WORKSHOP

BEFORE THE

CALIFORNIA ENERGY RESOURCES CONSERVATION

AND DEVELOPMENT COMMISSION

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APPEARANCES

COMMISSION MEMBERS

Mr. Arthur Rosenfeld

STAFF

Mr. Bruce Maeda

Mr. Bill Pennington

Mr. Maziar Shirakh

Mr. Ram Verma

PANEL

Ms. Elaine Hebert

Mr. Robert Mowris

Mr. Ken Nittler

Mr. Bruce Wilcox

ALSO PRESENT

Mr. Steve Brayley, U.S. Air Conditioning

Mr. Michael Day, ICE Energy

Mr. Charles Eley, Architectural Energy Corporation

Mr. Steven Gates, Hirsch & Associates

Mr. Michael Hodgson, ConSol

Mr. David Knowles, GAMA

APPEARANCES CONTINUED

ALSO PRESENT

Mr. Jim Lutz, Lawrence Berkeley Laboratory

Mr. John Proctor, Proctor Engineering Group

Mr. Robert Raymer, California Building Industry Association

Mr. David Roodvoels, D&R Consultants

Mr. Lee Shoemaker, Cool Metal Roofing Association

Mr. David Ware, Owens Corning

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PROCEEDINGS

MR. SHIRAKH: Okay. Good morning, everyone. I think we're going to get started.

I see we have a quorum here. My name is Maziar Shirakh. I'm the technical leader for the 2008 Building Standards. We have notice that Elaine Hebert is sitting in the audience smiling and I'm up here. Elaine has moved to a different assignment, so you're stuck with me for this.

We have a full day today here. There's one change in the agenda. I don't know if everybody has a copy of the agenda. It's on the table. There's an item this afternoon the time was 2:15, Revisions to the Standard 1,761 prototype. That's going to move up to the slot that's at 11:15 currently. And then the item that's going to be presented at 11:45, Suggestions To The HVAC Efficiency Improvements, that is going to move to this afternoon.

Other than that, the agenda holds.

I'd like to introduce some key Commission staff: Commissioner Rosenfeld, one of the 6 Commissioners on our Committee is here; and the other Commissioner, Jackalyne Pfannenstiel, she'll probably be represented by her advisor, who's going to be in and out; Bill Pennington, the office manager; and Ram Verma is the other technical lead for the 2008 standards. And in the audience is Charles Eley, the prime contractor for this contract.

Anything you wish to say?

MR. PENNINGTON: Just one thing. I done know if these are live or not. Am I getting -- are the microphones working here?

Okay.

I'm sorry for this room setup. I wasn't really expecting it to be like this, and so I apologize for that. I think what we need to do is for people who want to speak, they need to come to this microphone here to speak. So try to make the most of this inappropriate arrangement here to have a dialogue.

Thank you.

MR. SHIRAKH: Each presenter is going to present the topic areas. There's going to be a slide presentation. And at the end of each presentation, there's going to be a question and answer period. Just raise your hands and I will ask you to come to the podium. When you do that, you need to state your name and your affiliation every time, when you do that, for the reporter. It makes his life easier. And he may ask for your business card too, so please be prepared to give him your business card.

Today's topics are all residential and all has to do with modeling. These are the measures that will mostly impact the ACM manual. There's no non-residential topics today.

So with that, I'd like to introduce Bruce Wilcox. And the first topic will be the attic modeling.

(Thereupon an overhead presentation was Presented as follows.)

MR. WILCOX: Thank you, Mazi.

Is this on? Can you hear me?

I'm Bruce Wilcox and I was the prime contractor for a PIER project that's been going on for the last year or so, where we did some research and developed some things that were aimed at supporting the 2008 standards revision process.

And one of the prime things that we worked on was a new attic duct model for the residential ACMs for the residential alternative compliance methods. We had a rather large team working on this: Myself, Phil Niles, who's a retired CalPoly policy professor and the original author of the CalPAS, CalRES Micropas programs; Ken Nittler, who's sitting at the table here with me, who's been our programmer, and has carried the lead on that part of it; Larry Palmiter who works for Ecotope in Seattle, who's a world expert on duct system efficiency modeling and measurements, and he developed the duct efficiency model; and Danny Parker from the Florida Solar Energy Center who helped us with data collection and data analysis and comparisons with measured data for attics and roofs.

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MR. WILCOX: Okay. So what I want to talk about in terms of the attic model is a little discussion of the background. And then we're going to talk about the approach that we have taken to developing this model and the status of where we are with it at the moment. I've got some experimental data comparisons with model predictions to talk about to help put this in perspective about what it's capabilities are. We're going to talk about the issue of attic temperatures and distribution efficiencies predicted by this model compared to what we've been using in the past with the 2005 ACM models and previous.

And then we're going to talk about the impact of this model on energy use predictions and compliance and measure savings.

I also wanted to mention that there's a report that has the details of this presentation that's, I think, posted on the Commission website. And so you don't have to try and write down everything. The report will be available, is available now. And this PowerPoint presentation, I think, will also be posted on the Commission website, so if you want the details later.

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MR. WILCOX: Okay. So why are we interested in attics and ducts in California?

And the bottom line is that the typical situation in new California residential construction is you have an attic and the ducts and probably the furnace and HVAC system are all located in the attic. And this is a bit different than regional practice in other parts of the country, but in California a vast majority of new homes are built this way. So it's a big issue in terms of the HVAC efficiency.

Something on the order of 30 percent of the heating energy and 35 percent of the cooling energy is lost in that system located in that attic in an unimproved, kind of, typical year 2000 California house. So we're talking enormous impacts here on energy efficiency and energy use, if we sort of let things go the way they've been being done for a long time.

And then the third point here is that the situation is probably even more important on peak. And the attic tends to be even worse under peak conditions -- under peak cooling conditions when we have our big electrical demands. So for a lot of reasons this is important.

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MR. WILCOX: And I put this slide in because -- not because I knew Art was going to be here, but put this in from a paper that he wrote.

(Laughter.)

MR. WILCOX: And it tries to talk about why --

MR. RAYMER: It says your name down there.

(Laughter.)

MR. WILCOX: The footnote in the paper has got Art's reference to his paper on it. Anyway, this is a plot of the daily peak electrical loads for the year of 2000 from the California Independent System Operator. And so -- this blue line is the kilowatt demands -- or it's actually gigawatts of demand statewide for all the people hooked on to the ISO.

And you can see that starting in January we get this kind of stable pattern where the -- you know, you get a weekly pattern going on there where it's down on the weekends and up during the weekdays. And it goes along, and there's, you know, some variation, but pretty stable around 30 gigawatts.

And then you get to May and June and all of a sudden we're up here between 40 and 45 gigawatts on the peaks. And there's a 43 and a half gigawatts on August

16th was the peak for that year.

So this is the kind of issue that Art and his distinguished colleagues are charged by law with dealing with, you know, how to supply this 43 gigawatts in the middle of summertime. And what Art did in his paper was put the estimated peak electrical consumption for commercial air conditioning and residential air conditioning overlaid on this plot of the ISO loads. And to me the obviously is that if you look at the difference between the winter load and the summer load, a very large part of this is air conditioning demand. And about half of that is residential air conditioning demand. And I find this to be kind of amazing and puts the whole thing in perspective, because this is a serious statewide issue I think.

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MR. WILCOX: So here's an example of what happens in the attic duct system. And this is -- this is losses from a duct system calculated for 2 cases, an unimproved duct system in a typical year 2000 house and an improved duct system that meets the 2005 standards that went into effect in October. And this is for the peak day in climate zone 15 in Palm Springs.

And the typical attic has a dark roof has R-4 ducts. They're not sealed, so they leak. Whereas the

2005 standards require that that same system have a radiant barrier in the attic, have R-8 insulation on the ducts and the ducts are actually sealed so they don't leak air.

If you run this new attic duct model, that's where these numbers come from, is this is exercise of the attic duct model, you get these kind of losses for the unimproved duct system versus this for the improved duct system. The red area here is the loss due to duct leakage. That's by far the biggest chunk. There's the radiant and convective -- the radiant exchange from the supply ducts and the return ducts and then the convective losses from the supply ducts and the return ducts are all in there.

The peak load -- or the peak loss here at the peak hour for this duct system is about 18,000 BTUs, about a ton and a half of air conditioning. And that's, I think, about 30 percent of the system size for this house. So we're losing a third of the cooling capacity calculated in this attic. If we just do what the 2005 standards prescriptive requirements are, we basically cut that almost exactly in half -- a little more than in half.

And so I think there's a reason to believe that, you know, we can impact these systems and we can improve this kind of disastrous situation that's been the tradition. And that's one of the reasons we need a good attic model is so that we can figure out the -- do these calculations, figure out the magnitude, figure out what's cost effective and give people credit for doing the right thing.

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MR. WILCOX: So more background here. California -- those of you from California all know this, but I'm assuming some people aren't actually from California. In California we have a performance-based energy code. And the vast majority of people complying with that code do Calculations with a simulation model to show that they've met that performance requirement. This is relatively unique in the world of energy code compliance, but it basically -- builders in California make their own custom prescriptive package of measures for each house or each development and use the computer models to show that they have met the code. So these models are integral and very important in the compliance process.

In order to do that job, you need an accurate roof duct attic model that can evaluate all the measures that are of interest and make the kind of trade-offs that the builders are interested in, and do it right.

And you also -- the other important use for this model is in standards development, which is sort of what we're gearing up for here today. We look at potential measures for the building standards prescriptive requirements based on their calculated energy savings versus what their costs are and the Warren-Alquist Act requires that anything that gets put in the standard has to be life cycle cost effective. We need a tool that we can use to make those calculations, so this is the rationale for the duct model.

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MR. WILCOX: The design of the particular model we've developed here is constrained by a bunch of different issues. One of the most important ones is that we have to be able to handle all of the current measures and credits that apply to the buildings. We don't want to say that you can't any longer, you know, get credit for a radiant barrier because we've got a new attic model that doesn't handle those things. So one of the constraints was that this model had to include all of those current credits.

A second thing is that this is intended to operate in the code compliance world of building inspectors and HERS raters and people who go out in the field and look at buildings that determine whether they've met the building standards or not. There's actually other people that do this too, some of them who are sitting in the front row.

But the issue is that you really need to focus on -- I think -- that you need to focus on aspects of these systems that you can actually look at and check in the field and verify and make sure that they're actually there.

We're not interested in sort of paper compliance here. We're interested in things that actually can be verified and will actually work.

And also we've got all this idiosyncratic things that builders do. You know, sometimes they build with crawl spaces and put the ducts in the crawl spaces. So you've got to be able to, you know, give them a path as well. Some buildings have flat roofs, particularly multi-family buildings, which are also covered by this model. It's quite common these days to have multiple air conditioning systems in the house, and so you have to be able to handle that situation. And then all the combinations, multiple systems, zones, ducts in attics, crawl spaces. Some large houses have all of that stuff combined and this model is designed to handle all of those cases.

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MR. WILCOX: We designed to handle all these efficiency measures: duct sealing; duct insulation, including ducts that are buried in the attic insulation, which is something that came in in 2005; ducts that are located in conditioned space and other places; roof solar absorptivity and emmissivity; tile roofs; radiant barriers; attic ventilation; attic insulation; sealed attics; and insulation construction quality.

So those are all the aspects of the efficiency measures that are designed to be included here.

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MR. WILCOX: Another part of the compliance world is that you don't generally have time to do detailed descriptions of houses. I mean, we're talking pretty minimal kind of inputs. And, in fact, up till now there's been basically no information about the roof as part of the compliance world. So we didn't want to make it too complicated. We also didn't want to make it so that, you know, if some compliance consultant's input the roof and said it was going to be a hip roof and then the builder decided later that he was going to change the pitch or he was going to change it to a gable because he wanted to add -- to change the look of the house, that that shouldn't invalidate the compliance.

So the only description -- input description of the roof that we call for here is the pitch or the height of the peak, which is basically in order to be able to get the ventilation characteristics right.

We assume that the roof is generic. It's the same -- you know, it's got the same -- the attic floor area is equal to the ceiling area of the house that's on the top floor. And we generate a roof that has the correct pitch and height on top of that.

If you're going to do special ventilation, you need the free area and location of the vents. And then you have to pick roof types and so forth that are not dealing with those issues. And the duct system is currently -- is the current duct system inputs, basically the same as the way they are now.

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MR. HODGSON: Bruce, can you --

THE REPORTER: Can you identify?

MR. HODGSON: This is Mike Hodgson.

MR. SHIRAKH: Mike, you care going to have to come to the mic. I'm sorry.

MR. HODGSON: I'm unclear what you're describing, Bruce. Are you describing the existing model or the model you're proposing.

MR. WILCOX: The new model.

MR. HODGSON: The new model.

MR. WILCOX: This is the new model.

MR. HODGSON: Okay. So in the vent detail, you're saying that you can vary the amount of ventilated area in the --

MR. WILCOX: Yes.

MR. HODGSON: And location?

MR. WILCOX: Yeah. The current -- adding ventilation is actually an important issue. And it's -- the current standards require that you put in extra ventilation if you have a radiant barrier, but the extra ventilation is never modeled or taken into account anywhere. So now we're taking it into account. It's interesting results maybe.

Okay. So there's some limitations to the model we end up with using this approach. This is not the be all and end all necessarily. We have a generalized geometry. I mean we don't really know very much about the shape of the roof. In fact, any roof with the same attic floor area will be basically -- and the same pitch will look the same in this model.

So we're not dealing with all kinds of weird geometric things and self-shaving by the roof and so forth is not an issue that we're dealing with. We have a pretty simple duct model. It's adapted from the Standard 152 approach that's in the current ACM. You know, we're not putting in each piece of the duct system and connecting them together like you do in some of the detailed models.

We have a pretty simple regression based infiltration model that was developed. And so, again, we're not doing a flow pressure calculation that gets the integrated whole building. We're doing a pretty simple approach.

And we only have -- we're only giving capabilities for one attic space and one crawl space in each building. So that's, you know, kind of -- I think it's a big leap forward from having no attics to having one attic. But on the other hand, a real complicated house might have several attics, because they're not -- you know, if it's different levels and, you know, different wings and so forth. We're making the assumption that it's okay to say they're all one thermal space, which I think is a reasonable assumption for code compliance.

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MR. WILCOX: We have some new capabilities in this model that haven't been around before. We have the capability of improving the infiltration model in the house. And this is partly because infiltration from the attic to the house is one of the important paths for air leakage into the house. So if you actually know the temperature in the attic, you can improve your estimate of the impact of infiltration. So we're not proposing that we do that at this point in the modeling rules, but we do have that capability.

We can do unbalanced duct system leakage where the supply ducts have bigger leaks than the return ducts have or vice versa. The 2005 ACM and all previous versions of the ACM ducts' rules have assumed balance leakage, which means that the leaks in the duct system do not cause extra infiltration in the house.

Now the real systems where they're unbalanced when you have a big supply leak and a small return leak, then that causes infiltration to increase in the house whenever you turn the air on. We can handle that if we want to get into that later.

We haven't tested this much yet, but supposedly we can handle forced ventilation of the attic like you would get if you have one of these economizer systems.

Radiant properties of the duct surfaces in the attic and we haven't gone into that either. In theory, if the ducts had a radiant barrier on them, that could be a big thing. One of the issues in the current standards is that radiant barriers are required to be put on the roof deck and also on the gable and of the -- if you have a gable roof, it's to be on the walls of the attic as well as on the roof deck. And we can separately model that and hopefully maybe simplify that rule some, I think.

And the other thing is that we have an algorithm that we've picked up from the Florida Solar Energy Center model which adjusts the R value of the insulation in the ceiling based on the temperature of the insulation because of the well known standard properties of insulation that vary with temperature.

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MR. WILCOX: So the approach to developing this attic model for the project was to steal as many ideas as we could from other people's attic models. And we've done that. And there's a discussion of 4 other attic models that are in the report that we looked at.

And then we developed a beta test model of the program, tested it and compared that to measured data. We then integrated that attic model into a special version of Micropas, which is one of the certified compliance programs. But the idea is that there will be a special version of Micropas for use in the 2008 standards development process that will have this attic model. My team is going to provide support to people involved in that, so that this model can be used in developing, you know, the people's proposals for windows and all the other things that go into the 2008 standards.

And then ultimately the model is intended to be published in the ACM manual. It's going to be a public model. Everybody can use it, and hopefully it will be --

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MR. WILCOX: You wanted to say something, Charles?

(Thereupon a discussion occurred off the record.)

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MR. WILCOX: The status of things as of right now are that basically all the work is done; Micropas integration is complete with some exceptions for trying to make all of the inputs work seamlessly. We're still using kind of a -- we still have kind of a kludged input scheme. And there needs to be a few more things done and we can talk to Ken later about the details on that and when they're likely to happen.

Bruce.

MR. MAEDA: Bruce Maeda, M-a-e-d-a. What does UZM stand for?

MR. WILCOX: UZM stands for Unconditioned Zone Model. That's our tech head name for this. We originally started out calling it the attic model, but then we decided we needed to do crawl spaces, and how can you have crawl spaces in an attic model. But basically it's designed to do unconditioned zones with ducts in them all, but we don't do garages.

And so we've done all this stuff. And I'm going to tell you about the steps here on the rest of them.

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MR. WILCOX: So let's talk for a minute about comparisons with experimental data. We have 2 data sets that we focused on to look at and compare with the model, both of which provide data on attic temperatures, that under various conditions, under weather conditions and with various roof systems.

And so what we're able to do is compare the predicted attic temperatures from the UZM model with the measured ones for that same case. And we've done -- this is a pretty extensive technical piece of work to do this in order -- you have to take measured data, you have to make a weather file out of the measured data, so that you can actually run your model directly on the measured weather data. And then you have to make a simulation input for the test building. And then you have to figure out how to compare those numbers and what's wrong and so forth.

So the first thing we -- the first data set is a set of data from the experimental facility at the University of Central Florida, the Florida Solar Energy Center flexible roof facility is called. What they do is they're able to run in real time and real weather 6 different roof types side by side and measure the results, measure the attic temperatures and various other issues.

And so we've got comparisons there for summer average temperatures and heat temperatures for the 6 different roof types. I'll show you those in a moment.

The second thing -- the second data set is for a California production house. It was a project that was sponsored by Cardinal Glass. And they built 2 houses in Roseville, California. I was the project manager for that project and so I happen to know about this data set and know how it works and so forth. So I was just there.

The issue here is that this provides an opportunity to do a sort of typical California situation. Florida has got different weather. It's got different construction situation. The issues are really different in Florida because it's humid, and things don't cool off at night. And the radiant issue is not as big, and so forth.

So this also gave us a tile roof with ducts in the attic and enhanced ventilation, the kind of stuff that we need to be able to handle in the model that you could do in a straightforward way. So we have comparisons for a year of unoccupied an instrumented data in this Roseville house, which was coincidentally running the setup to run the exact California 2001 ACM occupancy building internal gains and thermostats and everything.

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MR. WILCOX: So here's a picture of the Florida flexible roof facility. It's pretty grand. And it's -- so it's a gable roof building. It's one space down below and then the attic is divided into 6 different individual spaces, each of which is insulated and sealed, so that they operate independent from each other.

And it's a gable. It's got both sides, so you get north and south exposure as well. And this is a plot for June 16th, 1997, showing the attic air temperature for 6 different roof types. The one on the top -- the black line here is their base case black shingle roof with minimum ventilation. The one on the bottom, the green line here, is a white roof tile, one of these things. So it has a very low solar absorptivity. It has mass. It has all of the tile stuff going for it. Whereas, the black shingle case has got the dark color and no mass and so forth.

In between, we have a variance. This blue line is the black shingles with a radiant barrier. The dark blue -- or the bright blue line is radiant barrier -- black shingles with a radiant barrier and enhanced ventilation, twice as much ventilation. The red line is the red tile and the kind of olive green line here is a white metal roof.

So you can see there's, you know, the range here is from an attic that's got to be 90 degrees to an attic that got to be 136 degrees on that same day at the same time. So we're talking a significant difference in conditions in the attic where you have those ducts that are leaking and losing heat and all that stuff.

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MR. WILCOX: So we set up the model to model each of these 6 different roof types and made a weather file and all the flowing that was involved in doing that. And what this plot does is it compares the, on the left-hand side, the predicted temperatures in the attic against the measured temperatures in the attic for those 6 different roof types. And these are the average of all the hours in July. So these are hourly average temperatures for July 1997.

And, you know, the black roof tile -- or the black asphalt shingle base case roof here, you know, gets to 128 degrees and cools off at night down to 70. And the UZM model of that case is pretty good in terms of matching the performance.

Again, as I pointed out before, the white tile roof down here is the best. It gets up to 94 degrees on average and -- in the model it's up to 91 in the real data. So we don't match it exactly. There's all kinds of technical reasons why it's hard to actually match real data, but I think we're doing -- the point here is that this model can discriminate between the roofs that have hot attics and the roofs that have cool attics. And it gets them more or less in the right order except for some issues on the radiant barrier case where the radiant barrier -- we predict a little better performance than the radiant barrier gets in the measured case, which may have something to do with issues of stratification in the attic.

This model assumes the air temperature in the attic is mixed, so that there's just one air temperature in the attic. And real attics, particularly ones with radiant barriers, tend to get stratified, so it's very hot at the top and not as hot at the bottom. That changes some of the heat flows. So we think the mixed temperature assumption is a reasonable one for the compliance model.

But I think it probably does have some impact on the way we were able to match these temperatures. There's the issue of if you're assuming a mixed attic and it's actually stratified, which temperature do you try and match? What is the mixed temperature? It's really hard to even figure out what the concept there is.

So anyway, we think this is a pretty good comparison.

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MR. WILCOX: And this next plot shows -- same plot. And it's the predicted versus the measured on the peak day of July of 1997. And so, you know, the peak day the temperature gets up to above 140 in our predictions and about 140 in the measured data for the black roof.

And, again, we've got the pattern, I think, pretty well. We've got -- we're discriminating between the roof types, I think, pretty well. And I think this is a very adequate overall situation.

So that's the Florida Solar Center Data of -- one more, one further comparison. As I said earlier, we cribbed from existing models as much as possible. So one of the things we did on the Florida data is we had the Florida Solar Center group run 2 other models that they were familiar with. One is their program. It's a DOE-2 version called Energy Gauge U.S.A., which they have a custom attic model that they developed that's in there.

And then the other one -- the third model here is actually an ASTM standard. ASTM C-1340, which is an Attic model that was developed by Ken Wilkes at Oak Ridge National Laboratory, originally 10 or 15 years ago. It's been a project they've been working on for a long time.

So what these plots compare is the UZM model, which is the black line, versus the data, which is the magenta boxes. And then the other 2 lines are the DOE-2 model in blue and the ASTM model in red. And so for the black shingle roof on the peak day, I think the UZM model is doing a better job on peak than either of the other 2 models.

For the red tile roof, the ASTM model gets a little closer during the middle of the day, but it's kind of off in the morning and the afternoon. And the DOE-2 model has got a big lag. I mean, they're all doing reasonably well. And then on the white metal roof it's a similar situation.

So my conclusion here is that this UZM model can match these different systems, you know, at least as well as the other models that are out there and have been developed for this purpose.

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MR. MAEDA: Bruce.

MR. WILCOX: Yes.

MR. MAEDA: Do you have measured solar data?

MR. WILCOX: Yes.

MR. MAEDA: Is it at angle or horizontal?

MR. WILCOX: I think it's horizontal. There's a lot of other measurements, but I think we used the standard weather station kind of data, wind speed measured on the site, the solar. The one thing that's always a problem in all these measured data experiments for this kind of stuff is that one thing that you don't ever have is cloud cover which is an input to the sky radiant model. We're using an adaptation of Berdahl's model here and that requires a multi-level cloud cover estimate. And you don't get that with any of the experimental data. So we actually used data from Orlando and estimated the cloud cover at Cocoa Beach based on Orlando, which is 50 miles away, so that's very approximate to get the radiant stuff right for this. Otherwise, I think the weather data is pretty good.

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MR. WILCOX: Okay. So here's the California data comparison. This is the Roseville house that Cardinal Glass did. And we ran these 2 houses side by side for several years. And the hole point was to try and demonstrate that high performance low solar, Low E glass worked and saved cooling load and saved peak and all that.

So it's only coincidental that we happen to measure the attic air temperature in these attics as part of the, you know, making sure we understood what was going on.

But we do have this good high quality data set with the weather station on the site and the whole works. These houses have tile roofs. They have high level ventilation. Just like the standard calls for for radiant barriers, there's no radiant barrier in these. They have a HVAC system with sealed ducts located in the attic R-4.2. We did all the duct sealing and measurement stuff, so that's all done very carefully. And we know what's there.

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MR. WILCOX: And so then we --

MR. RAYMER: Bruce.

MR. WILCOX: Sorry.

MR. RAYMER: Bob Raymer with CBIA.

Ceiling construction defects.

MR. WILCOX: OH. Yeah, this house -- actually, in retrospect, we did this work in, what, 2000 -- 1999 and 2000, I think. And, you know, that was before we got into the 2005 standards process where we developed the installation quality stuff. But these houses actually have big thermal bypasses it turns out in retrospect. We didn't realize what was going on so much at the time. So we use the 2005 construction quality factors in modeling these houses. And, you know, it's part of what the attic model handles and so we did it.

Does that answer your question, Bob?

MR. RAYMER: Yeah.

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MR. WILCOX: So here's a demonstration of how well the model can deal with the -- you know, the overall pattern. This is the week of the test year that has the highest outdoor temperature, highest attic temperature. That occurs here on this day when it gets to be 115, 118 degrees in the attic, and it's 109 degrees outside at that point. It's pretty hot conditions, normal California central valley summer.

And the measured data on attic temperature is the magenta boxes. Again, the dark black line is the model predictions. And the light black line is the outdoor temperatures. And, you know, we're basically getting this pattern almost right on I'd say. And I'm real happy with the performance of the model under those conditions.

Another way to look at this kind of data comparison is whether you -- if you're capturing all the stuff that's going on that's important, that you ought to be able to get the right answer on the average for big periods of time. And so this is the average hourly temperatures for August.

Again, the magenta is the data. The black line is the model. And the light black line is the outdoor temperature. The model from here is actually the UZM model. And, again, I think we've got the average conditions not here. It's a little -- I actually spent days trying to figure out why the time shift was the way it is there. But it's possible that there's some small thing going on on the program. I think it's actually probably because the houses face -- the house is oriented with the front facing east, as being exposed west facing gable roof element on the back. And I think that causes the temperature to get hotter later. Whereas, you know, our non-geometric attic model says that it's all uniform. And so I think that's maybe part of the difference.

But in any case we're not off by very much. We're within a couple degrees of the peak temperature. And we get the right amount of cooling off at night more or less. And I'm real happy with this.

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MR. WILCOX: And we don't do so bad in the winter. This model was really designed to deal with summer peak conditions, but this is January in that same house. And, you know, the data shows that the temperature goes down, on average, into the low forties at night. It gets up into the mid -- close to 60 degrees in the daytime. And the model is matching that data pretty well, within a couple of degrees. I think it's perfectly acceptable for calculating the efficiency of the ducts.

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MR. WILCOX: Okay. So, you know, I think that we've shown that the model can match the real data out in the world pretty well. So now the question is how -- what does it do compared to what we've been assuming up till now about duct efficiency and distribution efficiency and attic temperatures and so forth in the standards, is this an enormous change or is it no change at all, et cetera, and also what's the compliance impact. These are things we need to understand before we move forward.

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MR. WILCOX: So one of the big interesting things is that this model -- you know, we've been focusing on attic temperatures as one of the important things we know about. The current 2005 ACM has a procedure for -- specifies the procedure for calculating distribution efficiency for duct systems, and it specifies the temperature in the attic that you should assume. And those temperatures have been there now since 2000 or so I think. Certainly, the 2001 standards and maybe before that.

And it's a little murky, actually, where those numbers came from. But one of the things that -- one of the things that's petty different is that this model predicts pretty different temperatures in the attic than what we've been assuming for the last 10 years in the ACM.

So this is the heating -- the temperature in the attic for heating in the winter time -- well, these are for the UZM model it's the load weighted attic temperature, which means you take the temperature each hour and weight it by the amount of feeding load that hour. So it's the temperature in the attic that affects the efficiency of the duct system for heating distribution efficiency. And those are the red bars -- the magenta bars. The blue bars are the ones -- the 2005 ACM manual temperatures for calculating duct efficiency and heating.

And so you can see the model predicts a lower temperature in the attic than what the ACM manual has in the attic in every case except climate zone 16, which is the climate zone that's in the mountains where it really gets cold. And so, you know, there's some differences here. They're not enormous differences, but we're different. This is where the differences are big is on cooling.

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MR. WILCOX: And basically the UZM model says that the temperature is much hotter in the attics than what we've been using for the ACM manual. And it's not as dependent on the climate zone as what we had before. A good example of that is climate zone 1, which is Eureka, which has almost no cooling, maybe 1 or 2 hours of the year. And previously the ACM said you should assume that it's 60 degrees in the attic when the air conditioner was running in the house. And if you just think about that for a minute, that's kind of improbably. It's probably a sunny day if your air conditioner is on. And it's really unlikely that it will be colder to the attic than it is outside or in the house, either one. So I mean that's a little -- sort of puts in perspective how good these previous estimates were. And, you know, the changes are small in the hottest climate zones are smaller.

And this is a base case dark shingle roof. So the color of the roof was not an issue for the ACM manual, which was temperature.

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MR. WILCOX: Okay. So that's the temperatures that are assumed. They're not actually important for compliance. They don't -- in the UZM model they don't actually enter into the calculations except every hour you figure out the efficiency.

So what's the situation comparing seasonal distribution efficiencies? So this is the seasonal distribution efficiency for heating. And it's surprisingly small differences. The distribution efficiency average -- well, what these plots have actually are all 16 climate zones, 1 through .6, and then it's got the average of them, just a simple average. And then the last set of bars here is the weighted average, which is weighted by housing construction starts to try and get at a statewide average for new houses.

And the heating efficiency we predict to go up 1 percent on the statewide average weighted basis. And, you know, these models are really very different. The UZM model, keep in mind, is, you know, an hourly model. It's calculating the duct efficiency every hour based on the load that hour, calculating the attic temperatures and so forth.

The previous model is said we assumed it's 93 degrees in the attic, and you do it once for the whole season. So you don't get any of that interactive stuff. You don't get any of the ventilation effects. You don't get any of that. So it's surprising how close these are actually.

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MR. WILCOX: And the cooling efficiencies aren't as close. But I think this is largely due to the big difference in the assumed temperatures, at least it's consistent with that. The hottest climate zones efficiency goes down but only slightly. Climate zone 15 is Palm Springs. The efficiency goes down there slightly.

You know, it's a big difference in climate zone 1 where cooling doesn't matter. And on a statewide basis, the efficiency goes down from about 80 percent to about 76 -- or 66 percent for the weighted statewide average.

So this is a -- it's going to increase the value of cooling measures and cooling distribution efficiency measures and so forth.

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MR. WILCOX: Okay. So what does this mean in terms of compliance and usual measures and so forth? So we looked at some typical efficiency measures that you might want to -- represent things you might want to analyze for the standards, represent things that builders might want to do trade-offs based on.

So this is -- here, we're talking TDV savings as a percentage of the total for the climate zone. And it's annual TDV savings. In this case it's going from a minimum efficiency furnace to a 92 percent AFUE furnace. And, you know, the heating stuff didn't change very much. These numbers don't change very much. It's pretty uninteresting that it goes down slightly, less than a percent, I think.

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MR. WILCOX: Interestingly enough, the TDV savings for air conditioning changes doesn't change very much either. And I think that there's -- this has to do with the fact that again we're doing a very different model. When you calculate TDV with the UZM model and the air conditioning system and do all that on an hourly basis, then you get all these effects that the efficiency is really lower on peak than we previously assumed with our seasonal calculations. And all that stuff kind of trades off and it comes out to be not very different.

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MR. WILCOX: I was surprised. If you put your ducts -- take them out -- you know, if you start with a prescriptive house, which is a base case dark shingle roof prescriptive requirements for each of the climate zones. And you take the ducts out and put them in conditioned space, so you end up with perfect ducts, no ducts in the attic at all. And this assumes no leakage. Not the rules under the current ACM where you assume there is leakage from the attic anyway.

And so for this, the UZM model predicts increased savings. The statewide curve average goes from about 12 percent to about 14 percent. It goes up slightly, up 15 or 20 percent.

And most of the climate zones are better off. Some of the climate zones -- the mildest climate zones you don't actually come out ahead.

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MR. WARE: Bruce.

MR. WILCOX: Yes.

MR. PENNINGTON: You're going to have to come up, Dave.

MR. WARE: David Ware.

Explain -- if all the assumptions are the same when ducts are in conditioned space, why would you -- between the 2 approaches, why would you find that there are savings using the UZM model? I mean, there's no attic temperatures being dealt with, there's no ventilation being dealt with --

MR. SHIRAKH: Could you repeat the question for those on the phone?

MR. WILCOX: The question has to do with how did we construct this case to get it to come out this way.

So this comparison is between kind of a prescriptive house, right, got a dark shingle roof. It's got ducts in the attic. They're wherever the -- whatever the requirements for that zone are, if they've R-4, R-6, R-8 duct insulation. They're all sealed. There's either a radiant barrier or not a radiant barrier. All those details of the current prescriptive standard.

And then you take the ducts and then in the other cases, you take the ducts out and put them in the house. So that's the difference. And we've calculated it with -- the blue bar calculates it that case according to the 2005

ACM. And the magenta bar calculates it according to the UZM model. So it's the same trade calculated with 2 different worlds.

And, you know, you get a little better savings in the UZM model than what we've been giving people in the 2005 ACM. That's the difference.

MR. WARE: Okay. I'll just have to think through that for a minute.

MR. WILCOX: We can come back.

MR. MAEDA: Bruce Maeda, CEC staff.

Did you also assume that the system was in the conditioned space, everything was in the conditioned space?

MR. WILCOX: This is the extreme perfect duct case. Or maybe you have a system that doesn't have ducts. I mean, that's what this would be. I mean, you have a -- you know, some kind of a mini split heat pump or something like that. I don't know what it would be, but no ducts.

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MR. WILCOX: Okay. So here's the similar case, start with the base case again, prescriptive requirements, everything is the way it is. And the trade here is how much do you lose if you don't seal the ducts. It's a very popular trade off in the world of building, right. Prescriptive standards, so you've got to seal the ducts.

You've got to test and have a third party rater come in and all that stuff.

If you don't do that, how much do you lose? And under the 2005 ACM, you lose about 10 percent of your TDV. And with the UZM model, you lose about 12 percent, so it goes up a little bit. And, again, this is consistent with the higher temperatures in the attic in the summertime, I think, is the main driver here.

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MR. WILCOX: What happens if you increase the duct insulation from our $-4.2 to R-8? Again, this happens to be a dark shingled roof and unsealed ducts, because that's the one actually I had the data run for. And on a statewide basis not really very different.

In the hottest climate zones, the credit is not as big as under the 2005 standards. And, again, in the -- remember that in climate zone 15 the attic temperature didn't change very much. So all this other stuff trades off against that.

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MR. WILCOX: And here's the case if you take the radiant barrier and increase the attic vent, this is the prescriptive radiant barrier requirement we have now. You start out with a base case, dark shingle roof, unsealed R-4.2 ducts, R-30 ceiling, kind of a worst case, and you add a radiant barrier to it, according to the rules, which you know in our rules now, it also has more ventilation. And you get a slightly bigger impact from that. It goes from 4 percent savings to about 6 percent savings, when you add the radiant barrier.

But there's some interesting pieces over here where now we say you're actually worse off in climate zone 1, 3 and 5 if you put the radiant barrier system in. And I think that's because the combination of the radiant barrier and the added ventilation makes the attic roof or the attic colder in the winter time. And those are heating dominated climates. And you don't get as much solar gain in the winter to warm the attic up and you've got this big ventilation thing going, so it dumps the heat out fast. Not huge effects.

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MR. WILCOX: So the conclusions, I would propose, are that we've got a model here that provides attic temperature estimates that are consistent with experimental data for a bunch of different roof types in Florida and for a typical California tile roof.

The distribution efficiencies we calculate with this model are reasonable, and beat on those a bunch to try and make sure there wasn't anything going on with the model that was out of line.

And also I think that the compliance and measure calculation changes are reasonable. Nothing goes wild here. Things change some. And I think in ways that makes sense. And I think that model works pretty good.

MR. SHIRAKH: We have time for a few questions.

MR. WILCOX: We want people to come up here.

MR. ELEY: Charles Eley, E-l-e-y, with our Architectural Energy Corporation. You mentioned that the attic floor has to be the same as the ceiling area of the top floor. Is that what you said?

MR. WILCOX: (Nods head.)

MR. ELEY: Maybe you can explain why that's a constraint, for one thing, because I mean if you've got some mixed cathedral ceilings and attics and so forth -- that's the first question.

The second question is you mentioned that tile roofs were variable, but you didn't explain how those are handled in the model, whether it's an empirical thing or you're actually modeling the mass of the -- so those are 2 questions.

MR. WILCOX: Okay. The ceiling area issue, maybe I'm misspoke there, because what I'm really -- what the input is intended to be is based on the projected area. You know, it's essentially a floor area, right, horizontal. And so I guess in the case of a cathedral or, you know, funny trusses that wouldn't be the same. But the idea is that it's the -- if you had a floor area defined -- I don't know, did you want to say something about that, Ken. I think it's the condition floor area of the top floor of the building is what the intention is. You know, it's a real simple straightforward thing, based on, you know, how much area there is.

MR. ELEY: Some of it could have a cathedral ceiling.

MR. WILCOX: Well, a cathedral ceiling is fine. I don't think that's an issue.

MR. MAEDA: Does that reduce the -- the question Charles asked I believe -- Bruce Maeda -- is whether or not that reduces the floor area of the attic or not if you have cathedral ceilings?

MR. WILCOX: No. I mean -- well, you know, the main thing -- the main determinant of the performance of the attic is the area and properties of the roof, right. So we're starting with the -- what would be -- this horizontal measurement of the area that in a normal house is the floor area of the attic. And we're generating the area of the ceiling based -- or the area of the roof deck based on that. We're not requiring you to put any dimension in for this roof. It's just being generated based on that floor area.

MR. ELEY: I guess my question is why not? I mean, it's not that difficult to -- we're already putting in wall areas and window areas and orientations and everything.

MR. WILCOX: Well, I think, you know, roofs are very complicated.

MR. ELEY: Well, I'm not suggesting you put in all the details, but just the floor area of the attic, the area of the attic.

MR. WILCOX: Yeah, the area of the attic is intended to be an input. Now, maybe we need some rules about what to do to get.

MR. ELEY: Because that's not what I understood you to say. I thought you said that the area of the attic defaults to either, the area of the top floor.

MR. RAYMER: That's what he said.

MR. WILCOX: I did say that, I think.

MR. NITTLER: It's an input right now.

MR. ELEY: That's different from saying you enter the area of the attic and the rest of the roof is cathedral or something else.

MR. WILCOX: Yeah. Okay --

MR. ELEY: It just didn't seem right.

MR. WILCOX: The current situation in the ACM is a little murky about this ceiling area situation already.

I mean, I think it's pretty rare for people to put in knee walls, for example. There are millions of knee walls in California houses. How many of those get into the ACM calculation?

MR. HODGSON: Do it all the time.

MR. ELEY: Do it all the time.

MR. WILCOX: You do? Good for you guys.

MR. HODGSON: We have to.

MR. WILCOX: Yeah, the second question. The tile roof is modeled based on its mass. First principle is that there's a layer of -- the mass lawyer that has, you know, a connectivity and heat capacity. And then there's -- you know, generally underneath the tile layer there's an air space with an R-value, and you have a roof deck. So there's a multi-layer model for that roof deck that can do, you know, normal shingles or can have a layer of tile. And the intention here is that there would be a set of inputs for typical cases that you could pick from. We don't want -- we don't necessarily want people to be generating their own input, you know, details for certain tiles or anything. So it will be more the library concept.

MR. ELEY: So we would -- excuse me, this is Charles Eley. So we would end up expanding Joint Appendix 4 to include tile roof cases and non-tile roof cases?

MR. WILCOX: Right. And I expect that coming out of -- there's a project going on about cool roofs that Peter is reporting that it's being -- happening at LBL and stuff. I expect that there will be potentially some cases defined, some types defined, some, you know -- we'll define a certain type of roof that will have a certain assumed absorptivity and emmissivity that those things will be canned up and put in for -- to be selected if you qualify. I haven't tried to predict what those numbers would be.

Art.

COMMISSIONER ROSENFELD: Back to tiles. Tiles are supposed to be good because they have natural ventilation, stack effect. Did you handle that?

MR. WILCOX: No.

MR. PENNINGTON: I might comment. It appears to me they're not so good unless there's very careful design to make sure that the ventilation flow path exists through the structure, through the assembly. And so it appears that there needs to be some serious engineering done on how to accomplish that for a given roof. And our understanding is that there's at least one top company that's working hard on that problem.

COMMISSIONER ROSENFELD: Good.

MR. WILCOX: So to answer your question in more detail, Art, we don't have a convective model for the space under the tile, because I think that's kind of out of scale with all of that stuff we're trying to do. But I'm pretty sure that we can -- with the model -- the input that we have, we can get a good approximation of what these tile roofs do based on how I understand that they work. You can reduce the absorptivity or you can change the outside coefficient to handle that.

MR. PENNINGTON: You're going to have to go in order here. I'm sorry, I thought you were going to Steve. I'm sorry, I'll let Mazi run the meeting.

MR. WILCOX: Mazi, you want to call on people. That's a good idea we'll let you be the monitor.

MR. WARE: Dave Ware. I want to follow up on Charles' comment, and questions. As I understand it what you ran you assumed that the, I assume, the floor area of the attic to be equal to the roof area? What I'm getting at here is if in the case you have a cathedral ceiling -- let's say for argument's sake 50 percent of the ceiling area of the building is cathedral, would your results be different in your attic model, in that case, there's less attic -- 50 percent less attic, would your results be different?

MR. WILCOX: Well, currently -- my assumption is currently that you'll model the cathedral ceiling using this model as well, because you've still got to be able to deal with all of the stuff in this model like the absorptivity of the roof materials and all of that stuff. And those are issues for the cathedral ceiling and for, you know, if you have a flat roof, there are always the same set of issues.

And that my approach on this, and maybe somebody will -- some smart person will come up with a better one, but I think a cathedral ceiling is typically a very small attic, and the intention is to model it that way. I mean, they're basically all ventilated, normally. And --

MR. WARE: Supposed to be.

MR. WILCOX: And you know I think one of the things from a compliance point of view you want to have a consistent set of results that -- so if you have a cool roof on a cathedral ceiling, you get a similar calculation, than if you have it on an attic. You don't want to have the models to be completely divergent and, you know, different answers.

So I don't see any reason why from sort of a compliance level we can't use the same approach for both systems. And I think this works fine for flat roofs that have a, you know, don't have a pitch. They're flat, but most of them have a little attic in there as well, and they've got ventilation. They've got all the same stuff going on.

MR. SHIRAKH: Michael, do you have a question?

MR. DAY: Michael Day, ICE Energy. I saw that you were talking about attic ventilation. I'm thinking about, say for example, the night breeze system. Is this able to model the effects on mass of pre-cooling the attic to something approaching outdoor temperatures and the effect that that will have on the performance of the house over the course of a day?

MR. WILCOX: I think so. We have a mass model in the attic and a massive tile roof, and all of the materials are accounted for. And, as I said, the model was designed to be able to handle the night breeze system. To be perfectly honest, we haven't tested very much of that yet, but I think it will be okay. I think it will work fine.

MR. SHIRAKH: That gentleman there.

MR. GATES: Steve Gates with Hirsch and Associates. In your model did you do any sensitivity to the infiltration versus predicted attic temperatures and how critical is that parameter? Do you do much tuning on that?

MR. WILCOX: Well, the case that we really had to work on was that -- was the data set from Florida, where they had one roof with 2 different levels of ventilation.

And so I think we do a reasonable job on that. We didn't spend any time trying to do much on other cases. I'm not sure whether -- you know, if you have 1/300th of the floor area in ventilation area, which is the typical attic requirement minimum, then infiltration of ventilation we're saying is all the same thing.

MR. GATES: Yeah, because your correlation with the Roseville house was quite impressive. And I was wondering was there any tuning of infiltration involved in that or was that just, you know, using standard assumptions in the model and it worked out that closely?

MR. WILCOX: Well, we didn't spend a -- I spent some time looking at infiltration and how good it was. You know, how much difference it made in the Roseville house in particular. And one of the big -- you know, the big issues in the model are the outside film coefficient is very important and the ventilation secondarily is somewhat important.

The outside film coefficient is the most difficult one to figure out and know. We've implemented a model that Fred Winkleman and his friends at LVL wrote. And I think it does a reasonable job.

MR. GATES: Okay. Then kind of a follow-up comment on the vented tile roof scenario. I own a house that was constructed about 2 years ago. It was one that I had designed for me. And it has a -- because of where I live, it has actually a metal roof where the metal is actually formed to look like shingles. And these shingles are actually placed on a -- like a 2 foot by 2 foot grid of 1 by 1 wood to support the metal roof.

And because of fire codes and the fact that they don't want a -- the fire department does not want a void between the shingles themselves and the sheathing underneath that, there's actually 2 inches of fiberglass insulation that's placed under the metal and above the sheeting. And it's specifically to act as a fire stop, so that, you know, you cannot get convection up through that cavity, which would just very quickly take off the roof.

So the earlier comment about ventilated tile, you know, that's what I immediately thought was well, if you're deliberately trying to engineer a void under this tile, are you going to get in trouble with the fire department?

MR. WILCOX: You know, I personally think the ventilated tile cases are very problematic in a number of regards.

MR. GATES: Yes. And as a comment, this roof with the -- I have a radiant barrier on the bottom side of the roof sheathing, you know, with this 2 inches of insulation on top of it. And it works surprisingly well in terms of holding down attic temperature. I mean, it's actually quite impressive.

But related to that, you know, if you drop attic surface temperatures, are you aware of any studies done on how well infrared radiation can penetrate into the attic insulation itself? You've got a layer of insulation on the ceiling. And particularly if it's fiberglass, it seems like radiation is going to penetration into it further than if possibly you had a more infrared opaque material. I don't know if that's the case or not, but I thought I would throw that out there in terms of whether there's sensitivity to that.

MR. WILCOX: You're just trying to get Dave to buy your lunch.

(Laughter.)

MR. WARE: I've got data on that.

(Laughter.)

MR. GATES: You do?

MR. WILCOX: The simple answer to that is I know about that effect and I've thought about it some. And the conclusion that is behind the assumptions here is that whatever the effect is it's there when you measure the R value of the insulation, and it's no different. You know, if you do a hot plate test on an insulation sample, you've got hot surfaces and cold surfaces and they radiate. And it's basically the same situation. I think, I found that to be somewhat persuasive.

MR. SHIRAKH: We're going to take 2 more questions on this topic and then move on.

The gentleman right here.

MR. ROODVOELS: I'm Dave Roodvoles. I represent ARMA here this morning. I've got more than 2 questions, but I'll pick the high ones.

The first thing is the measured transmission. I can actually sit. That's good. The measured transmission into the houses. I know how the Florida things is, it's all one roof so you can't tell what's going in and any given attic. How about your Roseville example, did you measure what the contribution of the -- you know, you've got the temperature, but how much is actually going into the house.

MR. WILCOX: No. We don't have any heat flow data. I think there is some data in Florida. But, you know, from the point of view of developing a model for California, the duct system is so overwhelmingly the important issue that we haven't really spent a lot of time on heat flow through the attic ceiling, but I think we're doing a reasonable job.

MR. ROODVOELS: How about the variation in pitch? That model assumes of 4 in 12, is that what you --

MR. WILCOX: No, the pitch is an input.
MR. ROODVOELS: Oh, you can vary the pitch?
MR. WILCOX: Yeah. It mostly changes the area of the roof deck. If you have a steeper pitch, you get more roof area. You guys know about that.
MR. ROODVOELS: Yes. Thank you.
MR. SHIRAKH: That gentleman in the back there.
MR. SHOEMAKER: Lee Shoemaker, representing the Cool Metal Roofing Coalition. Just a quick question is what is the status of this program? Is it in the public domain? Is it a beta version? Is this what we should be using to make comparisons that we're going to be evaluating through this revision cycle?
MR. WILCOX: Ken, this is where you get to answer that question. We talked about it, remember?
(Laughter.)
MR. NITTLER: Ken Nittler with Enercomp. As part of the PIER funded project, we will make, call it, a research version that has these capabilities in it available to this spectrum of people interested in doing standards development work.
Where the model stands right now is it's -- there's sort of one major piece left to be done, which is to make it so that the standard design -- for those of you who aren't as experienced with what goes on

in California, when you do a compliance calculation, you actually do 2 calculations. You do one of the proposed house and then you do one of the standard design.

The proposed house stuff is fully implemented and working. There's a secondary input file that has all these 100 or so details of the attic model. What's not implemented is the part that automatically generates the standard design from the proposed design assumptions. It's very closely related, but that's the piece that's not there right now.

There are also -- that's the biggest piece of what needs to happen to make it a more useful tool for a wider spectrum of people. There are also like this issue of say cathedral ceilings is an example of where the compliance rules -- we have this model where you can put whatever input you want in. But before it's used in the compliance environment, presumably we're going to restrict certain inputs to certain rules and so forth, so that part also needs to be some additional effort.

This is a really long-winded excuse. I would say that realistically in May or something like that is when this would be available for a wider audience. I'll just leave it at that. Does that get close enough to what people want to hear?

MR. SHIRAKH: Okay. With that, we're going to move to the next topic. For those who walked in a little bit later, we rearranged the agenda a bit. Ken Nittler is now going to present the topic that was scheduled for 2:15 this afternoon. And also I would like to insist people that have questions do come up to the mic. We have people on the phone that cannot hear you when you call out your questions from your seats.

(Thereupon an overhead presentation was Presented as follows.)

MR. NITTLER: Ken Nittler with Enercomp. The work I'm going to present here was done under contract with the Commission through Architectural Energy Corporation.

And as you know, when we try and develop standards and try and estimate the impact of the standards, you have to have some sort of prototypes to work from. You also have to have some information about where homes are being built and how big they are, that sort of information.

So what I'm presenting today is a proposal for improving how we deal with the prototype issue and we'll see where that takes us.

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MR. NITTLER: So there's really sort of 2 parts to this presentation. One has to do with where are houses being built or dwelling units if you want to think of it that way? And the principal use of this is to take results from a few house models, prototypes and try and apply them across what the statewide impact is. It's very important in terms of figuring out what the impact is say for a proposed change. Let's say there was a change to the insulation levels, and the question is how much does that help the state across the whole spectrum of construction activity in residential.

So what we did here is we took -- there's a organization called the Construction Industry Research Board.

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MR. NITTLER: And they're a nonprofit and they collect housing start information by city and county across California, and, in fact, in other states as well. And we used this sort of data in the 2001 and 2005 processes. I don't know exactly what references might have been used before then. So this is really -- what we're proposing here is an approach very consistent with what we've done in a couple -- the last couple building code update cycles.

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MR. NITTLER: The trick here is you get this data from the Construction Industry Research Board that has housing starts that has single family and multi-family. It also has some information on additions and remodels. It's really stated in terms of dollars in those 2 categories.

But the real trick is that some climate zones have multiple -- sorry, some counties have multiple climate zones within them. The worst offender is Los Angeles county, which has 5 separate climate zones in it. And with our -- you know, LA county would be right in this region. It has 6, 8, 9, 14 and 16 are the climate zones contained within LA county. So somehow we had to map this county data into the climate zone data.

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MR. NITTLER: And in doing that I want to specially thank Chad McGhie here from ConSol. Over the years they've been tracking this data. They've used techniques where they start with the city data and map it into the climate zone data. So Chad and I have been talking over the last few weeks, and I think we came to some agreement about the right way to partition out this data.

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MR. NITTLER: The bottom line is this table here, which shows for single family and multi-family, the proposed weighting that we're talking about using. So, for instance, Climate Zone 12 where we stand today, when we do these statewide impacts, will have 20.7 percent of the single family homes constructed in it. And 9.6 percent of the multi-family housing units. So that's again very consistent with what we've done before.

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MR. NITTLER: And just to help you understand this, so how different is this from where we were before? You know construction activity changes over time. I'm sure most people that live here anyway are familiar with the concept that construction is moving inland right from the coastal regions due to cost and all sorts of other demographic reasons. And, in fact, that's pretty much what it shows.

When you look at 7 is coastal San Diego, 8 is Orange county, 9 is San Fernando Valley areas. Our areas -- that between 2001 and 2005 the change is pretty significant there.

On the other hand, some of the core inland climates, 11, which includes fast growing areas like Roseville and Yuba City. Sacramento is here in 12. Thirteen is Fresno and kind of the south San Joaquin valley are all areas where lots more building permits are going on. So there is definitely a shift towards climates that have higher cooling. Does that seem plausible to people? I see mostly people nodding. So that's what this proposal is.

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MR. NITTLER: This chart here is really the bottom line, that when we look at statewide impacts, you'll weight the results by these percentages. Now, at least during the few years that I've been fortunate to be involved here, we didn't do a lot of separate explicit modeling on multi-family. So another piece of this proposal is we are going to separately track the multi-family starts and hopefully apply a multi-family prototype to get a better grip on what the impact is of changes to multi-family as well.

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MR. NITTLER: The second piece of this proposal is the actual prototypes. And for quite a number of years we've been using a prototype that was developed in the early nineties, a 1,761 square foot 2 story slab on grade sort of house. And since that was developed, of course, houses have gotten quite a bit bigger. I think -- I don't have hard data on this, but anecdotally anyway, most people would agree with the move from 1-story to 2-story houses. There's much more 2-story construction going on as we've gotten higher and higher lot prices and things like that.

So it's kind of time to -- a little long on age here on the existing prototype. The gentleman sitting right here is the guy who drew the original ones. I should show the picture of you Dave.

Anyway, the main use of this prototype is similar to the statewide data is when we're trying to assess the impact on a statewide basis or we're trying to say what is the life-cycle cost effectiveness of a particular proposed change? Like, should there be a radiant barrier or should there not be a radiant barrier in a particular climate zone, you need something to do the calculation on. And that's the way we've been using these prototypes.

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MR. NITTLER: So to try and get our arms around this one, we had some constraints, as you always do, in these sort of projects in terms of time and in terms of budget. So the approach we're taking here is one that I contacted a number of people that are consistently stakeholders around here. And I posed questions about what do they know about house sizes and configurations.

And I got responses from 4 organizations ConSol, Inc. responded to us. RLW Analytics, they hold a contract doing the M&V, the measurement and verification, on the statewide -- I'm probably going to botch the exact name here, but it's the Statewide Energy Star Utility -- Investor Owned Utility Program from 2002 and 2003. Roseville Electric, which is a municipal utility serving Roseville. And SMUD, the Sacramento Municipal Utility District, also serving the Sacramento area.

And the data that we get back is really mostly from a subset of homes participating in these utility programs. There was, I believe, ConSol's data was actually for the spectrum of houses you looked at. So the ConSol data isn't only houses in these above-code programs.

The RLW data had some data on homes that were non-participating homes. And really the demographics didn't look very different for non-participating homes. So this is the data we had available.

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MR. NITTLER: This can be summarized in the report that you can see on-line is broken up into sort of 3 concepts here. In terms of the different samples that we had, these were the sample sizes, about 7,000 homes from the ConSol data set; about 900 or almost 1,000 homes from the Roseville data; about almost 7,000 from SMUD; and almost 7,000 from RLW. So those are reasonable samples. There's the total count.

In terms of floor areas, you know, I got kind of back different information from each of these groups. And so sort of summarizing it, the ConSol data showed 1 story and 2 stories of these 2 quantities you can look at them for each of them. I think they're, you know, really reasonably consistent.

So I calculated 2 different ways here of the average. And then I did a weighted value, but weighted by the size of the sample. And my conclusion, that you'll see here on the next slide, is really based on these weighted numbers.

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MR. NITTLER: Another piece of information we need to partition out where the impact is to know how many homes are 1-story and how many homes are 2-story. In 2 of the data sets, and I will certainly say, I'm sure I could have gotten this information from some of the other parties. Maybe I didn't ask the question correctly. So I'm not trying to bias the results, but in terms of the response I initially got back, I got story information from 2 of the sources. And it just turns out that both on an average basis or a weighted average basis that they're both on the order of 45 percent 1-story and 55 percent 2-story.

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MR. NITTLER: So taking that information and trying to meld it with the ultimate goal, I looked and discussed with staff kind of a couple different ideas. One is we're trying to create buildings that have simple dimensions that can be drawn, that I could put a set of plans in front of everybody in this room and we'd all come up with the same area of take-offs. We're not trying to create --

(Laughter.)

MR. NITTLER: Everybody laughs. I think we might actually be there on this one. But we're not trying to do -- was intentionally trying to keep it simple that way, representative but simple.

So to keep -- in light of that sort of goal here, we selected a 2,100 square foot 1-story, a 2,700 square foot 2-story. I'm going to come back to the multi-family in a moment here, but that's what we're looking at.

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MR. NITTLER: Again the paper you can see more details of this. This is what the 1-story looks like. I do 2 strange things in my life when I travel around. One is I go into Big Box stores all over the country, because I'm dying to see what products they offer. The other is whenever I have spare moments in my travels, I pull into subdivisions and see what current construction practices are in different regions. And I can tell you this house right here I can find in multiple locations within California right now. Designs are very boxy, at this point in time, not that -- this id kind of a traditional ranch kind of house. You can see the floor plan is very simple. The roofline -- I could go to websites and show you houses that look just like this. So that's what's proposed on the 1-story.

On the documentation there would be the elevations. There would be the floorplans. We have those prospective drawings. It's pretty straightforward stuff. And we'd supplement it with the building descriptions, where to avoid the laughter that I generated up here about everybody getting the same area take-offs, we'd actually create a table that says here is what the area take-offs are.

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MR. NITTLER: Now, there are some issues. One big one has to do with glazing, orientation and area. Now, the standards in 2005 moved all climate zones to a prescriptive package level of 20 percent for various reasons. When you look at statewide data in 2005, we used a glazing distribution based on some measured data done by ITron, which is called RER, that had the glass distribution. Now, some homes have 12 percent. Some homes have 25 percent. And it turns out the average is on the order of 16 or 17 percent.

And I didn't show it up here, but the data sets I had that showed glazing area showed 16 or 17 percent as the average for their particular data sets. So these drawings don't try to imply that we know where the windows are located or what the window area is, because as part of the analysis that I presume that we're going to do on behalf of the Commission estimating the statewide impacts, is we're going to apply a glazing distribution rather than just a single glazing configuration.

For those of you that might be doing runs on your own, you might make the assumption, for instance, that all houses are around 20 percent glass, since that's what the prescriptive package levels are. I'm sure you ConSol will do other things as well. So the dimensions and so forth are kept pretty simple as a result of that.

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MR. NITTLER: The 2-story house looks like this. Again, things are very rectangular and boxy. And, you know, the fundamental width of this home is 55 feet and the depth is on the order of 30 feet. And, again, you can go out and find houses that they'll have nicer architectural details in terms of the entryway and whatnot, but I could take you to 5 houses that look just like this over here in North Natomas at lunch if you are really interested.

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MR. NITTLER: On the multi-family, I don't really have a tremendous amount of data to go on. We know the number of starts. I talked with a few experienced people, especially the folks at HMG, Nehemiah Stone about what they see. They administer several of the multi-family programs.

I guess what we came up with is something like this. It's going to be a 2-story 8-unit multi-family home. There's four 780-square foot one-bedroom apartments. There's four 960-square foot, I guess you'd say, these are 2-bedroom apartments. What's tricky about this is the multi-family category in the CIRB data, also includes condominiums. If you had a condominium that shares a common roof and floor, then that data is incorporated in the multi-family category. If it doesn't share a common floor or ceiling, then it's -- at least according to the descriptions they have -- it should be accredited as single-family.

And I think anecdotally it's reasonable to believe that most of the condominiums are probably bigger than these square footages. So it's really meant to represent kind of a population of dwelling units. And certainly especially as you get -- my personal observation is, as you get into in-fill projects and more urban areas, the diversity of the building types is much larger than you see in suburban California where a lot of the starts are going on right now.

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MR. NITTLER: So this is -- never use yellow on slides, okay. It actually looks much better on the screen. I don't know why this.

It's pretty much a plain vanilla cookie cutter sort of situation, if you looked -- this is the floor plan for just the first story, the 2 one-bedrooms are the interior units, the 2 two-bedroom are the exterior units. And simply these are stacked. And, you know, you could look at a lot of a different configurations. I'm told that, for instance, a lot of the inn-fill in common practice is to build in essence a rectangular shape, where you could kind of put multiple copies of this prototype end to end and then turn corners with them. And so you could have this central core by doing multiples of this.

The other issue -- you know, the more units you have per building, the less exposed square footage of walls and ceilings and things like that per square foot of conditions floor. So there are a lot of issues there.

So this is what we're proposing. It's an improvement in one sense that at least we'll have real drawings and we will all be able to look and say that's what we've been doing the analysis on. And, you know, refinements could be made to these designs, if necessary, but that's really what's being proposed here.

Any questions?

MR. SHIRAKH: Come forward, you need to come up to the mic.

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

I wanted to ask if you'd done any -- in your looking, done anything about hot water, piping systems, hot water distribution systems and on multi-family whether it was individual or central water heating?

MR. NITTLER: To develop these prototypes, I did not ask any of those questions. We were looking just at the size of homes and the size of multi-family dwelling units.

In terms of the prototype as an example, when you talked about multi-family, you could easily apply a central water heater to that unit as well. The details of the insulation levels, the glass area, the glass distribution, all those things are dependent on what climate zone you're in and what the prescriptive limits are. So these are just sort of the building shell that we would apply when doing the analysis, rather than these

particular construction details.
MR. SHIRAKH: Any other questions?
Charles.
MR. ELEY: I'm curious why you didn't use the RER new construction data as one of your data sets?
MR. NITTLER: You're talking about the data from 5 years ago or something like that?
MR. ELEY: Yes.
MR. NITTLER: I don't have a great answer for why that wasn't included in this data set. We had very limited time and budget to work with this, so I was trying to concentrate on the most recent data I could find.
MR. SHIRAKH: Mike Hodgson.
MR. HODGSON: Mike Hodgson for ConSol. Ken, the 2-story build is 55-foot wide on its floor print, which implies a 65 to 70 foot lot. Now, we don't have 65 to 70 foot lots in production housing. So you may want to visit that and see whether maybe --
MR. NITTLER: So you're suggesting something narrower and deeper?
MR. HODGSON: Correct, maybe a little boxier. I'm not sure what the numbers would be, but just thinking about where you'd built that.
MR. NITTLER: What do you think the average lot width is?

MR. HODGSON: Typically, we don't see them over 50/55 right now with -- so we need 5-foot side yards, you're down to a 45-foot dimension.

MR. NITTLER: Well, your comment then would apply to the single family just as well.

MR. HODGSON: Probably.

MR. NITTLER: So you think the average lot size is more like -- width is more like 50? The lot width is more like 60 and the width of the house is more like 50?

MR. HODGSON: I'd say your lots are typically between 50 and 60 feet wide right now.

MR. NITTLER: Okay.

MR. PENNINGTON: So, Mike, are you okay with the 45-foot width for single family and multi-family? Are you okay with that?

MR. HODGSON: I don't know what I'm okay with. I'm just making an observation that I don't think that's -- I think the square footages sound quite reasonable even though the market is slowing down and getting smaller. Just looking at the house, I don't know where I'd build that other than a cul-de-sac. And so --

MR. PENNINGTON: Because I was hoping you were going to agree today on that width, that's what I had.

MR. HODGSON: I'll agree to 45. I just don't think there's any science in that. I'll agree to anything you would like me to agree with, Bill.

(Laughter.)

MR. PENNINGTON: Wow.

MR. HODGSON: Today.

(Laughter.)

MR. HODGSON: I mean, we could look 100 lots and figure it out, but I just don't know --

MR. WILCOX: We'll be back after lunch with some things.

(Laughter.)

MR. SHIRAKH: I think everyone is getting hungry.

Any other questions?

We're almost back on track so I'm going to move -- Bob.

MR. RAYMER: Bob Raymer with CBIA. It's been my experience in the Sacramento region that the split between 1-story and 2-story right now is about 25/75 or even 20/8, and that's with the higher density, production style building that's going on in climate zone 12 and 11.

I haven't gone around southern California much lately, but I know that there's a huge deviation, much more so than what your numbers were showing. But once again that's the Rocklin and Sacramento area.

MR. SHIRAKH: Dave.

MR. WARE: I just have a comment. Dave Ware

Owens Corning.

That's almost an 80 percent increase in house size from what we've currently been using. That's pretty big, notwithstanding that it's long overdue to take a look at the data. But there's obviously a lot of work that needs to be done with the new model that was, you know, that Bruce mentioned earlier to look at the impacts of just the prototype on statewide savings and current building practice and compliance, let alone all the modeling impacts. So I'm just making a comment, I guess.

MR. RAYMER: A lot of us gained weight, I guess.

(Laughter.)

MR. NITTLER: Actually, in response to Bob's comment first, they also got taller. These are all 9-foot ceilings. So maybe you guys could provide some comments on that, too.

Well, Dave here's my vision of what happens here. For people that are already working and doing runs and stuff, they can go ahead and continue to use the 1,761, because that would be used to establish that yes a particular proposal has merit.

Where these things, I think, come into play, on the impact more than elsewhere, is when the Commission itself does the impact analysis and establishes life-cycle cost effectiveness. I agree or it's clear to me that you could choose a lot of different sizes. And I guess the question I'd pose to all of you who have thought about this, is that these -- what's proposed here, I think, is a big step forward to at least acknowledge that there's 1 and 2 story to get the sizes more in line with what's currently there, to clearly show a drawing of what we're doing on multi-family.

Could we make this a career and only study the prototype sizes? Yes, we could. This is an effort to make an improvement to what we're currently doing, that, I think, most people would clearly agree is a step in the right direction.

I'll shut up.

MR. SHIRAKH: Okay. With that, we're going to go back to Bruce and his topic on furnace fan energy.

If you haven't done so, please make sure you sign the sign-in sheet at the entrance or leave a business card so we know who's all been here. Then after this presentation we'll break for lunch.

(Thereupon an overhead presentation was Presented as follows.)

MR. WILCOX: Okay. So we'll finish off the morning with a short and simple topic here, I think. I hope.

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MR. WILCOX: This is work that was done by the PIER Research Project. And in addition to Ken and I, John Proctor, who's in the audience here, contributed to this effort and Rick Chitwood did the field work. Jim Lutz has contributed some to this effort as well.

So I want to talk about the background. I'm going to talk about the field survey data that we collected, as part of the research project. I'm going to propose a heating fan model, and then talk about the impact of that similar pattern to what we just followed on the attic, and talk about the performance option for heating fans.

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MR. WILCOX: So we've already talked about the ACM. The residential ACM specifies the rules that are used to calculate compliance and compliance trade-offs and so forth.

The 2005 ACM, 2005 residential Alternative Compliance Methods Manual, and all the previous ACM manuals, have said that the fan energy for heating system is a fixed item. You always calculate it as .005 BTUs of electricity per BTU of heating output. In other words, a half a percent of the furnace output is fan energy going in. And this, I think, is originally based on some adaptation of the AFUE test conditions.

But what this leaves in the ACM system is there's no way to get any credit for having a better fan or duct system. There's no credits possible for better motors and all the -- there's a lot of technology possibilities there.

And, I think, as we'll show in minute, we're probably underestimating the energy consumption of these furnace fans using this approach. So that's the point of changing this.

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MR. WILCOX: In the 2005 standards we implemented a model for calculating the fan energy for cooling systems, based on a bunch of stuff we did as part of the 2005 development process. But, at that point, we stopped short of doing anything for heating, partly because it was my assertion at the time that we didn't really know very much about how furnace fans operated and what the conditions were and what the typical pressures and so forth.

So partly to solve this problem during the PIER research project, we did a field survey where Rick Chitwood went out and measured 60 different air conditioning and heating systems in new houses across the state. Fifty-five of them were in production homes, five in custom houses. We measured air flow in the winter time with a dry coil for the cooling. And we measured air flow and fan watts in heating mode and cooling mode in zonal mode if it was zone mode and so forth, measured the pressure drops and so forth.

So basically, we got a pretty good data set on what's typically -- what you typically find in new production housing and new -- a little bit of custom stuff in the state.

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MR. WILCOX: Now, this is what we're talking about. These boxes sitting up in the attic with flex ducts hooked onto them.

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MR. WILCOX: It's a pretty consistent life. So here's the data that I think is pertinent and relevant to the subject of how do you model the fan energy consumed in heating mode. And this is kind of, I guess, in retrospect it's kind of obvious. But one of the questions is what's the -- how much air does the furnace move when it's in heating mode?

And the answer that we've come to here is that the heating CFM is actually highly related to the cooling CFM. So whatever you -- however much air you're running for when the system is in cooling, the heating stuff is, most of the time, pretty close to that. There are a few cases in the data set where the CFMs are different. But mostly it's pretty close to the heating CFM. And we've got a little relationship that I'll propose in a minute.

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MR. WILCOX: And the question is how does the efficiency of this fan system, expressed here in terms of watts of motor input per CFM, watts per CFM, how does that -- how does the cooling and the heating watts per CFM relate? This is relevant because we actually have a pretty good model for the watts per CFM in cooling that -- with defaults and so forth that are already in the 2005 ACM.

Well, it's a similar situation. Most cases, you know, they're highly related. There are some exceptions. When you take your PSC motor and slow it down to the lowest, the CFM goes down a little bit and the watts per -- you know, the efficiency of the thing goes really bad, so then the watts per CFM goes up. And that's these cases here. These are the guys that have their -- running their furnaces on real low speed, because PSC motors -- actually, the standard motor in a furnace is called a permanent split capacitor motor, does not have very good part load characteristics. And if you -- the normal way to slow it done is you use a different tap in the windings of the motor.

And basically what that does is it makes it run slower and take the same amount of electricity as it would if it was running fast. So the efficiency goes down and you get a slightly lower air flow that way.

So anyway the principle here is the heating watts per CFM is pretty highly related to the cooling.

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MR. WILCOX: So the model here that we're proposed to be used in the ACMs for -- essentially for all the hourly calculations, there will be -- there's a default set that are -- that if you don't actually measure anything or for the standard design is a default set. And the proposal here is that the heating CFM is equal to 93 percent of the cooling CFM. And that's based on just the average relationship in this data set. The watts per CFM of heating is 88 percent of the watts per CFM of cooling.

And then the other thing you need to know is what's the heating capacity. And currently the -- you know, there's some rules in the ACM about heating capacity per square foot floor area and a bunch of stuff like that, but it kind of gets wild.

But, in fact, the data indicates that, you know, the basically all of these -- you know, the CFM is determined by this relationship between cooling and heating, and then the assertion here is that the capacity is a function of the air flow in a temperature rise of 40, is the proposal. And there's a range of temperature rises that are possible.

But the proposal here is that we assume the temperature rise through the furnace is 40 degrees. And then this calculated number, watts per BTUs of heat, it used to be .05. It's now going to be the CFM of heat times the CFM, times the watts per CFM divided by the capacity. And we get a number that is a little different.

But one of the -- so, you know, it doesn't change things very much. If we take our default numbers that I just proposed there and we run through this thing, the heating TDV goes up about 1 percent statewide. It doesn't change much of anything, the heating fan and the normal case is not a very big deal.

But this gives us a chance to have a performance option for higher performance systems. There's a performance credit available in 2005 for cooling fan watts and cooling fan CFM. And the way this would work in the ACM is you could -- the builder could propose a lower CFM or a higher CFM, and at different watts per CFM for the system they were going to install.

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MR. WILCOX: And they would get credit for that in the ACM calculations. So they could put in a furnace that has a low internal resistance and a much better fan and a much better motor and get a lower watts number and take credit for that in compliance. And then they would do a post-construction test. And then there would be a third-party verification, just like we're doing now for duct ceiling and so forth. And they could take credit for having a better fan system.

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MR. WILCOX: So that's the proposal. It's pretty simple. It's, I think, is pretty straightforward, and I think it will improve the modeling situation, particularly with regard to an area that's been fixed in no variation in the past.

MR. SHIRAKH: Any questions?

Could you please come up.

MR. KNOWLES: My name is David Knowles. I'm here from GAMA, representing the furnace manufacturers. Is this modeling going to take into account any of the credit you get from the heat loss from a PSC motor into the heated airstream?

MR. WILCOX: Yes.

MR. KNOWLES: Okay. Would it be in this module or another module?

MR. WILCOX: Well, I didn't explicitly put it in there, but in -- the assumption is that when you do this, you know, watts per BTU of heat, that all of the heat flow from that -- all of the heat from the motor would go into the airstream, so it's useful heat.

MR. KNOWLES: And that a certain percentage in the California market of furnaces sold are electrically commutated motors. So if you assume that all are PSC, then -- well you're going to introduce some errors into your -- into this model. And then, you know, of course, we're concerned about downstream that this model might be used for in future decisions, particularly in establishing a certain watt per CFM standard.

MR. WILCOX: Yeah. Well, I don't have any data on whether these relationships would be radically different if you had an ECM.

MR. KNOWLES: They would be.

MR. WILCOX: I assume they might be.

MR. KNOWLES: I can tell you they would be.

MR. WILCOX And that brings me to my point where I'm using --

MR. KNOWLES: You can contact us and actually get better numbers than what you're using here.

MR. WILCOX: Maybe, yeah.

MR. KNOWLES: Absolutely.

MR. WILCOX: Okay. I'd be happy to hear that.

MR. KNOWLES: I do have that information. And our manufacturers are willing to share this, because, you know, we want good results out of this process. And these empirical factors that you're using -- I mean given 60 homes, in California, I mean we can provide you with a much larger data set.

MR. WILCOX: Sure. And that would be very useful.

MR. KNOWLES: And then just another comment is actually our typical temperature rise is 50 degrees on half inch external static pressure. So, okay, that's what most of our manufacturers design to.

Part of the issue with furnaces as that slide showed is that a lot of California models are, what we call, low boys in the attic, and the space allowed for the furnace fan is very small, so we have to -- our manufacturers have to take a lot of compromises in order to meet the application demands. So that's part of these.

So we would essentially encourage you to, you know, focus in on mandating that good duct systems are installed, because you go from a half inch static pressure to a .8 inch static pressure, you're more or less doubling your fan power consumption. And I think you're headed on that kind of track.

MR. WILCOX: Yes. We're growing to present some information on that stuff later.

I would be very interested in seeing the data that you have on the typical rises and the typical ratios. That would be very useful.

MR. LUTZ: Jim Lutz, Lawrence Berkeley National Lab. The actual number that I've seen from your data from the product literature from the manufacturers is 55 degrees, but that's in the AFUE test procedure, which assumes an air flow -- a very low static pressure of .18 to .23, .27. So in the field your static -- your Delta T may actually be higher than the .5.

MR. KNOWLES: Your mixing things up there.

MR. LUTZ: What he's looking at is what's in the field.

MR. KNOWLES: Right. My comments before were pertinent to that, what's in the AFUE's test, ASHRAE 113 --

MR. LUTZ: So that was one question. The other question I wanted to ask was what about the draft inducer and the igniter and the stand-by power on the controls? Are you accounting for that at all, and do you want to?

MR. WILCOX: Not accounting for that at all at this point.

And I don't know, Jim, if you want to propose some way to do that, maybe we should. That's typically a smaller --

MR. KNOWLES: It's much smaller.

MR. LUTZ: It's 75/90 watts on that. The stand-by is about --

MR. PENNINGTON: Why don't you have a seat at the table there.

MR. SHIRAKH: That's the only way we can do it.

MR. WILCOX: You guys could take --

MR. LUTZ: The stand-by on PFC -- a furnace with a PFC motor is about 5 watts, 8,760 on the ECM ones that run about 10 watts.

MR. WILCOX: Okay.

MR. KNOWLES: Yeah. I mean our industry runs certain tests for ASHRAE 113 to meet the DOE requirements, and then other design considerations. And I forgot to mention also that furnaces are sized on cooling load. And then the furnaces -- the heating mode is kind of the other way around, so your conclusion is correct. So they are all sized on the basis of cooling load, 3 ton, 5 ton what have you, and then they -- so.

And often times the circulating mode and the heating on the PSC are the same. They do run on a higher taps for the cooling and that is covered in the efficiency standards, the SEER's standards. So these things -- the AFUE and the SEER standards do work in concert, especially in California, and, you know, across the United States in most cases. So if you have a very inefficient motor, you get penalized for it on your cooling mode.

So if you start mandating a certain fan efficiency, what you're going to do is be trading off on coil size, on coil area. So, you know, the SEER or whatever the SEER EER rating at the particular time is.

So, you know, it's a balancing act. The manufacturers try to do the best they can to get an affordable product into the market. Meanwhile, the efficiency standards in both heating and cooling modes help. It is a trade off, and you can't look at them really, in our opinion, independently.

MR. PROCTOR: John Proctor. I'd just like to make one clarification. On split units, where the furnace is not specified, the watt draw is defaulted as opposed to being from a particular fan. So it's not really an SEER for those cases.

MR. KNOWLES: I'm sorry. I missed that entire thing.

MR. PROCTOR: It was all directed to you, sir.

What I was saying was that for a split air conditioner where the furnace is not specified as part of the package, they use a default number, so the actual fan watt draw isn't in SEER in that case.

MR. KNOWLES: Well, okay, but what I go back to --

MR. SHIRAKH: I'm sorry, it's the mic thing again.

MR. KNOWLES: Just, you know, our manufacturers design differently. They have other things in mind other than the efficiency standards, in that, they know whether it's a split system with a furnace specification or a furnace without air conditioning. They still design things in a model line to go into the application. So they take it into account in their design and testing, so that as -- if it were going to be a split system.

MR. WILCOX: Thank you for your comments.

MR. SHIRAKH: Any other questions?

We're actually about 15 minutes ahead of time, somehow, miraculously. We're going to come back at 1:30. This building doesn't have any food establishments, so you're going to have to scatter around.

And we'll try to start at 1:30 sharp.

(Thereupon a lunch break was taken.)

AFTERNOON SESSION

MR. SHIRAKH: There's a little change in the agenda here. We're going to start out by the topic that was left over from this morning. Mr. Robert Mowris is going to present Suggestions for HVAC Efficiency Improvement. And after his presentation we'll resume the rest of our agenda.

(Thereupon an overhead presentation was Presented as follows.)

MR. MOWRIS: Thank you very much. My name is Robert Mowris for those of you who don't me yet. I'm going to present some suggestions for HVAC Efficiency Improvements for 200 --

MR. WILCOX: There are people actually on the telephone, so if you get close to the mic, that would be great.

MR. MOWRIS: Thank you. My name is Robert Mowris, and I'm going to present Suggestions for HVAC Efficiency Improvements for the 2008 California Energy Efficiency Standards.

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MR. MOWRIS: This slide provides an overview of suggestions. There's 5 of them.

The first one is to verify proper refrigerant charge and airflow and proper TXV, thermostatic expansion valve, installation by HVAC installers, working under third-part verification service providers and working with HERS providers and HERS raters.

The second one is an automatic alarm when air conditioner air filters are dirty, third-party quality control registration, permanent labels and locking Schrader caps to maintain proper refrigerant charge and airflow, which I'll refer to as RCA.

Eliminate the TXV as a substitute for proper refrigerant charge and airflow.

Number 4, proper evaporator airflow required by the manufacturer and rated efficiency for multi-zone damper systems, which comprise about 10 to 20 percent of new homes in California.

And then number 5, American Refrigeration -- Air Conditioning Refrigeration Institute, ARI, matching evaporator and condenser coils to provide rated capacity and efficiency for split-system air conditioners.

So those are the 5 topics.

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MR. MOWRIS: I'll go to the first one.

The first one is refrigerant charge and airflow. The recommendation, which I already gave, is to consider requiring proper refrigerant charge and airflow for all air conditioners under the 2008 Building Energy Efficiency

Standards.

So I've got 4 bullets here to describe the reason and the rationale behind this. First of all, field measurements indicate that TXV and non-TXV air conditioners have comparable efficiency gains due to proper RCA, irrespective of whether they are over- or under-charged. And I refer to study, which I handed out, that was published in the 2004 AC triple E summer study proceedings. And that's at the entrance to the room.

Two findings from that are TXV sensing bulbs are often improperly installed and current standards don't address the installation quality of the sensing bulb. There's 3 parameters associated with TXV sensing bulb installation. And those are insulating the bulb, proper contact with the suction lining the right location and orientation.

The laboratory studies that were used initially to establish TXV performance only showed a performance improvement for TXVs when units were under-charged. But it appears that the studies lack similitude with respect to field conditions and did not consider or describe potential TXV hunting issues with improper refrigerant charge and airflow.

So I brought a booklet, which I would also provide the Commission. This is a textbook from the HVAC

Excellence Series. That's a nationwide HVAC technician's training annual. And in there they highlight the importance of problems associated with hunting, which I'll get in to in a few moments.

Current Title 24 efficiency standards allow the TXV to substitute and receive the same compliance credit, and so builders generally look at that and perhaps don't think that proper refrigerant charge and airflow is an issue.

Manufacturers provide the same warranty irrespective of whether an air conditioner has proper refrigerant charge and airflow. It sends a signal to the market that proper refrigerant charge and airflow isn't important. So most people really don't understand -- when I say people, I mean the general public -- don't understand the value of proper refrigerant charge and airflow.

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MR. MOWRIS: This is a slide that's in the paper that I handed out of 10 EER 11 SEER TXV equipment that was incorrectly charged. In the first go round the power draw was about 5.86 kW and the efficiency was right around 6.87. We have a transition where the charge adjustment was made. Once the thing was charged properly, the power draw was quite a bit lower, about 1 kW lower and the EER was right around 10. You can see there's still some instability there, but generally the point is is that the efficiency went up significantly and the savings about 1 kW in this particular instance.

And this isn't indicative of every unit, but it will give you an example of one unit. Of the millions of units that are in California, 6 million or so units, 10 million units or whatever, not that many had a TXV at this point in time. So this will be the first year where we see probably 100 percent of new units going into homes that will actually have TXVs.

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MR. MOWRIS: So the other issue that is important for proper RCA is that the standards should promote, in my opinion, the HERS providers/raters working with Verification Service Providers to recruit, train and equip local HVAC dealers to deliver proper RCA consistent with the third-party quality control standards that are already in the regulations.

HERS raters haven't historically trained or equipped HVAC dealers to provide proper RCA and the HERS raters generally do not verify proper RCA or properly TXV installation. The research studies show that HVAC dealers lack interest, training, equipment, methods to install proper RCA and duct testing/sealing in general as well.

Instead, the technicians rely on rules of thumb, such as, "Add refrigerant until the suction line is 6-pack cold." That's very, very common. Or the "Suction pressure is 70 PSIG and less than 250 PSIG on the liquid line."

You hear a lot of other stories why a Delta T across the evaporator coil of 20 degrees, things like that.

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MR. MOWRIS: Improper RCA can cause ice to form on package units. And really this is a common problem even on brand new package units. This is a picture of a unit on top of a SEARS building. And you can see the evaporate -- the air filter is immediately adjacent to the evaporator coil. This is a problem that I don't address specifically in this presentation, but I'd like to see the air filters move back at least 4 to 6 inches from the evaporator coil so that when the filter does get dirty, you don't have this impinging.

What happens is the filter gets sucked into the evaporator causing low airflow pockets, which then causes moisture to condense out of the air. Then it starts to nucleate and form ice. And eventually you get ice going all the way back to the compressor. This is fairly common and you get this a lot of times at restaurants and places where there's a lot of humidity or just areas in California where you have a fair amount of humidity in the air. We don't have as much humidity in some states so it's not as much of a problem here as it is in other parts of the country.

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MR. MOWRIS: This is a picture of a unit that received about a $3,000 incentive. It was 2 months old. And you can see the power draw on the unit with an icy coil. It had improper refrigerant charge and airflow obviously because the coil was iced. But, you know, in 2 months time it had already degraded so that the efficiency was in the 6 EER range. Once the coil was cleaned and de-iced and the charge was adjusted, the power was down about 10 and the EER was up about 10, which is what it's rated at.

MR. SHIRAKH: May I ask a question about that now. I'm right here.

(Laughter.)

MR. SHIRAKH: Did that unit have TXV or it didn't?

MR. MOWRIS: This unit did not have a TXV.

MR. SHIRAKH: Is there any data of what would happen if there was a TXV on it?

MR. MOWRIS: If there was a TXV you'd see similar behavior with this unit, because in this particular case the unit was overcharged and the TXV doesn't mitigate against overcharging generally. In addition, this was really primarily an airflow problem of this nature, and so the TXV would not have really mitigated in this particular instance. It would be -- I don't think it would have had any effect.

MR. SHIRAKH: The TXV actually -- I'm still here.

(Laughter.)

MR. SHIRAKH:

MR. MOWRIS: I keep looking over here because your voice comes down here.

(Laughter.)

MR. SHIRAKH: So the TXV would actually perform better in an under-charged situation is that what you were saying?

MR. MOWRIS: Yeah. The research data -- the laboratory studies showed that the TXV outperformed the non-TXV when units were under-charged. And what I'm saying is that the technical manuals and training manuals in the research that we've done indicate that in the field you don't get that performance advantage generally, because of other issues, which are related to the way the sensing bulb is installed, and the fact that the laboratory conditions were testing the units with the TXV in conditioned space -- the sensor bulb was in conditioned space, so was the whole evaporator coil by the way.

There's a problem with the ARI testing procedures, but I won't go into it in this presentation. That's a subject on a paper that I am giving at AC triple E. But generally the testing procedures for most products that are regulated, at least 4 or 5 products that I could point out, have problems with the testing procedure not being similar to or lacking similitude with field conditions. Boilers are another example of that. Refrigerators and freezers are an example of that. Air conditioners are an example of that.

And so because of this lack of similitude, we have products that are promoted by utility programs or specified by standards that don't necessarily perform as advertised because of the fact that the test conditions aren't similar to real world conditions or that they're not installed correctly or fail because of other considerations, which I'll get into.

MR. PENNINGTON: I have a question, Robert, related to this particular problem. I think you said that this was an airflow problem relating to the icing, rather than the refrigerant.

MR. MOWRIS: This is primarily an airflow problem that's exacerbated by over charge, because when a unit gets overcharged the evaporator gets colder. And so it's an overcharge condition because the evaporator is colder, you're going to get more condensation of water, quicker freezing and, you know, more of the type of scenario that you have here.

MR. PENNINGTON: Okay.

MR. MOWRIS: Any time the unit is over-charged the evaporator is going to be colder.

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MR. MOWRIS: Okay. So the thing I'd like to talk about briefly is maintaining proper refrigerant charge and airflow. And I'm going to make presentation on this at AC Triple E about maintaining energy efficiency measures in general. But I come from a background in aerospace in quality control and industry at Eastman Kodak. And what we generally have in energy efficiency is -- the problem is we believe we've put things, we promote things, we have standards that require measures quote unquote.

We don't have a lot about -- in our standards about maintaining those measures. So in this case, what I'm saying is the CEC should require locking Schrader caps to maintain proper refrigerant charge and airflow, maintain public health and safety and encourage proper refrigerant management practices to prevent stratospheric ozone depletion consistent with Section 6068 of the federal Clean Air Act regulated by the U.S. Environmental Protection Agency.

And the rationale behind this is really a study that was actually funded by Carrier Corporation but was published by a non-profit organization called the Global Environmental & Technology Foundation to study the state of stratospheric ozone depletion is provided by this URL website.

What they're basically saying is governments, industry and environmental groups must create distinct and separate messages on stratospheric ozone depletion and the importance of the ozone layer in addition to climate change. And the California Energy Commission, we focus a lot on this. We don't focus a lot on this.

So what I'm recommending is that we start to consider the ozone layer, because ozone layer is really critical. Developments in technological innovation are necessary not only at the present time, but well into the future, because the refrigerant that gets released today stays in the atmosphere for 150 years.

So what we really want to maintain the healthy air is our layer. Most importantly, the public needs to be more effectively engaged to prevent further stratospheric ozone depletion. That's why in the program that we ran for 2 years with public funds, we required locking Schrader caps, not only to identify and lock the refrigerant in, but to maintain it. And in the event that somebody comes back to the unit, clearly looking at the unit they're seeing there's something different about this unit. It's got labels, permanent bumper sticker labels. It's got locking Schrader caps. It's registered.

That is really critical. Because currently if you require, let's say, refrigerant charge and airflow measures in your standards, but you had nothing to maintain it, the question is how long would it take for those units to be mal-adjusted.

And what we found in the field and what I --

MR. PENNINGTON: What is a Schrader cap?

MR. MOWRIS: A Schrader cap basically -- I've got some with me. The Schrader cap -- on most units you have a Schrader valve, like a valve on your bicycle. Just think about your bicycle, okay. When is the last time you put your bike in the garage and you went back in the spring and you had perfect pressure in your tires?

You know, so think about refrigerant charge. And that's a better valve on a refrigerant system. However, what you have is a situation where currently you have new units with plastic valve covers, you know, just plastic cheap old things, just penny, 2 cent plastic covers on $5,000 air conditioners.

But when you go out to the field you see that it's screwed down, but it's all deformed because it's made out of plastic. Okay. Now, you have the confounding problem of the Internet, young children are becoming aware of getting high by doing refrigerant, because refrigerant replaces oxygen in the brain. So in California we've had 2 children die from breathing refrigerant. What do they do? They take a baggy. You put it up to the Schrader valve. You take a pencil. You press the valve and you get some refrigerant in the baggy. You put it up to your face and you breath a little bit of refrigerant and you get high. Currently, it's in the top 10 of inhalants on Drug Free America as an inhalant. It's a cheap and free high.

And so, you know, if you're in an area where you're a homeless person or someone who just doesn't value your life very much, you know, it's an option at this point. And that's why the valve covers were actually developed was to prevent a problem that was occurring at the Church of Latter Day Saints churches where they were losing a lot of refrigerants.

(Laughter.)

MR. MOWRIS: In our case -- we have anecdotal information. We went out and did measurement and verification studies of refrigerant charge and programs where in 2 months after the unit was supposedly done correctly, it was already mal-adjusted not by the person who did it the first time and not by the person who's coming to breathe refrigerant, but by another technician, most of which are not trained properly, who come back and just do the 6-pack routine and be able to suction the line. It's not cold enough, they add refrigerant and it gets out of whack.

So we had Sears Corporation going out and doing literally thousands of units at apartment buildings. And they called me up the other day and said, you know, "Are you going to pay us for all this refrigerant we have to recycle?" And I said, "What are you talking about?"

They said well, we well, recycled, you know, 20 bottles of refrigerant from this particular apartment building. They were overcharged by 2 to 3 pounds every single unit. You know, and it's like the rebate is only X, and, you know, that's covered under the rebate. We can't pay you for that. But it gives you information that a lot of these people that do maintenance are, you know, not properly equipped, not properly trained, and so you have this issue of maintenance.

MR. PENNINGTON: How does the Schrader valve correct the competency of the technician?

MR. MOWRIS: Well, the idea is if you get the right tools, equipment and methods into the hands of the technician with Analysis or other programs, essentially the unit gets done right the first time. And then when you label it and you lock it down, the likelihood of somebody coming back who's not trained or equipped, let's say, in a program or for some other reason, the homeowner calls somebody else in, they see that it's locked down, and there is less likelihood for them to adjust the charge.

Think about your refrigerator at home or your freezer, you don't have service valves on it or like on many air conditions there's no service valves per se. And so they figure that they put the right refrigerant in it, and it's a raised metal system, so it won't leak out. With split system air conditioners and package air conditioners, you have that concept that the valve is there and can be serviced. So oftentimes it is serviced incorrectly.

That's why we have this problem, because there's so many units that are serviced incorrectly. So it's not the first time. It's the second, the third and the 4th time, when it can get screwed up. And, you know, you go out and talk to people in the field, they tell you over and over again, you know, if I can get it done right, and I can prevent somebody from messing it up, it's likely that I don't have to correct the refrigerant charge again.

So a lot of technicians who go out and service units and do preventive maintenance this time of year, for example, are not doing refrigerant charge adjustments per se on commercial buildings, they're primarily changing air filters. You find that many of them will tell if talk to them about this matter, they'll say, you know, we really don't adjust refrigerant charge. Even though, they're paying us to do it, we normally don't, because it takes more time. We don't have the right equipment. We don't have the right methods. We just change the filters and make sure everything is good, move on, and come back three months later and change the filters.

So a lot of places, schools in particular, all they do is change air filters. The Schrader valves where -- getting the Schrader valves is the issue of protecting the unit from being mal-adjusted and keeping the refrigerant in the unit instead of allowing it to leak out.

MR. PENNINGTON: So a technician would have to break this thing or I'm not quite sure?

MR. MOWRIS: Well, you allow the guy to have a universal key that --

MR. RAYMER: It's just harder to get at.

MR. MOWRIS: You have a universal key that you can use to get into it.

MR. PENNINGTON: So would these be available for all technicians?

MR. MOWRIS: You can buy them if you're EKI certified technician. There are red ones and green ones.

What I'm saying is that think about duct sealing systems. You know, for a long time people used duct tape. And everybody eventually found out due to the good work of the Lawrence Berkeley Lab and Mark Madera and folks there that duct tape didn't cut it.

So the Commission thankfully decided to address the issue by requiring better methods with mastic and reinforcements with mesh tape. So what I'm getting at is that we need to think of the same thing in terms of refrigerant charge. We don't want to just get it dialed in. We want to maintain it. We want to keep it, you know, properly charged for its useful life so that the likelihood of it getting out of balance is reduced. Did I answer your question?

MR. PENNINGTON: Yes, I think so.

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MR. MOWRIS: Okay, thermostatic expansion valves, I mentioned this earlier. What I'm saying is that no disrespect to the laboratory studies. I mean, when I talk to the authors like Dennis O'Neil or Robert Davis, and talked to them. You know, their experimental design was set up to be designed around the ARI test procedures. And these TXV sensing bulbs were thoroughly insulated multiple times, very well insulated, and the whole coil box was in conditioned space.

Now, even with those conditions, they only show a performance advantage when the -- compared to non-TXVs when units were undercharged. So all we're looking at is potentially for any correct charge over or under, right. Now, they only have an advantage when they're undercharged.

Okay, now we have very many units that have incorrect airflow. So TXV-equipped air conditioners will "hunt" when evaporator coils have reduced heat loads, caused by low airflow, dirty or icy coils, and low refrigerant charge. It's right in this book.

This is the book that John Tomczyk wrote, and it was used throughout the United States. Now, the guys that did the studies weren't looking at this book. Not saying they should have, I'm just saying, you know, we went out in the field and measured a bunch of TXVs and we promoted them in a program with Edison, did 1,400 TXVs one year and then promoted them to Roseville Electric and they did TXVs. And we started measuring them, and we were finding problems. And we were like, why are these not performing correctly?

With hunting the TXV can lose control and successfully overfeed and underfeed refrigerant to the evaporator while attempting to stabilize control causing reduced capacity and efficiency. Overfeeding liquid damages compressors, a phenomenon called slugging. When you get liquid into a compressor, it doesn't like it.

They're designed to compress gas. The tendency for hunting can be reduced by correcting RCA -- and this is right out of the book -- relocating TXV sensing bulbs inside the evaporator coil box and insulating the bulb.

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MR. MOWRIS: So here's 2 TXVs. These are right out of the program. Almost every unit, 95 percent of the units that we provided through the Edison program was a program implemented by the local government commission, primarily in the desert area of southern California.

Every TXV, for the most part, was installed like this. These are new ones. We didn't see a lot of these, but there's another problem. Only 2-point contact on this one, not insulated. This on -- a lot of these were not insulated. But at the time that they were installed, they slapped them on like this, where the refrigerant can come down here, this little tube goes back down the TXV and exerts a pressure on the spring that's in the TXV unit.

And those 2 pressures are fighting each other to keep a balance that you get the right flow into the evaporator.

You've got liquid in this line, you impact the ability of this sensing device to send a gaseous pressure to that spring and work against that mechanical spring to keep the TXV in equilibrium. Some of the TXVs in general if you studied mechanical engineering and control theory, is that they're Simply a proportional. They don't have significant integral or differential control built into that. So now there are manufacturers that are coming out with electronic TXVs which will hopefully take care of some of that problem. But at present, this is what we're dealing with in the market.

So it's not like -- I'm not trying to say TXVs are a bad thing per se. I'm just saying that they have problems. So we have uninsulated factory TXVs in the box, right here, with the temperatures are higher than the suction line, the vapor line. We have uninsulated field installed TXVs influenced by attic temperatures, where most of your new construction is, at 50 to 80 degrees higher than vapor line pressures.

And all of this stuff it's happening with the TXVs, none of it's recommended. The manufacturers recommend tightly clamping the sensing bull to the vapor line with good thermal contact at the recommended orientation to guard against false readings due to air or liquid in the suction line, and insulate the sensing bulb to prevent ambient air causing false readings.

So, you know, it's all there, it's just that it's not being implemented. And so the standards obviously immediately could say we've got to make those TXVs make sure they're stalled correctly. That should be a piece of cake.

MR. PENNINGTON: So did you observe problems with TXVs in units that were coming from the manufacturer with the TXV installed?

MR. MOWRIS: Generally, this is a problem right here. Most of the manufacturers that we have dealt with do not send the unit with installation from the factory. If you buy a kit from the manufacturers, from some of them you will get a piece of insulation in the kit. And you're instructed to, when they give you these instructions here in this slide, these are the instructions that are on most of the kits that come out.

However, if you are a installer who orders a TXV unit with the evaporator, then it's installed inside the evaporator, generally you will not get a piece of insulation to put over the top of the sensing bulb.

MR. PENNINGTON: So are you saying that the SEER 13 units that we're seeing coming to the market right now don't come with the TXV installed?

MR. MOWRIS: They generally will come -- it depends. New construction generally they will order a product that has a TXV with the evaporator coil. In many cases, it will be this type, where it's just laying on the top of the coil. Now, a lot of the manufacturers, since this particular manufacturer has switched, they're now putting that bulb inside. I don't have a picture of their bulb with me. I do have it on my computer and I can send it to you later.

And you'll see this manufacturer puts quite a bit more, what I call, plumber's tape around it. This is a very weak attachment here. In fact, what you don't see is that when I put the picture, that bulb wasn't even in contact at all. It was at a cockeyed angle, because this piece of cheap metal strapping isn't sufficient to tightly attach this sensing bulb to the vapor line. So this manufacturer makes this on -- puts a much wider strip of material on the sensing bulb, so it really depends on the manufacturer.

And I think if we did a survey, and take photographs, go into any distributorship, you could see what I'm talking about. And it would be very obvious to you that there's a problem.

MR. PENNINGTON: Do you have a sense for what percentage of the TXVs that you've observed are insulated versus not insulated?

MR. MOWRIS: The vast majority have not been insulated.

MR. PENNINGTON: And that's --

MR. MOWRIS: One large installer that we've worked with in northern California informs us that all of their sensing bulbs are insulated. We were not able to observe that in the field, however, because their boxes were sealed with mastic and they did not want us to damage the connection. So it's a very difficult -- even where they put the little whole for the HERS rater to inspect, they didn't -- it was mastic and so they did not -- they asked us specifically not to, you know, do anything. So I can't tell you that what they said was verified. I think it's an issue of concern.

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MR. MOWRIS: Now, let's go into multi-zone AC systems. About 20 percent -- 10 to 20 percent of new homes in developments are going in with multi-zone systems. And the recommendation is to consider standards requiring that multi-zone damper systems installed on conventional constant-speed single-stage split-system air conditioners to not reduce the rated efficiency or the airflow cross-sectional area required by the manufacturer.

I have some slides that I didn't show purposely today, because I didn't want to cast doubts on any particular installer.

But we've seen, generally, damper assemblies in the field that take a 4 square foot in cross sectional area of flow on the evaporator and take it down to 1.7 square feet of area with both dampers open. And when you close one of the dampers you have .85. And so what happens is you get a much greater static pressure, you get reduced airflow and you start to see icing and you see other problems when the dampers are actuated.

When the dampers are not actuated, you see, like I said, reduced cross sectional areas and reduced efficiency even when the dampers are open. I think that's the next slide -- no it's this one. I didn't put it in there.

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MR. MOWRIS: -- reduced efficiencies of 20 to 30 percent EERs and 10 to 14 percent lower capacity. Is that the next slide?

Yeah.

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MR. MOWRIS: Not too many. Okay. So what happens is the same problems you had before, icing, slugging, reduced efficiency, premature compression failure. And then the field measurements 10 to 14 percent lower capacity, 20 to 30 percent lower EER.

One development we worked in the problem was so severe on the damper systems that the drywall was being damaged in less than 6 months on the homes, because they were getting icing, thawing, melting, then water, which is the worst enemy of drywall.

Okay. HVAC dealer install larger indoor fans to accommodate the reduction in cross-sectional areas. Typically one to one and a half tons larger, that's what accounts for much of your reduction in EER, because you have like a 3 and a half ton system going in with a 5 ton evaporator fan, which uses 350 to 400 more watts, and so you end up with, you know, a problem. Even with that extra fan flow, you still have significant static pressure that cannot be overcome, especially when the dampers are engaged.

This causes greater total kW. I made a comment last year at the energy forum -- I think it was the year before -- about Governor Schwarzenegger wanting to do a million solar homes. That if we did a million -- this one or a couple other ones, we'd save about as much power.

So if we can reduce -- if the capacity that's needed for a house is a half a ton or a ton and a half less, we can save a lot. Now, this the only 300 watts, right, but 300 watts on 20 percent of homes is a lot on peak.

So what happens is you get lower field measure EER based on the field measurements that multi-zone damper systems reduce the capacity of EER that cause icing, slugging, et cetera. And I think we need more field testing really to see just the extent of this problem. Everything you're seeing here is people calling us with problems and going out and measuring units.

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MR. MOWRIS: Proper Sized HVAC Systems. I'm saying that I think you've probably heard this before, I think you already have standards leaning towards of requiring properly sized HVAC systems to improve capacity and efficiency of split systems. This also goes for proper sizing for packaged. The energy and peak demand savings are 10 to 20 percent. Field studies show most units are significantly oversized by a half to 1 ton. This causes inefficient operation and reduced reliability due to frequent cycling -- I think John Proctor's made this point many times, probably more eloquently than I'm doing now -- and poor humidity control with bigger units. Oversizing wastes the capital invested in both the HVAC units and the distribution system.

This where I'm getting at with this thing about the million properly size air conditioners properly installed, et cetera, et cetera, because if we can get rid of this, this extra half to a ton, we save .6 to 1 or more kW per home. And a kW of PD is worth about 10 K, but it only puts out .7, so we're paying about 12,000 for a .7 kW, but we're getting this. I mean, this is what we're getting right now. There's no doubt.

Oversized commercial units affect the ability of the system to provide simultaneous economizer and compressor operation, and exacerbates problems with distribution fan power, since the larger units are supplied with larger fans, which is the same problem of the damper systems. People are being sold multi-zone damper systems as a luxury item.

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MR. MOWRIS: Now the ARI matching coils is an interesting one, because it's -- when I say ARI matching, it's an illusive concept. And I'll get to that in a minute. But what I'd like to say is requiring that ARI matching the evaporator and condenser coils provide the rated capacity and efficiency for split-system air conditioners. Even with correct RCA, many split systems did not perform at rated capacity.

We went to a development in Redding where we measured -- it was a study to measure the performance of ground source heat pumps and split-system air conditioners. We found problems with the slit system air conditioners. We spent quite a few days investigating the problem. And we determined that the coils -- the evaporator coils were not matched properly. They were not listed with ARI. And they were only producing at 6.5 EER, even with proper charge and airflow.

So we measured them numerous times every which way to figure out what's going on. Finally we figured out these probably aren't matching coils. Called up the condenser, the original manufacturer who made the coils, the OEM of the condensing coil. They said we can't guarantee the rated efficiency of that coil, because it's matched with and evaporator coil made by an independent coil manufacturer.

By the way, it wasn't listed with ARI. So we contacted the manufacturer of the independent coil. And within 40 days they were able to get that coil to match with that condensing unit. They were able to send this information -- even though we knew that it didn't match, they still were able to get it to match.

How they did it was with simulation. And so what I believe is happening is that the simulation -- that the ICMs are in sort of like a battle with OEMs. The OEMs test their products in laboratory conditions. The ICMs are not required to do so. So you have this battle of ARI between OEMs and ICMs. You know, it's like well, you're not touching your product, so we can't guarantee the efficiency.

Well, on all new construction, this is what we did with independent coil manufacturers, not necessarily cheaper. That's another interesting phenomenon. Why are they putting them in? Because there's advantages. So we'd like to see possibly ARI requiring laboratory testing of ICM evaporator coils with OEM condenser coils.

And I think that that would be an interesting issue, because I believe that the CEC can challenge the performance of units that come out of ARI. You can challenge -- you can go out and test the unit and challenge the rating. There are -- you know, no one has ever done it, but there is a regulatory option to do that.

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MR. MOWRIS: So, in conclusion, I believe that the savings potential from these measures is fairly significant from proper RCA/TXV installation, RCA maintenance, multi-zone damper systems, properly sized units and ARI matching coils in the range of 2 terawatt hours and one gigawatt, plus or minus.

So I believe the CEC should consider standards to achieve these savings through the 5 elements that I've mentioned. There's a few others too that I didn't have time to mention. And I didn't talk much about the automatic alarm for air filters when they get dirty. Some systems have that, like the higher end carrier systems.

But I think what we have, in general, in the air conditioning industry now is a lot of problems. And I think that the Commission really is challenged to address these issues.

I'd be willing to help you as much as I can.

MR. SHIRAKH: Have you ever done any cost effective analysis on any of this to demonstrate if they are cost effective in these 5 measures?

MR. MOWRIS: Yeah, I did do quite a bit of cost effectiveness analysis on these measures and submitted proposals to the utilities. They did not fund any of the projects, however. All these measures are cost effective, but they're viewed as emerging technologies, I believe, by many people, because, you know, there's not a lot of consensus among utility program managers that there's significant problems out there.

And, you know, I would say I'm sure that Mr. Proctor would agree that these -- many of these problems are wide spread. The problem that we saw with the mismatching coils was on every unit -- every home that had evaporator coils in that development had that problem.

And, you know, when we arrived at the first house, I mean, the house was 98 degrees inside there. The air conditioner was running full out but it wasn't producing any cooling. We corrected the refrigerant charge and, you know, it was better, but it was still running quite a bit because of the reduced capacity.

Because the problem is when you get -- when you're paying for a big condensing unit, like a 5-ton unit at these homes that we checked, but you're only getting 3 and a half tons or 4 tons of cooling out of it, you're paying that extra 1.2 or 1.3 kW all the time it runs. So it is very cost effective, depending on which way you look at it. But just use your E3 calculator all these measures are cost effective.

MR. SHIRAKH: Questions from the audience?

Steve.

MR. GATES: Steve Gates with Hirsch & Associates.

I'd like to just kind of follow up and reinforce some of the issues that Robert is addressing here. In particular, I've got personal experience several years ago living in a house that had one of these so-called dampered 2-zone systems using the single unit. This particular house, about a third of the square footage was upstairs and two-thirds was downstairs. And so there was 2 thermostats in a single unit serving both with single speed fan single speed compressor.

What I observed typically in the winter time when only the upstairs needed heating was the upstairs thermostat would come on, this unit would come on at full airflow and try to cram its full airflow capacity through one-third of the registers. The registers would all be whistling. If any door was within 6 inches of being closed when the unit kicked on, the doors would slam shut, because the air also couldn't return because there wasn't provision for return.

All of the very light-colored carpets -- very interesting in terms of how effective silk calking is. The light carpets next to the exterior walls did not discolor, because those -- you know, under the sheetrock was caulked in accordance with Title 24 regulations. All of the interior -- all the carpets next to the interior walls all darkened -- you know, an inch to 2 inches away from the baseboard would all be dark because of the airflow going down through the carpet and then into -- and then rising up through the interior walls in order to escape somehow.

So this is a, you know -- this is extremely common. I think I would actually urge that in terms of these dampered systems that you look at them in even more detail in terms of how do you -- you know, is it even reasonable to have a single-speed unit serving a dampered system since the airflow just is destroyed when you actually just run one of the zones. So I think that's a serious issue.

Related to that is the whole consideration of, and is something I haven't heard addressed today in terms -- you know there's a lot of concern about distribution efficiencies. And a big on -- my observation is, you know, most houses in California flat out do not address the return side of the system, in terms of you have a central return in a hallway or whatever, but the question then is if you're putting airflow in the bedrooms, where you do not have a return, you know, is the airflow actually getting back. And there's actually quite a bit of data out there that indicates no it's not getting back.

And people say well, you undercut the doors a bit, but if you just do a simple calculation on what the pressure drop is underneath that half inch or a one inch undercut, and particularly when you put some carpet there, what you find out is that is simply not sufficient to get the airflow back to the unit.

So, you know, related to everything that's going on today, I think there's an area of significant potential here to be investigated just in terms of addressing returns.

One final follow up on that, you're talking about dirty filters. You know, it's one thing to replace filters -- you know, a lot of utilities recommend every three months or whatever. But everyone -- you know, most people are replacing them with these cheapy fiberglass filters. And fiberglass filters are great for knocking out cat hairs, but they're really not very good for knocking out fine particulates that can build up on coils and ultimately plug coils. And I think this is another area to be addressed is should California even allow fiberglass filters to be sold as replacement filters or should this be addressed -- it seems to me like they should be, you know, at least pleated media filter type. And maybe you go further than that in terms of, you know, is a 1-inch filter sufficient or are you better off addressing, you know, looking at 2-inch pleated medias together with gasketed filter frames, that type of thing to prevent leakage around the filters.

You know, these are all areas that are quite significant. The first house I ever owned, I couldn't figure out at first why when I turned on the air conditioner it was cool at first and then the longer it ran, the warmer the house got. And as Robert showed, I ultimately found than when I opened up the duct work that the evaporator was completely iced over after an hour or 2 of operation from the air conditioner.

This was an older house. The people before me had owned cats. I don't know how often they replaced the filters or how badly they leaked. But basically I peeled off a layer of filth on the front side of the evaporator coil. And, you know, once I did that, then the coil was not iced up anymore and I actually could cool the house.

So this whole issue of -- this is applies to commercial as well as residential, where you go into a lot of these commercial units and you see these cheap fiberglass filters in a loose leaky frame. And that simply is not compatible with the unit that you expect to have out there 10 to 20 years.

MR. MOWRIS: May I add one thing too. This is very common for ground source heat pumps. The largest manufacturer of ground source heat pumps have the same configuration. So when we were measuring the performance of ground source heat pumps at our facility that has received rebates, we had -- one of the units had 5 that were running that was icing up like this.

The same type of deal, they put the evaporator -- the filter right next to the evaporator. Everything he said makes sense to me. And, you know, I'd highly recommend consideration for funding for PIER or whatever to investigate how much that would be mitigated by requiring a minimum spacing between the filter and the evaporator.

MR. SHIRAKH: Related to the return air that Steve brought up, so what's the solution of having multiple returns from -- instead of a central return on that? Is that shown to be cost effective?

MR. MOWRIS: Yeah, I think --

MR. SHIRAKH: It saves enough energy?

MR. MOWRIS: Well, I'm not sure of the cost on multiple returns. I can't really address that. I'm not in that data. Maybe Steve could answer that. I don't know.

MR. GATES: Well, actually I tried to address that situation in my current house, which I had built for me. And I partially succeeded and also partially failed. I installed jumper ducts between bedrooms and the common hallways or common areas, so that I could return from there.

MR. MOWRIS: So you had a hole in the wall?

MR. GATES: Well, this was a register on one side of the door that then used a flex duct over the top of the door to another register on the other side of the door. And what I found is -- and in doing the jumper duct was an 8-inch duct. And this house was sized about 500 square feet per ton, which in retrospect is too big.

I let the contractor have his way. It ties into your issue of over-sizing the unit. The bigger the unit you put in the more issue you're going to have getting return from spaces that are closed. I really should have gone to at least 700/800 square feet a ton. That would have worked better in terms of actually giving me reasonable airflow.

I can write up something. I've read, you know, several different ways of getting air from bedrooms back. And one way actually is even to put a register low on one side of the wall and a register high on the other and letting the air return, you know, from through the wall.

You know, one of the criteria is you like -- because there's sound-proofing and privacy that type of thing as well, so you don't just want to have 3-inch gap under your door, which realistically is about what you need to ensure that you get adequate air flow.

So anyway, yeah, it's surprising. I still have a problem in my existing house with the air conditioner will push doors shut if they're within say 2 inches of the jam. When the unit comes on, the doors will close themselves.

MR. MOWRIS: Can I introduce one individual who came quite a ways to be here today.

MR. PENNINGTON: Before that I want to ask Steve a question. So your concern with the returns is increased infiltration at some point?

MR. GATES: Well, I saw on study that was published in the ASHRAE journal that looked at a, you know, house -- at modern construction, well sealed. They measured air infiltration rates of a quarter of an air change per hour when the system was off. When the HVAC system kicked on, they measured one air change per hour. So that comes from pressurizing bedrooms and then causing vacuums elsewhere. You know, they measured this with bedroom doors shut.

MR. PENNINGTON: Have you seen a cost effectiveness analysis?

MR. GATES: I haven't seen a cost effectiveness analysis on this.

MR. MOWRIS: You're talking one air change per hour when the system is on, ex-filtration.

MR. GATES: Yes. This was a study published in ASHRAE about -- geez, maybe somebody else recalls it -- it was within the last 3 years.

MR. MOWRIS: That's an impressive number of change per hour.

MR. SHIRAKH: Do you wish to address?

MR. BRAYLEY: Hi. My name is Steve Brayley. I'm with US Air Conditioning distributors. First of all, I enjoyed the entire meeting so far today.

A lot of the issues you guys are seeing, and Robert's presentation, as well as the gentleman with the Furnace and -- Representing GAMA here, a lot of it has to do with education at the contractor level.

These problems -- unfortunately, if you live in southern California -- I'm from southern California. I do come from the Palm Springs area that was mentioned earlier. A lot of these problems unfortunately are more the common than they are the rare. If you live in southern California anyways, chances are you do have one of these -- or more of these problems in your home.

Addressing them in the future would be a very intelligent way to go. Cost effectiveness, SEER ratings, TXVs, none of them work properly without airflow proper installation. Proper duct sizing is huge and duct engineering or duct design is vitally important. Charge and airflow is obviously overlooked quite a bit. We do sell products concerning refrigerant maintenance. The Schrader caps that he was referring to earlier, we have supplied those on several thousands of jobs in southern California.

One of the instances we ran into as a distributor was a builder had a maintenance person that was very upset because he couldn't gain access to the refrigerant. He called and wanted to know why the caps were on the job -- the contractor had put them on the job. They contacted us. They contacted the contractor. He was very angry. And the owners of the building company were on the phone with us. And come to find out this maintenance guy was running around the job site when the people were moving into the homes and letting the gas out of the air conditioning condensing units the tone reached a satisfactory level to his ear, as far as the operating efficiency goes.

So he would let them out and charge that unit by ear tone -- accepted industry practice.

(Laughter.)

MR. BRAYLEY: I'm totally impressed as a manufacturer and distributor by the work you folks do on all this stuff. But if we don't incentivize the contractors to be better educated and to do the finish job, all your efforts are really kind of in vain, because if improper installation is put in -- proper design is done and installation is not done properly and sealed, which I see every single day, it's not going to work properly. And the power usage is incredible the waste that goes on. Just a suggestion.

Thank you very much.

MR. SHIRAKH: Mike did you have something?

MR. HODGSON: I had a question for Robert.

Mike Hodgson, ConSol.

Robert, you said that there was a -- I just want a kind of a percentage of overcharge/undercharge My impression of the market is tends to be undercharged. Listening to you, it sounds like it's overcharged. What's your feel?

MR. MOWRIS: There's a slide in this paper that shows you, I think. Generally, it's pretty much equally distributed with about 30 to 40 percent of systems being okay, depending on the development. We've been at certain developments where the installers did not have any equipment. They only used pressure gauges and they had no recovery tanks. They always overcharged the units. So in their developments we would see everything being overcharged. It really depends if you do a statistical population sample, you know, random sample, I think you'll find a fairly normal distribution.

MR. HODGSON: As a follow up then, does it sound like it's a subcontractor installation technique, so that if we got ahold of this group without their proper equipment, it was overcharging, then we could correct that. Then there's a group that's always undercharge tends to be an economic issue many times. So, I mean, is it kind of -- if you look at a subdivision, it's not a bell-shaped curve. It's either overcharged or undercharged, based on the installation.

MR. MOWRIS: It could be. I mean it could be a normal distribution for the development too, because the problem is with the companies that do the installation, they oftentimes don't have the right equipment or the right training or the right methods. They might have the right equipment, for example. Let's say they have calibrated equipment. It would be very highly unlikely that they would. But if they did and they didn't have a proper methods, let's say, they might have a problem.

In the case of the method, when they say method, the method that has historically been used outside of Check Me or the verified program of reanalysis or Honeywell Services System is the cardboard calculator -- I didn't bring one with me. But it's a cardboard calculator they would move back and forth and you interpolate the numbers. And it's very hard for even an engineering student to do a job with that.

And many of them don't have the cardboard calculator, so basically a hundred percent of them don't have a method. So what Check Me provides were an analysis of method, quote unquote, and then obviously the training and the equipment. And so, you know, one of the points I'm raising in my talk is to drill deeper into the contractor market. And I think what you're getting at is, you know, that's what we have to do really if you want to get the contractors to do a good job is to have a process of verification and training and so on and go deeper into the trades. So the guys that you were talking about, if the guy that does all the overcharges he knows what he's got -- he's properly equipped to do the right job. The guy that undercharges has the right equipment.

Is that a good answer?

MR. HODGSON: Okay.

MR. KNOWLES: Dave Knowles from GAMA.

I'd just like to encourage CEC to look into possible avenues for some of this work here. I'm not debating any of these issues brought up. But, for example, there's standards organizations that are well founded, they're national, international, that if there's a safety issue, for example, the locking Schrader valves, there are established processes on -- you know, for example ANSI requires a balanced committee. So, you know, no more than one-third of the manufacturers and then the other two-thirds are open to other public safety and government organizations, so you don't have necessarily write a regulation towards this end, which would then perhaps get you in conflict with some other federal regulations.

For example, in training I mean I would reinforce the comments that a lot of the best efforts of manufacturers are foiled at the installation end of things. And there are some industry and independent technician training programs like NATE, which is the North American Technical Excellence training program. That's actually partly funded through ARI, partly funded through GAMA. And if you, for example, wanted to put a requirement in that a certain percentage of qualified installers go through something like NATE, a lot of times one person in the organization gets NATE training maybe 20 years ago and then covers for the rest of his people.

So I mean it's tough, that I'd just like to state and reinforce that a lot of the problems are not so much in the equipment or in the design even, it's in the installation. And there are some established ways of dealing that. And the Commission can get involved with any of those.

MR. MOWRIS: Could I do a follow up on the NATE issue?

One of the things we did, just as an interesting bit of research last year, is called every NATE and E-mailed every NATE-qualified company in northern California to invite them to participate in the verified refrigerant charge and airflow program. And not one of them was interested.

And what we found out, and we've actually talked to several of them, because they were using NATE as an advertising gimmick to give the illusion of quality to their customers. But they admitted, many of them, that they never checked refrigerant charge and airflow, and that most of the technicians were not equipped to do so. They simply changed the air filters and did preventive maintenance work. And they told us, in fact, that said you know if we did your program, we told our customers that we were going to come out and check your refrigerant charge, they'd say well, isn't that what we've been paying you to do?

So, you know, we just simply found that it wasn't that the NATE training -- we find that HVAC Excellence, which is similar to NATE, a lot of this training -- there's a lot of training that goes on across the country. But I don't think that it's really a training issue, per se. I mean, I think the problem is having a system that can really verify 100 percent of the jobs. You know, you really need that. I think we for too long we've naively assumed that we can correct the problem with training. And I'm not sure that that's going to work.

MR. BRAYLEY: Steve Brayley with U.S. Air Conditioning Distributors again.

To underline the NATE program, to answer Robert on that, with this gentleman, the NATE program is probably one of the best things that's happened in the industry. It's a nationwide program.

I just believe that maybe if we could somehow implement that. I became an ARI certified technician in 1992. I think I've shown my card twice. It's been requested twice that I show my identification when verifying work on some systems.

MR. MOWRIS: Do you mean EPA certified?

MR. BRAYLEY: EPA, I'm sorry. EPA certified cards. You're basically registered with your Social Security number. So it was, at one time, a serious deal that we all took seriously in the industry. But it has been put by the wayside. I'm not sure that the EPA certification is being held up.

Therefore, in your position if more requirements and some policing of that every technician has to be certified, and I believe is taking the test and passing the test and working with it. But are they keeping their skills up? There's no real policing structure, in fact, to test the tested so much. I don't know how else to put it. If you're certified and -- you know, a Toyota technician is, I think, it's NASE certified. They have constant updates and certification to keep that certification, just like a driver's license, just like any other type of licensing you can do. I think we're lacking that in the industry.

MR. MOWRIS: There is one thing on the EPA certification, too. One of the things we find is there is a requirement if you're EPA certified that you maintain a log book of how much refrigerant you've used, you've recover in a log book on your person, when you're out in the field or anytime an EPA policeman he wants one came to check you.

And what we find is that there's really no policing body associated with EPA requirements. So we had a standard and we have a test procedures and we have a regulation and fine of $25,000 for violations. But we don't have any policing structure that's set up to really enforce that.

MR. SHIRAKH: Okay. I was going to ask John Proctor for his comments.

MR. PROCTOR: John Proctor of Proctor Engineering Group.

Thank you, Robert.

I'd like to actually just sort of go through your 5 items real quickly. And, actually, I'd like to throw 2 of them together. I'd like to throw 1 and 3 together, because I think they have to do with thermostatic expansion valves.

I would say that the data shows that a properly installed thermostatic expansion valve mitigates the charge effect on an undercharged system up to a certain level of undercharge, which is a common level of undercharge, 20 percent undercharge or less.

I think that what Robert brings up is important to look at a couple of things. One is the improper installation of TXVs. I think it's important for us to take a look at whether or not we have a problem with the way the TXVs are being installed, you know, which he mentioned that he'd seen a very large percentage which were misinstalled, and how they were working when they are misinstalled. What's our potential energy savings by getting them installed right, for example?

With them installed right, I think we can look again at the cost effectiveness of, say, we get a certain amount of mischarge, we can look at cost effectiveness. When it's working right, is it still worthwhile to say that you should spend the money, the time to check and make sure that you have the right amount of refrigerant. Obviously, I favor having the right amount of refrigerant in every unit, personally. I think the only question is, you know, what's the cost effectiveness question for the Commission?

So I think those are things that we need to look at. Those are the primary -- well, if that's the biggest -- is there any other issues that you guys -- that the CEC folks would like me to address?

MR. SHIRAKH: I'd like to hear comment on all.

MR. PROCTOR: You keep coming from over there.

(Laughter.)

MR. SHIRAKH: What about the Schrader valve and the cap and so --

MR. PENNINGTON: Before you leave the TXV. So the Commission concluded previously that we didn't want to address the refrigerant charge measurement for packaging units, because the expectation was that the manufacturer would get it right and install the TXV.

MR. PROCTOR: Right.

MR. PENNINGTON: Do you have evidence in your field data that maybe that should be revisited?

MR. PROCTOR: I don't have sufficient evidence that I could recommend to the Commission that they change that position. I mean we have found units in the field which were newly installed package units that had the wrong amount of refrigerant in them, that's true.

But I don't have sufficient data to say well, you know, it's 30, 40, 50 percent of the time or something that would make it economically worthwhile to address

MR. PENNINGTON: You know, it's probably not a huge issue for new construction given that, you know, the evaporator units are split systems. But if we were going to address these kind of problems on change outs, a lot of those units are package units.

MR. PROCTOR: Fresno and Bakersfield.

MR. PENNINGTON: And so, you know, right now we're having a little difficulty explaining our current requirement that if it's a package unit, you might have to mess with it. So it might be worth revisiting that.

Another point in a different workshop Pete Jacobs reported that he was seeing problems with refrigerant charge in package units a few years after they were installed shortly after the technician had visited the site perhaps to service the unit. And the problems can crop up. So those problems might exist for change outs where it's borderline for new construction.

MR. PROCTOR: Well, our database has data for both package units and split units in it, commercial and -- most of the package units are commercial units. And we can take a look at it.

As I recall, the amount of mischarge in the package units was less frequent and more biased toward undercharge compared to unsplit units it's about 50/50 and existing units as far as the one that are mischarged, about half of them are overcharged and about half of them are undercharged. On new construction, we found that there's a bias toward undercharge on split units. In case anybody wonders how that happens, it's very simple, there's a enough refrigerant in the unit for standard length line set, generally 25 foot. Put a 35-foot line set on it, and don't add any refrigerant, you've got an undercharged unit. And that's the common practice is to not do anything to adjust for the length of the line set.

So, yeah, Bill we can look at what we see -- I think on new package units perhaps -- I'll try to come up with something that can address the question of whether the new package units are coming from the factory with the wrong amount of refrigerant.

MR. PENNINGTON: And the other thing I'm wondering about is in your earlier work you were finding that the savings was almost entirely on the undercharged side and not on the overcharged side?

MR. PROCTOR: That's correct.

MR. PENNINGTON: I'm not sure if Robert is finding something different or related to that?

MR. PROCTOR: Robert is showing some very large kW reductions on overcharged units, which is -- certainly, the watt draw goes down when you reduce overcharge on the unit. And really the only question is how much did the capacity drop at the same time in order to take a look at the efficiency. So I have some questions I need to ask Robert as far as how he made the corrections back to standard conditions to get EER or that kind of stuff, which probably we should do off line.

MR. PENNINGTON: Okay.

MR. MOWRIS: As far as the pressure, what we found is we did some analysis recently, because the gentleman who's doing some research for DOE contacted me, a company called name TIAX, formerly AVL. And so we looked at the pressure -- one thing we started looking at is the pressure difference, the discharge and suction pressure and the relationship in terms of the power is the natural logarithm of the ratio of the discharge to the suction pressure. So if you look at the ratio of the natural ratios of before and after, in many cases we found a very close correlation between the kW reduction due to charge adjustments and the pressure of the system, since it's a closed system.

So in situations where you have the data, in this particular case it's the on -- we have the data for this one -- it was very closely correlated to the natural logarithm of the difference in pressure between pre and post the power draw. And so one of the things that we were thinking is requiring that people capture both pressures when they do a sub-cooling job, capture the suction line pressures, as well as the liquid line pressure. When they do a super-heat job, capture the suction line pressure with that, so you can get the pre and post.

And if you do an amp meter draw or power measurement, you know, you can really see that that relationship -- how clear it is. And that's something that -- you know, we only have that information for some of the jobs that we actually measured everything -- when we there measuring everything. But the guys that are out there doing the work with the PDA that we provide them with, don't often capture, because we don't require it. So I think that's good data that we could get.

As far as the new commercial units, Sears did quite a few adjustments on new units that were installed at schools, and we found about 50 percent of the new units were incorrectly charged. Now, the problem with those is we're not sure if they were incorrectly charged by the installer shortly after they were installed versus that came from the factory. I don't -- it's very hard to find that data out, unless you know the schools or something is being installed with a lot of units and you go out immediately check them and pay the person not to adjust them or do anything, you know, because generally it's really hard to know if somebody made an adjustment before you went out and did your research. So I'm not sure that we have the data either of that nature.

MR. PENNINGTON: Any other questions?

MR. SHIRAKH: Yeah, especially item number 5 on the list of the matching.

MR. PROCTOR: Yeah. There's been a long standing feeling, probably more than a feeling, that the independent coil manufacturer's coils were not doing what the primary -- whatever they're called -- primary manufacturers -- OEMs' coils were. And I'd say that that's a feeling that's pretty widespread that I actually concur with, from what we've seen in monitoring systems over whole summers. I've seen an awful lot of third-party coils that were not delivering the capacity that they said that they were supposed to according to the simulation.

I think it would be worthwhile to look at whether there actually is any data that supports the simulation model that they're using today. And I think it might be something that would really be worthwhile for the Energy Commission to address if we can figure out a way to do it that doesn't sort of get -- you know, we don't get in the way of federal toes or our toes get in the way of the federal government's toes or however that works.

MR. MOWRIS: Well, one idea of one suggestion I had on this matter is -- which I think would be easy to implement regulation -- would be to on new developments to measure the performance of an air conditioning system before the units are built to verify that everything in the systems in the models is properly specified and delivering what it's supposed to. And then granting permission to the builder to build the rest of the homes.

What we find often times in developments is that the models which are built very quickly might have problems, and those problems are repeated throughout the whole development. So I was thinking well gee if it gets inspected by a HERS rater and you already have these problem, it's too late to do anything about, because they just built, you know, the 200 or 300 homes.

So my thinking is couldn't we intervene earlier in the process -- and we could do -- this could be an emerging technologies or PIER funded project to go out and monitor and inspect and measure the performance of air conditioning systems on models, and determine if we find problems. And if we do, then come back and think about how you might be able to implement a regulation of that nature.

The models are put up fairly quickly early in the game usually and you have sufficient time at that point to really determine -- unless they're built in the winter, of course, like in northern California, but generally I would think that there would be enough time to get things corrected at that stage.

MR. PROCTOR: I think on the zone systems, we've certainly seen problems in the field with the zone systems. Now, I can't remember his name -- Rick Chitwood has looked at a lot of zone systems and found similar problems as far as inadequate airflow. I think this is really something that we need to take a look at and see if there's something. We certainly know what the effect of low airflow is on efficiency, so we can pretty well nail down the -- nail down that part of it.

The squeaky part of it is, is there really any savings associated with the zones? I mean, CEC gives credit for zones, I believe, in Title 24, but I think the data to support that is pretty sparse.

So it's like, okay, so if zoning actually saves you money and reducing the airflow costs you money, where did you end up? Maybe the place you started.

So we should look at really at the dampering issue if -- I think certainly if zone systems continue to be a credit, I think it's worthwhile making sure that they actually deliver at least the expectation.

MR. MOWRIS: And may I add one thing to on the ARI matching coils for a moment?

What I'm thinking on this is that if the coils are delivering, let's say, a half a ton less capacity than they should and we determine that that's a consistent problem, the savings would be fairly huge, because, you know, half a ton is .6 kW. So if we could just save everyone to put in the correct match, and it really does perform, we save a half a ton in every home, hundred thousand homes or whatever. That's a lot of kW.

And so I think the cost effectiveness is fairly large. And a lot of these matters, like the dampering is a problem or a charge or airflow, all of these things, the over-sizing is an issue because it corrects for many sins.

MR. PROCTOR: Hides many sins.

MR. MOWRIS: Hides many sins. So it's like okay, we know the ducts are leaking, we know the charge is up, the TXV is installed correctly, the evaporator is full, it's at the right capacity, it's up in the attic, you know, what I mean -- and so what do we do? We oversize the system.

So the question is if we corrected the many sins through intelligent intervention --

MR. PROCTOR: Is that anything like intelligent design?

(Laughter.)

MR. MOWRIS: Totally different.

MR. PROCTOR: Need anything else?

MR. SHIRAKH: Do you have something to say?

MR. DAY: Yeah really quick. I'm Michael Day with ICE Energy.

I wanted to bring up that when we're talking about refrigerant charge and airflow, when we're talking about thermostatic expansion valves, there are classes of equipment coming onto the market now, such as ours, that have refrigerant management systems that operate in liquid overfeed, that have receivers, pressure sensors and are much less sensitive to over or undercharge and are able to deal with that, so that as regulations or requirements are developed, that the systems that may be possible but more but have that -- that have a much wider band of satisfactory operation and are able to account for that in their system design, I don't know, have that capability recognized in them simply because they operate under somewhat different physical properties.

MR. SHIRAKH: Well, I trust that, Michael reminded us, there's a gentleman on the phone who wishes to be heard?

MR. PROCTOR: I think you actually put it on mute.

MR. VERMA: Hello, Eric? He's not there.

MR. SHIRAKH: Any others?

Commissioner Rosenfeld.

COMMISSIONER ROSENFELD: Let me first say I'm very impressed with this in general. I don't know whether maybe I'm very impressed because I'm so depressed.

(Laughter.)

COMMISSIONER ROSENFELD: Obviously, a lot has to be done and we are going to take all this very seriously. I mean, you know, we need to get together also with the utilities who run training programs.

But my dumb question is I'm impressed with Robert's thoughts of savings a lot while getting the charge right and getting the airflow right. How much would it cost -- in this modern age where sensors aren't so expensive and where we're going to have interval meters and the possibility of relaying data to the utility and then back to the homeowner to have some sort of a relatively permanent monitoring of the efficiency of an air conditioner, that is in kilowatt hours per ton, so that sort of like once a month the owner could look at some sort of display and see whether his air conditioner in the system is failing on him.

I like my computer in my car. I sort of like the fact that I can see how many miles per gallon I'm getting occasionally. I don't look at it every minute, but I sure look at it once a month.

Does anybody, Robert or John Proctor, anybody want to answer that?

MR. KNOWLES: I'll offer a comment on that.

COMMISSIONER ROSENFELD: Please.

MR. KNOWLES: Dave Knowles with GAMA. Sensors are not really at that point. There's things like thermocouples that are pretty simple. Now I'm speaking for the -- obviously for the furnace manufacturers, but a lot of those also manufacture air conditioning. They tell me that designing a furnace to last 18 to 20 years in a typical -- you know, typical home that's defined by DOE which is somewhere in Pittsburgh, that that's the equivalent of driving a car a million miles with no oil changes, because people do not maintain their units. If there's some kind of nuisance relay switch or something like that that gets wired out. And as you've heard here in the previous discussion that a lot of the maintenance staff is very poorly trained and very poorly monitored.

So having a system like that where, you know, just recently they've introduced a more sophisticated thermostat with automatic setbacks and those were just plagued with problems before they kind of arrived to where they are today.

So we're not quite there. It's a noble thing to think about that to have an intelligent appliance. These things are being looked at, but the state-of-the-art isn't really there, and the cost would be pretty expensive for the homeowner and probably would not be marketable to your average American.

MR. SHIRAKH: There's a PIER project on-board diagnostics, fog detection, I wonder if that can actually be applicable to these type of systems. Bruce.

MR. WILCOX: I want to make one comment on this the subject, which is, I showed you pictures of the Roseville project that I'm doing. Wearing another hat I've done a lot of experimental work and field stuff including -- I currently have a project in Fort Wayne, Indiana with the Cardinal Glass company.

We have 4 houses. And my experience there is that -- I mean, there's an issue that nobody has brought up yet, which is that the typical air conditioning systems, based on my experience, also just fall apart in the field almost immediately, as soon as you get them installed. Three out of the 4 air conditioning systems in Fort Wayne lost all their charge within the first 2 years. And it's just because they've got coils that leak and they got systems that are not very well made.

And so the problem with trying to have something where you get some feedback is very important because these things -- there's no way to tell that's going on if things just sort of -- deficiency goes down and down and down.

And fortunately we have very extensive monitoring, and you can see this happening just all the freon leaks out. So it's a big issue right now.

MR. SHIRAKH: John. And then after that, we're going to go to the next topic.

MR. PROCTOR: Certainly it's technologically possible, that's obvious. It's the economic question. We actually have a project which we're doing which is called the service light for Sacramento Municipal Utility District. It's very simple. It gives a signal directly to the homeowner that there's a problem.

But there are other folks in the field who worked on it for years and we all keep trying to bring the price down to a point where we can do it. And I actually believe, if I'm not mistaken, Bill, it is an option today in Title 24. It's an existing option.

MR. PENNINGTON: It's an option in Title 20 actually.

MR. PROCTOR: In Title 20.

MR. RAYMER: What does this cover?

MR. PROCTOR: To take care of charge and airflows, as I recall.

COMMISSIONER ROSENFELD: I want to say something.

I guess what I want us to do is to think about this issue a little bit. As Mazi knows, because he's responsible for our specs for what will go into new houses, programmable communicating thermostats. We are going to require -- we are going to have interval meters in new houses. We are going to have your electricity use time stamped to the nearest hour. We are going to have thermostats which notes time of use every minute on critical heat days.

There are also plans for the California Solar Initiative to have a lot of PVs going in place. If you believe the claims, it will be a million over 10 years. We want to go in the direction of performance monitoring for them too, because much better to give the incentives, of which $3 billion is allocated, based on performance rather than based on capacity.

So a lot of groundwork will go into the basic communications issue. And I'm just sort of hoping that people in the HVAC industry will sort of figure gee, well, this is coming anyway and let's move in that direction. So I hope in a year or so this discussion will make a little better sense.

Thanks.

MR. PENNINGTON: Before we move on -- are we done?

MR. SHIRAKH: I guess I'm going to give the last word to Robert.

MR. MOWRIS: I think that what Dr. Rosenfeld is recommending is a good idea. And I think John is working on some things. And I think that this stuff is easy to do. I don't think it's that complicated. I mean, you know, all we really need are sensible temperature senors. We don't really need sensing bulb in California, and airflow static pressure is not that complicated to measure. We're already measuring the kW, so I just don't see that this is that complicated. We just need to spend enough money on it and we can see the savings are potentially huge. So it just seems like we just need to focus enough money on it. And there's so much money available, it's really just getting the right person to make a decision to fund the project.

We have intelligence out in Silicon Valley. We have so much venture capital down there, it's just astounding. So I would, you know, urge the Commission to really look at how we could accomplish Dr. Rosenfeld's recommendation.

MR. SHIRAKH: My concern is how much of this we can actually capture for the 2008 standards given the timing of this standard. We'll deal with that.

Bill.

MR. PENNINGTON: Robert, I wanted to thank you for bringing all these comments today. And you have been after me for a long, long time to hear these things, so I'm glad you had your day.

Thank you.

MR. MOWRIS: Thank you.

MR. SHIRAKH: Okay. The next topic is slab edge modeling.

MR. WILCOX: Now we come to the exciting stuff.

(Laughter.)

(Thereupon an overhead presentation was Presented as follows.)

MR. WILCOX: I'll try and be brisk with the discussion of slab edge modeling.

MR. HODGSON: And lively.

MR. RAYMER: We've been waiting for this all day.

(Laughter.)

MR. WILCOX: Anybody else have anything else they'd like to say?

(Laughter.)

MR. WILCOX: Okay. So this is a proposal to revise the model that's in the residential ACM on slab edge heat flow or slab heat flow. And Ken and I worked on this.

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MR. WILCOX: I'm going to begin again with the background, what the CEC slab loss model as a proposal for what to do in residential ACMs. And again an analysis of the impacts on the TDV for typical homes and the impact on slab edge insulation figures.

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MR. WILCOX: The residential ACM again specifies the rules. The only requirement in California for slab edge insulation is in climate zone 16, where R-7 is required in the prescriptive standards.

We have a long-standing rule that we assume that 80 percent of slab floors are carpeted and 20 percent of the slab floors are hard surface. That's one of the rules. In the 2005 ACM, the model is that there's a conductance that goes from the indoor air temperature to outdoor monthly ground temperature and that conductance is based on the ASHRAE F-2 factor that Mike is so enamored with.

So that model was updated in the 2005 standards to try and make it better, but the reason we're into this is because there's been some complaints that this model in the 2005 standards doesn't give enough credit for slab edge insulation. If you wanted to actually do slab insulation, particularly in heating climates and that there's too much credit for cooling losses from the slabs.

So that's how we got into this.

--o0o--

MR. WILCOX: It turns out there is a model that's around that's highly advantageous. It was developed by the Energy Commission by Joe Wong at LBL and some other people there. And it's a simple model designed for our simulations, exactly the kind of thing we're looking for. The LBL guys ran a 2-d model and then they did regression analysis and abstracted that and came up with a model that they designed to put in to DOE-2 that covers carpeted and hard-surface slabs, and basically designed to exactly what we need.

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MR. WILCOX: So the proposal here is that we simply upgrade to this DOE-2 style model and put it in the current ACM manual for residential.

It has all these advantages. You don't have to change the current slab inputs much. It is a model based on carpeted area and hard surface area, based on the perimeter length for each of the slabs, exactly like we do now. All we have to do is add an input for the location and type of the slab edge insulation, if there is any, and the R value and depth of the insulation.

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MR. WILCOX: And what fundamental of this model is a table of these coefficients. The model fundamentally says that instead of having a heat conductance to a monthly temperature, like we have right now, there are actually 3 temperatures that you have conductances too. One is an annual deep-ground temperature that's from the middle of the slab going straight down, basically, think of it that way.

The second conductance to a monthly temperature that's sort of for the stuff that's closer to the edge.

And then there's a conductance to a weekly temperature from strictly the slab edge.

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MR. WILCOX: And what Joe and his friends did is they came up with this set of conductances for the perimeter weekly, perimeter monthly, perimeter yearly and so forth. They're all canned up for most of the relevant cases. So the user in this model selects from a library and we can interpolate the R values to get the exact R value of the system and maybe interpolate for the depth of the insulation to cover that.

We've implemented this model and tested it, and compared it to the 2005 model, which there's great bar graphs, also 16 climate zones across the bottom and then the weighted average for the State. If we assume an uninsulated slab, which was 99.9 percent of all the cases in California, we increase the annual TDV about 2 percent when doing this model, so it's not a big impact for the standard cases. It all defaults and nobody has to know anything, we just do it.

And then if you're interested in slab edge insulation, like all you've Build America types or advanced guys are really interested in this stuff, then this model will give you a pretty significantly different answer on the savings for slab edge insulation.

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MR. WILCOX: The blue bars on the left are the 2005 model and the magenta bars are this new slab edge model. And what we're looking at here are savings in TDV per square foot of floor area per year. So this basically proportional to the life-cycle cost effectiveness of a slab edge insulation system. And you can see that the current model actually, you know, says slab edge insulation is a bad idea, and a lot to fill one of the southern California climate zones and not much -- not much of interest in the central valley either, that's kind of a little questionable.

But the new model gives pretty significant savings for the central valley climates and for climate zone 16, which is the mountains, and increases the savings for slab edge insulation by a factor of almost 10, a statewide average basis.

So this is kind of a forward-looking thing. Davis Energy Group guys have a project where they're trying to develop a slab edge insulation system. And there were complaining bitterly at the previous one, because they couldn't get any credit at all for doing good slab edge insulation. So I think this is something we can implement. And for all the standard cases, it doesn't really change things much, but it does offer this path forward.

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MR. WILCOX: There, how's that for quick on the slab edge. That's the conclusion.

The propose model works for the current inputs. It covers the current prescriptive requirements. It offers a path for future credits and has minimal impact on current compliance.

So I think it's a winner.

MR. SHIRAKH: Any questions?

MR. RAYMER: Rob Raymer with CBIA.

Offers a path for future credits, but what about termites?

(Laughter.)

MR. WILCOX: The model -- the model strictly --

MR. RAYMER: Not the model, but the actual --

MR. WILCOX: The model strictly excludes termites. There won't be any termites -- won't be any termites in the house because of this model.

COMMISSIONER ROSENFELD: What's the problem?

MR. RAYMER: It's the pathway for termites.

MR. WILCOX: The builders evidently hate slab edge insulation because of the termite problems. It's difficult to keep the termites from using the slab edge insulation as a way to get in your house.

MR. RAYMER: The little void between the masonry and the insulation, if there's any void at all, it's a pathway for termites. After while you can have a boring through. Since the mid-eighties our industry has been afraid of using the product. You know, so I was kind of hoping maybe great advances had happened, and this is no longer a -- you know, I've seen stuff where, I mean, clearly gets bolted to that, but still --

MR. WILCOX: I mean, I think there's potential for great advances in the products. This isn't based on that. This is just based on trying to get the heat flow right. And I think this will improve the, you know -- it's a good step forward, because I think it's a better model, but I don't have anything positive to say about slab edge insulation in particular.

COMMISSIONER ROSENFELD: I'm sorry. Can you explain in a couple of words, it's just replacing dirt, isn't it? I mean, it's some inert plastic in the ground?

MR. HODGSON: No.

COMMISSIONER ROSENFELD: What do I not understand?

MR. WILCOX: The issue, Art, is that on a normal slab, you are obligated to keep the ground levels 6 inches below where the wood is on top of the slab, so you get 6 inches of bare concrete that the termites have to figure out how to cross that. And you can -- if they manage to build tubes or whatever, you can see them, right, and go after them.

But what the slab edge insulation does is it gives them a protected path. You can't see in. They can get in there. They can -- they're safe. There's no way, you know -- and so they, you know, can go into your house and get into the wall.

MR. GATES: The insulation extends above the ground.

COMMISSIONER ROSENFELD: Maybe a compromise between thermal and termites is to not have it go up that high, you'd still have the 6 inches.

MR. ELEY: It's not very effective.

COMMISSIONER ROSENFELD: Then you lose most of the effectiveness. Okay, I see.

MR. RAYMER: Is that a motion?

MR. WILCOX: It's a very difficult practical problem, I think.

MR. HODGSON: You can control termites in the log.

MR. RAYMER: Speaking in favor of termites.

(Laughter.)

MR. WARE: Okay. Dave Ware, Owens Corning. I do have a slab house, by the way, that was built in 1985 passive solar house in Auburn with slab edge insulation. No problems to date with the integrity of the slab on the outside. To my knowledge, I don't have any termites as well. Just as point of reference on that. That wasn't why I wanted to make the comment.

(Laughter.)

MR. WARE: The implication of what you have up there, Bruce, was that there's -- with the new model, a significant savings can be achieved with using slab edge. Now, you indicated that real ease of making that modeling change the current compliance ACMs, but you didn't say anything about the implications of those savings on mandatory measures or anything like that. Is there --

MR. WILCOX: That's right.

MR. WARE: You haven't gone there yet.

MR. WILCOX: I haven't gone there yet.

MR. WARE: You purposely have not gone there.

MR. WILCOX: I haven't.

MR. HODGSON: Not purposely.

(Laughter.)

MR. WILCOX: We already have a requirement for R-7 insulation in climate zone 16 so, you know, we've already got this issue.

MR. WARE: I know.

MR. SHIRAKH: Bruce Maeda.

MR. MAEDA: It is also our intent to use this in the non-residential area, as well hopefully. The big issue there is that's not -- writing that into it the new of DOE-2.1A, DOE is D-o-e.

MR. SHIRAKH: Charles Eley had some comments.

MR. ELEY: Can you go to that slide that had the coefficients.

Yeah, that one.

Yeah. Charles Eley with AEC. How do you divide up the perimeter -- if you've got 10 feet of perimeter, do you multiply that perimeter times the week number, the month number and the year number?

If so, why don't you just add them up and you have the same number -- or does certain depth go to the year, a certain depth to the week and --

MR. WILCOX: No. This is the model that's presented in Joe's paper. We actually -- in the implementation that we proposed and input in the ACM, we do add them up.

MR. ELEY: Then all we're doing is putting in new F-2 factors.

MR. WILCOX: No. No, but you still have 3 different temperatures, you see. That's the trick here is that there's an annual temperature that -- I mean, the stuff going straight down into the middle of the slab in a big building is assumed to be mostly going to this temperature that doesn't change and it's basically equal to outdoor annual temperature.

MR. ELEY: All right.

MR. WILCOX: And near the edge you're affected more by the seasonal stuff.

MR. ELEY: Okay. So what these represent are simply weightings of heat transfer to the week, the month and the year.

Okay. Now, what about the core? How do you define the area of the core?

MR. WILCOX: It's a very simple mathematical formula. The amount of core and the amount of perimeter of each slab is a function of if it's area and the perimeter length. And it's just a simple equation. I mean, the thinking is that the perimeter is a certain

width all the way around the edge.
MR. ELEY: How wide is it?
MR. NITTLER: Two feet.
MR. WILCOX: I don't remember what it he had in there.
MR. NITTLER: Two feet.
MR. ELEY: So the core is the area of the house minus the 2-foot perimeter.
MR. WILCOX: Yeah. So it's all very close. It's a closed form thing. You don't -- and I'm suggesting here that the user just puts in the perimeter and the area like they always have and the program just figures out all the other stuff.
MR. ELEY: Okay, I understand.
MR. MAEDA: It's kind of a based on a fixed geometry though. Bruce Maeda, CEC staff.
MR. WILCOX: Fixed geometry?
MR. MAEDA: Yeah. All you have is the ratio of the area and perimeter. You don't have a lot of detail other than that.
MR. WILCOX: Yeah. Well, it's a simplified model for sure.
Okay, any other questions?
MR. HODGSON: Just a quick comment. Mike Hodgson.

Bruce, you're coordinating some of this stuff with what Building America is doing on the slab edge model?

MR. WILCOX: Well --

MR. HODGSON: Could I recommend that you do that.

MR. WILCOX: I've been talking to Marc Hoeschele with Davis Energy Group who is the one who pushed this issue. And he's working on -- I don't know if his is Building America or not. And I know that Rob is interested in the subject and I haven't heard anything from him.

MR. HODGSON: Okay.

MR. PENNINGTON: So I think we're aware that Rob's interested in it, so we'd like to make that contact.

MR. HODGSON: And I think it's more than -- I think there's 3 or 4 of the 5 teams that are working on it. So there's a lot of information that's being generated and proposed, so I would just think that you could share the information.

MR. WILCOX: Yeah. I think one of the problems with that is that the Davis Energy Group seems to be -- you know, they're doing a 3-D ground loss model that's custom for every house. And it's kind of, you know, a research oriented different thing entirely, but we do need to talk to him.

MR. HODGSON: Yeah, I think they're trying to -- I think that's one side. And then they're trying to get into more practical implementation of F-2 factors type thing.

MR. WILCOX: Okay.

MR. SHIRAKH: We're going to move on to the last topic. And we're probably going to go past 3:30, which I indicated was our end time, but bear with us and we'll try to wrap it up as quickly as possible.

The last topic is Revisions to the Residential ACM Calculation for Indoor Air Quality and Ventilation.

(Thereupon an overhead presentation was Presented as follows.)

MR. WILCOX: This is also pretty quick.

The same thing we had before.

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MR. WILCOX: Okay, the current modeling ACM for indoor air quality is -- it's kind of a thing of its time. We currently assume that new houses with sealed ducts have a specific leakage area an SLA of 4.4, which is the -- it's the measure of the envelope airtightness. We assume the houses are pretty loose.

And then we calculate infiltration in the ACM models for both energy purposes, but then we keep track of the infiltration rate in the models hourly. And if the infiltration rate falls below a criteria that I believe was set at .35 air changes per hour, then we assume that the occupants open the windows to get more ventilation, that they sense that there's not enough ventilation and they open the windows.

The amount of time that this occupant intervention happens depends on how tight the house is. The tighter the house is, the more often it happens. It also depends on the climate zone. You don't get much of this IAQ window opening in houses with default leakage areas. I mean the default is loose enough so it rarely happens.

There's also a whole set of models for mechanical ventilation in the ACM all set up to do mechanical IAQ ventilation stuff, that's been in there since the '98 standards, that's very rarely used, I think.

So this is the background.

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MR. WILCOX: All right. So there's going to be a proposal. It hasn't been presented yet, but there's going to be a proposal for mechanical ventilation. And we've talked about it, so most of you guys know about this already, I think. We've talked about it in several venues before. It's an implementation of ASHRAE standard 62.2 disallowing the window ventilation option.

The default is going to be a continuous exhaust fan. The proposal will probably end up being a ventilation rate that's in Standard 62.2, which is .01 CFM per square foot of floor area plus 7 and a half times the number of bedrooms plus one, which is just a modest amount of ventilation. For example, in the 1,761 prototype that's 48 CFM. So we're talking about --

MR. ELEY: There's a parentheses around the bed rooms plus one.

MR. WILCOX: Yeah. It's not 1 CFM. It's one bedroom.

And then there's an energy consumption issue here, so we're proposing that the default CFM is going to be .25, which is the kind Of thing you get with a good high quality low noise bath fan, like a Panasonic bathroom exhaust fan.

Okay. So this proposal is going to happen. The issue today is really what do we about this in the ACM modeling?

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MR. WILCOX: And the ACM model proposal is that we simply implement a model that does this. And it's pretty simple to do. And so we're proposing to turn -- to use the existing mechanical ventilation capability that's in the model and run it at the specified CFM rate.

And I use the default watts for CFM. And we turn off the window opening, so that that's not happening anymore. And, voila, we're in the new world.

And so we've done -- we've implemented this in the prototypical version of Micropas that were testing all this stuff in.

--o0o--

MR. WILCOX: Let's see somehow something got missed. Oh, I managed to bop past this slide, which is the other proposed change, is that, as I said earlier, the current proposed specific leakage area is 4.4 with sealed ducts. That was actually based on a study that I did of houses that were built between 1984 and 1987 in California, which is some time ago.

And I think there's a fair amount of, at least, anecdotal evidence that houses are getting tighter since then. For example, there was a -- the RCQ, Residential Construction Quality, Study that PIER supported that we used a lot in the 2005 standards process, there were 2 samples of houses there that had average SLAs of 3.2 and 3.5. Those were groups of houses that were participants in utility incentive programs, so they were supposedly better than code minimum houses, but their specifically leak traits were pretty low.

And A.L. Wilson also came and made a presentation at one of our PAC meetings of a study that he'd done in 2002, they measured 76 gas heated homes in southern California for the gas company. And the average SLA of those houses was 2.8, which is, you know, significantly lower than the 4.4 number we're using.

MR. RAYMER: Those were new homes built in 2002.

MR. WILCOX: Yes, new houses built in 2002. And, in fact, Wilson was very adamant that he thinks that things have radically changed and something needs to be done about the problem, because this was much tighter than the homes he'd measured previously that he did.

Okay, so the proposal here is as far as this IAQ ventilation proposal is that we assume that the default SLA is reduced down to 3.8 from its current 4.4. 3.8 is kind of -- what we're looking here for is kind of a -- you know, it's an Energy Commission default. It's kind a worst case high end number, because it's the one you get if you don't measure anything. And its big impact is on energy use for heating.

And so the assumption here is that we'll end up with a -- that if you did do testing or put in air barriers and do the kind of things that Mike is getting all builders in his program to do, that they -- that that number could get a lot lower.

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MR. WILCOX: So we have that plus the mechanical ventilation a turning off the windows. And you put that all together and this is the result of -- what this is showing is TDV per square foot totals for the house, including everything and the -- so we're adding to -- with this new -- the blue bars again are the 2005 ACM and the magenta bars show the new model. And the differences are that we've added the fan, which is increasing the infiltration or ventilation rate on a constant basis by running 48 CFM continuously. There's the energy use for running the fan continuously 87 times 60 hours.

And it's kind of a trade-off having the reduced leakage area reduces the heating and cooling loads when the Delta Ts are big and under peak conditions.

So the end result of that combination is that the energy use goes up about 1 percent on a statewide basis. And that's the proposed default case for implementing this IAQ ventilation.

MR. RAYMER: Bruce.

MR. WILCOX: Yes.

MR. RAYMER: Bob Raymer of CBIC.

Proposing a change to the standards that would increase energy consumption in the home overall?

MR. WILCOX: Hardly any.

MR. RAYMER: Hardly any. But it is a small increase?

MR. WILCOX: That's right.

MR. RAYMER: And this is done for indoor air quality purposes?

MR. WILCOX: That's right. This is done to solve your problems with mold, mildew and all those lawsuits over people dying in your houses.

(Laughter.)

MR. RAYMER: Where did Bill go?

MR. SHIRAKH: He's had some meeting with the Commissioners, so he had to go.

MR. ELEY: I have a question. Charles Eley with AEC.

Do you worry about where the air comes from? I mean, you have an exhaust. Is it just assuming it leaks in through this 3.8 SLA?

MR. WILCOX: That's right. If you assume that a house is -- well has an SLA of 3.8, then there's no problem getting enough air in. If you get down to, you know, a half or a third of that in the leakage area, then you might have to start worrying about having enough -- having, you know, holes for the air to get in. But there's not an issue with typical California houses.

And what you're really doing is you're providing a floor for the natural infiltration, and making sure it happens all the time. And if you look at the -- from my point of view, if you look at the data on the ventilation rates in the houses, the time when you really need this system is when it's very mild weather outside. The wind -- it's calm, and there's almost no Delta T, and people don't have their windows open, because the air conditioner is not running.

MR. RAYMER: We're talking about one bathroom fan here.

MR. WILCOX: One bathroom fan.

MR. SHIRAKH: Mike.

MR. HODGSON: A couple questions. One is you said that this kind of mimics ASHRAE 62.2, but it doesn't match the recommended ventilation rate of ASHRAE 62.2.

MR. WILCOX: Yeah, it does.

MR. HODGSON: Does it?

MR. WILCOX: Yeah.

MR. HODGSON: Because I thought the minimum that you came up with ASHRAE 62.2 was 75 CFM?

MR. WILCOX: Max's proposal that you've seen before -- Max Sherman has worked on this worked the most. Max's proposal was that we ought to take the 62.2 continuous ventilation rate and add something to that to allow for people to turn off the ventilation periodically, like in the afternoons in southern California when there are ozone alerts and you're supposed to stay in the house and not ventilate.

And so he figured out that if you were to turn the ventilation off for 4 hours every day, then you needed to have a larger fan, and he estimated how much bigger he thought it should be. And that's what he was recommending for a rate. That was the 75 CFM in the same house.

And so we've been going around and around about this. Some people think it's a problem if you increase the energy use of the house. So some people are sensitive to that. And so rather than doing something that was essentially a larger ventilation rate than 62.2 required, this proposal says okay, we're just going to do what the 62.2 standard requires.

MR. HODGSON: As kind of a follow-up, Mazi. I understand trying to get the modeling assumptions more accurate, which is really what this workshop's about.

MR. WILCOX: That's right.

MR. HODGSON: And the authority that the Commission has to do that. But in that is a ventilation requirement, which has a negative energy implication. And I don't see the authority that the Energy Commission has to regulate ventilation indoor air quality.

MR. RAYMER: ACD has that authority.

MR. HODGSON: Hang on. So does the CEC propose that they're going to now regulate indoor air quality? And if so, do they have that legal authority to do so?

MR. RAYMER: Yeah, Bruce.

(Laughter.)

MR. WILCOX: My model doesn't have anything to do with that. I don't answer the question, so I don't know. Somebody -- we're not actually proposing the requirement here. This is the model that would handle the situation.

MR. HODGSON: One in the same.

MR. WILCOX: Yeah. Well -- okay.

MR. SHIRAKH: Well, I'll raise that question with Bill.

MR. MAEDA: Typically -- well, I mean, the reason why we've got into ventilation at all was because we had a lot of complaints from -- there was a lot of lobbying activity going on in the early eighties to get involved and we did so reluctantly, but we also want to make sure that we don't have any negative environmental impacts. So anything we propose is basically mitigation on the environmental impacts of the standards. That's why it comes in.

MR. RAYMER: Bob Raymer with CBIA. If you look at the EIRs that you do with many of the 1980 and '90 updates, when you address the issue of indoor air quality, the Energy Commission had a pretty patented response, to the best of our research and knowledge, we know of no negative indoor air quality impact being created by the standard. So that's been your, time after time, the response from the Energy Commission on this issue.

Here you're taking the -- you may be taking a step at the IAQ issue, which actually has, albeit very small, a negative efficiency impact.

MR. SHIRAKH: I think the reason for that is that, as Bruce mentioned, the houses are getting tighter, so the SLA is getting smaller. That you may actually be creating a situation that could be hazardous to people's health, and we're trying to address that.

MR. MAEDA: On the residential side -- well, on the non-residential side, we've had ventilation rates associated with the non-residential side specifically, from the mechanical situations. The residential side our -- we have relied in the past upon both ASHRAE 62 allowances for natural ventilation and our belief that that was adequate.

The research that was done on the surveys indicates, especially in winter times when people aren't operating their windows, so there are definitely periods of time when the ventilation from windows is not adequate. So that's -- I mean, again it's a mitigation measure rather than a specific one.

MR. SHIRAKH: In the 2005 standards we introduced demand control ventilation in the non-residential specifically for those purposes. So there is some precedence in the standards for indoor air quality.

MR. RAYMER: But by taking this measure, are we saying that a compliance with existing standards today and -- from like 1998 on, creating an unhealthy situation. Whereas, compliance with 2008 will mitigate that unhealthy environment created by compliance standards?

I'm thinking how would a lawyer look at this.

MR. MAEDA: It's leading in that direction.

MR. RAYMER: Yeah, it sure is.

MR. WILCOX: Yeah, personally, I'm a member of the 62.2 Committee and I'm the Chair of the Committee that sets the ventilation rates. So I'm --

MR. RAYMER: You're a popular guy.

(Laughter.)

MR. WILCOX: I'm pretty committed to the idea that ventilation is a good thing. So just in case you were wondering.

MR. GATES: Steve Gates with Hirsch & Associates. I've got a series of questions that are all related to each other, which really kind of centers around what indoor contaminants are perceived as a problem in residential buildings. For example, this proposal mentions, you know, there's one factor per square foot, then there's another factor per number of bedrooms. I would assume the number of bedrooms implies the number of people in the house?

MR. WILCOX: Yes.

MR. GATES: So the CO2 is an issue in -- I mean, has there ever been any measurements in terms of CO2 levels in houses indicating that that's a problem?

MR. WILCOX: The issue is not CO2, but the thinking is that there are 2 activities -- or there are 2 things going on in houses, 2 mechanisms that generate indoor air quality problem for pollutants. And one of those is the stuff that's emitted by the materials that are used to build a house. And there's lots of evidence that there's chemicals of all kinds. There's a -- I think you can --

MR. RAYMER: Environmental tobacco smoke.

MR. WILCOX: What?

MR. RAYMER: Environmental tobacco smoke.

MR. WILCOX: There's that too. And then there's the stuff -- on the second hand is the stuff that people generate by their activities. We never -- actually, we never mentioned tobacco smoke as being a pollutant.

MR. HODGSON: No.

MR. RAYMER: They all smoked.

MR. WILCOX: It's now legally a pollutant in California, so maybe we can talk about it here. So there's that, and there's, you know, people polishing their finger nails and doing all the stuff that people do that releases pollutants.

MR. GATES: Are there any issues in California with radon?

MR. WILCOX: Yes, there are, but did not -- they're not huge.

MR. RAYMER: Little areas.

MR. WILCOX: There's a couple of areas, but this is not designed to -- this will not mitigate radon, this kind of ventilation. This is not the way to mitigate radon.

MR. GATES: Okay. The other observation in terms of maybe something to address as part of this, my observation of looking at houses constructed in the last 5 years or so is that gas stoves are becoming more and more popular.

Now, technically whenever you turn on a gas stove, you're also supposed to turn on the vent fan on the hood over the stove. My observation of that is that people almost never do that, because the vent fans are noisy and no one wants to sit there and cook and have this fan just buzzing away for an hour while they're cooking.

MR. WILCOX: Well, you'll be very happy with this proposal, which is going to require quiet -- somewhat quite vent fans.

MR. GATES: Yeah. Well, but basically what I'm driving at here is my understanding is is that houses that have -- you know well sealed houses with a gas stove that's not actually ventilated may have levels of NOx as well as carbon monoxide that exceed EPA levels allowed for outdoor usage.

So as part of this ventilation standard, you know, should gas stoves be addressed in one form or another and perhaps if you're going to do this type of ventilation, should the ventilation actually be built into the range hood, so that regardless of whether you have the vent fan on or not, you're at least pulling out the most concentrated source of potential pollutants in the house.

MR. WILCOX: I think that it's -- I mean my response to that is that certainly cooking is a big source of pollutants, whether it's gas stove or electric stove. Gas burning is certainly an issue inside tight envelopes, but those are not by any means the only things that are a problem.

I think you can make the case -- Max wrote a paper last year -- Max Sherman wrote a paper last year making a case for these kind of levels of ventilation based strictly on formaldehyde emissions from the furnishings in the new house. And I think you can make that case -- and formaldehyde is a recognized pollutant and so forth.

So it's a whole combination of things. The real bottom line is that we don't really know what the pollutants are. I mean --

MR. RAYMER: And the synergistic effect of all those pollutants.

MR. MAEDA: Excuse me?

MR. WILCOX: It might be the stuff that's in vinyl flooring.

MR. MAEDA: Bruce, we do have ongoing research, as a follow-up to the survey. I mentioned about the window operation, there's a field study of actual homes. And we'll be doing IAQ tests in the homes on certain specific pollutants. According to the ARB indeed cooking is a major issue and concern about. There is some possibility of actually direct venting of the oven compartment of the -- stoves rather than just on top of the hood. There's also a hood fan criteria.

MR. WILCOX: The ARB has an ongoing study right now that they're going to be measuring -- doing very detailed measurements of pollutant levels in 100 new houses in California. So they're trying to get at some of those issues, but that's not going to be done for 2, 3 years.

MR. GATES: When I built my house I actually went with a vent hood with a remote blower, especially so that I can induce my wife around the fan when -- she's the major cook and I'm her assistant, but she never wanted to turn on the vent fan. I pretty much solved that problem. But, you know, the observation here basically is if you're concerned about these various pollutants and you know that one of the single biggest points sources of pollutants in the home is the stove, or the oven, does it make sense to do the exhaust there to try to directly capture those as much as possible, and the other stuff also goes out as well.

MR. WILCOX: Well --

MR. MAEDA: A little anecdote. Every time I grill a steak, I set off the smoke alarm.

MR. SHIRAKH: I saw a hand there. Is that John Proctor?

MR. PROCTOR: Never mind.

MR. SHIRAKH: Any other questions on this topic?

Seeing none, I'm going to close the workshop for today. We're going to have at least one more staff workshop, emphasis on at least. And the next one is currently scheduled for some time in early May, and that will include topics for both residential and non-residential. It's going to be a substantial workshop actually. And perhaps we'll have one after that, depending on how the workshop goes. So stay tuned, the fun continues.

So with that, have a nice day and --

MR. WILCOX: Thank you all for coming and for your comments.

(Thereupon the California Energy Commission workshop on Building Energy Efficiency Standards for 2008 adjourned at 3:40 p.m.)

CERTIFICATE OF REPORTER

I, JAMES F. PETERS, a Certified Shorthand Reporter of the State of California, and Registered Professional Reporter, do hereby certify:

That I am a disinterested person herein; that the foregoing California Energy Commission workshop was reported in shorthand by me, James F. Peters, a Certified Shorthand Reporter of the State of California, and thereafter transcribed into typewriting.

I further certify that I am not of counsel or attorney for any of the parties to said workshop nor in any way interested in the outcome of said workshop.

IN WITNESS WHEREOF, I have hereunto set my hand this 10th day of April, 2006.

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