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STATE of CALIFORNIA

STATE ENERGY RESOURCES CONSERVATION and

DEVELOPMENT COMMISSION

In the matter of:	Docket No. 19-BSTD-03
2022 Energy Code Pre-Rulemaking	STAFF WEBINAR
	RE: 2022 Energy Code Compliance Metrics

WORKSHOP to PRESENT and DISCUSS
the UPDATE to the CODE COMPLIANCE METRICS
for the 2022 BUILDING ENERGY EFFICIENCY STANDARDS

Held via WebEx and Telephone

from the
California Energy Commission
Warren-Alquist State Energy Building
1516 Ninth Street
Sacramento, California 95814

Thursday, March 26, 2020

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Public Commenters:

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I N D E X

P R O C E E D I N G S

MARCH 26, 2020 9:00 a.m.

THE MODERATOR: So I just wanted to --

MR. SHIRAKH: Okay, --

THE MODERATOR: -- use the pending -- go ahead, Mazi.

MR. SHIRAKH: Yeah, why don't you start making -- making your announcements and then I'll take over.

THE MODERATOR: Okay. So bear with us. If we have any issues, it's our first fully online workshop we've done, so we might be overloaded with chat and Q&A through the WebEx. So bear with us. We will answer your questions as soon as we can, but if you do have any questions just use the chat feature and send it to the host.

And also if you have questions during the question and comment period, just use the raise-your-hand feature. And then I will unmute you in order, probably alphabetical order I guess, and I'll unmute you. And just state your name and affiliation, and your comment. And the hand raised and Q& -- or hand raised and chatroom will be our means to communicate.

And if you have any technical issues, use the chat as well and we can try and get those worked out.

MR. SHIRAKH: Fritz just sent me an email and says his password is not working. Can somebody help him?

THE MODERATOR: Yeah, I'll send an email.

MR. SHIRAKH: Can -- can the public hear me now or is it just us?

THE MODERATOR: Yeah, everyone can hear us. They've been able to hear us.

MR. SHIRAKH: Can you see the agenda that I have? Shall we start?

THE MODERATOR: Yeah. Whenever you're ready, Mazi.

MR. SHIRAKH: Okay. Good morning. This is Mazi Shirakh and I'm Project Manager for the Commission's Building Decarbonization effort.

Back in October of 2019, we had a workshop where we presented the results of our TDV analysis and updates for natural gas and electricity and other components and various other plug-ins into the TDVs. We received extensive comments. And we made some additional changes to the TDVs for both natural gas and electricity, which we're going to be presenting today. This is -- today's workshop is largely about the updates since the October workshop. We will not be revisiting topics that were presented and were noncontroversial at the time.

So what you see here --

THE MODERATOR: You're not showing your PowerPoint. You're just showing the agenda --

MR. SHIRAKH: I'm showing the agenda then.

THE MODERATOR: Okay. Yeah, just wanted to make sure you knew.

MR. SHIRAKH: Yeah. And so this is the agenda for the day. And, again, the times will vary. I mean we're going to run probably past 12:00 noon, and that depends on the public comments that we'll get. But, you know, we'll try to do the best that we can and finish as soon as we could.

So after my introductory remarks and a brief presentation, E3 will show the lifecycle, cost, and methodology; the metrics that they have used; and any optics that they have incorporated since last time.

I will encourage a brief comment period after each presentation before we go to the next presenter. And then we will also have a public commenting at the end. But when you go after the presenter, please limit your comments only to the -- related to the presentation that you just saw. The broader topics would have to wait until 11:30 p.m.

After E3, Bruce Wilcox will present the impact of these new changes on residential measures. Then NORESCO will show the impact on nonresidential measures. Then we'll have public comments and then we'll adjourn.

I have a brief presentation. Can you guys see that?

THE MODERATOR: Yeah, it looks good.

MR. SHIRAKH: Hello? Okay.

THE MODERATOR: Yeah, Mazi, that looks good.

MR. SHIRAKH: So this is the workshop agenda. Again, you know, I just presented it.

A little bit of background. The recently-adopted 2019 standards. That was the last code cycle that was primarily focused on ZNE goals. The upcoming 2022 workshop and other subsequent cycles will be having building decarbonization as the primary goal. So that's an ambitious goal and it requires us to come up with new tools, metrics, and methodologies. And we spent the better part of last year and year and a half to develop these tools, which were presented during the October workshop. And the optics will be presented today.

Then these new tools will have consequences. So, you know, the effort here is to basically have the public understand what are the implications of coming with these new tools and metrics. And that's what largely today's workshop is dedicated to.

We have ambitious goals. You know we must support building decarbonization while at the same time support the resilient building envelope and shell, at the same time we want to maintain strong demand response signals. All three goals at the same time, so that's where we actually spend most of our time: Trying to come up with a tool that will do all three.

Also we updated the weather files, reflecting the planet's warming trends. And these were represented back in October and now they're both -- incorporated in both CBECC-Rex and CBECC-Com.

So during the October workshop we introduced the weather files, as I mentioned, and they're already incorporated. They will not be revisited today.

We introduced/updated lifecycle costing methodology, the new TDVs for natural gas and electricity, updated for 2020, all the various components that go into TDVs have been updated. And we didn't receive extensive comments on both the natural gas and electric TDVs, and some of these comments will be addressed today.

A major change for this cycle is introduction of a new source energy metric, which is designed to align buildings with our decarbonization policies. And this was extensively covered at the October workshop, so today's workshop will not be revisiting this. But I'll be happy to answer any questions that might arise. I do have my October's presentation ready and I can go back to it if we need to.

We also introduced a new 2EDR approach. The 2019 standards relied on Energy Design Grading, or EDR, which had two components. That was the Efficiency EDR and then we had another EDR that captured the impacts of PVs, battery storage, and demand flexibility. And then the final EDR. So we call the 2019 EDRs collectively as the EDR2. We introduced an EDR1, which is the source metric, the source energy metric. And the two EDRs must work together. And I think E3 has some slides that has a recap of how these two work together.

And up to the TDV that we're going to be discussing today, for natural gas we have updated it to include the impacts of methane leakage associated with the buildings. So essentially what happens, if a mixed-fuel building is switched to an all-electric building, how much methane leakage or reduction will we have. So that's what this metric is all about, and E3 will present that.

The same thing on the electric side. There is a component in the electric TDV which is called the retail adder, and that has historically been flat. During the October workshop, we received extensive comment on why should this be flat, why shouldn't be some other shapes. You know we actually did look at that and see how it impacts energy-efficiency measures, like envelope measures, high-performance attics/walls/windows, better equipment efficiencies. But we are also going to be interested in knowing how this impacts photovoltaics and battery-storage systems and demand response. And so that's what we're going to be presenting today.

One other parameter that we have looked at but we're not ready to present today is the impact of the global warming potential, or GWP impacts of refrigerants on electric TDVs. E3 will present a brief discussion about that, but today we're not ready to show you the results. This will have a significant impact on fuel-switching measures.

The last slide, you know even though ZNE was not primarily focused at reducing CO2 from the buildings, but by virtue of encouraging energy efficiency and renewables, it actually did a fairly decent job of reducing carbon emissions from the homes. And if you can see my cursor, you know existing homes on the grid today that emit about six and a half metric ton of CO2. With the 2019 standards, with the standard design, this is a mixed-fuel home, the standard design PV system, we can reduce that to a 2.3. A very significant drop.

If you include battery storage, we can drop that further to 2.1. But the biggest savings comes when we switch to all electric. As you can see here, depending on which scenario, whether you have battery or not or whether you have a little larger PV system, we can actually bring this very close to zero.

What ZNE does not do is encourage electrification, switching from natural gas to electricity. And that's what this decarbonization effort is all about.

So that is my last slide. We're ready to move to E3 unless there is a question on what I just presented.

If not, why don't we switch to E3.

THE MODERATOR: Let me check the hands real fast.

I don't see anyone with their hands raised. If I missed anyone...

[IT STAFF]: RJ, there is a question from Ted Tiffany.

THE MODERATOR: I've unmuted your mic. Go ahead and make your question.

MR. TIFFANY: Yeah.

THE MODERATOR: Yeah, you can just state your name and affiliation.

MR. TIFFANY: Yeah. Ted Tiffany, Guttmann & Blaevoet Consulting Engineers.

Mazi, I just wanted to ask if the 2EDR approach is going to apply to nonresidential as you presented it for residential.

MR. SHIRAKH: We think so. We haven't developed the tools for it, but that is our intention.

MR. TIFFANY: Okay, great. Thank you. I appreciate it, sir.

THE MODERATOR: So I don't see any other hands raised. I see some Q&A, but if those people would like to make a public comment, just raise your hand and I'll unmute you. Otherwise we'll move onto E3.

All right, Mike, I'm going to make you the presenter.

MR. SONTAG: Can you guys see my 3 okay?

THE MODERATOR: Yes, yes. R1. You're not in slide 3 yet, so just go to the slideshow and then we'll see the full stream.

MR. SONTAG: Can you see the slideshow now?

THE MODERATOR: Yeah, yeah. Looks good.

MR. SONTAG: Great. Good morning, everybody. My name is Mike Sontag. I'm a senior consultant at E3. I appreciate the opportunity to get to present to you all today about the tweaks we've made to the 2022 TDV workshop. It might be said the main things we're going to talk about today are: The sensitivity around the retail rate adjustment and the electricity TDV and Mazi talked about incorporating methane leakage and natural gas TDV. Lastly, I will talk about the progress we've made on refrigerants and kind of what we have left to do today, get that totally incorporated.

So starting out with the retail rate adjustment. I appreciated reading all the comments on this from the previous workshop. And I wanted to start this off just to provide some background, figure out the couple of, you know, misconceptions around the retail rate adjustment, what it is, what it's trying to do, and the signal it's trying to send.

So, first, what is the retail rate adjustment. So this component is included to build TDV as to the cost estimate from the perspective of the building owner. It closes the gap between utility marginal costs, which are volumetric, and retail rates forecast, which are also volumetric. This is kind of a what-does-it-cost test, to make an analogy to the standard practice manual achieved by the Public Utilities Commission.

So the retail rate adjustment component represents the fixed costs that are required to operate a utility. You know this is all the things like the, you know, infrastructure, meters, poles, you know all that is kind of a function of being connected to the grid. It is not as much the energy used.

The next question is: Does a flat retail rate adjustment mean it is a fixed charge? In our case, no, it is not a fixed charge. While this component doesn't vary between hours, it is applied in a volumetric basis. So that would be, you know, dollars per kilowatt hour, dollars per Btu. You know, as your consumption increases or decreases, the amount of that cost component would scale as well.

Then does it reflect in your typical retail rate structure, that you recover these fixed costs largely on volumetric basis, so, you know, the utility bills. And we see, you know, fixed costs are baked into the dollars per kilowatt hour that we pay. If it were presented as a fixed charge, you'd see it as like a monthly meter charge, or something of the sort, which are fairly minimal in today's retail rates.

Lastly: Why has the retail rate historically been flat? This is in TDV, so this spreads the volumetric cost recovery for the utility fixed costs across all hours evenly. You know, again, similar to how retail rates are designed, retail rates are currently designed. You know, with the retail rates that we see, you know, even hours where the marginal costs of electricity is zero, even negative, the retail rates are still recovering costs, fixed costs based on volumetric consumption. So even seen the wholesale electricity prices on the grid go below zero, you know the retail rates to consumers that the -- you know, still have a positive charge. And this is, again, to, you know, recover costs for all the fixed charge -- fixed costs for a utility.

Taking a step back as well just on what TDV is trying to represent as far as util- -- retail rates go, you know again TDV is meant to represent this prohibitive cost test, so to keep the cross -- customer bill intact. You know, it is forecasted over a 30-year time horizon and just to, you know, talk about kind of the uncertainty in retail rate design that happens between today and 30 years from now. You know we do the best we can to represent the customer bill impact, realizing there is a lot of uncertainty, we, you know, are generalizing this to, you know, avoid getting into a discussion on retail rate design.

We acknowledge that, you know, retail rates vary pretty significantly between utilities. You know there's over 40 utilities in California with their own retail rate design. These, you know, change every year. Trying to do all of these each perfectly, it would be very difficult. See you have an example of, you know, what all factors go into these and how this might be difficult to forecast out.

For the section here with Bonbright's principles of public utilities rates over on the right, you know, these are all kind of just designed principles that go into, you know, effective retail rate design. You know, particularly I wanted to call out number 3, you know encourage efficient use is kind of what some had a lot of TDV in finding, you know, good price signals that encourage efficiency.

So, you know, with all this said, since we're not trying to predict retail rate design, you know we are trying to generalize this, TDV is just a forecast, you know, the combination between utilities, the marginal cost of service, and the utility recovery system fixed costs. We think that this generalization helps create a stable signal for retail rates and, you know, is able to be generalized across the state.

Going on, I also wanted to kind of unpack this chart that we've historically shown in TDV reports. So this annual average is what has been typically seen through what we've presented in the fall workshop. I wanted to highlight that, you know, there is increased variability that this chart doesn't necessarily show. These are, you know, annual average values in the chart in the lower left.

So for, you know, noon, in this chart that's the average of all noon during the entire year. There is much greater variability than what is seen in this. You know TDV is a hourly metric. There are, you know, 8760 unit values. These vary by week, temperature, season, system load, you know, many factors. You go onto climate zone.

This gives a sense of the change in, you know, hourly variability. I focus on, you know, the June-through-September average, which is what we kind of see defined as the summer season in a lot of retail rates these days. And then also October to May. We do see in this that June to September, where we have more of our transmission and distribution charges. There is more variability here.

We also thought it would be helpful to benchmark this as an existing retail rate. This is comparing Climate Zone 12 from TDV to PG&E's current Btu/UV retail rate. We see, you know, in the winter that we do have a little bit of greater variability. This also does capture the spring months that we have the depth curve, and so, you know, again to stress that there are, you know, other signals that are kind of of buried in these averages here.

You know comparing this on the rates, looking at the summer retail rates versus TDV, we see that we do find on average, you know, greater variability, so lower charges during the day and higher charges in the evening, you know, particularly the difference between the max and the min on these I think is important to call out. And, you know, again to stress that this is the average TDV values. So on a given day it could be much more variable, it could be much less. It depends on what other -- you know, what was happening on the grid.

And here we do think kind of the way this is, is we do get a strong signal for load shifting out of this.

Image for full transparency. I want to show how this compares to other IOUs. You know, again, we realize there's many other utilities in the state, you know I don't want to disparage by not including them, just to give a sample of kind of what retail rates are out in the world in California and how they compare to the TDV signal. I mean these don't quite match up as cleanly as the PG&E example I used but, you know, again we are seeing a good amount of variability in the TDVs to date.

So onto the sensitivity analysis on scaling. This retail rate adjustment is the light blue down here, to the ability of the system cost of service, so the costs vary by hour. You know, doing this will enhance the value of TDV storage and load shifting. You know the balance on that is that, you know, we looked to how it might diminish the signal for energy efficiency for photovoltaics.

So the option we're proposing here is 15 percent of the retail rate estimate and scales that to the hourly utility system costs, so, you know, basically everything above the light blue section gets, you know, is what is being scaled to. So in the October-to-May average we have a slight increase in the hours where the kind we have in the evening peak in the spring; going over to the summer, the hours where we have the transition and distribution piece, we see larger scaling.

And, again, the 15 percent was collected based on a sensitivity analysis looking at a number of different ways to scale this, and we found this was, you know, more balanced than other options. I think from an economics perspective, we're just -- you know, a pure -- a pure economics perspective, there isn't, you know, a strong justification for feeling that -- you know, that hourly variability for that utility system cost does show up in other metrics, but you're just looking at providing other signals for energy storage and load shifting.

Again flipping over to the same I showed before except with the 15-percent scaled retail rate adjustment, we do see that, you know, again that increases the hourly variation by, you know, to some extent. We'll see in the following presentations the impact that this has on various measures, so.

So those -- that's all the information on the retail rate adjustment. And, again, the original will show what impacts this has on building design.

So flipping over to methane leakage emissions now. The two sensitivities we're going to look at in the following presentations are without the impact to methane leakage. This is how results were presented in the last workshop. Then we'll look at TDV with methane leakage. The methane leakage is included in the emissions cost component. That's a natural gas TDV.

So just to take care of what has changed since the last workshop, this slide shows the retail gas carbon intensity over time as was incorporated in the previous workshop. As a reminder, we see in this, you know, due to the scenario that was projected in our PATHWAYS scenario out of renewable natural gas that between sales biogas, hydrogen injection, synthetic natural gas, the carbon intensity when you combust, you know, the amount of natural gas corresponds with, you know, tons of carbon dioxide equivalent. This decreases over time as we assume the percentage of renewable natural gas increases.

If we include methane leakage on top of this, it increases it by some amount. You know, again, .7 percent was the leakage rate that was selected for this code cycle. When you convert that to -- you know, compare it on a per PT or a per therm basis, it increases the emissions intensity of the, you know, retail to natural gas by about six and a half percent.

Just to give you an idea of how big of an impact this makes, you know, the emissions related cost and gas make up about a quarter of the annual natural gas TDV. So, you know, six and a half percent of 25 percent yields about an increase of two to three percent.

The total signal. Just for posterity sake, yeah, the biogas leakage is included. You know, the biogas leakage from the natural gas distribution system is considered. You know, since biogas is a fairly small portion, I guess it has a minimal impact overall.

And then, lastly, to discuss about refrigerant leakage emissions. So the framework for this, for incorporating it into TDV is still under development. We think that including this as a noncombustion emission sort is important, along with methane leakage, to get a full picture of the climate impacts of our building design decision. We think that this allows, you know, a holistic comparison of total carbon dioxide, the equivalent emissions between all-electric and mixed-fuel buildings. And, more importantly, what I'm most excited about is that it, you know, begins to send in an incentivization signal to use lower equivalent potential refrigerant.

I think there has been a lot of, you know, interest and focus in that recently, which I'm really excited to see. So even some of the technologies that are already starting to pop out are things like carbon dioxide, heat pump water heaters, you know, those other just local warming potential refrigerants that are under development by many technology companies and, you know, I'd be excited to see it get credit because of the cloud benefits that they have in building zones.

So, you know, kind of open eyes that still could be determined how we might create -- balance the trade-off of the refrigerant choice with -- for, you know, with other energy characteristics of the building standards. As Mazi mentioned, you know due to the really significant global warming potential for some of these refrigerants, it does make a pretty big impact on the overall TDV score. So just seeing how that might be a balance with your building shell measures. They're, you know, under the flexibility of things of this sort.

There is a, you know, question so if there is a stable enough parking for this to be included to -- you know, and a significant extent in TDV, and then also making sure that there aren't any, you know, redundant pathways to incentivize global warming potential with refrigerants, you know, through things like actions the Air Resources Board might take or through the recent Senate Bill 1477, the same as creating the build and tech program. So incentivize teapots (phonetic).

Getting into the weeds a little bit on how this is actually incorporated into TDV or may be incorporated, there is a really active -- really comprehensive database from the Air Resources Board that lets -- you know, for many different applications and equipment that -- what the, you know, typical refrigerants are. What the average annual leakage is and what the end-of-life leakage is.

Tapping into this, you know, along with making some assumptions about total refrigerant charge, we're able to get the -- you know, the equivalency of two emissions of certain refrigerant choice. We can apply those to the -- you know, economy wide of abatement costs for GHG emission and then get a TDV score based off of that. You know, any design decisions would be compared to baseline refrigerant leakage, so in the all-electric building you'd be comparing the refrigerant leakage to a mixed-fuel building.

You know many mixed-fuel buildings that already have air conditioning in them, so by collecting the epump for space heat and space cooling, you know, the total change in, you know, refrigerant-based, climate-impact might be pretty small because of the change in refrigerant knowledge.

That's everything I had on refrigerant leakage and where we are with that. With that, I will open up the floor for comments. And if there are no comments, we can transition over to reasonable costs.

THE MODERATOR: So I don't -- oh, I see a hand raised from Pierre.

You now -- go ahead, Pierre.

Pierre.

MR. DELFORGE: Good morning. Can you --

THE MODERATOR: Pierre? Yeah, we can hear you. Yeah, just state your name and the affiliation, please. Thank you.

MR. DELFORGE: Yes. Sorry. It took me some moments to unmute myself. So Pierre Delforge with the Natural Resources Defense Council. A couple of comments and questions. But first, you know, thank you for presenting this result following up on the last workshop.

So a couple things. First, I would like to ask why, I was just looking at a 15-percent scaled retail rate at an activity, which is still pretty minor compared to, you know, the -- the more extreme alternative would be a hundred percent, so, you know, did you look at a 30-percent or 50-percent sensitivity and is there a reason why we're only, you know, considering 15 percent today? And, you know, we'll see the results in Bruce's presentation, but I'm curious about that.

The second point I'd like to make is that the -- relative to methane leakage, the assumptions seem to be pretty conservative on these. You know, only looking at a 100-year global warming potential instead of 20-year. And I know we all know that we don't have a hundred years to mitigate the climate crisis, so there are tipping points which are just a few years away and that we need to reduce emissions, you know, right now. So a hundred years doesn't seem to reflect the urgency of the situation, and I would encourage the Commission to look at 20 years instead, which would make the impact of methane much more significant.

The second assumption which seems to be very conservative is only looking at behind-the-meter leakage. That's a fairly minor share of the impact of methane leakage. Most of the impact comes from upstream, particularly out of state, you know, from well to processing to distribution. And I would like to point out that we count out-of-state emissions for the electricity sector where, you know, a lot of the emissions from imported electricity are included in electricity emissions. And I think for -- it's fairness then to have a level playing field.

The same thing should be done with methane leakage. And out-of-state commissions should be considered as part of the impact of the use of gas. If we weren't using this gas in California buildings, this gas wouldn't be imported, some of it wouldn't be drilled, and we would avoid a lot more emissions than just behind the meter.

I think that's all for now. I think for refrigerant -- well, maybe just one last point, is on refrigerant impacts, I think you mentioned that you would consider that the homes that already have AC, which is most of new homes, that would be considered in the comparison, because I think it's important to consider that when you add a heat pump to your home that already has AC, most homes in California are sited for peak cooling loads rather than peak heating loads, and therefore the -- there would be no or

very little additional refrigerant in the system, so there should be no additional impact from all-electric homes. At least, you know, it depends on the climate, but in most cases I
would expect that to be the case on average in California. So I was concerned or puzzled by the statement that electrification would have a significant impact in terms of HFC leakage, whereas we already have a lot of HFCs from AC. And that -- you know, air conditioning is what is driving the impact (indecipherable), not electrification.

So I'm going to leave it there and look forward to any answers. Thank you.

MR. SHIRAKH: So this is Mazi. I will attempt to answer the retail added question, and then others can chime in.

There was a lot of questions in there, Pierre. I'm not sure if I caught all of them.

Anyway, your first question is why 15, why not 50 or something. We actually did look at three scenarios, 100, 50, and 15. In general, changing the retail adder had marginal impact or no impact on envelope-efficiency measures -- I shouldn't say no impact, but insignificant or modest impact on energy efficiency measures such as better wall insulation, windows, high-performance attics did suffer a lot of. And as we increased the same of the retail adder, so did things like Daylight Savings. But, again, most of those impacts were modest.

Where changing the retail adder makes most of its impact is on PVs and storage. So with the 150-percent retail adder, we found out that essentially you will decimate the PV industry. The credit for PV actually goes out the door, to a point that they will not be cost-effective, anyway. It has a huge impact on it.

On the reverse side, it amplifies the credit for battery storage -- hugely. So you know we all support, you know, battery storage and storage strategies and demand response, but too much of a good thing is probably not good. So having a metric that would -- basically modifies all the credit for the PVs and then gives it all to the battery storage has all sorts of unintended consequences, the least of which is that it's going to make the PV industry very unhappy.

So the 15 percent is where we settled. And, again as you will see, it has a negligible impact on energy-efficiency measures. It does have a modest impact on PV still. PVs get a 7- to 10-percent penalty. And it does give a reasonable boost to battery storage.

So if these metrics have no or modest impact on energy efficiency, why do we want to change the shape of the retail adder if it only impacts PV and battery storage?

And, you know, the question is, is a 0- or 15-percent retail adder not giving us enough signal for demand response or battery storage? You know, is that the issue? Why do we want to go to 50 and give it more signal and then decimate another industry?

So those were the choices that we had and that's why we landed at 15. And even at 15 percent, again I'm still asking the question: Why are we doing this? Is the current flat retail adder not giving us enough signal for PV and storage or PV and storage together?

There is a case to be made that the 15 percent will encourage coupling PVs with batteries, so you know I can see that. But going anything beyond that is really an artificially large signal that's not warranted. So that is my three cents. I will let E3 chime in if they wish.

MR. SONTAG: Thank you, Mazi. We still have all your comments on the retail rate of adjustment. Pierre said exactly to your last point which you were mentioning about the incremental change in refrigerant leakage between all-electric and mixed-fuel building, you're a hundred percent current in that, you know, if you already have air conditioning and there isn't really much incremental. So I think that the design of this will reflect that, you know, comparing to any baseline building, it already has refrigerant in there, you know, by including more heat pumps, you wouldn't necessarily be increasing the amount of refrigerant leakage.

Certainly we also want, you know, to create a signal to use low global warming potential the refrigerants in buildings. That would be really beneficial to have that incorporated as well.

THE MODERATOR: Okay. We have some other hands raised. Let's go down the list here.

George, I see your hand's raised. I'll unmute you now. Go ahead and state your name and affiliation.

MR. NESBITT: George Nesbitt, HERS rater. Can you hear me?

THE MODERATOR: Yeah, loud and clear.

MR. NESBITT: Thank you. Why don't we go one at a time. TDV is a forecast. And can you just clarify that is this is a forecast over 30 years that is then brought down to an average by hour for a year period or is it a different time period?

MR. SONTAG: I think George is --

THE MODERATOR: Go ahead.

MR. SONTAG: You know, this is a -- this is a forecast for a 30-year period that has brought, you know, all -- its present value to, you know, one year. So the TDVs themselves are, you know, one year's worth of power, so 8760 and its present value of the 30-year forecast or 15-

year forecast for some of the non-residential buildings.

MR. NESBITT: Okay, great. Thanks. It just -- you know, I don't think that's always clear in the presentations or even in the code that it is.

So I was reviewing the October E3 presentation on TDVs and I noticed that the propane retail price does vary, whereas natural gas and electric hasn't. So I think one argument for why should natural gas or electricity retail prices are used because propane prices vary, and we know that prices vary. And since it is a forecast, you know, we're looking out in the future, we're partly creating what we think is going to happen in the future, so that would be my -- my reasoning.

Because the time of -- so when you look at the time-of-use rates that are currently in effect, they don't -- I don't think they really -- they don't reflect the fact that our lowest carbon electricity is in the mid-day, and really should also be then the lowest cost because -- the problem is we have been so dependent on photovoltaics we have now mandated photovoltaics on residences. And all our forecasts are depending on -- mostly on photovoltaics into the future. And we know the problem that that causes.

So -- and I think to get to Mazi's kind of comment, the thing is what we are -- we're driving to a future where we're absolutely dependent on batteries. And so, yes, that devalues the photovoltaics. It will value batteries but it also values using that energy in the middle of the day.

And then I just want to make one comment on the -- on refrigerant leakage -- well, actually I'll make a comment on natural gas leakage. The reality is we're going to have a natural gas distribution system and that system is going to have leakage far into the future. Unless we somehow come up with a policy that says we are going to start removing the distribution system and forcing people to electrify, we're going to have those impacts. While we might use less natural gas, it's still going to be there, it's still going to leak.

And then on refrigerants, I just want to point out the project drawdown, they're number one measure for addressing climate change is refrigerant management and the leakage of refrigerants and the proliferation of refrigerants and of course right now they're HCFCs and high global warming. And so that sort of wraps up what I want to talk about right now. Thanks.

MR. SONTAG: Thank you, George. Just one quick point of clarification. As far as, you know, the daily variations, in this slot I was not so clear before, but the TDV value would be at the top of this bar chart as it goes along, so that the value that the building sees, you know, at eleven o'clock, this is an average, but, you know, is around 20, at six o'clock it would be over 70, so we do get kind of that varying signal like I think you were mentioning.

And there is, you know, some variation on the natural gas side as well for the rates one would pay. I think it's similar to propane, but seasonally typically retail gas is a little more expensive in the winter when demand is higher.

MR. NESBITT: Yeah. I mean the TDV for electricity definitely reflects sort of the impact of when we use electricity. I just -- I do think that reflecting the retail rate in a forecast of what those rates should be in the future should be part of it, which in a sense does skew -- skew that more. But, yeah, and natural gas is more expensive typically in the winter when we use more, so it seems like that should be reflected.

MR. BOZORGCHAMI: This is Payam. A little comment here.

I'm going to ask even though you guys are having conversations back and forth like you just did between Mike and George, please state your name every time you get on. These recordings will be transcribed, and so the transcribers don't have a difficult time trying to figure out who is speaking. Thank you.

THE MODERATOR: Okay. So, Payam, do we want to read some of the Q&As now or do we want to keep going through the hand-raised voice comments?

MR. BOZORGCHAMI: This is Payam. I think what we're going to have to do, we're going to have to go through all the hand-raised comments. And then I'm not a hundred percent sure if the Q&As will all be recorded. So if it's beneficial, I think we should open -- not do Q&As but actually have people raise their hands and then answer those questions as they come after each presentation. I just don't want anybody's comments to be missed. That's all.

THE MODERATOR: Okay. All right, Jon, I'm going to unmute you. You're next on the list. Go ahead and state your name and affiliation. Thanks.

MR. MCHUGH: This is Jon McHugh, McHugh Energy. Can you hear me?

THE MODERATOR: Yeah, loud and clear.

MR. MCHUGH: Great. A first question I had is related to what is the cost of carbon being used, sort of the range from, you know, year 0 to year 30, or whatever? And what fraction of total cost is this for electricity and natural gas? Thanks.

MR. SONTAG: Thanks for the question, Jon. This is Mike Sontag of E3 and I'm going to go back into the previous workshop for you there. This might take a second.

So this slide here shows the carbon price forecast for the reasonable TDV. I don't want to go too deep into the details of the different emissions cost components, but for our -- what we call the cap and trade emission price, it starts, I believe, around $30 in the nearterm and goes out over $200 by 2045. This is in nominal dollars, for clarification.

We also have our electricity GHG reduction in the side of abatement, air quality wide abatement, GHG price side, and that starts at about a hundred dollars per metric ton and that increases to about $300.

I think there is a fraction of electricity TDV. Let me see if I can find a good slide for that. I guess the inspector sidebar chart. I believe, you know, it's also around like a quarter of the TDV. I don't have the exact number off the top of my head. And again for natural gas it is also about 25 percent of the total annual value.

MR. MCHUGH: Thank you so much. That's great. The next comment or question has to do with the -- looking at the shape of the retail rate adder, and looks like much of the discussion was around residential building standards, but my understanding is most of the measures that are being looked am I code cycle have to do with nonresidential standards. And I was wondering if there was some sort of evaluation of the impact on efficiency measures. And I would have thought that given that this would reduce the cost basically during typical business hours that this actually has a negative, that increasing, you know, the scaling factor for the retail rate adder would have a negative impact on efficiency measures. I was wondering if that evaluation has been done and what you've found. Thanks.

MR. SONTAG: Yeah. To get into this again. Again Mike Sontag with E3. NORESCO looked at the impacts on nonresidential measures that we'll get to later in the presentation today.

MR. MCHUGH: So that's going to be described later on? Thank you so much.

THE MODERATOR: Okay, let's go down the list here. Pierre, I see your hand's raised. I'm going to unmute you now. Go ahead and state your name and affiliation, please.

MR. DELFORGE: Can you hear me? Oh, so I just followed up on my previous question. I just wondered if you could address the question of methane and only considering behind-the-meter leakage versus system-wide leakage and also the horizon, the 20 year versus 100 year double one potential.

MR. PENNINGTON: This is Bill Pennington. Can you hear me?

MR. DELFORGE: Yes.

MR. PENNINGTON: So I was going to respond earlier, but I was having difficulty with my muting here. I'm a novice at participating in these things from long distance.

So, yeah. So the Energy Commission is thinking about this a lot not only for building standards but also for the AB 3232 proceeding. And the -- the attribution to building and what can be accomplished by reductions in natural gas use in buildings is -- you know, is a challenging question, for which actually there's surprisingly little supporting data for assigning more of the system leakage to buildings.

A lot of the studies out there are seeing very anomalous leakage dominating the production and storage portions of the infrastructure. And, you know, very little of the -- you know, there's much less leakage in sort of normal production facilities than there are in a very limited number of cases where there is extreme leakage. And, you know, the studies are saying that this is really anomalous and shouldn't be happening and that there need to be actions taken within those facilities to reduce that leakage, and that there is sort of a national emphasis being made on addressing within that infrastructure at those facilities what is causing that extreme leakage.

And the other thing is that a lot of this extreme leakage is coming from, you know, production facilities that are flaring a bunch of natural gas at the origin -- at the initial production of the well and it's just bad flaring practices.

Some of the leakage that is occurring in storage that, you know, again these are extreme cases, are existing facilities. And so, you know, one of the expectations is that as we add new facilities to address new demand or, you know, maintaining the current demand, those new facilities are going to get much, much better at addressing this leakage. So that's one aspect of it.

But there's also leakage in the transmission and distribution sectors of the infrastructure, that those lines are pressurized and a significant portion of the leakage is related to the pressurization that's occurring there.

The other thing that's happening is that ARB is mandated by legislation to -- to dramatically reduce the methane leakage in the California infrastructure, which is dominated by transmission and distribution. And they have until 2030 to make major reductions there, and there's major efforts going on in conjunction with the PUC to do that. And ARB's comment to the Energy Commission in the AB 3232 proceeding is that they don't think that leakage should be associated with building natural gas consumption for the sectors that they're mandated to focus on because they think that would result in double counting of reduction in methane leakage. And -- and that's a problem that, you know, they're focusing on.

The other thing is that there's really only one study out there that has looked at the correlation of methane leakage on a system-wide basis with natural gas consumption in building. And that was the single study that's being done for the L.A. region, L.A. Basin. And there is some correlation that's being found there. The researchers have said that they don't necessarily believe that that's causal -- casual that, you know, the correlation is there but it's not necessarily true to conclude that buildings are causing the leakage.

The conclusion also they -- they reach is that these are first-time studies of major new ways of researching the question and they think that there need to be other studies of other regions done and there needs to be, you know, comparison of results and confirmation of results.

So if that leakage rate was used instead of the .7, it would increase it because there is some limit to correlation found there, but it wouldn't be, you know, nearly as much as the studies that are pointing out the anomalous leakage that's happening at the production and storage parts of the system.

What else I might say here?

MR. DELFORGE: That's -- thank you, Bill. Do you have any results on the global warming potential timeline?

MR. PENNINGTON: So that's an interesting question. ARB is doing this calculus across all climate-change-impacting pollutants, if you will. And they're sticking with a hundred-year timeframe for their general policymaking. And, I don't know, that's -- that's something we could query them again about, but that's kind of where ARB is at on that.

MR. DELFORGE: Great. This is Pierre again. Just maybe one last closing comment. So thank you, Bill, for all these insights.

Let me just comment that what we're looking at in terms of decarbonization is a large-scale change in demand, not just one or two buildings, it's, you know, millions of buildings across California and that will necessarily result in a reduction of new wells drilled and therefore of anomalous events. It will result in a reduction in storage needs and therefore leakage events or accidents like the Aliso Canyon accident.

So I think when you take a look at it in terms of the longrun marginal approach, just like we're doing with electricity, and while I agree and understand that the non- -- the attribution may not be a hundred percent, it's not zero either. And I think doing -- making a realistic assumption in terms of what attribution is even given -- you know, even in spite of the lack of robust data is better than assuming it doesn't exist at all and that reducing demand of gas has no impact on emissions. So I'll let it there. Thank you.

THE MODERATOR: Okay. Let's go down the list. Claire Warshaw. I'm going to unmute you now. Go ahead and state your name and affiliation. Claire? Claire, you have been unmuted; are you there?

Okay, I'm going to mute you. We'll come back to you.

All right. Scott, I'm going to unmute you now. Go ahead and state your name and affiliation.

MR. BLUNK: Hi. This Scott Blunk from SMUD. And --

THE MODERATOR: Hi, Scott.

MR. BLUNK: Hi. And I want to thank Bill for all the information he just provided us on the natural gas leakage and for Pierre for asking that question. And it's similar to mine and the 20- versus a hundred-year GDWP of methane, so what I heard is the CEC will talk to the Air Resources Board again about using that number. But also what I -- my takeaway was that we can also talk to the Air

Resources Board and see what we can do, because this has been brought up in like every public forum I've been to. It's easy why we're using the hundred year.

But my question really I think goes to the year .7 percent methane leakage is that -- we're using that we did cite the use. It's kind of the behind-the-meter piece. Where is that .7 coming from? Is that the .7 percent of the natural gas that would have been used in a building like that? What's the number?

MR. SONTAG: Hi. This is Mike Sontag at E3 again. Just a quick point of clarification. The .7 percent is aligned with the Air Resources Board's GHG inventory, so it should, you know, just represent I believe the full system, not just behind-the-meter. But I think you asked the question, Scott, about what the .7 percent -- what it represents. And this would be -- you know, .7 percent is a volumetric gas consumption. So in a mixed-fuel building you're setting that as the baseline. That would have a certain amount of -- you mentioned that would be, you know, valued at the emissions top. You know, conversely, an all-electric building would not have those because that would kind of be seen as the savings on the total emissions part.

MR. BLUNK: Okay. So this is Scott Blunk from SMUD. So the 0.7 percent is 0.7 percent of all the emissions from a typical mixed-fuel residential building I assume here is what we're looking at?

MR. SONTAG: Correct. So this is the carbon intensity. So as gas consumption fills up so too would nonemission and, --

MR. BLUNK: Sure.

MR. SONTAG: -- you know, whether it's for residential or commercial, this would just be with whatever their gas consumption is.

MR. BLUNK: Okay. So it's not a 0.7 percent leak, it's a .7 percent emissions, you know, peak, or something, okay.

MR. SONTAG: So, yeah. Sorry, one last clarification. This is Mike Sontag again. So it's leaking .7 percent. When you convert that on a per-therm or per-Btu basis, so the, you know, volumetric consumption it becomes a 6.4-percent increase in CO2 equivalent emissions.

MR. BLUNK: Okay. And so Scott Blunk with SMUD, one more time. So if this was 20 years, so this would just be multiplied by five to increase the 20-year GWP of methane?

MR. SONTAG: Mike Sontag again. I don't know off the top of my head what the 20-year GWP of methane is, but just assume the 100-year GWP is 25, so whatever that 20-year, you know, GWP would be --

MR. BLUNK: Yeah.

MR. SONTAG: -- with this conversion factor.

MR. BLUNK: All right. Thanks.

MR. [SPEAKER]: This is -- this is new. One more clarification on that. I think when you're saying, Mike Sontag, that .7 percent is the whole system, it's really tuned to the ARB inventory, which only includes the instate component. So I think that the conversation of out of state is still valid.

MR. BLUNK: Interesting.

THE MODERATOR: Okay, let's go back to Claire and see if she's there -- oh, no, hand is lowered, okay.

Pierre, I still your hand is still raised. Do you have another comment or question? I'll unmute you now. No, or --

MR. DELFORGE: No. I apologize I --

THE MODERATOR: No worries.

MR. DELFORGE: I will put my hand down. Thanks.

THE MODERATOR: Okay. Sean, I'm going to go to you next. Go ahead and state your name and affiliation.

MR. ARMSTRONG: Hi. This is Sean Armstrong with Redwood Energy.

Correct?

THE MODERATOR: Yup, sounds good.

MR. ARMSTRONG: So on this topic of gas leakage, it has always struck me as weird that the state does such a careful analysis of the inefficiencies of energy that is delivered over state property, electricity over the state by three, where there seems to be intellectual omission, like a blind spot, to all these studies that show the gas leakage outside of the state. And those were -- those were raised, you mentioned them saying the flaring, the leakage from high-pressured pipes from longterm storage systems, all the rest of it. My question is like how -- how do you guys justify ignoring everything that's happening out of state was 90 percent of our gas delivery, whereas you provide such like refined analysis of electricity, do you see the inconsistency that I see?

THE MODERATOR: Panelists, anyone want to respond to that? I don't hear any speaking, so.

MR. PENNINGTON: So -- this is Bill. So, again, a lot of this gas leakage is not necessarily associated with building natural gas consumption. Whereas I think on the electricity sector it's virtually all associated with the consumption of electricity. So, you know, a lot of the -- for example, the natural gas production is often co-associated with oil production. And so these facilities have to operate, particularly at production facilities have to operate to address the oil production that's happening as well. So -- so a reduction in natural gas in the building doesn't necessarily affect, you know, the extent of activity at those production sites. And -- and, you know, a lot of the oil-related production is associated with the transportation sector. So there's all these other things that are outside the influence of building natural gas consumption that is -- is causal to the total leakage in the natural gas infrastructure.

And, again, there's been one study that's tried to look at this on a regional basis, in L.A., and it's moderately higher than what ARB is currently assuming in their inventory. And Mike Sontag was correct that that inventory includes not only building leakage but other leakage.

So, yeah, I think we're trying to, you know, be as careful as possible in making a good -- addressing this in a valid way in assigning the leakage that is clearly appropriate.

The other issue is that there potentially is the ability to avoid significant portions of the -- of the infrastructure if all buildings become electrified. And so if the standards were actually causing all buildings to be electrified, then big additions to the distribution system could be eliminated, and that would have a significant effect. But what the standards are able to do at this point is to make incremental changes. And -- and not in this code cycle will we be able to cause all end uses to be all electric. Maybe our standards will drive up an increase in the percentage of buildings that are all electric, but it's unlikely that the standards will switch that. And so with that being the case, then there's going to be a continuation of the infrastructure supplying the buildings for the other end uses.

And so, you know, I think it's appropriate also not to exaggerate the fact that the standards can have on the question, because then I think there is a very large risk of double counting. And, you know, if you're relying on that double-counted amount coming from building and it doesn't come, then you're going to have to -- you're going to be in a situation where you don't have as much savings as what you need. And so, you know, I don't think you'd want to de-emphasize all of the activities that are going on to make improvements here by exaggerating the contribution individual ones or double counting them. Like I think it's important to be careful that we have a valid way of looking at it.

And as research like the L.A. research gets replicated, if that got confirmed in other areas, then it would be logical to move towards that in the future.

The other thing I would say is that the analysis that we want to get to here today indicates that the impact of this variable on TDV is not strong enough to make a major difference. And if you doubled it or tripled it or multiplied it by five, it still wouldn't be, you know, a really major influence. So that, you know, when we get to those -- those presentations we can see that.

MR. SHIRAKH: So I'd like to encourage us to move along. We're 20 minutes behind schedule here, so if we can expedite this, the better.

THE MODERATOR: Yeah. We have -- we have a few more hands raised. Next is Clifton. We'll go ahead and unmute you now. Go ahead and state your name and affiliation.

MR. LEMON: Clifton Stanley Lemon. I'm with the California Energy Alliance.

Since we're behind I'm going to only stick to one question here and I'm hoping this relates. We're talking about electrification, so I think it does. In calculating or looking at our analysis of TOU and TDV and electrification in general, because they're related, what has been -- have we been looking at the costs of stranded assets for the utilities? We were talking a few minutes ago about slowing down or removing gas distribution infrastructure. We're concerned that there is a bit of a backlash to jump onboard too quickly with electrification, even though it's a really good idea and it reduces GHG and gives us great efficiency at once, which is good, but I think we need to see it from the capital cost standpoint of the utilities and anybody, you know, investing in maintaining or building new gas distribution. So was that calculation looked -- is that being looked at right now as part of the whole picture?

MR. SONTAG: I thank you for the question. This is Mike Sontag at E3 again. I want to make sure I'm understanding your question correctly. Were you asking about the stranded assets in the gas distribution system?

MR. LEMON: Yes.

MR. SONTAG: Okay. So those are factored in the gas TDV side in the gas retail rate forecast. So the scenario that was selected has a curve (indecipherable). Granted, so the retail rate impact that was selected has a change in volumetric, you know, delivery of gas. And so to the extent the revenue requirement would be spread across more or less consumption, that cost is reflected in the natural gas retail rate forecast. There is more detail to that in the previous workshop slide.

Does that answer your question?

MR. LEMON: Yes.

MR. SONTAG: I'm not sure if we quite had the right -- the data's maybe not quite framed in the right way to exactly respond to what you're asking.

MR. LEMON: I think it generally does. Thank you.

THE MODERATOR: Okay. George, I see your hand's raised. I'll unmute you now. Go ahead and state your name and affiliation. Thanks.

MR. NESBITT: George Nesbitt, HERS rater.

Just real quick. Has there any been -- been any consideration about leakage on the propane side?

MR. SONTAG: George, thank you for the great question. Mike Sontag of E3 again. We have not really factored that in on the propane side. I would love to do so if we had, but in our studies on that we just -- if you come across that on our initial search that you're aware of anything, we'd be happy to it.

THE MODERATOR: Okay. Thank you.

Scott, I see your hand's raised. Do you have more comments or is it just still up? Let's see, I'll unmute you. Go ahead.

MR. BLUNK: It's just still up.

THE MODERATOR: Okay. Claire, do you want me to try again to unmute you so you can make your comment? Go ahead. I'll unmute you now. Try to state your comments and questions if you can.

Okay, I believe that's -- that's it. Let's go onto the next.

And unless -- Payam, unless you wanted to read any of the Q&A, or we could save those for later.

MR. SHIRAKH: I suggest we -- this is Mazi -- just as a question in there, we'll hold them till later because we're really beginning to run late.

MR. BOZORGCHAMI: I agree, Mazi. And I think -- this is Payam -- and I think what we can do, we have -- you guys on the phone can still submit your comments in writing to the Energy Commission, to the docket, and we will evaluate those and respond back one way or another.

THE MODERATOR: What is the timeframe for that, Payam? People are asking about how long they have for their written comments.

MR. SHIRAKH: So today is -- this is Mazi -- Thursday, the 26th. How about -- in about two weeks from today. That would be Friday, April 10th.

THE MODERATOR: Okay. So, yeah, why don't we move onto...

MR. SHIRAKH: Again I would like to --

(Simultaneous talking.)

MR. SHIRAKH: -- for those who are submitting comments, is to docket those comments so we can respond to them.

THE MODERATOR: All right. Bruce, you should be presenter. Go ahead -- or -- there we go. We see your slide, yes.

MR. WILCOX: If I get myself unmuted, we might be able to do the communications. Thank you.

THE MODERATOR: You sound loud and clear, yup.

MR. WILCOX: Okay, good. I'm Bruce Wilcox and I'm the technical lead for the Residential Performance Software, CBECC-Res, and I'm going to be presenting the promised analysis of the impacts of these new metrics and the alternative metrics on the residential sector.

There are two important things here that I want to say right off the bat. One is that there are two functions of this performance analysis. One is that it uses -- the Commission uses it to establish what measures can be put into the building standards or required in the building standards. We evaluate lifecycle cost-effectiveness using the simulation software and the TDV factors, and all of that stuff so that we can say, yes, it's cost-effective to require insulation of x R value in the walls. So that's one immediate use for this.

The second thing is that most of the code compliance in California is done using performance, at least in residential. And so the same procedures and analysis are used to determine whether your building complies under the performance method, and so that's the other things that I'm going to be talking about here.

Okay, so here is the agenda of what I'm going to talk about. And it's kind of a large sort of conglomeration here. But I'm going to start out by talking about EDRs and the 2022 CBECC-Res performance compliance calculation. I'm going to give some example -- or talk about an example, comparison, and prototype house for calculations and present those results of calculations on that house. I'm going to show the alternative metrics that we're going to be presenting today and those are -- there are five of those and we'll get into those. You've already heard about with and without the flat retail adder -- or with the not flat retail adder actually is the way to probably put it, and then the impact of methane leakage.

And I'm going to compare those metrics in several different ways. We're going to show the total TDV for a mixed-fuel home and then we're also going to show the total EDR for the same mixed-fuel home. And this actually has to do with this dual purpose here of lifecycle costing versus compliance. And the total TDV is what's used for lifecycle costing, whereas the total EDR is now on our new scheme in the world used for compliance. So I'm going to show it both ways and that's the reason for doing it that way.

Then we're going to do the same for an all-electric home. And we will be able to see the difference, how that is impacted by these new metrics.

I'm going to talk about this methane -- which is called CH4 all over the place here -- leakage impact. And, as we've already discussed, I won't go into this in great detail, but I'm going to show you that the current proposal, the methane leakage is not a significant issue.

Then we're going to go on and look at measure savings for 2022 analysis, both mixed fuel and all electric, and how those are affected by the alternative metrics.

And then we're going to look at Maxi's big issue which is the flexibility measure, total EDR savings, how those are impacted by the alternative metrics. And so the big -- the two big issues there are the savings for increasing PV in an all-electric home and then the savings for adding a battery in that all-electric home.

So that's the outline here.

So we talk about EDR since we established it as the compliance mechanism in the 2019 standards. That's short for Energy Design Rating. This is meant to be, to some extent, similar to what's used nationally by RESNET organization for rating homes. They use an Energy Design Rating, and we've copied a lot of the approach that's there to try and harmonize with the national standards.

So EDRs are -- in CBECC-Res are reported for both proposed and standard design. Get this little window which I -- there we go. The proposed and standard designs. Is for every -- for every compliance analysis in CBECC-Res, we simulate the energy performance of the proposed design, which is what the builder is proposing to build in all its detail, and then we make a second version of that house, called the standard design, which is identical to the proposed design except that it minimally meets all of the California prescriptive standards. So it has the required insulation levels and window properties and furnace efficiency and all of that. And each of those is simulated. And then we calculate the Energy Design Rating for each of those. And for each of those cases the Energy Design Rating is the ratio of the energy use of that proposed or standard design to the energy use of the reference design.

And the reference design, here is where we are trying to harmonize with RESNET, the reference design is a version of the proposed design that minimally meets the 2006 International Energy Conservation Code, which is the national model building code.

So the idea behind this is that we're using the 2006 code as the reference because that way there is -- the EDRs tend to be stable over time. The same exact building EDR under 2019 will be supposedly similar to the same exact building EDR under 2022 standards. And so that's the reason for doing these three different cases and making this calculation. Of course when we change TDV factors, that changes the ZDRs even though we haven't changed the reference design, so that's a complicating factor here.

Okay. So for CBECC-Res 2022 compliance, we have, as Mazi said earlier, we have one new EDR for labeling as EDR number 1, and there's a criteria there that you have to meet for compliance. EDR1 is calculated for the standard and the proposed and the reference using hourly-source energy rather than TDV. I'm not going to talk about that much today because hourly source energy calculations have been presented before and we haven't changed those as part of this TDV update.

Then there -- in addition there are 2020- -- what are current 2019 compliance criteria which remain for 2022, and those are the EDR2 efficiency, which includes the envelope requirements, the HVAC requirements, the DHW efficiency requirements, and these are generally the things that are the hardest to meet the standard.

Then there's a second criteria which includes the efficiency but adds PV, battery, and demand response, and that's the EDR2 total. In order to comply and get a building permit, you will have to meet -- you will have to have the EDR for your proposed design less than the EDR for the standard design for all three compliance criteria.

We're jumping through multiple hoops here to cover various aspects of the goals for the standards, is really what's going on. One thing that's very important is that there's no tradeoffs between the -- this new hourly source energy EDR and the two EDRs for efficiency and total that are based on TDV. And there are only limited tradeoffs between the EDR2 efficiency and the EDR2 total. So this whole system is what protects the basic envelope and HVAC efficiency in the building from the -- able to be traded away for large PV systems and big batteries.

In the 2022 CBECC-Res Compliance Summary, this is a screen shot of the report you get at the end of each analysis and it completely implements what I just said, but to -- so there's a row for the standard design and you get the Energy Design Rating, number 1 for source, number 2 for efficiency, and number 2 for total. And then you do the same for the proposed. And you do a simple subtraction and we get you -- we show you the -- what we call the compliance margins.

So this one is, you know, 46.6 minus 44.9, and that, because the proposed design is lower that comes out a positive number. And if all three of these compliance margins are positive, then the building complies.

Okay. So we have an example comparison set here that's based on -- to look at all these EDR TDV effects. And this is intended to illustrate the combined impact of all the changes from 2019 to 2020. One of the big ones is that 2022 weather data which has been updated to a whole new dataset, more representative of current weather that's been changing and warming since -- for a long time now, and the 2019 weather data was actually mostly considerably older and represented a smaller dataset. So the weather data change is significant and it's included here, although we're not going to focus on weather in this presentation. The main thing is the alternative 2022 TDV metrics is what we're really trying to illustrate.

All of our examples are calculated for one prototype house that -- or will be typically used for calculations in the building standards arena. It's a 2700-square-foot, two-story, four-bedroom kind of typical production builder house that you will see being built all over the state.

And for each of our cases -- or for each of our examples we're going to look at two cases. One is the mixed-fuel case. Mixed fuel means -- is a code name meaning that the -- we're assuming that the house has a mixture of gas and electric -- electricity involved. It's got gas base heat, water heat, cooking, and clothes dry, kind of the traditional California house, and it's got electric cooling. So that's the mixed-fuel case.

And then the alternative is the all-electric case, where all of these things are converted to electric versions. And then you do the accounting on that basis.

So I think it's been said earlier that TDV metrics are sets of hourly values of electricity, natural gas, and propane. And, as we just had lots of questions about this, but the idea is they include the cost to produce and distribute the energy for a representative weather year in each of the 16 climate zones.

So here is the alternative metrics that we're including for this analysis, with the names that I'm using. So the kind of historical reference here is the 2019 standards that's current, production compliance versions of the 2019 weather, TDV and calculation rules. So this is the answer you get if you try and make this house comply today for a building permit.

And then we have four different versions of the new ones for 2022. And the one that's labeled simply 2022 is sort of our base case and that's the one that was, I think, essentially first proposed in October last year. And so it's got the 2022 weather and the 2022 rules, and the TDV with a constant retail adder. I think constant is the right term.

So we then have three more variances of that. So the same with the methane leak and then the same with the 15 percent retail adder. And so this is the 15-percent variable retail adder. The constant retail adder is in the base case. And then we have a combination of the 15-percent retail adder and the methane leakage.

So we're going to show in some cases here five different results for each analysis.

All right, so here we are, lots of colored bars.

All right. So this is a slot is I'm going to show you several that are similar to this. So the bottom axis, we have climate zone range from 1 to 16, and then a statewide weighted average. The statewide weighted average is weighted by historical housing starts in each of the climate zones. And then the five bars here are: The blue bar is the current, 2019, analysis; then we have our four versions of the proposed new metrics. The first orange bar is the base, 2022. And then the gray bar is that with the methane leak. And the other, the yellow bar, which is the 2022 with the 15-percent retail adder, the variable 15-percent adder, and then the green bar has got the 15-percent retail adder and the methane leak.

For visual convenience, we have also put this orange line in which is the statewide average for the 2022 base case metrics, just so you can see how things vary from climate zone to climate zone.

So the conclusions here for mixed fuel is that the total TDV, this is you take the value of the gas and electric energy use by this house by the -- yeah, by this proposed house in each climate zone, present value essentially, as we've just been discussing earlier. In the

2022 analysis, no matter which set of metrics, we're always predicting a higher number than we did in 2019. So how much for -- so much for consistency and over time, et cetera. But this is a driven by many things, but maybe most importantly by changing the TDV value of natural gas.

And the other thing to see here is that the methane leakage, as we discussed in the previous presentation, is -- has a very small effect. The difference between the orange and gray bar or the yellow and green bar for each of these cases. And, you know, it's -- as -- I don't know, it's pretty small.

Okay. Now if we take that -- those exact data here and we convert it to EDR, and this is -- so this is the terms under which we're going to do compliance. So that changes this -- particularly the climate-zone-to-climate-zone differences because, as you recall, the EDR is a ratio between a few cases that are both calculated using the same weather, the same metrics, and so forth. So as long as the standards are relatively -- the measures required are relatively the same, the EDRs tend to be closer than the total TDVs.

But one of the things that happened here is that EDRs have gone up significantly in the two coldest climate zones, climate zone 1 and climate zone 16. That's, you know, Eureka and Blue Canyon, the Sierras. And I believe that has to do with a value of natural gas being higher. And, again, you can see that the dif- -- in the case of EDR, the difference in natural gas, whether you have the CH4 or not, the methane leakage or not, is in most cases even smaller and that's because it's now a ratio, when before it was absolute in the previous slide. So that's total EDR. This is for a mixed-fuel house.

So then we go back into the total TDV metric again, like the first slide I showed. And this is for an all-electric house. And, you know, it's a similar picture. The TDVs have gone up in the cold climates. The TDVs tend -- but this is not as clear because the TDVs in 2022 are not always higher and so much more kind of similar results.

You will note here that there is -- since this is all electric there is no natural gas use in this building so that the methane leakage absolutely has no impact. All the methane and not methane bars are the same height.

All right. So then we convert that to EDR, the compliance variable. This is -- you know, it's a somewhat different picture than we got for the mixed fuel, but it's still showing that the winter, the heating zones have bigger EDRs than they used to have. And I think part of this is -- this one is definitely not due to the value of natural gas. I think this has to do with weather data maybe. Maybe other things. But it's the picture for EDR of all electric.

So here's -- here's the -- if you want to just pull out and look at the methane leakage impact on TDV, and this is just looking at those four 2022 bars, the same bars we saw previously. You know, our -- my conclusion here is that these differences are so small they're not going to impact any calculations for lifecycle costing or, in the long run, any compliance issues. And so from here on out I'm not -- we're not even going to include the methane leakage bars and we're not including -- we're actually only showing the 2022 and 2022 with the 15-percent retail adder and no methane leaks from here on, to be clear, trying to cut down on the color stress. Okay.

So if you look at EDR savings in a mixed-fuel house for efficiency measures, this is what the picture looks like for the alternative TDV metrics. Now this is maybe the one that's the most interest to a builder, this view, because the builder is always looking for ways to meet that efficiency EDR requirement. And you can't meet this requirement with PV or batteries or demand response. You have to meet this with efficiency measures.

And so this shows three different sets of efficiency measures and how they respond to the three different metrics. And so that -- I'm sorry. Not in how they respond to three different metrics. These are all for the base case 2022 metric, which is -- you know, this is -- we already talked about it, but -- so if you look at the yellow bar, it's what happens if you convert from double glazing to triple glazing. Triple glazing is not a prescriptive requirement in any of the California climate zones, so it's kind of a nice virgin measure to look at here from an efficiency point of view, and you will see that the -- you know, that we get these big positives in the cold climates, as you would expect for basically a heating-oriented measure. And, you know, the tradeoffs are reasonable all the way across. We're getting an average of almost two EDR points statewide for triple glazing.

If we go to a package of efficiency measures for the -- well, it's a water hearing measure basically, which is one of the builder savers always. So this one is a trade upgrade from a .82 tankless water heater to a .92 tankless water heater that involves condensing. Again, these are all for a mixed-fuel house, so the water heating is natural gas. And we're getting about a one EDR average, and it depends on how cold the climate is, climate zone 15. That's Palm Springs. the water is warm and the water hearing loads are lower, so you don't get as big a benefit.

And then the third example here is suppose you go to high-efficiency equipment. So this has a condensing-gas furnace, an 18 SEER air conditioner and with 13 EDR, and you get, you know, very respectable, large EDR tradeoffs from that, an average of a little over two.

So if we look at that same picture for an all-electric house, there are significant differences but a lot of things are quite similar. If the HVAC and electric heat pump, water heaters and so forth, efficiency measures -- well, it's actually this is an HVAC measure on this slide, if that was equivalent to the previous one, on average you're getting about the same EDR, a bump of two EDR points. And again it depends on which climate zones and it's quite strong.

The water heating measure here is converting the standard design electric heat-pump water heater to the high-efficiency Sanden electric heat-pump water heater, and that gets a significant EDR boast, particularly in the coldest climates. And then water heaters, not only is the water heating load low in climate zone 15, but Sanden water heaters don't work very well at high temperature, so Palm Springs is not a good place for that application.

And then the triple glazing, the picture is, you know, quite similar to the previous one. So you've got an average 1.5 in here for all electric and you get an average of maybe 1.8 in for all -- for mixed fuel, for triple glazing, which is exactly the same measure in both cases.

All right. So those were looking at the impacts of these metrics on the value for one measures. So now we have the -- looking at the two big tradeoff measures that Mazi mentioned before. So this is in an all-electric house how much EDR you save if you increase the size of your PV system. So this is kind of relevant if you're going for some kind of zero net energy or super green design or you want to -- you want to actually do better than the standards for some reason, so this starts with the minimum PV required by the standards and increases it to the maximum PV that we allow based on the assumption that we shouldn't give credit to people who are producing more electric onsite than they use no site. In the CBECC-Res program we put a limit on how much credit you get for PV. And so we're going from the prescriptive minimum up to this maximum, which depends -- the maximum depends on the climate zone since it depends on how much electricity you're using.

And you can see that for 2019, the blue bars here, the current standards are always bigger. And so either one of our 2022 metrics here, either the base case or the base case with 15-percent retail adder, are worse, and the 15-percent retail adder is worse than the base case. Mazi mentioned this earlier, but this is -- you know, to make that case very clearly. The value of PV is going down with the new metrics here, one way or the other.

And here is the -- the other measure we talked about in terms of flexibility, which is adding a battery. So we took the same -- the same house, starts with a standard PV, and then for the second case here, our comparison case, we've added essentially a Tesla power wall, a 14-kilowatt-hour battery. And we've assumed that you're going to be -- the builder is going to sign up for some kind of as-yet imaginary utility program where the utility would control the batteries and do a very sophisticated job of only charging and discharging them at the most advantageous times for the grid.

And, again by and large, the 2019, well, it's high. It's not always the highest. And the base case 2020 is significantly lower than 2019. But when we go to the third bar here which has got the 15-percent retail adder, that reverses the -- the impact of the 2020 TDV to a very large extent. On average, the -- you look at this statewide average bar here, with the retail adder we're very close to the same value of batteries that we had before. In all the mild climate zones, the -- or a lot of the mild climate zones, like climate zone 9, Los Angeles, the battery values with the retail adder the significantly higher.

So this is illustrating the kind of tradeoff calculation that Mazi was talking about in terms of the batteries versus the PV.

So that's my presentation and I will be happy to take any questions.

THE MODERATOR: Okay. So this is Nehemiah --

MR. SHIRAKH: Mazi again. Looking at Bruce's slides, and as you can see the biggest impact of the nonflat retail adder is on PV and battery storage, where PVs get -- they get discounted by about seven, eight percent on the average and batteries get a much larger credit. Really no change on energy efficiency, very, very modest.

So the question we need to answer here, and then we're going to also look at nonres results, which will show the same thing as, you know, why do we want to do this, isn't the current signal with the flat retail adder enough for PV plus storage, you know, is there a reason why we need to amplify that signal, that when we couple PVs with batteries you get an extra incentive at a cost of standalone PV systems by themselves. So I mean that is actually the question that we'd like to discuss and get some feedback from the public. Thank you.

THE MODERATOR: Nehemiah, I think you have some comments. I'm going to unmute you. Okay, you are now unmuted. Go ahead and state your name and affiliation. Thanks.

MR. STONE: This is Nehemiah from Stone Energy Associates. My questions were about Mike's presentation, so

I'll hold them until the end.

THE MODERATOR: Okay, we'll do that. I'll make sure to call on you later then. Great.

MR. BOZORGCHAMI: Okay. We have one question on the Q&A and that's from Mr. Clifton Stanley Lemon. And he says: Will the EDR mechanism make the compliance easier or more difficult for the average building owner/builder? It seems to me that compliance in general is already sufficiently complex, expensive, and difficult.

MR. WILCOX: So you want me to answer that, Payam?

MR. BOZORGCHAMI: Sure, Bruce.

MR. WILCOX: So --

MR. SHIRAKH: The question, if I understand the question -- this is Mazi -- is that is additional EDR1 making compliance more difficult; is that what the question is?

MR. BOZORGCHAMI: I'm not sure. It says: Will the EDR mechanism. We can unmute Mr. Clifton and have him explain that.

MR. SHIRAKH: Because we've been using the EDR method, so actually we have enough for 2019 standards, we are relying on the EDR metric for compliance. It's --

MR. WILCOX: One way to look at this, Mazi, is to -- this is Bruce -- one way to look at this is that if you're going to do the performance approach, which a vast majority of builders do for reasons that they think are important, then we're not actually changing the amount of effort involved in compliance at all. You still have to describe your proposed building in the input language of whatever piece of software you're using and their alternatives. And then you push the button and the software comes back and says you either pass or you don't pass. And if you don't pass, you have to put in some measure that will, you know, make you pass.

And so adding metrics of changing those metrics doesn't change the difficulty of complying. It might change how expensive those measures are that you have to put in, but that's -- you know, that's different from making it hard to comply.

MR. SHIRAKH: Let me explain another way. In the past we used compliance margin, percent compliance margin, to determine if -- and that was based on TDV -- to determine if a building passes or not. And that hasn't changed. If a building has a positive compliance margin, it will also pass the EDR criteria, so I agree with Bill that that's not making the standards really -- mechanism any harder or easier.

The only difference is that on the EDR score, you can tell how close you are the zero. You know it kind of gives you an index, a performance index, you know when you buy a refrigerator or something and it says this shall performance this way. It's like miles per gallon. So it's not making compliance harder or more difficult, but it conveys an additional information like the MPG for cars.

Now we are adding a second EDR, EDR1, which is the source energy for the next 2022 -- 2022 cycle. I think that's part of the decarbonization strategy. And that will actually limit some tradeoffs. So, you know, if you are making tradeoffs in a building it has to be features that does not increase the natural gas emissions from the home.

But as Bruce explained, this is all done under the hood. You describe your building as you always had. You know, if it's a prescriptive building, close to it, it should pass. And then you can do tradeoffs like you've always done.

THE MODERATOR: Okay. Clifton, I can unmute you now. I'll go ahead and do that and you can state your question or if you have -- if we answered it. If no, if not, --

MR. LEMON: You guys generally answered my question. Part of that question was: The EDR mechanism seems to be new, is that correct, or how long has it been used?

MR. SHIRAKH: It's been -- it's actually the first time. It's in the 2019 code, which just went into effect about three months ago.

MR. LEMON: Right.

MR. SHIRAKH: And so that's the first time it's been used and it will continue in the next code cycle. Pretty much the same, maybe one more parameter added to it.

MR. LEMON: All right. So what you're saying is that the way builders already comply, this doesn't add much, it's just a slightly different way of looking at how they need to comply?

MR. SHIRAKH: In addition -- in addition, it communicates additional information. In addition to saying that you passed, it also tells you like, you know, what is the mile per gallon for this home, EDR is part of --

MR. LEMON: Yeah, right, right.

MR. SHIRAKH: -- 20 is much better than the EDR score at 40.

MR. LEMON: Yeah. So they can turn the dials on the things that they can change to get to compliance.

MR. SHIRAKH: Right.

MR. LEMON: Okay. Another question I have is how you calculated the cost-effectiveness of the standard model of the EDR. I assume you're using current cost-effective metrics than we are in the process right now, in this code cycle, and taking a deep look at these cost-effective metrics. Can you comment on that at all?

MR. WILCOX: Well, that's --

MR. SHIRAKH: Oh, --

MR. WILCOX: -- actually part -- that's not actually part of this presentation at all, so that will be done -- there's a whole series of stakeholder meetings that are going on led by the case utility teams and so forth. And, you know, the context here is that those case teams use these TDV values for assessing lifecycle cost of measures, but there's nothing here about the cost of measures. That's all done by the people proposing the measures, so.

MR. LEMON: Let me see if I can get this thing, --

MR. SHIRAKH: Actually --

MR. LEMON: -- so when the -- when the -- when we have agreed on cost-effectiveness in measures, and those apply to the standard EDR model, correct?

MR. SHIRAKH: Yeah. You know when we did this type of measure, it's cost-effective, again the cost-effective determination is totally independent of the EDR. It is done like we've always done it. We use TDV to determine if a measure is cost-effective or not.

And let's assume that, you know, there is a new measure. It's like triple-pane windows. I'm just using it as an example. That is determined to be cost-effective, it becomes a prescriptive requirement as part of the standard base line. And that's where the EDR will be based on. And then when you build a building, you know, if you put in triple-pane windows, then you meet that requirement. If you don't, then you have to do tradeoffs like you've always done. So most of those things do not really change under this scheme.

Bruce, did you want to add to that?

MR. WILCOX: No. I think -- I think that's fine, Mazi.

MR. LEMON: Thank you.

THE MODERATOR: Okay. George, you're up next. I'm going to unmute you now. Go ahead and state your name and affiliation. Thanks.

MR. NESBITT: George Nesbitt, HERS rater.

THE MODERATOR: Hi, George.

MR. NESBITT: Thanks.

Bruce, thanks for the presentation. I'm not surprised by, I guess, any of the results. They seem to make sense based on the various changes and what you'd expect.

I do and I sell it for a long time, I do believe that time-dependent value is a good metric for determining cost-effectiveness. I don't believe it's a good metric for code compliance. And I think some of the things we're seeing is because TDV is essentially an hourly time-of-use price metric.

So as far as the -- you didn't show any results for EDR1. That may be just because there's no change, but there is certainly a relationship between EDR2 and EDR1.

And as far as the retail adder devaluing PV, I don't see that as a problem because I think between net metering version 1 and 2 we saw a devaluing of PV in the time-of-use rates. And as we put more PV on the grid and we have more excess production at times of day and times of year, we will see that value decrease with time. That's -- that's just -- that's a reality.

And so the fact that batteries are now given more credit is a reflection of over production in mid-day and the need to shift load. So another way to look at the batteries is any load-shifting measure: Heat pump water heaters, precooling, whatever it is, the battery is a reflection of that. And I don't see in any of that that we are disincentivizing efficiency, which is another way to achieve some of the same goals. So I really -- you know, I really don't see a problem with going to an adjustable retail adder. Thanks.

MR. SHIRAKH: Thank you, George.

Any other questions?

THE MODERATOR: Yes.

Pierre, I'm going to unmute you. Now you're -- you're next, you're unmute now. Go ahead and state your name and affiliation.

MR. DELFORGE: Pierre Delforge, Natural Resources Defense Council.

Thank you for the presentation. And I am going to address the question about the should we go for the second defense scaled retail rate adder. I agree with George's comments previously around, you know, the changing value of PV versus batteries or storage and, more generally, in terms of load management. I know this is a priority at the Commission and I think rightly so. And having a sliding scale retail rate adder will improve the value of load-management measures such as heat pump water heater, load shifting, heating, precooling, and will spur the market to meet this demand and made -- and make building built under the code more grid friendly. So I think it's a really important signal to give and, you know, to be able to value these measures. So I think second design is a motion due. We may -- I realize that there are some challenges going much further than that, but I think at the minimum we should be doing in this code cycle. Thank you.

MR. SHIRAKH: This is Mazi. Just to make a clarification that, you know, we showed the results of what happens with the retail adder, 15 percent in the flat when it comes to batteries. But I think both Pierre and George hit it on the head that I take it just not about battery storage, it's about all sorts of storage and demand response. So thank you for that clarification, Pierre and George.

MR. DELFORGE: Mazi, if I may --

THE MODERATOR: Okay.

MR. DELFORGE: -- and everybody, sorry, if I may add one comment? This is Pierre again obviously.

It's definitely a question. We talk a lot about the TDV signal here, but another key component in terms of how the code is going to incentivize decarbonization is what are the center designs and baselines and whether they're going to vary by fuel, whether you have a signal base line across fuel or with separate ones. And I wonder when the Commission will be able to share its thinking about how it's going to propose to address it in the 2020 code cycle?

MR. SHIRAKH: So you know we talked about this at the last workshop. You know we didn't really put it on the slide, but I can briefly mention that to really kick electrification and decarbonization into high gear we need to have a single baseline. For 2020, we will still have a double baseline for low-rise residential buildings, but we can go to a single baseline for nonresidential and high-rise multi-family.

When we do go to a single baseline, we have several options on how fast or how slow or measured we want to proceed towards decarbonization. One proposal is to start with a mixed-fuel home, as Bruce just described, where water heating, space heating, cooking, all of that is natural gas; and then flip one or two or all three of those -- there's actually four, there's laundry too -- either one or two or three or all four of them from natural gas to electricity and establish a carbon footprint and enforce that through EDR1. I would expect that it would be a more measured approach where, you know, we take, for instance, water heating and flip that to -- to be a heat pump water heater and establish a carbon budget based on that and enforce it through EDR1.

So those are for the future. We do have the mechanisms and the structure for it. We need to extend it to nonresidential buildings, the way we set it up for Res, and so that part of it is going to be something we're going to be doing in the next few months, addressing and developing the approach for nonres buildings. Thanks.

MR. BOZORGCHAMI: Okay, Mazi, --

THE MODERATOR: Next -- or go ahead, Payam.

MR. BOZORGCHAMI: Mazi, I have Mike Hodson (phonetic) asking a question and -- one second, I just lost it -- sorry.

MR. HODSON: The software, when will it be available?

MR. BOZORGCHAMI: Yeah. When will the software be available for -- for them to try it out for the residential analysis?

MR. SHIRAKH: We do have -- I think, Bruce, you're in a better position to answer that, but I think you are working on the research for the 2022. And it's --

MR. WILCOX: Well, we've already released an initial research version and we have a goal to release another upgraded -- or update of that soon. And so I don't have an exact schedule, but soon, I guess is where we are.

MR. SHIRAKH: Is soon good enough for you, Mike?

Okay. So any other questions?

THE MODERATOR: Yeah, we have some questions in the Q&A about the gas leakage.

Bruce, do you think you can clarify. So the gas that is leaking, is that from heat pumps and gas systems? Is it -- we discussed --

MR. WILCOX: I can clar- --

THE MODERATOR: Yeah.

MR. WILCOX: I can clarify that. The only leakage that we considered in this analysis is the proposed methane leakage that was discussed at length in the previous presentation, the .7 percent inside the building. And that was what --

THE MODERATOR: That's in the gas system, right?

MR. WILCOX: Yeah, that's only from natural gas. There is no -- no leakage considered here for refrigerant leakage from compressors or any of that, so.

THE MODERATOR: Okay. Okay, perfect.

So, let's see, Jon, you're up next. I'm going to unmute you now. Go ahead and state your name and affiliation.

MR. MCHUGH: Sure. This is Jon McHugh from McHugh Energy.

I just wanted to highlight, it's not only a question but just the value of the EDR metric. The EDR metric allows someone, especially from marketing, to describe the relevant efficiency of their home in California. So if you're a builder you're able to describe the efficiency of your home relative to a home in another state because these are, you know, somewhat comparable to the national RESNET rating.

And the EDR2 would allow you to say, you know, approximately this is -- you're able to look at what are the reduction in utility bills relative to a home that you might have bought in another state with a different RESNET rating. And, similarly for EDR1, you could -- you can roughly compare the reduction in emissions or source energy from your home relative to that home built in another state. And so ideally this is a good marketing material or use for builders to show that, you know, these standards actually provide value to their clients. Thanks.

MR. SHIRAKH: Hi. This is Mazi. I totally agree with that. And it's a really good marketing tool to really differentiate good construction practices, efficient construction practices from, you know, other products and from existing home market too. So it is a lot like miles per gallon the way it is used, so.

THE MODERATOR: All right. Ted, you're up next. I'm going to unmute you now. Go ahead and state your name and affiliation. Thank you.

MR. TIFFANY: Yeah. Hi. Ted Tiffany with Guttmann & Blaevoet Consulting Engineers.

Bruce, thanks for all the hard work on this. I got a question: If you had investigated the higher leakage rates for methane in the system? And I know that's going to be, you know, not really relative to what we've got, a baseline equivalent for gas and then electric, but it is going to make a bigger difference, I think, in the single gas space only for nonresidential. So can you give me your thoughts on that and how you guys arrived at that .7 instead of some of the higher leakage rates that would include kind of the source leakage rates out of state, like we do for electricity?

MR. WILCOX: So thanks for the question. This is

Bruce Wilcox. I actually had nothing to do with that estimate and I was -- I don't know maybe as an aside here, I probably shouldn't say this, but I was as shocked anybody. So that was all done by the people you've heard from before, so we had nothing to do with investigating leakage.

MR. TIFFANY: So, Mazi, did -- was there any discussion or investigation on the higher leakage rates for methane in the system and using those higher values in this exercise?

MR. SHIRAKH: I think that this is a Bill Pennington question because Bill is --

MR. PENNINGTON: Well, I think you can look at it -- so, Bruce, could you pull up a slide that shows the methane, you know, versus not in a slide?

MR. WILCOX: There it is.

MR. PENNINGTON: So it's the difference between the orange bar and the gray bar. So that -- so if you look in climate zone 10 and you look at the line through climate zone 10, the line is pretty much on the top of the orange bar. And you can see the difference in the gray bar above that.

So the .7, that's what the .7 looks like.

MR. TIFFANY: Right.

MR. PENNINGTON: And then the highest value that's out there or at least the aberrant study is a nominallyreferred to study. That's about three to four times bigger than the .7. And that, you know, is the study that says this is all anomalous and we have to go fix the infrastructure, it's the horrible thing (phonetic). And so if you multiplied that gray sliver above the line there by three, you would be pretty much at the maximum estimates for total infrastructure leakage.

And Bruce was saying he thought that this amount was insignificant, the multiplied by the highest value that has been talked about would make it insignificant times three.

MR. WILCOX: So let me clarify that. I'm not saying we shouldn't do it, I'm just saying if you could -- if we put it in, it wouldn't change any of the results from here on with the current number, so I just was trying to make it easier to look at the graphs.

MR. TIFFANY: Yeah, --

MR. PENNINGTON: That was what I was trying to do also.

MR. TIFFANY: And -- and that's fine in terms of the relative values, but I think, you know, the CEC down then and Commissioners should be really looking out to those out-of-state impacts. And definitely as Pierre said on the 20-year-time horizon because, you know, the building standards that we're putting in place will affect buildings for that 2030 year timeline that we're talking about. So if -- if we -- we need to apply that 20-year cycle rather than the 100-year cycle because we're not buildings that are 100-year buildings anymore. You know, we're buildings that are, you know, 30-, 40-year-cycle buildings.

So please reconsider doing this analysis based on that, using a higher leakage rate. And, you know, that said we've got a fuel-neutral baseline for residential, so this looks really different for nonresidential, that we need to get some window into. I think we're not seeing the whole picture of the comparisons.

So thanks for all your hard work and I appreciate the consideration.

MR. PRICE: So this is Snu Price at E3.

I was thinking that it might be useful to just do a quick kind of comment on this, just to remind everyone. When we're looking at the TDVs of natural gas, it's really a cost metric and it's got all of the costs included, including, you know, delivery through the whole pipeline and system. It isn't showing stacked bars of, you know, the impact of climate, on the climate of natural gas, for example. That's included as a share of the cost, but there is also all of the other costs that wouldn't be changed with the change in the assumption, either the leakage rate or the 20-year.

So I just wanted to put a little context if folks feel or are expecting that even with those changes it would have a really big impact, it's not as big as you might think because of the total cost of delivered gas type of metric. So I just wanted to kind of explain a little bit why it doesn't peak up as much as some people might think.

MR. TIFFANY: Snu, this is Ted again.

Just to clarify then, are we including the infrastructure costs and decommissioning and stranded-assets costs in that, does deliv- --

MR. PRICE: Yes, all that's in here. That is correct. So this is -- this is essentially, just like on the electric side, a forecast of somebody's natural gas bill. And we have included in that a cost of CO2 equivalent emissions, but you know that's just a share, I think about 25 percent.

The cost of the stranded-asset piece just is in our forecast we assume the gas company is collecting all of their costs of depreciation of their assets despite their lower volume. So that just increases the retail rate. It's not like we're riding off assets in the stranded-asset case. We're just assuming basically that the utility will collect the cost it needs to recover that.

MR. TIFFANY: That kind of mentions the assumption, but thanks for your response. I appreciate it.

Thanks.

THE MODERATOR: Okay, we have two follow-up questions. Jon and then -- you now go ahead and state your name and affiliation.

Jon, are you there?

MR. MCHUGH: Oh, I forgot to put down my hand. Sorry.

THE MODERATOR: Okay. George, you're unmuted now. Go ahead and state your question.

MR. NESBITT: George Nesbitt. I want to go back to the source energy metric, just in part because it wasn't presented and it is sort of relevant. And question, my first question on it: Is it also a 30-year average as is the TDV?

MR. SHIRAKH: It's a longterm marginal cost of electricity. I'm sorry. Yeah, but I'll let either Michael or Snu respond to that.

MR. PRICE: Yeah. So -- you can jump in here too, Mike. But, yeah, essentially it's the same -- it's the same process as, you know, basically the 30-year assumption. Assuming each year, you know, basically it's the same house, same weather every year for 30 years. The system that's supplying the energy changes over time and each year according to our, you know, forecast. So the marginal resources on the system to provide electricity vary as we move out toward an SC100 (phonetic) world and it gets averaged back.

MR. NESBITT: This is George again. So is it actually then source energy and/or carbon or is it cost?

MR. SHIRAKH: It's --

MR. NESBITT: For energy --

MR. SHIRAKH: It's carbon, it's not cost.

MR. NESBITT: Okay. This is George. Yeah. Should then the source energy or the EDR1 reflect -- does it reflect things like natural gas leakage as well as refrigerant leakage on the electric side? Would that then not be more reflected directly there than it is in TDV?

MR. SHIRAKH: I'll let Snu answer that.

MR. PRICE: Well, it's source energy. It's not carbon for some arcane reasons around federal preemption. So it's just the energy content. And really if you look at it either on the natural gas side, natural gas use in the building, or on the electricity side it's really natural gas use in the powerplants, so either way it is, it's the energy content of the natural gas that combusted to provide the energy on both sides, either side of the equation. But it's just a direct emis- -- it's just the direct source energy of the natural gas, no leakage.

MR. NESBITT: Okay, this is George. Yeah, I mean it seems like if -- if we're adding things in on the TDV side, those should also be reflected on the source energy side to make things sort of equal.

But -- and I guess one of my hesitations about electrification, I'm just going to say it now, is so Germany -- after the tsunami in Japan, Germany shut down the nuclear powerplants and they went to the dirtiest coal they could, and they have not reduced their emissions. And Japan closed down its nuclear powerplants and also in part went to coal.

My worry about the push to electrification in the source energy is the question, you know, being is it more polluting today to go to electricity than it is from natural gas versus that 30-year average? So that's sort of one of my -- one of my hesitations on -- on that topic. So thanks.

MR. SHIRAKH: Not in this state, no. I mean we have very few. Diablo Canyon is still out there, but that's forecasted to be decommissioned in 2025. And so after that, you know, we're relying more on renewables than anything else. So who knows, I mean nobody forecasted this virus four months ago.

But it's very unlikely. I think our electric grid is getting cleaner by the month and it will continue to do so. So switching away from natural gas to electricity will definitely reduce carbon emissions -- even today, as the grid is today.

THE MODERATOR: Okay, we have a comment from Sean Armstrong.

I'm going to go ahead and unmute you now. Please state your name and affiliation.

MR. ARMSTRONG: Sean Armstrong with Redwood Energy. Thanks.

To that previous question, there have been a number of analyses of this, but it's simple. The Department of Energy issues a conversion ratio for site and source. So if it's a hundred percent fossil fuels, then the efficiency of the device you're using needs to be greater than a COP of three. And most heat pumps now are greater than C -- than three. The federal minimums aren't, but most of the ones actually on the market are COPs of three to four and a half. The Sanden is a COP of, at worst in the wintertime, is 3.5 and during the summer it's 5 or greater.

Rheem heat pump water heaters similarly in the summertime have a COP of six and in the wintertime have a COP of like two, two and a half. So there will be some seasonal valuations, you have to say, is like what is the seasonal COP of this device and what is its fuel mix. But, fundamentally, you could burn a -- of coal and if you had a reasonably-efficient heat pump, it would be less polluting overall.

In Japan, as you pointed out, which is using a lot of coal, that's also the center of innovation of heat pumps. That's one of the reasons they adopt heat pumps, because all their COPs are three to seven. They definitely produce less pollution using electricity with their coal by using a COP of a three or greater heat pump. So it's been proven out in Japan in the actual circumstance you're talking about. So we can proceed with electrification without increasing pollution as long as we use a COP or greater of three, and with coal. That's all.

THE MODERATOR: Okay, thanks, Sean.

Let's see, Nehemiah, I see your hand's up. Do you want to make a comment now? You're unmuted.

MR. STONE: Yeah, it looks like we've gone into the general question. So I'd like to ask a question about -- related to Mike's slide number 5. Do you want to pull that up first or do you want me to go ahead and ask?

MR. PENNINGTON: So, Nehemiah, this is Bill. So we have a whole another presentation here on nonresidential that I think comes before the general questions.

MR. SHIRAKH: Yeah. I mean let's -- let's go to that before we go to general discussion. I do have a question from Bob Branaird, came through text. And he says: Will the base case mixed-fuel home in 2019 comply with the regs in 2022? The answer is: Yes, we're not proposing any changes to the prescriptive requirements.

Having said that, though, since we're changing the TDVs, the tradeoffs might have -- be different under 2022 because different measures will get different credits when we switch TDVs, but the prescriptive requirements will not change.

THE MODERATOR: All right. Sorry about that. I mean part of the problem is we can only show Bruce's presentation right now, so we're going to do all general after -- after the NORESCO presentation in a minute.

It looks like we've got everybody at this point, so we can move onto the next presentation if you guys want.

Mazi, are you ready to move onto Roger?

MR. SHIRAKH: I am.

THE MODERATOR: Okay. All right, Roger, I'm passing the baton to you.

MR. HEDRICK: Okay. Thanks, everyone.

So I am going to -- so this is Roger Hedrick. I'm with NORESCO. I am the technical lead on the commercial software, CBECC-Com. And so I'll be talking about, similar to what Bruce was just doing, but the impacts on nonresidential projects. Let me show the slide. There we go.

THE MODERATOR: Oh, perfect. Thank you.

MR. HEDRICK: Yeah. Sorry.

So we did a whole bunch of simulations of eight different buildings and all different, all 16 climate zones using both the 2022 weather files and the 2019 weather files. And we were really looking at what will be the effects of the new metrics, meaning source and the 2022 TDV option, one of the TDV options, compared to what you would have gotten -- what would have been your results in 2019 with the 2019 TDV.

In particular we're looking at the effects of switching from gas heat to some sort of electric heat, so we've got multiple system types for each of those buildings, which include a mix of both gas heat -- gas heat options and electric heat options. And then we also looked at some selected potential efficiency measures that might be used to -- that might be traded off against the impacts of those system switches.

In particular we wanted to look at what the -- you know, if someone wanted to reduce the envelope efficiency by trading off against increased -- against a system choice change or increased heating and cooling efficiency, how would that tradeoff look.

And then, finally, we -- we tried to look a little bit at PV and battery and the grid harmonization signals that would result.

So just like Bruce, we have -- we were given files that gave us four TDV variants and two source variants.

Although it turns out that the source energy variants are actually not variants. They're identical. So I'll only be talking about source in here. But we have the same TDV with zero-percent adder or 15-percent adder and then with or without CH4 leakage in the gas portion of the TDV. And so the CH4 leakage only applies to the gas portion of the TDV calculation, so if there is no gas then there's no difference, as Bruce showed.

And so just as sort of a comparison, I plotted the annual average value by time of day in climate zone 12 of electricity of the source energy, which is the blue line, 2019 TDV, and then the 2022 with and without -- or with the zero- and 15-percent retail adders. And so the takeaway here is that, A, the 2019 TDV is higher during the middle of the day and the 2022 TDVs are lower during the middle of the day, particularly the 15-percent adder is lower than the zero-percent adder. But then in the evening when that -- when the PV generation goes away, now the 15-percent TDV adder goes higher, the 2019 TDV was higher still with -- with the zero-percent at or being slightly lower.

But I wanted to point out that the source metric, the percentage changed from middle of the day to evening is larger than you get with this -- with the TDV change. So -- you know, so this is about two and a half times as high as the middle-of-the-day value, whereas this is -- or five times as high, you know, evening versus mid-day.

Now I will caveat that in that this is an average and TDV is more variable over -- you know, by day, and so you will have days when these TDV values go much higher than this average, so.

But this is a general -- a good thing to keep this sort of pattern in mind as we look at some of the detailed results that I'll be showing.

So what we did is I've selected the results from certain buildings. I'm using climate zone 12 in general, just because, you know, I have a lot of results and I have to narrow it down. So this is for a large office building. And what I'm showing here is the change in compliance margin that you get if you make a switch. And so the baseline case here, the baseline system is a built-up variable air line system with chilled water, coils, and hot water coils supplied by electric chillers and gas boilers. And so, you know, we don't have any of the EDR stuff currently in the -- on the commercial side. We're just -- we do a simulation with a baseline building, which is -- has many characteristics based on prescriptive requirements, although the system is always -- the HVAC system is selected following a system map, which may well be different from the proposed design system.

We always use gas heat in the baseline. And although water heating depends -- most -- many of the commercial buildings in the baseline will have two water heating systems: An electric water heater for -- for spaces where electric -- for water heat -- hot water heat is low, so just office, versus they will get a gas water heater for space types where water heating -- hot water consumption is high. So athletic facilities, kitchens, hospitals will get gas water heaters. And if you have a mix of offices and low -- and high-consumption spaces, you will get both, a gas water heating system and an electric water heating system in the baseline. So -- so that's the baseline case here.

And then I've got -- so now I've got a gas VAV, which is similar to that although it's all gas water heat, and so it's almost the same. So we have very small compliance margins.

Then I'm comparing to a water source heat pump system, which is primarily electric heat. You've got a heat pump in each of the zones. Although in this case you do have a gas boiler that is the backup on the water loop. So if all the zones are in heating, the water loop will get colder and colder. And so eventually the boiler will come on to maintain a minimum temperature on that loop. And so eventually you do get some gas heat, but primarily the space heat is electric.

And so in this case -- so I'm showing -- the solid-color bars here are showing the compliance margin for the different metrics, so the dark red is 2019 TDV. And you will see that the 2020 TDVs, you get less of a penalty for going -- for making the switch from this gas VAV to the source heat pump system, but it is a penalty still in TDV for all four of those.

As with Bruce's results, you will notice that the differences between any of these flavors of 2022 TDV are quite small. And so whichever -- any one of these you will make the same decision when you are making a design choice. no matter which one of these TDVs you use, the results of the building design are not going to be affected by a different choice of the TDV metric. But we're not adding the source energy metric, and what this is shows is that switching from the gas heat to the water source heat pump gives us this large increase in -- in source energy compliance margins. So now we have a more positive compliance margin there.

I have added these empty boxes, just outline boxes. These are showing -- these plot on the right-hand margin here, and they show a difference in electricity consumption relative to the baseline, in terms of Btus -- kBtus here -- or gas. And so if I'm making the switch from the baseline to the source for heat pump system, we're increasing our electricity consumption by some value here, one and a half, 1.7 million kBtus. But we're reducing our gas consumption by 2.8, or something.

And so -- so that increase in gas usage is why we're showing this negative compliance margin in TDV. And actually that -- that increase will also give us a compliance margin in the electric portion of the source energy as well, but the savings in gas offsets that increase in source energy, and so we get this -- this increase in compliance margin for the gas.

And so what this means is that if I make a design choice as I'm designing my building to use a water source heat pump system, then I would need to do something in addition in order to improve my TDV results to get them to be above the zero line here. And so that's going to be -- so I'm going to have to look at some other efficiency measure to improve this TDV. And so I need to do something to improve the -- to reduce that TDV deficit.

In comparison, one of the other systems I looked at is a four-pipe fan coil system, which again uses hot water and chill water coils, but these are with -- you have a small fan unit in each zone. And that's going to be a constant-volume fan that will cycle on load.

You also have a different -- a separate system which is supplying ventilation, the dual system. And that system runs continuously. It also has hot water and chill water coils for -- to temper that air. And so in this case I have a negative -- I'm increasing my electricity consumption. That's largely due to additional fan power, compared to the VAV system. And I'm also increasing my -- my gas consumption. And I haven't really thought about exactly why that is, but I think it has to do with the fact that I still have a constant amount of air and the integration of the outdoor air and -- you know, I don't -- I can't reset my cooling fixture (phonetic). It's just the way the system works is enough different that I end up increasing my gas consumption a little bit.

And so in this case I am seeing negative -- you know, increased negative compliance margins in all of the metrics. The TDV, the five different TDVs are almost the same, but because I'm increasing both gas and electricity consumption my source energy goes down quite a bit.

So now in this case I still need to -- you know, if I make the -- if I decide to use this system, again I will need to do some other change to my design to increase the efficiency of that design, but if that efficiency change has equal impact on TDV and source, I'll need to do something extra. You know, so here I have to increase the efficiency so I get my TDV to zero. Now increasing the efficiency to get to the TDV to zero is not going to be adequate. I have to do something more still to get source energy to zero, because in the 2022, the proposed 2022 software at least at this point you -- the baseline gives you a TDV level and a source level of consumption, and your proposed design has to be better in both of those and you can't trade off between the two. So you're going to have to get them both better than the baseline.

Moving on, the next option that we looked at here, these two are all electric options. And so this electric VAV is similar to the gas VAV or the baseline, except that instead of a gas boiler to do a reheat, we have electric-resistance coils in the VAV boxes in each zone. And so you see a reduction -- you know, another increase in electricity consumption here because you're creating heat from gas for heat by electricity. And so again our -- we see this negative TDV compliance margin, but because we're saving the gas that we were using, so even though this increased electricity consumption would give us negative source energy, the decrease in gas consumption brings that back up to a positive compliance margin.

So, again, with this electric heat case and with this one as well, the efficiency changes that you need to make in the design will be focused on increasing that TDV.

And then, finally, this water source heat pump. This is the same as this water source heat pump over here except that we have an electric boiler on the -- on the loop. And you can see that our energy savings are almost the same between these two, which tells me that the boiler is doing very little of the heating in this case. You -- one of the advantages of a water source heat pump system is that because a zone that's in cooling is adding heat to the loop while a zone that's in heating is pulling it back out, ideally if you have a mix of heating and cooling zones, which you often will on a large commercial building such as this large office, then you don't need to do very much to maintain room temperature. And so that's why we see very little impact of the boiler switch here.

So the next case I have is a small office. So this is a single-story, 5,000-square-foot office building. And so because we have access to the roof we have more system options. In this case the baseline is a single-zone air conditioner rooftop unit which has a DX cooling coil and a gas furnace for heat. It has a constant-volume fan. And so, again, this single-zone AC option is very close to that.

Then our next case is a single -- it's essentially the same system except that we have a variable-volume fan in it. And so we get significant reduction in electricity use. Our blue box here is positive. We're saving electricity. But that savings in electricity, you know, that electricity of fan power is adding heat, and so by reducing that we have to increase our gas consumption a little bit to offset it.

And so that's why we see a negative heating value here. But the result of this is that we get significant -- you know, increased, improved compliance margins in all our metrics but particularly in the TDV metrics and especially in our -- again, there is very little difference between the 2022 layers, but they are all somewhat better than in 2019. This may also be partly due to the weather change. It's difficult to separate -- you know, this case was run and the baseline that I'm comparing this one to was run with 2019 weather, while these five were run with the 2022 weather as was the baseline that they're being compared to.

So the differences here are due both to the metric change and to the weather change and it's difficult to separate them out.

These other case -- so the next one here is a gas rooftop VAV unit. And so we see results that are similar to what we saw with the single-zone VAV, but because this is serving all the zones at once you get somewhat less variation in air flow and so you get somewhat less TDV savings, less electricity savings.

Again we're showing a water source heat pump option and we get ever better savings. And so this is largely due to the heat pump is rejecting heat to the water loop which is cooler often than the outdoor air and so it can operate more efficiently than these DX systems rejecting heat to the outdoor -- to the ambient air. And so we see even better savings. We even see gas savings in this case. And so because we had those gas savings, our source energy savings are much higher than we saw over on these two cases.

A four-pipe fan coil is somewhat less efficient. These are constant-volume fans, so we don't get the savings we saw over here, but we do get savings. And, again, TDV gets more TDV savings than we do source because this is a gas hearing option.

Then the last four are the all-electric options. This one is the same kind -- the single-zone heat pump rooftop unit is very similar to the single-zone air conditioner except that it has a heat pump coil with electric-resistant backup instead of a gas furnace. And also we have an electric water heater in this case, although water heating in this -- this building is very, very small. So it has almost no impact on any of these things.

But, again, we see an increase in electricity because we're switching to electric heat and a reduction in gas. And so that's what we see here. Our TDV changes are quite small, but our source energy goes up. We get a benefit in source energy by making the switch.

And then these are all-electric options. So, again, this is similar to the single-zone VAV air conditioner exception it's heat pump heating instead of gas furnace. And so we see savings in both gas and electricity due to fan energy and the switch to electric heat. So the fan energy is more than offsetting the -- so over here we see the fan energy savings are up here at the 30 percent. Here we've got fan energy savings and then it comes back down by the electric heat. And so the difference between these two is essentially the electric heat penalty, but it's clearly a win compared to the single-zone AC. And, again, we get the gas. You know, all four of these gas boxes are the same because this is how much gas energy we used in this base case, and it's all going away.

The water source heat pump. The same kind of result we saw on the -- on the large office. They're identical results, essentially. And -- and then this is a VRS system, which we didn't see before.

So this is an all-electric system as well. Variable-refrigerant flow systems. We see some good electricity savings with this as well as getting rid of all our gas.

So, again, all of the all-electric options, you -- the TDV is the one that you -- you know, so potentially if you made one of these system switches, you're getting a compliance benefit in every case, and so you could potentially trade off -- you know, if you switch to this water source heat pump system, you could trade off the efficiency of some other component of the building efficiency, whether that's lighting or envelope, or something else. And so we'll look at that a little bit later.

But you get more benefit -- you have more room in source energy than you do in TDV, so TDV is sort of the limiting criteria for these electric cases. In the gas heat cases it's the opposite. The source, you don't have that much room. And so if you were to trade this off, you -- you can't do any more than would take this source energy to zero.

Another building we have is a retail building. This is our medium retail which is sort of a target kind of building. And so again we have access to the roof, so we have the same, essentially, system options here. Although I don't have a water source heat pump system for this -- this kind of a building, but in this case the baseline is a single-zone DAB. And so you see the similar -- so our single-zone, variable air-volume air conditioner case, again we have -- this case is very similar to the baseline, so our differences are small. But relative compared to the last one, so this -- these differences are about the same, right, and it's just that now this is our zero and these go negative. Instead on these results sort of track with what we just saw with the small office. It's just that our zero point has moved, and so -- so some of these become negative instead of positive because the single-zone VAVs simply performs better than the baseline we used in the small office.

But our trend is the same, and so that is that the electric heat options over here, we see TDV has always -- has a more negative or a smaller compliance margin than source energy, but when we have -- so these are the -- all over here, these last four. And then these three are at our gas heat options. And so in this case our TDV is the more negative and the one that we need to worry about offsetting in some way.

And then, finally, I want to -- we wanted to look at high rise residential case is a little bit more complicated. There's more moving parts. And when we look at a high-res residential case, then -- then an office or a retail building, partly that's because water hearing is more significant in this building and also because -- and because -- and while water hearing is more significant, it's also more complicated because we actually have different -- you know, we have the water -- the baseline water heating in the residential units of this, follow the residential software, the fact that you can use the residential software to do the calculations for the water hearing energy consumption of the residential units. And in that case the baseline fuel type tracks with the proposed.

And so when we have an all-electric building, which is the Class 3, we're putting an electric water heater in the residential units. So our baseline is electric. Whereas when we have a gas option which are these three on the left, we put gas water heaters in the proposed design and then the baseline is also gas.

In addition to that, this building has nonresidential spaces. And so we have different base lines HVAC system types as well as different water hearing so the nonresidential water heating follows the same rules that I talked about before. So the exercised room would gets gas water heating, whereas the office and lobby and other spaces will get an electric water heater. And so we've got three different water heaters as the baseline in each of these cases and that one of those type switches, depending on the fuel type.

In addition to that we have a four-pipe fan coil is the baseline HVC system for the residential units, but we have a built-up VAV system which serves the nonresidential spaces in the baseline. In all of those cases we have a chiller and hot water boiler that's providing the heating and cooling for that, but that -- but because we have a mix of system types in the baseline, we don't have a case here where I -- where I sort of match that baseline. So this -- so this four-pipe fan coil is all four-pipe fan coil. So I've put four-pipe fan coil systems into the nonresidential spaces as well the residential. And so that's why we don't have a case that's close to zero here.

So here we put -- we call it a PTAC, but basically it's an air line with a DX coil and a gas furnace, single-zone unit that is serving each -- each zone. And so because that's a constant-volume fan, again we see this negative fan-energy impact. And just because of the difference in the way that system operates compared to the VAV system and then nonres spaces we also see a small gas penalty. And so all of our metrics are negative here, go negative -- go more negative. But in this case because the gas energy is not changing very much, but we're seeing a significant increase in electricity, our source energy -- we see a fairly substantial increase in source energy here.

If we look at this four-pipe fan coil case, here we're seeing a somewhat larger increase in gas consumption, this red box, and a smaller increase in -- in electricity consumption because we've still got a chiller doing our cooling instead of a DX -- DX units. And so we see a smaller decrease in TDV, but our source energy -- so the source energy -- the gas -- increase in gas consumption would cause this source energy bar to go down, but the -- (coughs) -- sorry -- the smaller -- the better electricity performance brings it back up. And so we see a slight improvement in our source energy relative to this PTAC case.

Then when we move to the water source heat pump, our electricity goes up again relative to four-pipe fan coil, but not quite as much as here because we're -- we've gotten rid of our chiller and we're using those heat pumps, but it's more efficient than this because we're redirecting heat to that water loop and our gas energy has mostly -- has gone up, not all the way here because, you'll see when we get over here, this is how much gas we were using in the baseline. And so we save -- you know, we're not using as much as we used over here, but we're still using some gas. And so our source energy is still down relative to the baseline and our TDV is down as well.

But -- you know, and so -- but now when we go over here, we're -- these are all-electric cases, so in every case we got rid of all of our gas so our gas savings are here. And -- but these different systems use different amounts of electricity and so that's what's driving our differences in TDV here. And so these are two very similar in overall energy use and so you see the TDV is very similar as well.

But in every case our 2019 TDV was -- would have been more negative than what we got with our 2022 metrics.

But again I'll point out that the difference between any of the flavors of TDV, whether it's the CH4 gas leak in the gas portion, so you see a very small difference between the dark and light, green or yellow bars, that's the leakage portion of the gas TDV, and then the retail adder, again, between the yellow and green, very, very small. And so in this case it's even smaller than what Bruce was showing for the residential case largely because most of -- you know we have in these commercial buildings -- no, this is residential so what I'm about to say doesn't apply to this one. But residential is occupied all the time and particularly in the evening, whereas commercial buildings are not. And so -- so if you remember the time-of-day distribution, that evening is when you get a lot of your impact.

So -- finally, so those were all switching HVAC system types and electric versus gas. And so, you know, you -- by making a system switch you get some compliance difference which you can trade off or you have to make up in some way. And so I used a large office here to show the impact of some -- some efficiency measures that might be used to either be traded off or to offset a negative compliance margin. And so that is I reduced -- so these are all independent of each other. And you really can't compare the height of any of these bars between two measures because the magnitude is arbitrary and independent. So -- so, for example, I reduced the lighting power density from 1.1 -- this is a large office, so I started -- the baseline has a 1.1 watt per square foot and I reduced it here to .65. And so I get some change in compliance margin.

If I made it a different value, that .65 was completely arbitrary, if I had said .8 or .4, then these bars would be a different height and so comparing between any of these really doesn't have any meaning. What we're really looking at here is the relative change in TDV versus source. And so what this tells me here is that if I have a gas heat building, right, and I reduce my lighting power density, I get more value -- I get more TDV impact than I do source energy impact, which you would expect because this is an almost purely electricity change. You do get some by reducing your lighting power. You do add the need for some heat, so it's not all electricity but it's mostly electricity. And so TDV is what you see changing more than another.

This next one is I'm changing the heating efficiency of my gas boiler in this case from .8 to .92. And so what I'm mostly seeing here is I'm getting an increase in my TDV -- or in my source energy compliance margin. I don't see a lot of impact on my source energy by my -- sorry. I don't see much impact in TDV, it's most source. So if I had made a system switch and could make a similar -- I mean if I made a system switch I may not have a gas boiler anymore, but if I made -- if I had done something that gave me a source energy penalty, I could offset it by a heating efficiency improvement.

Now in gas, you know you're limited as to how far you can change your efficiency, so magnitude here is pretty well defined. I mean this is -- you can't do much more than that.

The next option was a cooling-efficiency change. And, again, this is an arbitrary change in the efficiency of the chiller. This change in heating efficiency was about 13 percent, and so I used the same 13-percent change in cooling efficiency. And so here, again because this was primarily a reduction in electricity, I see more TDV benefit than I do source in this case. There is zero impact on gas for this case, and so this source change is solely from the reduction in electricity consumption.

The other measures I looked at all had to do with the envelope and concerns that by increasing cooling efficiency, for example, that might allow me to reduce the performance of my envelope. And so what I've done in these last cases is I've reduced the R value in the walls and roof or I've increased the solar heat gain coefficient of the glazing or the U value of the glazing or I increased the window-to-wall ratio. The base -- base case in my proposed design in all of these others use a 20-percent window-to-wall ratio. This is a 40-percent window-to-wall ratio.

And so -- and for these three, I've changed from the prescriptive values, whatever they were, so that's the wall insulation or wall U value is actually the prescriptive value, but the corresponding R value of the insulation, to the mandatory maximum U value or solar heat gain coefficient or U value of the glazing. So -- so this is a change from the prescriptive to the mandatory maximum -- you know, basically the minimum efficiency that's allowed to be used.

And so as you might expect, by increasing the -- sorry -- by reducing the insulation in the walls and roof, I'm increasing my energy consumption, both glass, heating and cooling, and I'm getting negative compliance margins in -- in both TDV and source. But what's interesting is that source is being impacted more negatively than TDV is.

In the solar heat gain coefficient, what happens is I will increase my cooling load and decrease my heating load. And so I see a decrease TDV compliance margin, but an increase in source energy compliance margin because these are all -- this is with our gas heat TAV system with a gas boiler.

Then just like with the wall insulation, the glass U value, we see the same effect although it's larger with these two changes. I mean so the magnitude of these two changes is independent of each other, so you could scale these however you wanted by changing the values to different values. But, again, we see more of an impact in source energy than we do with TDV.

And then, finally, increasing the window-to-wall ratio means we're, you know, adding solar daylighting potentially, but we're also reducing the thermal performance of the envelope because the glazing is less efficient than the opaque wall in terms of reducing heat transfer. And so again we see fully negative in all of our metrics, but mostly particularly so with source.

So by changing -- by adding this source energy metric here what we're doing is we're making it -- we're magnifying the negative consequences of reducing envelope efficiency, which was one of the goals that we wanted in the metric analysis.

MR. SHIRAKH: Roger, --

MR. HEDRICK: Over here -- yeah, go ahead.

MR. SHIRAKH: I have a question.

MR. HEDRICK: Sure.

MR. SHIRAKH: You said you're increasing glass U value. You've got a plus sign in there.

MR. HEDRICK: Right.

MR. SHIRAKH: Yet --

MR. HEDRICK: Means the -- means less thermally efficient. Increases heat transfer.

MR. SHIRAKH: So -- okay. So you're increasing the U factor. That's what it means.

MR. HEDRICK: Right. Right.

MR. SHIRAKH: Okay. So that's where we're getting --

MR. HEDRICK: Right, right.

MR. SHIRAKH: Now down the LPD, when you say minus LPD, it means you are reducing LPD?

MR. HEDRICK: Correct. From 1.1 to .65, so I'm making it more efficient. So the first three are more efficient, the three on the right are less efficient.

MR. SHIRAKH: So then the window-wall ratio, so you're making it less efficient. What is it, you're going from like 20 to 40, is that what you're doing?

MR. HEDRICK: That's right. From 20 to 40, that's -- that would be right. And, generally, the sweet spot for an office building is going to be in the mid twenties somewhere.

MR. SHIRAKH: Okay. All right. I understand. Thank you.

MR. HEDRICK: Yeah. Okay.

And then on the right-hand side it's the exact same changes in these -- in these performances except that

I'm using the gas VAV system, meaning electric resistance reheat in the VAV boxes, as -- and so I'm showing the change from the -- so before I had -- so now in my large office I had a gas VAV system, which is the baseline, but I also had this electric VAV case. So what I'm comparing to is this electric VAV case. So I'm starting with this and then I'm applying those efficiency measures. So they're the same efficiency measures, the reduction in LPD, which gives me somewhat smaller TDV benefit because I'm trading -- I'm now, by reducing this lighting power, I have to offset the heating and I'm doing that now with electricity rather than gas, and so that reduces my TDV savings somewhat. But because it's -- it also increases my source energy a little bit.

In heating efficiency, it's a hundred percent efficient, so there is no change possible here when it's electric resistance heat, so that's why this is zero. And then -- but now when I increase my cooling efficiency, this looks almost identical to this case over here because, again, I'm just increasing the efficiency of my chiller.

But now when I -- when I've got my electric heat case and I reduce the performance of my envelope, what happens is that my -- the -- if you compare between here and here, you'll see that the TDV negative consequences are larger because I've got to make up the reduced efficiency with more electric heat so that consumes more TDV, but I'm using -- you know, but it -- because I'm not increasing my gas consumption, I get somewhat smaller source energy penalty.

SHGC, I get -- I get -- now here I'm trading cooling savings with a heating impact, heating increase, and so my source energy comes down because the heating increase shows up in the TDVs being not as negative as they were over here. So I saved some TDV by -- sorry. I increase my cooling, and so that would bring me down to here. But then by -- the heating impact brings it back up to here, so you see the TDV impact is somewhat less with electric heat, but my source energy savings come down somewhat as well.

And then the U value of my glass gets less efficient. I use more heating and cooling, and so I see the same kind of pattern that I saw here with the envelope and with the insulation change, so my TDV penalty goes up but my source energy, because it's electric, is not as big.

And then window-to-wall ratio. Again, the same kind of pattern, but the penalties are larger in TDV.

Then the last few things is I wanted to compare the impact of PV using these different metrics. And so in order to have a way to compare, what I did is I calculated the TDV impact of a certain size PV system, but then I scaled those impacts of the PV system such that I got the same amount of kWh savings that I got with a cooling-efficiency change. You know, so when I did this case, right, I increased my cooling efficiency by 13 percent and I saved some amount of kWh, which I don't have shown on this graph.

Then I said, okay, if I had a PV system which gave me the exact same kWh savings over the year, produced that much kWh, so I'm ignoring any net metering impacts or anything like that, this is just a PV system that gives -- produces x amount of kWh, I would get a TDV impact, the cooling-efficiency change gives me a TDV with a zero-percent multiplier gives me a 34-ish, but the TDV only gives me 21, or so. If I use the TDV with a 15-percent adder, the difference is magnified a little bit, I get more TDV savings from the -- you know, the TDV savings of the chiller efficiency goes up a little bit and the PV goes down.

And then if I do -- like at source energy, that -- both of them are smaller than we saw over here, but the difference, the relative difference between these two is the largest still. This one, the relative values here are about a factor of two, a little bit under. This is about 1.8. And this is somewhat over 2, almost 2.5. And so you see that the source energy will -- gives you less, values the PV less than it does the cooling efficiency.

Similarly, I wanted to look at PV and battery.

Now we don't have battery in the commercial software. We're actually -- at this point we're using the residential software to do our battery calculations and our PV calculations as well. And so the timing of the battery discharge in a residential building versus a commercial building may not be the same in reality, but what I'm showing here is using that residential software. This is -- they are simple control algorithms, so, you know, Bruce could tell you more about the differences among the control algorithms. He was using a different one from what he showed in the res software. But in order to have some sort of common basis here, I did a PV system and it gave me TDV savings of so much.

And so then I scaled the PV and battery such that the TDV with the zero multiplier were the same and so why that's you see these two as being the same. But then what I -- if you then show the TDV with the 15-percent retail adder, the PV value -- TDV values go down, but the battery goes up significantly, but then in source -- now the numbers in the source here are just smaller than they are in TDV, so these bars are much smaller, but what we want to look at is the relative difference in these.

As you can see, you know, this is equal, this is maybe 20-percent different, 25 percent. This is a factor of, what, eight different. And so source very much credits battery more than it does PV. And whereas TDV was a zero multiplier, credits TDV relative -- or PV relatively more than these other metrics. And then the TDV 15 percent is somewhere in between.

So conclusions. Source energy will help drive electrification and so that's the reason that it's been added here. Whereas TDV will continue to drive cost-effective options, so TDV is a cost metric and so making a design choice which gives you a large TDV penalty is essentially saying you're going to -- you're not -- you know, you don't want to -- we continue to use TDV to make sure that cost-effectiveness remains part of the evaluation of our different options.

It appears that trying to trade off even against other efficiency measures will give you a large source-energy penalty and actually a larger TDV penalty than we saw on the 2019 metrics. And so that will -- both of those will help protect envelope efficiency. And so all the metrics give credit cooling efficiency more than PV, but source energy in particular, and then source energy will magnify the value of battery storage more so than the TDV will. And of course TDV, as we saw before, TDV with the 15-percent adder gives you more credit for battery than -- than does the zero-percent adder.

And then for all of the things we looked at, the difference between the different TDV variances were very, very small, except when we got to that battery question. Only then did we see really a significant difference between TDV zero and TDV 15. And that is all I have.

MR. SHIRAKH: Well, thank you, Roger.

I just had a suggestion. This is 12:34. What if we all take a five-minute break? We've been sitting here for three and a half hours. Let's take a five-minute break. You know, go to the fridge, use the restroom, come back at 12:40. And we'll take your questions from Roger -- we'll ask questions and -- from Roger -- and then we'll go to the public comment. So see you in about six minutes. Thank you.

(Recess taken.)

MR. SHIRAKH: Okay, RJ, are you still there?

MR. BOZORGCHAMI: Mazi, we can hear you fine. I don't know if RJ is available or not, but you are on the line.

MR. SHIRAKH: Okay, okay.

MR. HEDRICK: So while we were on the break I saw one typed question/cross and that was -- this is Roger again -- what software was used. All these simulations were done in Energy Plus 9.0. Energy Plus is used as a simulation engine in CBECC-Com and so all the models started as CBECC models and -- to create our basic input files, and then we modified them in native IDF form to get our different cases. So, for example, changing insulation R values or heating or cooling efficiencies through TDVs, those were all -- those changes were all done in Energy Plus native files.

THE MODERATOR: Mazi, shall we take some questions? I have a few hands raised.

MR. SHIRAKH: Yeah, yeah.

THE MODERATOR: Okay. Sorry.

MR. SHIRAKH: Yeah. Why don't you unmute them. Thank you.

THE MODERATOR: Okay. Nehemiah, I saw -- you're up first, so I'm going to go ahead and unmute you now.

MR. STONE: Okay.

THE MODERATOR: Go ahead and state your name.

MR. STONE: Yup. I have three, I think, fairly quick questions. For high-rise multi-family, Roger, did you look at strictly residential analyses also rather than just representing multi-family that is mixed use?

MR. HEDRICK: No. I used the prototype high-rise residential model that we have, and that is just a mixed use prototype. So I don't really have an easily accessible residential-only model, --

MR. STONE: Okay.

MR. HEDRICK: -- so, yeah.

MR. STONE: Also I didn't see any heat pump only options in the high-rise residential. In other words, a large -- you know, a large heat pump water heater with storage instead of, for example, electric -- an electric-resistant boiler. Did you -- did you --

MR. HEDRICK: So -- so --

MR. STONE: -- elect to look at anything that was all just heat pumps --

MR. HEDRICK: Right. Yeah, yeah.

MR. STONE: -- electric?

MR. HEDRICK: So -- so in this high-rise res model when I have electric heat, electric water heating, those are heat pump water heaters. So all of the all-electric option. So basically --

MR. STONE: So what an electric boiler --

MR. HEDRICK: -- PTHP, that's just a backup boiler on the -- on the water source heat pump loop. And so -- so most of the heating here is heat pump and the water heater is a heat pump water heater in each unit for the residential portion of the building. The same with the PTHP, this is -- well, all three of these. The residential water heater is an individual unit heat pump water heater.

MR. STONE: But the hot water is supplying the water source heat pump loop, comes from an electric boiler, not from the heat pump, correct?

MR. HEDRICK: That's correct, yeah. The backup heat on this -- on this water source heat pump loop is an electric boiler and of course a tooling tower on the cooling side.

MR. STONE: Could you perhaps speak to how much different your results would have been had that been a heat pump instead of electric boiler -- electric boiler?

MR. HEDRICK: Yeah. So -- so that's the case -- so this one over here has a gas boiler but it also has gas storage water heaters in each unit. So the difference between this water source heat pump case here and this one is the electric backup boiler and the switch from gas to electric water heat -- water heating. It's hard to compare these because the baseline is different as well, so the baseline over here is a gas water heater and the baseline here is an electric water heater. So it's hard to -- it's hard to tease those different things out --

MR. STONE: Yeah, I thought that --

MR. HEDRICK: Yeah. Okay. Yeah, go ahead.

MR. STONE: -- like that. What I meant was --

MR. HEDRICK: Okay.

MR. STONE: -- in the last case on the right here, instead of --

MR. HEDRICK: Yeah.

MR. STONE: -- an electric systems boiler you had a heat pump, --

MR. HEDRICK: Oh.

MR. STONE: -- just apply the water source heat pump loop, --

MR. HEDRICK: No, no.

MR. STONE: -- can you speak to what that would have been -- how that might have changed as well?

MR. HEDRICK: I -- I don't know. You know, I don't know. Like I -- you know, when we looked at the commercial buildings, the backup heat on the loop is relatively insignificant. I don't know that that's the case on this building. My suspicion is it's probably more significant here, but I don't really -- in CBECC-Com, we don't have a heat pump option as primary equipment. So I -- we're not able to analyze that in CBECC-Com and I didn't analyze it in Energy Plus, so, no, I can't really comment on that --

MR. STONE: Okay. Last -- last question. On the next slide, slide 8, you also mentioned -- you also say electric heat on the -- in the box on the right-hand side.

MR. HEDRICK: Right.

MR. STONE: Again, that's electric resistance, not a heat pump?

MR. HEDRICK: This -- this is electric resistance, that's right. So this is a VAV system, built-up VAV system with electric reheat, reheat coils in the VAV boxes.

MR. STONE: Why? Sorry, but --

MR. HEDRICK: Well, because -- because my -- you know, if -- if I'm designing -- well, first of all, heating is relatively small in this building, a small portion of the overall load. And so the cost impact versus the energy difference, I think, an electric resistance reheat box is not going to be an unreasonable design choice.

MR. STONE: Okay, that makes sense.

MR. HEDRICK: I don't -- you know, --

MR. STONE: Thank you.

MR. HEDRICK: Yup.

MR. STONE: I have other questions, but they're for Mike, so I'll hold.

MR. HEDRICK: More general, yeah. Okay.

THE MODERATOR: Yeah, we'll do general in a second on the system, yes, and --

MR. STONE: Not so much general as it was for specific right for limitation (phonetic).

THE MODERATOR: Yeah, right. Okay, let's see. Randall, you're up next. I'm going to unmute you. Go ahead and state your name and affiliation.

MR. HIGA: Randall Higa, Southern California Edison.

My question was on the ZE chillers and what was assumed in each case. For high-rise, base case high-rise, larger office or for large office that's a water cool chiller?

MR. HEDRICK: Yeah, yeah.

MR. HIGA: But for the other cases where you have four-pipe fan coils, and there's a few different situations using that, including high-rise residential, et cetera, are those considered to be ultra water source or does it depend on the number of stories and the type of occupancy?

MR. HEDRICK: Right. So in the baseline it's always water cooled and depending on the size of the building, it would -- it might be a positive displacement instead of centrifugal, but it's always water cooled.

And I don't -- and so in my alternative cases, they're also all water cooled, so I don't have any air-cooled chillers in here. Clearly that would be a valid design choice in smaller buildings, but I didn't -- I didn't include it.

MR. HIGA: So specifically the small office would --

MR. HEDRICK: Oh, yeah, there --

MR. HIGA: -- would also be a water cooled, is that --

MR. HEDRICK: There's no chiller option here. There's no chiller option in the small office. This is all rooftop units or, you know, this gas PVAV, that's a packaged VAV rooftop unit with DX cooling, so there is no chiller case here. I do have a water loop --

MR. HIGA: -- fan coil, --

MR. HEDRICK: Oh, yeah, yeah.

MR. HIGA: You have four-pipe fan coil, so --

MR. HEDRICK: Oh, yeah, you're right.

MR. HIGA: -- so is that air cooled --

MR. HEDRICK: Oh, yeah, you're right.

MR. HIGA: -- or water cooled? Positive or centrifugal? Pau- -- yeah.

MR. HEDRICK: Um, --

MR. HIGA: I'm just curious.

MR. HEDRICK: You know, I don't remember. I would have to look. I set these up for the -- for the workshop in October, and I don't remember now. Might -- a good question. I'm sorry, I don't know the answer.

MR. HIGA: Okay. Yeah.

MR. HEDRICK: Yeah.

THE MODERATOR: One question in the Q&A, Roger.

MR. HEDRICK: Yeah.

THE MODERATOR: Where can stakeholders find like the list of equipment for these buildings, like for each option? Would that be like the ASM or can we send --

MR. HEDRICK: Well, --

THE MODERATOR: -- or publish something to the docket maybe?

MR. HEDRICK: I mean the ASM describes the baseline, but all of these alternative cases are just -- you know, I switched to some types in CBECC-Com and generated Energy Plus files from that switch. And so -- excuse me. In CBECC-Com we have an auto-efficiency option for noncompliance cases. And so we use that and so essentially our default rules for the system for the equipment type and capacity were used to set the efficiency, which are generally based on prescriptive requirements for that kind of equipment, so.

THE MODERATOR: I know we used to have like a system -- like the summaries of each system type in the ASM, and it's not there anymore. But --

MR. HEDRICK: Right.

THE MODERATOR: -- could you do something similar to that for the ones you used in this presentation that we could post?

MR. HEDRICK: I don't know that I have a summary like that put together. You know, I could put one together if it's deemed worthwhile. If it's not, you know.

THE MODERATOR: Okay. We have another question, so from Pierre.

I'm going to unmute you now. Go ahead.

MR. DELFORGE: Yes. Hi. Pierre Delforge from NRDC.

Roger, thank you for the presentation and the knowledge. I was wondering if you could help us understand, based on the charts, how source energy drives electrification here. That's a comment or one of the conclusions you have in your last slide, but it wasn't obvious to me --

MR. HEDRICK: Right.

MR. DELFORGE: -- on the slide.

MR. HEDRICK: Right. So -- so essentially what happens is when we add a new metric some -- some designs will already comply with that, right. And so they comply using TDV and source energy. They comply with that, so it doesn't change anything in the design.

Other design options, particularly gas heat, will -- you know, so if I were to design my medium retail building and -- and put in -- well, let's see, this isn't a good case. Let me go to this.

So if I were to design my high-rise res- -- my high-rise office building with a four-pipe fan coil system, right, and so just if I kept everything in my design at prescriptive values, just switched the system, I would now have to -- I would not comply because my TDV is negative. And so I would have to do something to bring my -- my TDV values up. And so if I just increased the efficiency such that these TDV values came up to zero, if I only had TDV to worry about, now comply, but by adding source energy as well, bringing the TDV values up here, my source energy might still be negative and now I still don't comply, so I have to do something extra to try and bring that source energy up as well.

And so all we're doing by adding the source energy is we're essentially making it somewhat harder for gas-heat buildings to comply. Whereas when we add source energy to an electric-heat building, they still have the same difficulty that might have had before complying using TDV, but source energy generally will not impact them the same way it would a gas-heat building. And so in that way we're making it somewhat more difficult for gas-heat options to comply and therefore tilting the balance toward electric, just in a relative sense.

MR. DELFORGE: Okay. Thanks, Roger. Clarify though, the TDV still seems to be a hurdle for electrification --

MR. HEDRICK: Yes.

MR. DELFORGE: -- in the cases you're showing here.

MR. HEDRICK: That's correct. We -- we -- by adding source energy, we don't make it any easier for an electric building to comply than it did before. You still had the same TDV hurdles. Depending on your system option, that hurdle may not be as bad. So you can see that our TDV penalty for this water source heat pump, for example, is smaller than it was in 2019, and that's true in a number of case, I think. But, yeah, you still have a significant TDV hurdle to overcome when you switch to electric heat.

MR. SHIRAKH: So for instance here is -- the compliance margins are at best maybe three, four, percent negative. That shouldn't be too difficult to make up. And you can improve your lighting or putting better windows, I think that would probably --

MR. HEDRICK: Right.

MR. SHIRAKH: -- help get over the hurdle. So --

MR. HEDRICK: Right.

MR. SHIRAKH: -- again the intent here is to decarbonize in a cost-effective way.

MR. HEDRICK: Yeah.

MR. SHIRAKH: And I think that's what this is legislating.

MR. PRICE: Mazi, this is Snu. If it's okay, can I chime in just really quick?

In case not everybody is following, what this is really saying is that, you know, the TDV is basically our measurement of the customer's utility bill. And the source energy --

MR. SHIRAKH: Right.

MR. PRICE: -- is really our proxy for greenhouse gas emissions. So with these examples that we're showing here, the customer's utility bills are still a little bit higher, a couple percent. You know, it's a difference between the change in the gas and the electric side. Even though the electricity might be more efficient at the relatively higher-cost fuel. So that's showing up as a utility bill dip, but the source energy because of our electricity is so much lower carbon it's -- it's a big benefit. So that's a tradeoff there between these two. And having added the source energy gives us that other dimension that focuses right in on emissions, which is why I think Roger's conclusion that that could drive electrification because, you know, you can set a limit for that and ratcheted down over time, et cetera.

MR. DELFORGE: Keep electrification.

THE MODERATOR: Next up is Ted.

I'm going to unmute you now. Go ahead and state your name and affiliation.

MR. TIFFANY: Yeah. This is -- thank you. Thanks again, Roger. This is pretty fantastic work.

Can you go to the high-rise residential example? One thing I'm concerned about with this one and something we've been discussing with the CEC staff is that they find in this particular situation seems to really eliminate any electrification choices. And even if you were to comply on source energy, it still doesn't seem to be a compliance option on the CDV. And if we're going to hold to EDR1 and EDR2 to show compliance in each category for nonresidential, this baseline system becomes a challenge. And I'm wondering if the CEC staff had you look at that alternative baseline for this particular occupancy that's in the current 2019 version.

MR. HEDRICK: Yeah. So we're actually, I believe, changing the baseline system for high-rise residential buildings of this certain that aren't so high. So I believe it's eight floors and above will still have four-pipe fan coil baselines, and below that they will have a single-zone air conditioner baseline. And there's been some work done on that and to incorporate that in the research version of CBECC-Com that have gone out.

As I said -- mentioned before, I started this analysis in preparation for the October workshops, and so I have not updated the baseline in this case based on the latest -- those latest changes. I'm not sure that they are completely settled yet.

MR. TIFFANY: Yeah.

MR. HEDRICK: And so, yeah, so there is work going on there. But I do want to point out that you will see that the negative-compliance margin is much less using these new TDV metrics than it was in 2019. So we're seeing -- you know, you need to get negative-compliance margins in the 5- to 10-percent range, whereas under the 2019 it was, you know, 20 to 30 percent. So it's much better than it was, just by the change in metric even if we don't change the baseline, so.

MR. TIFFANY: Absolutely recognize --

MR. SHIRAKH: This is Mazi. I actually had struggled with this slide myself because it doesn't show, you know, a zero margin for a baseline. Everything is, --

MR. HEDRICK: Right.

MR. SHIRAKH: -- you know, negative. And I think Roger's correct, I'm hoping that we can actually correct that and we can show one of the scenarios to be the baseline. And that will adjust everything else up accordingly, so it becomes a lot easier to comply.

Is that true, Roger?

MR. HEDRICK: No. I mean we would have to -- if we -- if we do -- you know, when we finalize a different baseline, that would change everything here. But by adding -- you know, to show a zero margin I would have to have a case where I've got the four-pipe fan coil in the residential units and then the VAV system serving the nonresidential spaces. And so I'd have a mix of systems in the proposed design, which in this -- you know, for this analysis I have one system type throughout the building, so.

MR. TIFFANY: So, Roger, a question.

MR. HEDRICK: Yeah. Yeah.

MR. TIFFANY: So if you -- if we were considering what Nehemiah suggested that we look at not a mixed-use building here to represent high-rise residential, --

MR. HEDRICK: Um-hum.

MR. TIFFANY: -- but an entire high-rise residential building, --

MR. HEDRICK: Right.

MR. SHIRAKH: That would help.

MR. TIFFANY: I beg your pardon?

MR. SHIRAKH: That would definitely help.

MR. TIFFANY: Yeah, that's --

MR. HEDRICK: Yeah.

MR. TIFFANY: -- what I'm suggesting, that that -- I mean I find this quite confusing to understand as well.

MR. HEDRICK: Right.

MR. TIFFANY: And your explanation really helped. I'm a little closer to understanding it, but --

MR. HEDRICK: Right.

MR. TIFFANY: -- it seems like if we're really going to be focusing on high-rise res we should look at not a mixed-use building --

MR. HEDRICK: Um-hum.

MR. TIFFANY: -- to understand what's going on here.

MR. HEDRICK: Right. So part of -- you know we've done some work for some of the case teams. And part of that was to develop some new high-rise res prototypes. Nihil Kapur did those, and I'm not entirely familiar with them. One of them may be -- it was a five story and that may be all residential, I don't know for sure, though. And so --

MR. KAPUR: This is --

MR. HEDRICK: Go ahead, Nikhil.

MR. KAPUR: This is Nikhil, Nikhil from NORESCO. Yeah, so we did about a two number photovoltaic case and one was a five-story building and one was essentially borderline. But, unfortunately, both were still mixed use.

Now we could possibly do a variation of those with the high-rise residential spaces only. The challenge would be that we would also have to exclude the corridors from that because the rules would otherwise put in like a system for the corridor, so there is some work needed on our end to kind of resolve some of the challenges that -- some of the spaces that are actually associated, but nonres is associated with the high-rise res basis. But we could possibly do a fairly -- you know, just doing units in the model and make an artificial scenario, but we can apparently do a variation if need to -- if that makes things clearer, so.

MR. HEDRICK: Yeah. And even with one of those options, of this we left the nonres spaces, the system serving the nonres spaces unchanged so we're only changing what's happening in the residential, that might also be clearer.

MR. TIFFANY: You know, gentlemen, this is Ted again. I just want to kind of point out one challenge that we may not have thought about, or maybe you guys have. But the ZDR1 and 2 approach with residential where you've got a fuel-neutral baseline makes it a little bit easier with complying with both TDV and source energy. This kind of mixed-fuel baseline approach that we're keeping for nonresidential, we're going to have these cases where you're never going to be able to meet one or the other let alone both, so be conscious of that going forward, especially with this baseline right now for high-rise res and I think even with the alternative baseline will help that. And, Roger, I do recognize that the ZDR multipliers really did help this situation, but --

MR. HEDRICK: Yeah.

MR. TIFFANY: -- I think we're still going to see a couple of those cases where compliance with EDR2 with the carbon emissions or source will be favorable, but we still can't meet TDVs with that kind of mixed-fuel baseline comparison. So --

MR. HEDRICK: Right.

MR. TIFFANY: -- let's just be prepared for that --

MR. HEDRICK: Yeah. Well, yeah, I mean, as Mazi mentioned earlier, there is a desire to implement an EDR1 and EDR2 equivalent kind of an approach in the nonres side. And so that process may very well change the baseline cases. You know, so we'll be looking at the baselines as part of that process, and so, you know, this may very well not reflect what ends up in the 2022 software.

MR. SHIRAKH: Yeah. This is Mazi. I appreciate that comment, Ted. And I think Roger is correct. And we haven't even started that process yet and it will be soon. And obviously we don't want to create a situation where nonresidential buildings cannot comply. So we have several options in selecting appropriate baselines and the different things we can do, but that will be part of this process. And I'm sure we'll have public events where you can chime in, and others.

MR. TIFFANY: Thanks.

MR. HEDRICK: Yeah. The focus of this

presentation was on how is the switch to these new metrics going to change compliance. And so the switch makes it easier here in these high-rise cases. There are other issues that still -- that we're not really addressing here, so.

MR. SHIRAKH: Yeah, that's an important point. Like when you're looking at this graph, we're a lot closer to compliance using TDV, any of these metrics in 2019, which is denoted by those red bars. So we have a smaller lift, but we still have work to do, obviously.

MR. TIFFANY: And please forgive me if I haven't really thanked you for all your hard work, all of you, on this effort, and it's huge improvements. So I don't think I'm not there, but thank you very much.

MR. HEDRICK: Sure.

MR. SHIRAKH: Thank you, Ted.

THE MODERATOR: Nehemiah has a comment on this ASWl, so I'm going to go to him real fast here.

You're unmuted now. Go ahead.

MR. STONE: Yeah. Nehemiah at Stone Energy Associates.

On the case teams, one of the things we're doing with -- to do with the residential analysis in the mixed-used building is -- and, by the way, Nikhil was right that both of the mid-rise and the high-rise are mixed use. But one of the things we're doing is we're simply eliminating -- not looking at the nonresidential portion, considering the area between that and the residential is adiabatic, and then just doing the residential analysis. That would help an awful lot in helping understand where the baseline ought to be set. Thanks.

THE MODERATOR: Thanks.

Okay. George, you're up. I am unmuting now. Go ahead.

MR. NESBITT: George Nesbitt, HERS rater. Can you hear me?

THE MODERATOR: Yup, loud and clear.

MR. NESBITT: Yeah. So I'm trying to understand this too, and there's a lot going on. On the current slide, so for the first two cases, it's quite clear that there is a patently in both TDV and source energy. What I'm trying to understand is in, say, the last three cases, which I guess maybe are all truly electrification, there is a source energy benefit. It looks like there is a TDV penalty, but what I'm confused about is your -- your empty bars, your compliance margin electric and compliance margin gas, because it appears that the gas bar is bigger than the electric bar in most of them, which would sort of indicate you had a positive TDV margin.

MR. HEDRICK: Well, perhaps --

MR. NESBITT: I didn't hear any. You cut out.

THE MODERATOR: You cut out for a second there.

MR. HEDRICK: So on a per-Btu basis, electricity has a much larger TDV value than gas does, so the multiplier on electricity is something like, I don't know, 20 maybe, and I guess it will be much smaller. You'd have to look at the actual factors, but --

MR. PRICE: Yeah.

MR. HEDRICK: -- gas has a much smaller TDV value than electricity does.

MR. PRICE: This is -- yeah. This is Snu at E3. I mean it's just a reflection of, yeah, the delivered retail rate cost of electricity per, you know, Btu is higher than gas, so I think this --

(Simultaneous talking.)

MR. NESBITT: But it -- I mean when I'm seeing a bar that is higher positive than the bar negative, it seems like there should be a net positive.

MR. HEDRICK: Well, so -- so when I first did this graph I used kWh and therms, in which case the kWh bar is three times -- you know, is much -- is bigger, and the therm bar is a hundred times smaller. And so, you know, it's -- they're not -- they're not showing the same thing, so one's electricity, which has a value of, you know, like I say, 20 kBtus of TDV per kilowatt hour versus a gas is a multiplier of 1.2, or something, you know. The multiplier on those are very, very different. And so, you know, it's like I saved 10 units of silver but it cost me 10 units of gold, right. They're still 10 units but the value of the two is completely different.

MR. NESBITT: Okay, this is George. So the --

MR. HEDRICK: Yeah.

MR. NESBITT: -- hollow bars are site energy?

MR. HEDRICK: That's correct.

MR. NESBITT: Okay. All right, that -- okay. That -- yeah. All right, that makes a lot more sense.

MR. HEDRICK: Right.

MR. NESBITT: So I think if you go back to slide 4, if you can go back there real quick, so -- well, those all have mostly positive source and negative TDV.

I think it's obviously what we -- our goal is decarbonization, and so source energy savings is the right answer. The dilemma is the tradeoff between -- I mean the new source energy metric absolutely favors electricity over gas, whereas historically source energy favored gas well over electricity. And so if we only use the source energy metric with our current tradeoff between heating, cooling, water heating, and in nonres lighting, it would easily allow you to do something that has a good source energy benefit, quote-unquote, going to electricity, yet it would allow you to build a much less efficient building.

But the TDV is definitely --

MR. SHIRAKH: That's why we -- the ZDR --

MR. NESBITT: So the t- -- TDV is definitely a barrier to electrification. I predict that you're either going to have to do one of two things or both. You're going to have to eliminate TDV as a compliance metric and/or you're going to have to eliminate tradeoffs at least between heating and cooling. And this is -- this is what passive house has done. You have to meet your heating budget, you have to meet your cooling budget, and then the metric they use is source -- is site energy for those budgets, but then you still have a total source energy budget. And that kind of method may very well give us the lowest carbon building without sacrificing efficiency. And we're completely fuel neutral, yet the source energy favors electricity. So that's -- that's my thought, and I think that needs to be looked at. Thanks.

THE MODERATOR: All right, thank you, George.

So, Payam, let's go through the Q&A. Do you want to read some of those?

And, Roger, respond?

MR. BOZORGCHAMI: Sure.

Roger, we got a question from Ms. Laura Patel Rowe (phonetic) about -- sorry if I pronounced that wrong -- she's asking if you can provide a summary of equipment for each of the options on these tables. That's a little bit too much information on each of these pages and a little bit of clarification would be good. That'd be great before we provide -- the comment period is over and before we posted it on the docket.

MR. HEDRICK: Yeah. So I don't have anything like that prepared at present. It could be prepared if the CEC tells me to do it, so.

MR. BOZORGCHAMI: Okay. Then the next question is from Ms. Claire Warshaw, and she asking: Are the TDV values compared to building population density at all or is it per person TDV?

MR. HEDRICK: It's neither. It's -- this is total TDV compliance margin, so it's the difference in total annual TDV consumption for the proposed design relative to the baseline. And so -- so what we're showing here, for example, is that the electric VAV case, if you look at the TDV zero percent would leak. That shows a minus six percent compliance margin. That means that the TDV consumption of the proposed design was six percent more than the baseline.

MR. BOZORGCHAMI: Thank you. Now Ms. Clifton -- excuse me -- Mr. Stanley Lemon has a question: Did all your analysis consider PV and storage separately, or did any of them consider combined PV and storage?

MR. HEDRICK: No. So none of the -- you know, PV and battery are not part of the commercial software at this time. And we're working on how that will be incorporated and how credit will be allowed or not. And so the PV and battery data that I showed on later slides, that was all done independent of the -- as standalone, basically, measures, and then scaled to match up with results from the building simulations, so.

MR. SHIRAKH: Roger, I have a question.

MR. HEDRICK: Sure.

MR. SHIRAKH: Mazi. Looking at this graph here, now the reason we see all this negative TDVs is because our baseline is gas VAV, correct?

MR. HEDRICK: Correct, yes.

MR. SHIRAKH: Now if we switched our baseline, again, we talked about this, to either --

MR. HEDRICK: Yeah.

MR. SHIRAKH: -- water source heat pump or electric VAV?

MR. HEDRICK: Right.

MR. SHIRAKH: Then this whole graph would be drastically different, correct?

MR. HEDRICK: That's correct. So then if that were true, then you would basically move your zero line down to whichever of the TDV metrics you would want to use. And so -- and then everything that -- so say you picked the TDV 15-percent no leak, the dark green, you would basically move that -- the zero would be -- you know, minus six would now become zero, and everything that's less than minus six or better than minus six. So then the water source heat pump electric boiler, for example, that would become plus two instead of minus four in TDV --

MR. SHIRAKH: Right. So, again, there is to select the right baseline. And then the problem is like --

MR. HEDRICK: Yeah.

MR. SHIRAKH: -- you know, we prefer the slides to show the relative impacts of different TDV metrics.

MR. HEDRICK: Right.

MR. SHIRAKH: What this slide meant is to show what happens when in the future we select the proper baseline, so that's going to be our --

MR. HEDRICK: Right.

MR. SHIRAKH: -- our primary task.

MR. HEDRICK: Right.

MR. BOZORGCHAMI: Okay. We have one more question from Mr. Bruce Severance. His question is: Questions were raised earlier by Pierre regarding whether all lifecycle costs are in the carbon and TDV analysis. Please confirm if these TDV values include short-term methane leakage impacts at well sites and throughout the gas infrastructure.

MR. HEDRICK: So I'll let Snu answer that one. Snu or Michael.

MR. PRICE: Yeah, this is Snu. So on the TDV side, we're looking at a cost metric. So what it has in there for the leaks is the .7 percent. And this is a TDV factor that we're showing that has the leakage. We have looked at variations that don't, but for those that do it's the .7 percent leakage valued at the carbon cost that we're using in the model with the 100-year global warming potential, so it adds an additional cost with the leakage. On the -- so that's the -- that's how it's working through the lifecycle costing.

THE MODERATOR: So there's a question in the chat from Scott Blunk: I don't know if someone can explain how the decision is made to change the baseline equivalent for each of these building types.

MR. HEDRICK: So the baseline HVC systems have not changed much in many, many, many years. And they were, you know, selected by somebody back in the mists of time as reasonably typical and efficient systems -- you know, basically reasonably difficult buildings are Have a conversation system for a given building type. And they essentially have not changed much over the years, other than in terms of efficiency. You know, so the heating efficiency has increased a little bit, the cooling efficiency has increased, but the system type hasn't really changed much for a long time.

Like I mentioned before, as part of this EDR1 and 2 concept, I expect to reexamine what we used for the baseline. And now that we have these -- so the change of a baseline system type just moved your target value up or down. And you -- since we only had one TDV value, that was the target. Changing the system type was just equivalent to moving that yardstick up or down.

Now that we have two metrics that we're going to comply with, not only do you move them up and down but you move them relative to each other when you change system types. And so now the selection of system option in the baseline will become more significant because if we choose an electric versus a gas system, that will change the relative -- so if we switch from a gas system to an electric system, the source energy requirement will go up and the TDV requirement will come down and so become more easy to approach. So we're moving them both relative to each other and so system map becomes more important now with the two metrics than it was when we only had one.

MR. PENNINGTON: So this is Bill. I would add to that comment a little bit.

In general, the Commission has established standard designs based on cost-effectiveness and figured out, you know, -- and used cost-effectiveness to drive improvements. Related to system type, I think this mapping to the different building categories generally came out of ASHRAE 90.1. And maybe there has been a little bit of deviation from that in California, but I think that's had a strong influence.

And then there's also a question of practicality, I think, and making a choice, what is viewed as normal practice for the building type. So that can be sort of a modifier related to the choice. So I think we do have the opportunity to change our choices.

THE MODERATOR: So I have a follow-up from Scott. He's got his hand up, so I'm going to unmute his mic now.

Scott, go ahead and state your name.

Hi, Scott, are you there? I have unmuted you.

Oh, there we go. I can hear you now.

I don't -- I can't hear you. I'm going to mute you and we'll go to another follow-up question. We can come back to you.

Clifton, I see your hand come up. Do you have a follow-up to your question in the Q&A? You're unmuted now.

MR. LEMON: This is Clifton Stanley Lemon with the California Energy Alliance.

Roger, I wanted to make a comment about your very detailed presentation here, which is that a general comment.

I think it's really useful to take this data analysis and turn it into design visualization, because when you're -- I haven't seen anything quite like this that visualizes my tradeoffs and different envelope choices or different systems. And I think that it can make building engineering and design a lot more efficient when you're doing this very preliminary system and material selection in buildings. And so that would work to where you could do sliders and stuff and see the interactive effects of all these things, which is actually -- those are relatively difficult to determine even for designers and engineers who have been doing it for a really long time, especially when it comes into new compliance measures, source energy which is kind of new, EDR which is kind of new. So that's what I'd like to see with this. That's what I have to say.

MR. HEDRICK: Okay, thanks. That's -- it's a difficult thing to actually implement, something like that, just because of the complexity of these buildings or the potential complexity. We actually have developed something along those lines that would be useful for smaller, simpler buildings, and so we'll see what might happen with that.

MR. LEMON: Okay.

THE MODERATOR: Bill, Mazi, or Roger, can you speak to how the big plan could be changed, as a follow-up from Scott?

MR. HEDRICK: Sure. So -- so each code cycle or periodically we issue the ACM, the Compliance Manual, and that describes how the performance analysis is done, including what the baseline systems will be. And so that's sort of the point at which public intervention is available. And so, you know, I think -- well, and I'll let anybody from the Commission side speak to anything beyond that.

MR. PENNINGTON: This is Bill. I think that particularly with these TDV values changing there is a potential for different systems to be cost-effective relative to these baseline systems that exist now and potentially that could be a driver for making a change. We would have to look at unintended consequences, making a change like that, so it's not like a single factor that we would consider.

Frankly, I would like to look for ways of -- it seems like changing these systems from one to another is like a big -- like a big change and electrification options might have difficulty competing on a cost-effective basis with a sort of wholesale change from one system type to another system type. So I'm kind of wondering if there might be, you know, ways to mix this and add particularly efficient electric approaches in combination with -- with these systems. And I -- you know, I want to explore this a lot more with Roger and other people who have thoughts on this.

MR. SHIRAKH: You know, this is Mazi. And if, for instance, look at the water source heat pump and look at the light green bar which is, you know, the TDV with leakage at 15 percent, and the penalty for that is about minus three percent, the compliance margins. I mean one strategy would be to look at that baseline and make some enhancement to it. It doesn't take a whole lot to make up for three percent. And if that becomes the baseline then that makes the last one, the water source heat pump with electric boiler, that also becomes a compliance option.

And electric VAV, if somebody wants to use that, that will be a much easier path. It would definitely penalize all the electric -- or the gas options. It will be much more difficult to comply. So there's a variety of things we can do to look at this thing and select the proper baseline.

THE MODERATOR: So at this point we don't have any hands raised for Roger's presentation, so let's move onto general questions.

I know, Nehemiah, you had questions for Mike's presentation. So why don't I give the presenter role to Mike and then, Nehemiah, you can ask your questions.

MR. STONE: Sounds good. Thank you.

So, Mike, if you can pull up slide 5, that would be helpful.

MR. SONTAG: Give me one second, please.

MR. STONE: Sure.

MR. SONTAG: Can you guys see the slide that I have up on the screen.

Okay, go ahead.

MR. STONE: All right. So one of -- a recommendation that has been made to the PUC is to accelerate cost recovery for gas infrastructure to account for the winding down of the natural gas system over the next, say, 20, 30 years. I'm wondering if it wouldn't make sense to incorporate that same sort of acceleration of recovering the gas infrastructure costs in your analysis.

MR. SONTAG: This is Mike Sontag responding to that.

We have somewhat of a signal in the data TDV, you know, saying that the through-put decreases the, you know, fixed-cost increase. We don't have, you know, a signal just covering all the -- what would become stranded assets in the pile of efficiency cure (phonetic). You know it does become at some point kind of a circular argument that as the gas retail rates become less cost-effective and then as it becomes less cost-effective it, you know, has a spiral eventually, so I think it's part of the role in selecting the scenario, and this was not having, you know, a positive feedback loop at that point.

MR. STONE: Well, the reason I ask, Mike, is because it's -- I focus almost entirely on multi-family. And 80 -- 88 percent of people that live in multi-family qualify -- I mean they're much lower income than the people that live in single-family. And as people like this, the gas system primarily, it's going to be those that can afford to first and the cost is going to be stuck on the people that are left on the system and they're going to be people least able to afford those costs. So it's very reasonable to assume that the Public Utility Commission is going to do something about in the gas rate structure. And if you did that, it seems to me that it would provide a more temporal -- closely temporal decision for people building multi-family and other buildings, to move away from gas.

So I don't know if -- I don't expect an answer that, yeah, that's what we have to do definitely at this point, but I really would like E3 and the Energy Commission to consider the acceleration of the gas infrastructure cost.

The other question I had, I guess this is probably more for Bill.

Bill, you mentioned that one of the reasons for not trying to capture the impact of methane throughout the system related to buildings, the fact that a lot of -- that the gas use is related to transportation because it comes along with the extraction of oil. And it seems to me that as our transportation system then moves more and more to EVs, does that mean that as more EVs -- as EV connection to the -- to the grid increases, will the CEC reduce the portion of T&E costs allocated to buildings, you know, in the same way that you were just talking about in terms of gas and transportation?

MR. PENNINGTON: I mean one -- one thing that's going on here is that just the first time we've ever tried to deal with -- with methane leakage and trying to figure out how to do it. And, you know, we haven't iterated on that approach multiple times like we have with other things in the standards. And so, you know, it's hard to imagine what might happen that might be considered, so I mean we really haven't gone into all of that.

MR. STONE: I guess -- yeah, you're right, that probably was an unfair question. I retract the question then. Thanks.

MR. PRICE: Bill, if you'd like, this is Snu at E3, I can take a shot at this a little bit.

MR. PENNINGTON: Sure.

MR. PRICE: Which, you know, there's a few different aspects rolled up into this question. So I guess one thing to point out is that really a lot of this is a driven by the retail rate forecasts that are underlying our estimate of, you know, our utility bill, and for the natural gas side and electric side where we've taken those from is actually from a really pretty extensive study on the future of natural gas distribution that was funded by the CEC through the EPIC program. And we picked this scenario in there for natural gas rates that was one of many scenarios looked at that in that -- in that study. And I guess, you know, it's tricky, right, there's rates. And then -- and in the building standards, with such a longterm forecast, we're often in this situation of forecasting or trying to estimate what the PUC will do, but I would just say that at least it is a estimate that includes hitting the state's climate goals and it does have radiant impacts embedded in the natural gas side of the equation because of that. It's not the most extreme scenario. And there's people on both sides of arguments about more or less extreme natural gas pricing.

The second thing I would say is that for residential and nonresidential, we're adjusting these to equal potentially the state average retail rate level. That gives us some consistency in the standards across even different utility service territories. And if there is a significant sales share to other uses, you know, including industry, including transportation, then those -- that would flow through and adjust the residential and commercial rates.

So, you know, the framework that we have can account for all of those different futures of how do we collect the gas system costs, what about those sales, to transportation, all those things kind of are embedded in our framework. And then the question is just which forecast and which assumption and which set of policies do we want to project the future with. And we try to lay that out. There's quite a bit of detail on the scenarios that we picked in the October workshop. So that might be one source of that, and I believe in there is also linked to the reference to the study on the future of natural gas so that folks can get an even more detailed and rich set of assumptions about the future.

MR. STONE: So, Snu, I appreciate that a lot. So can I ask you kind of simplifying question related to what you just said? So then the forecast of the T&D component of the rates that are allocated to buildings is -- are you -- in the forecast, is that declining over time as more EV comes online?

MR. PRICE: Does it -- let's see, so the T&D component in the rate and in the TDVs are still driven per, you know, kilowatt of coincident distribution peak loads from the sector that we're talking about. So if we're driving more residential demand, really this is the early evening and many distribution systems with a building, then it bears the cost of that incremental distribution. If you -- if you have a building that, you know, middle of the day and the local distribution, you know, what-have-you has its distribution coincident peak times in the evening, then it won't trigger, you know then it won't get much allocation of the distribution guide.

So it's -- I guess the way that transportation would factor into this would really be if the rate for transportation pay a good -- it basically raises and lowers the overall rate. So if you have a lot of cost born on the transportation sector, then that tends to drive a lower increase or even decrease on the rates for other sectors, then that wouldn't show up not on the distribution component, which has that sort of marginal costing, but it would raise or lower the overall -- you know, the retail adder that we're talking about.

MR. STONE: Okay, --

MR. PRICE: I know you tried to answer -- ask a simple question and I gave you a complicated answer, but the mechanics are pretty complicated.

MR. STONE: Yes, I understand. Thank you very much.

MR. PRICE: Yeah.

THE MODERATOR: So a chat -- we don't have any hands raised at this point, so --

MR. ARMSTRONG: Sean, --

THE MODERATOR: -- we're going to --

MR. ARMSTRONG: I had a hand raised.

THE MODERATOR: Oh. Oh, go ahead, Sean.

MR. ARMSTRONG: Hi. Sean Armstrong with Redwood Energy.

So, as you can assume, you know I'm disappointed in what Nehemiah is saying as well, that there's such a small reflection of the actual leaked gas in our valuation. I'm accepting that, which I don't, but just for the moment accepting that so you guys can proceed, then if you're saying that all the rest of that leaked natural gas is actually a consequence of fossil fuel use for cars, all the rest of it, right, not the stuff that's in the building, but all the other leakage is just because of cars is what I heard you say, in essence, then are cars getting the weighted like addition of methane leakage associated with their fossil fuel use or are you guys just disappearing this? Unacceptable obviously to disappear it, but that's my upset/worry/fear is that you're, you know, hand-waving it away, saying it's someone else's place to count it. We're the state government, are you counting it someplace else?

MR. PRICE: Sean, I think -- this is Snu again from E3 -- in the answer to the last question, I was talking about electric vehicles and, you know, what share of the electric infrastructure costs are allocated to electric vehicles versus buildings, right. It seems like your question is something more about fossil use in cars, so I'm not sure how to square the two.

MR. ARMSTRONG: I'm talking about the methane leakage associated with buildings, which the statement earlier was that because the methane leakage is coming from primarily the oil fields, the storage facilities, that that's where the leakage is, the argument was made is that are those leakages really a consequence of fossil fuel extraction for the purpose of vehicle transportation. I don't know if there's other places where it's going to get allocated to, either buildings, powerplants, or vehicles, right, that's the basic uses of the fossil fuels coming out of the ground? So if only .7 percent of, say, a total 3 to 5 percent are being allocated to the buildings, where does the rest of the leakage get allocated to in the state? How do we take responsible for our gas leakage if we're not doing it in the building sector? Where does it get accounted?

MR. PRICE: So the comment wasn't that -- wasn't that all the rest of the leakage is associated with the transportation sector. The comment --

MR. ARMSTRONG: That's -- now you don't think understand. My question is where on a positive sense -- you said that .7 percent of 3 to 5 percent can be allocated to the buildings. My question is: Where does the other 2, 3 to 4.3 percent being allocated? Where is that leakage being counted as a real climate change impact as a consequence of fossil fuel use? If it's not being counted in the building's fossil fuel use, where does it get counted by the California state government?

MR. PRICE: So I think ARB is trying to go after that with their other programs and taking actions on that. I think the federal government is taking actions nationally on that.

MR. ARMSTRONG: The concern is that you don't double count, but I'm wondering are you half counting. Is this being disappeared. I hear you pointing at the ARB. I want some scientific rigor to this. Is it -- if you're going to assume a three-percent gas leakage rate in the state of California, allocating at all, I mean like properly, is it getting counted, all of it, or not?

And I realize you might not be able to answer that question because you might not be familiar with exactly what the ARB is doing, but I don't think that this code should proceed with that question unanswered. I think that you guys need to take responsibility for the leakage -- I definitely advocate you taking on three-percent leakage, which is responsible for the gas delivery. I don't -- except that this gets blamed on some other service. If that's where you want to go with it, then I'm just saying you guys need to allocate, you need to explain where that's getting allocated in a scientific way, not just sort of point the finger.

MR. PRICE: Okay. We can inquire with ARB on this.

MR. ARMSTRONG: That'd be great. If you can make sure that makes it into the comments so that I can do some peer review, and others can as well? This has come over in this session because it's so important. You know the climate change impacts are burning it, are equal to the climate change impacts of three-percent leakage. So if you're not accounting for leakage, then it's a huge problem, right. So I'm hoping this gets rigor.

THE MODERATOR: We have some comments from Joe.

I'm going to unmute you now so you can make those. Go ahead and state your name and affiliation, please.

MR. CHOW: Can you hear me?

THE MODERATOR: Yes, yup.

MR. CHOW: Okay. This is Joe Chow from SoCal Gas.

I'm making on the same line as the previous speaker on the leakage rate. I think if, depending on the level fuel and for the customer are our ratepayers, we need to go to every free trial vacates (phonetic) if it lasts more than your methane leakage. And methane leakage is you need to probably qualify what percentage, what portion is from gas valves switching on and off or from the transmission compressor stations. The more detailed the more convincing, that is.

And for electric transmission, high voltage up stations, I saw on the news that there is an insulating gap why they use -- cause sulfur oxoflouride (phonetic). That is many, many times more damaging than methane, so everything is considered, I think that's a fair gain. Thank you.

THE MODERATOR: Okay, we have a hand raised from Pierre.

You are unmuted now. Go ahead.

MR. DELFORGE: Yes. Thank you. Pierre Delforge from NRDC.

I just want to add to the first comments on methane, that ARB has policies to reduce methane in state but only about ten percent of the methane used in California comes from California and most of the leaks are actually at the wellhead or at the pro sink stage, which is, you know, for the 90 percent of the gas that we import happens out of state. And there is no federal policy around methane mitigation right now. And I think it's important that the State of California takes responsibility for the out-of-state impacts that it has from its own consumption, just like it does for electricity where we take responsibility for the emissions from electricity imported into California from out-of-state powerplants.

Sorry. Just about one more thought on this while I have the mic. I think the -- you know, I get the point that the impacts on this of methane are relatively small from the analyses that were presented, but if we were -- instead of so .7 percent we use 2 or 3 percent and we use a 20-year global potential instead of 100 years of global potential, I think the impact then would have to be quite significant. So I think that the reason it's pretty small right now is a result of the current set of assumptions and it doesn't mean that they wouldn't be more significant with a different set of assumptions. Thank you.

THE MODERATOR: Thank you, Pierre.

So, Mazi and Payam, I don't -- I have one comment from Scott.

I don't know if you want me to unmute you or not. I'm going to call on you just to see if you wanted to make that comment about the .7 in the building.

We don't have any hand raised, so let's go ahead and do the unmute all. We want to accommodate anyone who can't use WebEx but has called in. So at this time just be warned we're going to unmute everybody, so that anyone who hasn't been able to speak can. Please try to minimize background noise or remute yourself as I unmute you. All right, so we're going to unmute everybody. Anyone who wants to make a comment on any part of the presentations today, please do so now.

[RECORDING]: 2 is not available. At the tone please record your message. When you're finished recording you may hang up or press 1 for more options.

We did not get your message either because you were not speaking or because of a bad connection. It's next --

MR. BOZORGCHAMI: RJ, I don't think unmuting everyone's going to work, so I think most likely we're going to ask everyone to submit their comments in writing and we'll capture it that way.

I think, Mazi, are you --

MR. SHIRAKH: Yes.

MR. BOZORGCHAMI: I think --

THE MODERATOR: We were advised by the Public Advisor to try that, but it did not work at all, so yeah.

MR. BOZORGCHAMI: (Indecipherable.)

MR. SHIRAKH: So let's make it clear that if you wish to comment please do so by close of business next Friday, April 10th. Please do not assume that if you made a comment in the chat box that's going to be captured. You need to docket your comments by sending it to the CEC docket by April 10th and we will read and respond.

Thank you for the day-long workshop. It was very productive. This was the first time we actually did this, because there's nobody in the CEC building. It was all done remotely.

And please stay safe. To tell you, this virus is very serious. I have a cousin who is in intensive care in coma because of it. Do not take it lightly. Stay safe and send us your comments. Thank you so much.

(Whereupon, the Workshop was concluded at 1:54 p.m.)

REPORTER'S CERTIFICATE

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

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

IN WITNESS WHEREOF, I have hereunto set my hand this 20th day of April, 2020.

PETER PETTY
CER**D-493
Notary Public

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I do hereby certify that the testimony in the foregoing hearing was taken at the time and place therein stated; that the testimony of said witnesses were transcribed by me, a certified transcriber.

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IN WITNESS WHEREOF, I have hereunto set my hand this 20th day of April, 2020.

Susan Palmer
Certified
Reporter
CERT 00124