, track the water as carefully as we estimate and track the energy for things like hot water. If that's all we're working on, we just do it for the ones we're working on and we figure out how to track those numbers as we're doings things. And that would help in not this cycle, but the next cycle being more ready as to, “Hey, we figured out how to do this, what do you think?” and moving on to the next step.

The valuation of water for its own sake promises to be a frightful job. When were you planning to retire Martha? Say it before we start on that one.

MS. BROOK: Uh-huh, anyway I didn't want to interrupt your --

MR. LUTZ: Well, just on the hot water. From the little bit of end use data that I'd seen every shower starts out with, if you look at the shower head use, starts off with a couple gallons of water leaving the water heater, but not going out of the shower head. That's people doing the tub spout to flush the cold water out of the line before they start their shower. So showers where the plumbing system is laid out poorly every shower wastes a gallon or two. So, you know, you could count that in as part of the cost of a poorly designed hot water distribution system is a gallon or two of hot water for every shower.

MR. OSANN: Yeah, the modeling done by NREL suggests that it's about ten percent of shower hot water use is purged in a typical three-bedroom home, three-bedroom, two bath home.

MR. KLEIN: I guess Jim has found it could be as high as 30 percent, so it varies. It depends on the silliness of the plumbing layouts.

MR. HOESCHELE: So, on the -- I don't know how much more time I have Jim?

MS. BROOK: About negative two, really.

MR. HOESCHELE: On the solutions front, let's see here. The first one is kind of the stick approach that the state licensing board or the CEC, you know, there's some authority to punish the contractors for doing work that isn't -- you know, noncompliant. I mean, the general enforcement problems that we have and how we can change that and one is certainly the stick approach.

Another issue or solution on the carrot side was to give Utilities the opportunity to provide more training to contractors. And I don't the details of that exactly, but, you know, to provide more incentive for them to provide outreach training and so forth. Working with Utilities, I mean there's a lot of data we can mine theoretically from their rebate programs they're running on these new technologies. You know, how are their customers responding to them, what are the issues, what are the maintenance requirements to fill in the piece of are we promoting technologies that make sense for the long term?

Reevaluate how plumbing design is handled in Title 24. I mean, basically just reflecting the current recognition of how alternative designs are valued and credited or penalized in the system. You know, can we be more precise or more fine-tuning to, and I guess this might get it, during my presentation to talk about some way to create a greater value for an overall compact house solution that benefits the distribution system, both HVAC and hot water and so forth.

Let's see, a water resource valuation study, I mean, we kind of talked about that.

Homeowner, a how to use guidance, basically to make sure that homeowners have a better idea how their systems in their home operate and what to expect and indications of when there are problems. We feel that that's lacking.

And well one thing, Title 24, a top down review of the systems design approach versus kind of a usual measure look at things. And, you know, one thing as we move to ZNE and we're looking at all the -- I mean issue I have is as we focus on all these detail issues with the big picture and miscellaneous energy loads and where PV starts to fit in. I mean that there's a kind of a consistent outlook on where as we focus on our minutiae areas that we're kind of consistently handling these issues and making sure the solutions are cost effective. As opposed to just technology specific solutions that make sense, but in the context of the whole building may not be the best approach.

MS. BROOK: So help me out a little bit with that one there. Are you saying that when we develop our prescriptive standards they should be more holistic and less focused on individual measure level things? Or are you saying that we're losing the forest through the trees?

MR. HOESCHELE: Well, I think a little

bit of the latter, maybe. I mean, Larry brought up the system design and the synergies that maybe we're overlooking at times when we do measure X, Y and Z and then we have some other consequence, some other benefit, that we're not recognizing or Larry?

MR. WEINGARTEN: I just wanted to add, one of the guidelines that you have is that everything be cost effective, looking at individual measures one at a time. And it may be that it makes sense more to look at all the package of measures, because one at a time they may not meet that criteria.

MS. BROOK: Well actually our requirement is that we look at it as a whole, but for better or for worse we've given ourselves the assignment of trying to make sure that every measure is cost effective. And so your point is well taken that maybe that is not appropriate.

But just for background the reason that we have done that is because it makes it, it's like due diligence, it makes it a harder bar to pass, right? But the other thing that it does for us on a practical basis is that it keeps the perpetual motion machines from getting proposed to us, right. Because basically we're putting ourselves under the situation of proving that everything that we want to do is cost effective, therefore everything that somebody else proposes has to be cost effective in its purest form.

MR. WEINGARTEN: So how do you deal with the, spend more money to air seal the shell of a house? By doing so you may reduce your cooling load so you don't need a cooling system at all. It makes the air sealing very cost effective, yet air sealing on its own may not seem to be.

MS. BROOK: So I mean think that we do model and therefore look at the budget at a holistic level, but we also -- and I think there is room for us to back away from this measure level cost effectiveness requirement, because it isn't a requirement. It's just been a practice. And we do need to understand those interactive effects and actually get to a point where we can do things that as a system that are cost effective. That at maybe onesie, twosie, they aren't. But I'm not -- is that what you meant too?

MR. WEINGARTEN: Yeah, I think so.

MS. BROOK: Okay.

MR. HOESCHELE: You know, as well as making sure that we are --

MR. STONE: The mic's falling away again.

MR. HOESCHELE: That's because I'm thinking.

MR. STONE: Well, while you're thinking I want to say something really quick. In addition to what you said Martha, about looking at things individually and maybe that's not the thing? The Commission made a decision a long time ago to go beyond the mandate of its cost effective to actually saying it's the most cost effective. In other words, if you draw the J curve of first cost versus life cycle savings anything below the line of what the current technology or current standards require, anything below that line is cost effective. And the Commission typically goes to the lowest point, the most politically acceptable, you know, because it's the most cost effective.

Whereas you could keep pushing to lower, lower life cycle costs without getting above that line and still be cost effective. And for approaching zero net energy it seems to me that it's maybe time to move away from the bottom of the curve and start moving closer to the Y axis.

MR. ACKER: If I could add something to what Marc was saying earlier. I'm thinking what Nehemiah just said too. The builder primarily builds homes to meet code standards, which is basically if you look at it from an A to an F it's on a D level or C level. And every time I talk a builder I say, “You build a home to code?” “Oh yeah, I build it by code.” I said, "Is this is just acceptable to your son or daughter going to school and coming home with a D grade?” “Oh, no.” "Well, then why are you doing it?” The point being well taken.

One of the things we've brought up today was that it's all interrelated whether it be energy, water. And I think Gary pointed out something that was very important, that is hot water has got a lot more energy involved to it than just cold water. But the energy cycle where the water comes into a home involves sewage agent, CO2, carbon and everything else. But if you could also distribute water in a way that you can create the water heater to be more efficient, because it's actually heating less water then you're creating another energy savings or bringing less water that may be a lot colder from the outside, which again can create more energy efficiency.

So it's a package that we were talking about today, not just energy, water, sewage and CO2, but also the fact that you can effectively create a more energy efficient water heater that's already energy efficient. You're just creating it so it doesn't have to work as hard.

MS. BROOK: I see, okay.

MR. ACKER: That's what I'm talking about. I remember meeting with John Glendall, the chairman of the State Industry, one of the largest water heater manufacturers in the world at one time. And he had developed, he had spent $5 million to develop a tube that goes down under water, with the tank water heater. And he had it curled at the end with a bunch of holes on it and I said, “John, what's that for?” And he said, "That's a five million dollar error.” And I said “What do you mean?” He said, “Well, I designed that with the concept to getting enough flow coming in to my water heater to keep the tank water heater, or gas water heater primarily, from settling and building sediment at the bottom. Because that's where most water heaters are destroyed for gas water heaters."

And I said, "Well that sounds like a great idea." And he said, "It doesn't work." And I said, "Why?" And he said, "Because with all the low flow fixtures now I can't get enough GPM in to the tank to make it work effectively."

And he said, "You already knew that." And I said, "I did?" He said, "Yeah, because what you've developed does that automatically with any water heater."

It's the idea of getting a higher flow into the tank to keep that from settling at the bottom, from building up, so we potentially increase the water heat life by 20 to 25 percent. But again, it's just not saving water energy it's a packaging or controlling a lot of different things that go on with the house. And I think that's what I was referring to.

MS. BROOK: Okay, so it sounds like we need to do a better job trying to quantify all those things that are sort of on the fringes now that aren't getting counted in our kind of systems analysis that we do.

MR. HOESCHELE: I think that's true.
MS. BROOK: Okay, any other questions for Marc?
MR. HOESCHELE: It doesn't look like it.
MS. BROOK: Okay, thank you.
MR. ZHANG: Well, I'll just go through this relatively quick, we have negative time left. All the group talked about what we can do in multi-family buildings. I think it turns out to be less a technology discussion, more a philosophical discussion.
So we start, the issue was there is a lot of things we don't know or don't know enough, which is true. We don't know, I will start with for example, energy use patterns, hot water loss patterns and mechanisms. And towards the end here's a long list of items, for example, how do you consider system. And it get sub-coded by all those issues: anti-scalding mixing valves, solar system, pipe diameter and storage volume and all that. The question is we don't completely understand how each fact is precisely affects system performance and therefore leads to R and D requirements. And to resolve that you need a better modeling. Tools, that's all I think, and

it sounds very logic.

But we then also talk about maybe we can also look at the problem from maybe another angle, because one thing is if we emphasize unknown long after a potential conclusion is it also is limiting our capability to find possible solutions. So the question is without knowing all those details, mechanisms, factors, how they work in the system, is it possible we can still do our possible solution to make this go on forward? So then as a school of thought within the group basically saying that maybe we could, based on what we do know now, to come up with possible alternative solutions based on first principles, based on engineering analysis.

And we talked about for example, you know, look at Marc's study on 18 buildings. It gives you a picture of only 18, and early on people comment it's only 18. But it does show you how different types of water heaters, the efficiency varies with your hot water draws. So there is some information there. And we also have previous studies look at how pipe loss is going to be depends on recirculation or just a branch on pipe diameter, miscellaneous.

You know, in my previous PIER research we looked at the recirculation in multi-families. And Marc has been long doing everything to improve his hot water SIM models, right? They're dealing with, in fact comprehensive plumbing designs. It's recirculation plus or all different kind of trunk or branch designs. So they're not necessarily perfect, but I think again the point is that from another angle maybe we should begin to consider alternative solutions and then consider how those different factors can vary the performance of those alternative solutions.

So all the diagrams we come up with here it used to be very clear but there was --

MALE VOICE: We all scribbled on it.

MR. ZHANG: So after a few people drawing on it, obviously it's hard to recognize, but there's still some pattern there. So we're saying this is kind of like a efficiency scale. If we look at what we are doing with current Title 24 maybe on average it's going to here. But obviously it varies. It varies depends on the precise draw patterns, exact locations of your fixtures relative to hot water heaters, relative to recirculation loops. It also depends on, for example, senior housing versus student housing and other market rate buildings.

And so what we can see is that you're going to have your actual efficiency in the field vary around this average. So this is where we have a lot of unknowns. Now, if we only pay attention to the unknowns we can maybe refine our understanding, but towards the end we can improve our efficiency potentially from here, maybe to the upper range of this range.

But if we again do thinking alternative designs, even though especially those maybe not even there those commonly used in the market then maybe we can see possible solutions of bringing efficiency at those levels. The potential is higher in uncertainties. Again we have a lot of unknowns, but it allows us to kind of jump our consideration of potential efficiency requirement from one step to a next level. So if we can follow that approach then maybe we can emphasize how uncertainty in the new system is going to be, so it allows us to move ahead quicker.

So to conclude that and there was, for example, leads to Gary's suggestion we need to do lab tests of first principle designs, first principle considerations. So maybe one approach you can consider as a first step is maybe based on what do we know today? Whatever the field data with the engineering and knowledge we have let's consider different design options, symptom options, as we proposed to you all in this room in the past. And then it's based on all first principles. And then that allows us potentially to kind of rank them to see what we are talking about different technology, what their efficiency is going to be, what their uncertainty is.

Kind of like it's mapping out them. Is it here versus here, how much? Maybe draw a circle around different technologies. Kind of a like a bubble chart so you can see oh, maybe this is a weak envisioning and the map is going to be. So that allows maybe the group just to come decide and then next basically going back, dealing with unknowns R and Ds. Maybe we'll say, "Hey, this is what we know so far, but we see big potential with this bubble maybe we can spend more efforts on that."

So I think that kind of conclude our discussion, no specific suggestion what are we going do, right next step.

MR. STONE: One other piece you left off there was that we think it's probably time to start looking at the difference between senior housing, student housing and all other, because there are definitely different usage patterns. So it may be time to make that segregation.

MR. ACKER: I have a question to ask in regard to that. It's come up in the past that what do you consider multi-family? You have a lot of different buildings out there now that do the same thing as multi-family, but they're not considered multi-family. For example, vacation things like the Hyatt has and timeshare type programs in buildings. I mean, there's huge amounts of these. What category do they fit into, do they fit in to multi-family? Not really, they're not commercial, because they're really owned by homeowners. So I think that was a problem that we ran in to a couple of years ago when we were running some tests on that basis as well. It would be good to define that area as well.

And the other thing is on talking about your plumbing, and I don't know if that happens on multi-family, but sometimes you get a plumber that plugs and he builds different loops off one pump. In other words he loops it, it comes back down. That's always been a problem, because if you don't run a pump 24/7 you can't fill all the loops. Well, we've actually solved that. We can monitor three different lines now with one pump. So that's we were talking about new technologies earlier, but Nehemiah brought up that there is new technology, it's already available.

But we're trying to meet technology as a way of not only they built buildings in the past, but also the way we think they should be building buildings in the future. And one of the things that we featured and we try to do is if the building is really poorly designed like Carl was saying it earlier today, and that is that they're building bigger houses with poorly worse plumbing designs. The worse the plumbing the better we can make it work, the more savings we get. The better the way the house is done, the better the structure is of any home or building, the less energy you're going to save, because you're already saving it the way you're designing the building.

So there's different ways of looking at this. And that's the approach that I'm trying to bring up. We've got to define, first of all in multi-family what is considered multi-family? And I don't know. And I think there was another issue where I think even San Diego Gas and Electric was having a problem with, “Well, I don't know. It's not in our category. It's no longer multi-family, it's commercial.”

MS. BROOK: Oh, oh my goodness.

MR. ACKER: You know, and you've got two different categories within the utility who were debating what it was. So it's hard for us as manufacturers, I don't know if it's any other manufacturers here, but if it's hard for us manufacturers to buy products to make if we don't know what the building, you know, what category it fits in to.

MS. BROOK: Okay.

MR. ZHANG: Within the code dealing with multi-family hot water systems what we do have is to ask, kind of propose a building design to specify are you using one water heater to serving multiple dwelling units? So versus are you using one water heater for each dwelling units? So it's kind of like designing-wise how each of the system design works instead of are you multi-family or single family unit. Obviously a single family unit does not have the issue, it's only multi-family. You could have different system design.

I think that the extent of what you're talking about it maybe also makes sense to have better definitions of different hot water system designs.

MR. ACKER: Well, there's thousands and thousands of “vacation” like Hiltons and Hyatts that are huge, huge groups. Their golf courses and everything else, they're timeshares basically. And they're anywhere from six buildings to twelve buildings to twenty-four buildings, but their circulating systems operate just like a multi-family. That's how they operate.

MS. BROOK: Yeah, Jon?

MR. MCHUGH: Hi, so many conversations have been more global and not specific to particular measures. And I thought of one thing. You know, we've got all this brain power here and people thinking a lot about water efficiency.

And we've developed a list in conjunction with the Energy Commission on potential measures for the 2016 standards. And in advance of the actual kickoff for that work I've been collecting information, just trying to lay the path.

And one of those things had to do with a water efficiency measure that seems to apply to a lot of, not to every building category, but to many residential and non-residential building categories. And that is the issue that we heard kind of earlier with the fairly extensive comments of Mr. Van Decker. And that's the vertical film drain heat recovery or some of form of drain heat recovery.

And so I'd like to ask this assembly of water experts, am I missing something? It seems like I wasn't even that aware of it, you know, not that long ago and it seems a fairly robust technology. It seems to make sense from efficiency point of view. And so is there something that I'm missing that I'm actually not seeing a broader use of it up to this point?

MR. DELAGAH: One thing is in Canada they have basements and they have a lot colder water. It works for Colorado, but we don't have basements as much here and we don't have that really cold water to get that heat exchanger effectiveness. So our payback for drain water heat recovery for residential is not very good.

MR. MCHUGH: When you say not very good, what do you mean, like how many years?

MR. DELAGAH: They actually, I think the Canadians have a website where you can put in all that information to figure out your --

MR. MCHUGH: For the specifics of your climate, so they get a model there?

MR. DELAGAH: Yes.

MR. MCHUGH: Excellent, okay.

MR. DELAGAH: We don't have that model yet, but you can calculate it.

MS. BROOK: Well yeah, Gerald gave us that equation, right. I mean, I'll give it to you Jon.

MR. MCHUGH: Okay.

MR. DELAGAH: But ultimately we still don't have basements. You know, it's something that we would really have to figure out how we're going to incorporate.

MR. MCHUGH: Right, but you know, the last time Bob Raymer was talking to us I believe he said something like two-thirds of single family homes are two stories, so you don't have to do it in every house, but two-thirds would be okay with me.

MS. BROOK: Yeah, and we actually heard just recently that they might be moving to more like rural houses, because the new sprinkler requirements mean that you don't need to have the offset between buildings anymore. And since builders want to maximize their lot space they're going to be slapping those buildings right up against each other and going up. So it could be even --

MR. STONE: That sounds like multi-family to me.

MR. KLEIN: It sounds a lot like that, yeah.

MR. MCHUGH: Or whatever, but low-rise multi-family. So the question is, is there something? I mean, for instance is the Delta-T being somewhat smaller than in Canada, does that extend it out past that? You know, for the residential standards we look at a fairly long time period, because of the 30-year period of analysis and the 3 percent discount rate.

MR. DELAGAH: I think it's still cost effective. It's definitely worth looking at and doing the calcs for it.

MS. BROOK: Okay.

MR. DELAGAH: And looking at the building stock that's going to be built and since we're looking at new facilities or new residential houses, especially since we're going up, it would make more sense than with a single story.

MR. MCHUGH: And hotel-motel any sort of?

MR. KLEIN: I think you need to spend more time talking with Gerald Van Decker. They've done enough construction for different applications that he can be helpful in your thinking. They've put together units that gather six drains into one heat exchanger or six shorter heat exchangers in one bigger system. So they figured out ways to do some aggregation of multiple stacks and how you handle multi-story applications, where you gather four of them together for every individual unit. And so there are some things that are being done to look at that, so you basically buy one drain water heat recovery device and split it among four sources and so your cost effectiveness goes up.

The single family, the single unit case or the single family case, the dilemma you face is that if you have two showers you now have two sources. And since we're not smart enough to put them back to back or right on top of each other you can't easily share the same drain line and therefore you have to either just get to pick one or the other. And if you pick the wrong one you're not going to get anything out of it.

MR. STONE: Another consideration besides just the cost of putting the drain heat recovery in, is the required changes to the rest of your design. They won't fit in a two-by-four wall. It doesn't fit easily in a two-by-six wall, but it can. And a lot of times the showers are not against the exterior wall, so they're not going to be two by six. So you have to account for the extra cost of that construction to allow it.

MR. SPLITT: I just want to mention that in our group before I brought up the fact that in Santa Cruz they actually require plumbing design for new residential buildings, so I end up doing that a lot. And it's almost 100 percent always after the architect is completely done with the plan. And they never think about it. Well, I wouldn't say that categorically that architects never think about mechanical or plumbing systems, but --

MR. KLEIN: You have evidence?

MR. SPLITT: I can't remember one offhand one that really does, well maybe one or two. So anyway the problem is that you get a plan and basically all we'll end up doing is sizing the pipes, because the bathrooms are already spread all over the place and it's too late to do anything. And you can't go to the client and tell them that you think the architect didn't design the building well or you would never get a job from them again.

But like for this drain system it's almost guaranteed that that shower on the second floor, that drain is right over the middle of the living room below. So the problem is you --

MR. STONE: Copper pipe is pretty attractive.

MR. SPLITT: Yeah, so the problem is if we're thinking about plumbing systems we really have to think about upfront how to get the entire design integrated, so that this stuff actually works.

MS. BROOK: Right. Yeah, okay.

MR. KLEIN: To Nehemiah's point one of the folks in Canada, I think it's in Canada, actually took their drain water heat recovery stack. And instead of hiding it behind the wall in the corner that it came it, they exposed the corner and they had them polish it up really pretty and put a light on it, so it's a feature. The bathroom's upstairs so then people will go, “Well what's that?” And they go, “Flush that” and they figure out how to make it work. It's pretty funny.

MR. WEINGARTEN: One other thing, if I may, they actually have even despite what Gerald says there's another manufacturer that has created a horizontal heat exchanger. So they're --

MS. BROOK: Oh, okay. And it's not half as efficient like you said, maybe it's a little --

MR. WEINGARTEN: I talked to the inventor and he claims it's better than that.

MS. BROOK: Oh, okay.

MR. WEINGARTEN: So we have choices.

MR. DELAGAH: We've tested the horizontal heat exchanger for food service applications and it does work. I'm sure it works for residential applications, we just have to do more field. You have to have funding to put this stuff in the field and give it a go and I think that's where we are in California. We haven't really invested in the technology.

MS. BROOK: Okay, so I have a process issue. I have run and catch a bus in five minutes and I want you guys to keep going as long as you want to or need to. And Danny, I don't care about his bus schedule, so.

MR. TAM: No, I rode a bike.

MS. BROOK: Yeah, he rode a bike so he can stay as long as you want. But I really do appreciate you guys coming. It's always a pleasure to talk with the water heating guys. I miss you guys, I used to be in research with you and it was really fun and I appreciate having the chance to talk with you again.

And I think we've promised to summarize the notes and to get them posted on the docket page that Danny has put up for the water heating stuff. And we're really serious though. I mean, we've said it before, but we really do want to do something good with water heating in the 2016 standards. So I hope you guys will help us.

MR. LUTZ: Are you going to come to the Hot Water Forum?

MR. KLEIN: It's not in California, let's start with the obvious.

MS. BROOK: Oh no, but thank you for asking.

MR. KLEIN: So I think we've all had a pretty long day and I would recommend that we probably call it one.

I would observe that I heard a couple of themes that ran through each of the discussions. One of the ones that struck me was the discussion of plumbing design being needed in all of the three categories we were describing. All right, that was one of the things and what a surprise, of course I pay attention to that one, that's my specialty area.

The other one that came up is the interactive effects question. If you have this, this and this do they work well together or do they not work well together? That kind of thing came up in all cases.

I think we also heard that while we know some things we don't know others. And we do have to scope out how to learn more quickly about this in order to make progress as we move forward.

MR. LUTZ: There's one other sort of overarching one and that's that the Energy Commission is not the only player. There's other people writing codes and standards and doing programs and incentives and they don't seem to be all that well coordinated yet.

MR. KLEIN: Well, they're not. And I know that there's work going on in IAPMO's base uniform plumbing code as well as in their green technical code. I know Ed and I work on both of them and so I know that that's there. And I know that if those go through it will impact what the Energy Commission is able to do, because it will become base plumbing code. So things are happening whether there's energy consequence, or not or well understood or not. It's going on all around us that we have to pay much more attention to.

MR. STONE: Just before Martha left I

asked her if she would appreciate getting copies of anybody else's electronic notes, so to help the summary she's putting together. And she said yes, so anybody that took notes electronically please feel free to send them to Danny or Martha or Owen. Just send them all to Owen.

MR. KLEIN: Are we done? We're done.

MR. STONE: We're done.

MR. KLEIN: A toast, thank you all very much it's been great having you all here today.

MR. STONE: Thank you guys for doing this, this was great.

MR. KLEIN: Danny, thank you.

MR. TAM: Oh, you're welcome. Thanks.

(Adjourned at 5:23 p.m.)

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