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CALIFORNIA ENERGY COMMISSION

In the Matter of:

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| Pre-Rulemaking | ) | |

WARREN-ALQUIST STATE ENERGY BUILDING

ART ROSENFELD HEARING ROOM, FIRST FLOOR

1516 NINTH STREET

SACRAMENTO, CALIFORNIA

TUESDAY, OCTOBER 6, 2020

9:00 A.M.

Reported by:
Troy Ray

APPEARANCES

STAFF

Mazi Shirakh, CEC Lead for Building Decarbonization

Payam Bozorgchami, Project Manager

William Pennington, Commissioner’s Office

Peter Strait, Supervisor

Danny Tam

# P R O C E E D I N G S

9:01 A.M.

SACRAMENTO, CALIFORNIA, TUESDAY, OCTOBER 6, 2020

MR. BOZORGCHAMI: Hello everyone. Thank you for joining us today. We'll start the workshop about 9:05 just to allow people to log on and take care of any technical issues that they have.

(Off the record at 9:01 a.m.)

(On the record at 9:05 a.m.)

MR. BOZORGCHAMI: I've already received one question, if today's presentations will be posted on our docket. Yes, they will be. They will be done so by tomorrow morning.

This webinar will also be recorded, and it will be transcribed, and we do have a court recorder on hand, and we will be posting those at a later time.

So, this presentation is being recorded, and hello, everyone, good morning. My name is Payam Bozorgchami. I'm the project manager for the 2022 Building Energy Efficiency Standards. I want to welcome you to the Energy Commission Virtual Pre-Rulemaking Workshop for the 2022 Energy Standards.

The workshop today is on heat pump based on requirements for low-rise residential, high-rise multifamily and nonresidential buildings. This workshop also includes PV and battery storage requirements for high-rise multifamily and nonresidential buildings.

Excuse me. But, first, let me provide you some housekeeping rules. We will be muting everyone, and after each proposed measure is presented or every presenter, we will pause for questions and answers, and you can either raise your hand and we will unmute you, or you can submit your questions in the question and answer box within Zoom, and we will try to answer your questions as they come in.

There's going to be a lot of people on the call today. I see right now there's about 118 attendees. Bear with me. I know there's going to be lot of questions asked and there's going to be a lot of raised hands, and I will do my best to get to everyone.

And if you're on your phone you could use star six to mute and unmute yourself. One important thing to remember is that when you do -- when we do unmute you, please state your name and who you're affiliated with. And I'll apologize right now. I'm going to be very stickler about this, and the reason is we have a court reporter on hand, and he needs to know who is presenting, who's asking the question or who's commenting for the record. So, apologize right now. I'm going to be a little bit of a stickler.

This program is the best we got. It's totally different than what you folks are used to in coming to the Energy Commission and having the workshops at the Energy Commission, so apologize for any inconvenience, but it is what it is.

So, with that, I'm going to share our -- what we're going to be covering today, but, first, before we start we're going to have some opening comments from Commissioner McAllister's office, Bill Pennington, one of Commissioner McAllister's advisors, has a few words to say. Bill.

MR. PENNINGTON: Okay. Let me get my notes up here, Okay.

Good morning. My name is Bill Pennington. I'm a member of the Energy Commission staff. Recently Commissioner McAllister requested that I provide him with advisory assistance for the 2022 Building Standards.

The Commissioner would definitely have liked to have been able to be here this morning to provide opening remarks for the workshop, but he has multiple competing obligations and asked for me to share his thoughts instead.

So, to begin with, the Energy Commission has a strong policy to pursue decarbonization as its highest priority goal. The Energy Commission recognizes the potential for heat pump technologies to dramatically reduce GHGs for space heating and water heating.

A priority of the 2022 building standards is to identify ways the standards could encourage the expanded use of heat pumps.

The status quo today in the marketplace is that the market penetration of heat pumps in newly constructed buildings is in the single digits, and we must recognize that to change this to a situation where heat pumps are the predominant choice in newly constructed buildings will be a substantial process.

Heat pumps are different animals. You could maybe characterize them as slow and steady.

They don't create the instantaneous heat that consumers may have learned to enjoy. The heat pumps extract heat from the ambient air in a much slower process than combusting fuels or heating up electric resistance coils. And the heat that heat pumps produce is generally at a substantially lower temperature. As a result, they don't provide the instantaneous heat that comes from combustion or electric resistance.

Heat pumps need to run consistently over hours really to achieve and maintain the desired level of heating. And as we go forward we need to be careful to recognize those characteristics and avoid extensive inopportune use of electric resistance backup, especially in climates where temperatures fall below 40 degrees Fahrenheit.

As we proceed, building occupants will need to perceive heat pumps as just as good at providing the functionality that they expect.

Building developers will need to be satisfied that if they switch to heat pumps they will not lose customers or receive excessive customer complaints and call backs. They will need contractors and workers who can do a good job of installing these more complicated machines.

There should be no product availability issues that delay completion of construction, and heat pumps that come into the market are not poor quality or prone to defect.

It also is important for the manufacturing industry to deliver heat pump products that succeed at meeting occupant expectations.

Along the way there will be a need for customer information to make sure that consumers understand how to operate heat pumps and have reasonable expectations for them, that there be good installation and commissioning of heat pumps, and there be good and consistent delivery of high-quality heat pumps.

For the State to be successful in moving to its goal of broad scale use of heat pumps it will be important that we accomplish the transition in a way that encourages market acceptance and builder, developer buy in and engagement.

Today's workshop will provide information about approaches, staff and Energy Commission contractors are investigating to determine where heat pumps can be good candidates for baseline technologies in low-rise residential, high-rise multifamily and selected nonresidential building categories.

So, I just want to add to Payam's welcome of you all. Thank you very much for your participation. I'm sure the Commissioner will regret what he misses hearing today in person, but he's very interested in your comments, and we definitely will want to entertain all of your questions and comments. Thank you very much.

MR. BOZORGCHAMI: Thank you, Bill. So, next I will go through some key information for development of the Title 24, Part 6. Then after myself, Mazi Shirakh will give you folks a general overview of heat pump base lines and PV and battery storage requirements for high-rise multifamily and some selected nonresidential buildings. These are the buildings that we're going to be looking into closely for 2022. And then our consultant NORESCO, actually our nonresidential consultant NORESCO's team, will be presenting on baselines.

Then again, the NORESCO team and our other consultant E3 will be talking about nonresidential PV battery storage for both, and also for high-rise multifamilies, and then Mazi is going to come back on and share some cleanup languages that we're looking into for 2022.

So, with that, this is our standard -- 2022 standard process and our schedule dates. As you can see, we're right now in this arena of August of 2020 to October, 2022. We're doing pre-rulemaking workshops and receiving codes and standards enhancement reports from everybody out there, including the utilities, including private associations like the California Energy Alliance and private manufacturers like Vertiv providing proposals for us to evaluate for 2022.

A lot of this CASE reports and presentations you'll be hearing you've heard. I think there's been six workshops, and there's going to be quite a few coming up, has been sponsored and supported by the independent-owned utilities, those folks including Pacific Gas and Electric, Southern California Edison, Sacramento Municipal Utility District and Los Angeles Department of Power. Thanks to them, they've submitted quite a few proposals. They've held quite a few workshops within their own arena, and they've gotten feedback from you folks, and they've made their final reports, and they're coming to us three or four at a week right now.

So, we have a lot to do in the next few months. We need to have our 45-day language hearing sometime in February of 2021. This is really not that far away. It allows us about six weeks or so to write code language to be presented for the February workshop. I'm assuming there will be three workshops happening, most likely one for residential, one for nonresidential and one for multifamily, and actually, maybe a fourth one for electrification.

And then all this, we have to develop 15-day language, and we're hoping that we go to the July, 2021 business meeting for code adoption. And then after that we have a few months to work on compliance manuals, the computer modeling program, CBECC for both res. and nonres., and then we're trying to get all that done at least about 12 months before the effective date of January 1, 2023.

So, that allows everybody out there about a year to really get familiar with the program, with the documentations and with the standards itself.

So, with that, we've -- our tentative rulemaking schedule, as you can see, we've had quite a few.  Right now, today being October 6th, we're going to be listening on the proposals for today, and we will be revisiting these proposals in the final language to be implemented into the 45-day language on November 19th.

One other key area that we had recently, we had an indoor air quality workshop with the scientists.  It was a round-table workshop led by Commissioner McAllister, himself, last week on September 30th.  Feedback from that workshop and evaluation from that workshop we will have proposal language ready to be presented at another workshop on October 29th.

There's a lot of information on these three links here.  The first link is the utility sponsor stakeholders, the draft CASE reports, the comments that they've received is all located here.  Based on what you're interested in you can go there and there's quite a few sublinks for residential, nonresidential, multifamily.  You're more than welcome to go and evaluate what was original proposals that was evaluated by the utility team, that we have our building energy efficiency program via the Energy Commission. This is our website that has all the information, not just for 2022, but we have the information for 2019 and 2016 standards. This includes the manuals, the joint appendix, and the documents needed for compliance.

And the last website or the last link is the most important link for today. This is where you will find information on what we present today. This is where you can submit your comments by October 20th. And we're being a little stickler this time around for 2022. We really don't have much time. So, the sooner you submit your comments, the better we are and the more production and productivity we can have with you and more round table we can have with you to get the right message across and the standards, itself. So, please, the sooner we get your comments, the better we are.

Some key staff members. The person that is really leading this electrification is Mazi Shirakh. That's his email and his phone number. Myself, my information.

Larry Froess. He's the lead. He's a

senior mechanical engineer with our office. He’s responsible and he’s the lead engineer over the computer software program and what goes into the program.

Peter Strait, he’s one of our supervisors here at the Energy Commission. He oversees the staffing that help develop the building standards.

Haile Bucaneg, he's our senior mechanical engineer with our office. He’s been very helpful with the work that’s happening on these workshops and looking at case reports and evaluating case reports.

And, also, we recently we have a new office manager. We’ve been with -- we’ve been working in the dark without an office manager for a long time, and Peter Strait was most gracious enough to take that role temporary. But Will Vicent has started with us the past two weeks. And I don’t have a phone number for him as we’ve not been back to the office and he’s not received one, so if you need -- if you have any issues with any of us you can always email him and he will take care of it.

And then, again, comments for today’s

workshop. You'll see this one slide over and over again today because it's very important that you folks docket your comments, your concerns, and like I said, today we'll try and get to you as best I can, but if we don't, you're more than welcome to submit your comments in writing.

Any questions? If not, I'm going to pass the baton over to Mazi and, Mazi, I'm going to stop sharing, and, Mazi, you could share your presentation. Thank you, everyone. Mazi, can you share your presentation and unmute yourself?

MR. SHIRAKH: I was muted. I'm working on it. I want to make sure I open -- sorry, I opened the wrong document. Okay, here it is.

Good morning, everyone. I'm Mazi Shirakh and I'm currently the Energy Commission's lead for building decarbonization efforts.

And, so, we're going to -- just one second -- first, I would like to introduce our 2024 Standards Building Decarbonization Team. Besides myself, it's Bill Pennington, and he just introduced himself, and there's a lot of help from Bill. Larry Froess, and he's our senior mechanical engineer in charge of the software, CBECC software. Danny Tam, he's been really helpful in helping develop some of these baselines, Payam you know and Will you know, and Will Vicent, again, he's our new office manager, and just joined from Southern California Edison which is really helpful because, you know, now we have a utility and IRU perspective in the office, which is very relevant to development of PV and battery storage systems.

We also have a consulting team that includes E3, NORESCO and TRC, and you'll hear from them today.

So, for the heat pump baseline and the storage workshop we actually have two workshops scheduled, and the first one is today and the next one is going to be on November 19th.

The difference between the two is that today is a high-level overview of the requirements for heat pump baselines and PV and storage for these different buildings.  We will only include largely TDV, time dependent valuation, discussion today, and we're not going to spend a whole lot of time on the source energy baselines.

Please recall that earlier in the process we proposed a two-step approach that includes two metrics, the real TDV that we've always used, but in addition to that, a source energy that will basically behave as the carbon proxy for the buildings. However, the first step is always to develop a TDV baseline first, and then we can design a source energy threshold, a carbon threshold for buildings based on that.

We will not be presenting any draft language today. It's only the concepts, and, you know, we are very interested in seeking your input for the material we're presenting. Comments are due not by October 19, but October 20th as Payam just mentioned. I need to correct that date.

And then we're going to have a second workshop on November 19th, and that's where we're going to actually present the draft language and detailed analysis, and it will include both source energy and TDV baselines.

And, again, we'll probably get more comments after that workshop, which after we incorporate it will become the basis for the 45-day language that will be presented next winter.

For heat pump baselines we're considering options for low-rise residential buildings, high-rise multifamily and selected non-res. occupancies. And we're also -- and by expanding the PV and battery storage requirements for high-rise multifamily and selective non-res. occupancies.

So, these are the buildings that we have in mind currently, is low-rise and high-rise multifamily, office buildings. And office building has actually three categories. It's small, medium and large, and they're very different creatures actually, in that they're all office, and the rest of them present some data on that.

Same thing with retail. We have small, large -- medium and large, and, again, very different creatures as you can imagine because the mechanical system, air conditioning system are very different based on the size of these buildings.

We're also going to be considering educational facility and warehouses, and any mixed-fill building where one or more of these type of uses make up at least 80 percent of the floor area of the building.

Heat pumps for space and water hearing,

again, for high-rise multifamily and selected non-res. buildings, we'll establish appropriate source energy and TDV baselines.

And the key point here on this slide is number three, must be feasible and cost effective. This goes back to the comments that Bill Pennington just provided. You know, we need to be careful to come up with standards not only that are cost effective, but they're actually feasible and it can be installed in actual buildings, that it does not result in cessation of building construction. And, so, we're going to be very careful about that, and there are some challenges, as you'll see, for some of these occupancies.

PV and battery storage requirements, we're going to be considering cost effectiveness for these systems. We will start with NEM2 which is the current CBECC rules for solar PV compensation. And, in short, the current NEM2 compensates behind the meter self-use and hourly exports at retail or near retail, you know, accounting for some non-bypassable charges.

However, we do know that the future may be a little bit different, so we are going to be considering alternative tasks, where the hourly exports are compensated at the lower avoided costs or even wholesale, and we'll examine cost effectiveness under each of those scenarios.

We're going to be emphasizing to maximizing self-utilization of the PV generation and minimizing exports to the grid. To the extent possible, you know, we would like to use the generated kWh, kilowatt hours, on site rather than exporting it back to the grid. And the way we're going to do it is by right sizing the PV system to avoided large exports and coupling the PV system with battery storage system, EV charging and other load-shifting strategies to maximize self-utilization.

EV charging is actually a really good possibility for non-residential buildings, and E3 will present some material on that one.

We're also considering possible credit for standalone battery storage systems. Not all buildings are covered here, nonresidential buildings. It's possible that some of the other building types may want to install battery systems and we'll explore the possibility of providing a credit.

One of the main limits to rooftop PV installation is the availability of the rooftop areas, especially when we get to taller and taller non-res. buildings.

So, what about low-rise residential? You know, we adopted 2019 standards and that included many enhancements for low-rise residential buildings, single-family and low-rise multi-family, and that which included some concepts like attic insulation, high performance walls, IAQ and many others, and on top of that we required PV systems.

Now, that by itself, those changes, have really helped to reduce the carbon emission from buildings dramatically from an atypical existing building that's about 20 years old. It's probably generating about 19 metric tons of CO2 from the building. A 2019 compliant building, mixed fuel generates about three tons, so we're down from 19 to around three, and with all electric or heat pump in the baseline we can reduce that amount to less than one metric ton per year.

So, the question here is now how do we encourage builders to switch from natural gas appliances to heat pump end uses. So, here are two thoughts that we have for part six. We're going to create an approximately two EDR credit, and that's just a base credit and it goes up, the credit, if we consider a tier-four heat pump water heater and the demand response credit, this EDR credit can go up to around three-and-a-half EDR credit.

And this would be available for builders who voluntarily switch to both heat pump water heater and heat pump space heater, and they can take that two to three-and-a-half EDR credits and use it to do tradeoffs, or to basically use it for compliance. You know, many buildings they may have more windows than prescriptively allowed, or they may have more west-facing glass, and to do full orientation and compliance they need something that can help them to trade off.

So, this will be available for that, but we're also very concerned about maintaining the integrity of the building envelope components, because, you know, we think building envelope efficiency is our first line of defense, and with all experiences of kind of a nasty summer, and even the previous summers, where, you know, we have heat wave after heat wave, forest fires. And, you know, the thing that's going to help us avert or minimize the impact of new buildings is really a good building envelope.

So, we are proposing to come up with a credit so they can use for tradeoffs, but at the same time we want to maintain at least a minimum performance from both the building shell, which includes a mandatory requirement R13 below deck roof insulation and a U factor of .064 for walls. .064 walls allows basically a two-by-four wall, but it still requires R4 continuous insulation on the wall.

So, you know, we feel good about this because we think, you know we can provide some flexibility while still maintaining a decent building shell.

And the mixed fuel buildings will not be affected. If a builder wants to build a mixed-fuel home they basically have to comply with the current requirements which includes an R19 roof deck insulation and U factor of .048 for walls, and, you know, we can do tradeoffs using the prescriptive package that is available and do tradeoffs within that.

For Part 11, which is Calgreen, we're proposing something similar. And here, you know, this would be available for local jurisdictions, cities, counties who want to adopt a more aggressive code. What we're proposing is a baseline that includes a heat pump water heater and more efficient windows in the standard design.

Again, we have to be mindful when we create these packages that we don't run into pre-emption issues, and that's why this option is offered in this manner.

So, the builder would have a choice. They can switch to a heat pump water heater and include the more efficient window, or they can comply by switching both heat pump water heater and heat pump space heater, and that would also comply.

And, again, the same two mandatory requirements for R13 roof deck insulation and .064 U factor for walls also applies.

And on top of that, we'd like to consider battery storage ready requirements for new construction. This would be for low-rise single family or multi-family. And the reason for this is we've actually had in the past similar requirements for heat pump water heating. We've had heat pump water heating ready, solar ready and some other features, PV charger ready requirements.

The reason we would consider this is because these enhancements can cost very little at time of new construction, but they will -- they can be very costly as retrofit.

So, some simple measurements that I've listed here is panel requirements that can accommodate electric end uses, PV electric vehicles and future battery installation. It may cost a few dollars more during new construction, but it can cost substantially more as a retrofit. And I've actually personally had experience with that.

Second is identification and isolation of emergency circuits that can be readily tapped into in the future. And we want these enhancements to be compatible with both battery storage system and backup generators. So, in the event of a PSPS, which is public safety power shutoff events, which is becoming very common in this state because of our hot, dry summers and the wild fires and winds, so these buildings would have the option of adding a battery storage system or a backup generator that he can purchase from Home Depot or Costco. And these enhancements will reduce the future battery storage installation by $2,000 or more, even though they may cost around a hundred bucks as new construction.

I'm going to skip through these slides. I'll come back to them. But I want to show the updated Duck Curve from CAISO. And the point of this slide is to suggest that the best course of action if we're considering PV's is to couple that PV with battery storage systems and other load-shifting strategies to basically flatten out the generation of the PV system. Otherwise, you know, we will aggravate this Duck Curve and which will result in more curtailment.

And the way we do that is through grid harmonization strategies, and these are strategies and measures that allow the home occupants to use their energy assets to maximize self-utilization of the PV output and limit the grid of exports.

And, again, the strategies include

battery storage systems, demand response, thermal storage system or even electric vehicle, in particular in nonresidential buildings.

And here's what a battery storage system can do for a building. This is a 2019 compliant building. This is an August 6th day in climate zone 12, Sacramento. And this is a building that has all the appropriate wall insulation, attic insulation, windows and everything else and about a 3 kW PV system.

The red line that you see here is how this building behaves without a battery storage system. So, it's importing electrons from the grid during the night, and the sun comes up and the PV starts generating, then you start exporting to the grid, and then during the ramp when the evening sun has gone done, then you rely on the grid. And this actually stresses the grid because this is the time when everybody turns on their air conditioning systems and the grid has to bring probably some of its at least clean generation resources.

And if you look at the shape of this red line, it looks like a good Duck Curve. However, if you add about 14 kilowatt hours of battery storage system, you'll see that this building is hugging the zero line about 20 hours out of 24 hours. And so that means it's actually invisible to the grid during these hours. And for a period, then, when the batteries are all charged up, then, you know, that is the charge. And then what happens here during the ramp, instead of relying on the grid to meet loads, we are relying on the battery to meet loads. It really harmonizes this building with the grid.

So, with that I'd be happy to answer any questions. Otherwise, I'm going to turn it over to NORESCO to make their presentations. Any questions?

MR. BOZORGCHAMI: So, Mazi, this is Payam again. We have quite a few questions and questions/answers, but we have one raised hand, and that's Enrique, and Enrique, I'm going to unmute you, sir. Please give us your name and your affiliation, please.

MR. RODRIGUEZ: Hi, Payam. Enrique Rodriguez, Building Standards Commission.

Mazi, I noticed that you skipped over some of the slides. Were you going to go back to show or --

MR. SHIRAKH: Yes.

MR. RODRIGUEZ: Okay, okay. That was just my comment. Thank you.

MR. SHIRAKH: I should also add this workshop would probably take about five hours, and we're about 50 minutes, 45 minutes into it. So, hang in there. We may have to break for lunch and then come back to finish things up.

To answer Enrique's question, yeah, I skipped over the clean-up language. That's going to come after our consultants talk about the topics that they're going to be presenting.

MR. BOZORGCHAMI: Thank you, Enrique. Thank you, Mazi. We have some questions and question/answers.

MR. STRAIT: Do you want me to read those off?

MR. BOZORGCHAMI: Peter is going to do those, but please state who it is from and their question.

MR. STRAIT: Sure. I am going to be going mostly in order, but I am going to be skipping ones that aren't specific to the topic material.

First, Joe Cain asks, "If office includes high rise as well as low rise offices?"

MR. SHIRAKH: Yes, it includes -- again, we don't differentiate by the number of floors. We differentiate by the square footage. So -- and I think NORESCO's presentation will clarify that.

MR. STRAIT: Sean Martin from the International Code Council asks, "Is electrical energy storage the only option being considered or are other energy storage technologies like thermal in play?"

MR. SHIRAKH: Anything that has load shifting can be used. Again, the key is when we use kind of battery storage system as kind of a catchall, but the goal is here to kick those kilowatt hours and use them behind the meter. So, whatever helps us to do that and it's feasible and cost effective is good. So, that's the answer.

MR. STRAIT: All right. Claire Warshaw asks, "Can we please mention what size panels in terms of the main size amperage are typically being required for these systems? For an example, square footage residential homes."

MR. SHIRAKH: We're working with the

California Storage and Solar Association to nail some of the details, and currently the panels that are available for new construction are 200-amp panels.  And, unfortunately, it appears that the next step up is 400 amps which is for like small commercial units.

And we're trying to explore possibilities to see if we can actually have panels that are either a 280 or 320, but that's a work in progress for now.  We can potentially have a bus bar that's connected to an existing 200-amp panel that carries about 225 amps, but that seems to be the limit.

But, you know, we are attempting to explore the possibility of seeing if the panel manufacturers can actually make available large panels in the 280 to 320 amp.

MR. STRAIT:  Michael Winkler, I think you might have already answered this, but they're asking, "Would you allow thermal storage as an alternative to battery storage?"

MR. SHIRAKH:  They can work side by side. Again, the key is to -- they can be an alternative, they can be side by side.  The way that TDV works is that we're going to set a budget for storage systems in general for load shifting. And the building on our designers, they can use any of the available technologies or a combination of them to get to those targets. So, they can be complementary to each other.

The only caveat is that sometimes when we're talking about thermal storage and battery storage, they compete for the same rooftop space, and then that really becomes the choice of the designer to look at their building, what's available, and what is the cost and what's the benefit, and decide which system they want to use.

Again, you know, we're going to set performance targets using TDV and source energy, and then we're agnostic as how they get there. But there it is going to be likelihood involved some battery storage because they're so effective in load shifting compared to other strategies, because what battery storage do, they actually shift the entire load of the building, including HVAC, lighting and plug loads. Most other battery storage technologies impact only one or two of those end uses. But, you know, it is what it is. You know, we will provide the means within the software for any of these technologies to have an opportunity to meet those targets.

MR. STRAIT: Brian Finn asks, "Where can we find the heat pump ready language that has been developed and they're specifically looking at low- and high-rise multifamily residential?"

MR. SHIRAKH: Stay tuned. It's coming right up.

MR. STRAIT: I can add to that that there are some local ordinances that have language to this effect. If you want an example of what that language could look like, but again, we are working internally to develop that.

MR. SHIRAKH: Okay.

MR. STRAIT: Tom Paine asks, "Is there cost benefit data for heat pumps that the Energy Commission is using that is available for review?"

MR. SHIRAKH: It will be part of our final report, yes.

MR. STRAIT: Clifton Stanley Lemon asks about incentivizing. That's not really a question for us. I'm going to dismiss that.

Sean Armstrong is asking to explain the difference between minimum wall requirements for hybrid versus all electric. I'm not sure --

MR. SHIRAKH: So, I think he's talking about -- let me go back to this slide here. Did I go back too far? Yeah.

So, if I understand the question correctly, you know, we mentioned here that if the builder voluntarily installs a heat pump water heater and then a space heater they'll get between a two to three-and-a-half EDR credit. But we want to make sure that that credit is not entirely used to compromise the roof deck insulation and the wall insulation. So, we instituted these minimum requirement for this voluntary option only.

If the builder continues to build a mixed view home or decides to forego this credit altogether, because this will likely be a check box in the software, if they don't check that box, then they have scenario just like it is today where you have a mixed fuel home and the baselines include an R19 -- these are prescriptive requirements -- R19 roof deck insulation and .048 U factor for the walls. And they can still do tradeoffs, like putting in better windows. They can put in more efficient furnaces, water heaters. They can hire efficiency air conditioning as it is today. Those are all available to both options.

So, I don't know if that answers the question. Sean, feel free to email me separately, and if I'm not understanding your question correctly I'll be happy to respond.

MR. STRAIT: This may be a rhetorical question but I'm going to ask it in good faith. Nehemiah asks, "Why not include enough battery storage to turn the shark fin, the Duck Curve, into a flat line?"

MR. SHIRAKH: It's a question of cost effectiveness, and, actually, I looked at that myself quite a bit with my simulations and I think E3 is confirming that it becomes virtually impossible in some nonresidential buildings to eliminate all the exports, even if you put infinite amount of batteries, because the building powers and the way the loads work, you know, after a certain level the batteries will have a diminishing return.

So, the best strategy would perhaps to minimize the exports down to a level around 10 percent, maybe lower, something in that neighborhood and live with some limited exports. But that would allow us to actually have a very reasonable and more reasonable than cost effective battery storage strategy.

So, again, we'll get into those details hopefully when E3 presents in the November 19th workshop.

MR. STRAIT: Sure. Steve Rosenstock asks, "For the battery storage in residential facilities is there going to be a minimum kilowatt hour capacity that will have to be installed?"

MR. SHIRAKH: So, we're not recommending any change to the low rise, but I believe -- I wish that Danny Tam had the -- I think the minimum requirement is either seven-and-a-half or five, and Danny could answer that question.

But again, battery storage is not required for low rise. You can put in any size battery that you want, but if you want to get compliance credit for that battery, it has two requirements. It must be J12 compliant, and it must have a minimum capacity of I believe at least seven-and-one-half kilowatt hours. It could be five kilowatt hours. I need to check on that.

MR. TAM: This is Danny.

MR. SHIRAKH: Yes.

MR. TAM: J12 would require five kilowatt hours.

MR. SHIRAKH: Thank you. Okay, so it's five.

MR. STRAIT: Alice Sung asks, "Does the current selected nonresidential sector type considered for electrification include preschools and daycare centers?"

MR. SHIRAKH: So, it says educational facilities. That would include preschool, because a lot of preschools are actually part of the elementary school. So, it would include that, but as far as daycare centers, I don't think so. That's not what we call an educational facility. We're talking about high schools, elementary schools, community colleges, universities.

MR. STRAIT: Steve Rosenstock actually has a follow up of how big of a battery can be used with battery-ready requirements," but I'm not sure. Battery ready would imply that the battery is not yet installed, so I'm not sure if

I'm understanding the question.

MR. SHIRAKH: So, you know, we're going to basically size the circuits to accommodate -- a lot of times people put in one or two battery storage systems in a residential unit which could be the capacity as high as 28 kilowatt hours. But the wiring will be sized based on the discharge rate of the batteries, which is something in the neighborhood of five to seven kilowatts. And that stays the same whether you have one or two batteries. And when you have more batteries it doesn't necessarily increase your discharge rate. It increases the number of hours that those batteries can discharge. So, and we'll be considering these factors in our recommendations.

MR. STRAIT: Bruce Severance asks, "If we are considering the carbon footprint of lithium batteries under lifecycle issues as a variable in EDR and TDV." So, I think this means like the embodied carbon.

MR. SHIRAKH: The embodied carbon, that's something we need to decide.

MR. STRAIT: I do know that we have some staff that are looking into some embodied carbon metrics, so we're trying to get up to speed on that one.

MR. SHIRAKH: Yeah.

MR. BOZORGCHAMI: Peter, let me interject here for a minute. I had two raised hands earlier on, Megan Cordes and I forgot the other person's name. I apologize.

MR. STRAIT: Before we do that, I believe right now we're going to go through the questions and then do any public commentary, or are we saving the public commentary for the end?

MR. BOZORGCHAMI: These folks had their hands up for a while now. I was wondering if it's okay for them to jump in real quick.

MR. SHIRAKH: Let's hear it out.

MR. BOZORGCHAMI: Okay. I don't know, Jim, you had your hand raised. There we go. Please state your name and your affiliation and unmute yourself, too.

MR. PUREKAL: Can you hear me now?

MR. SHIRAKH: I can hear you, yeah.

ME. PUREKAL: Great. This is Jim Purekal from SunPower Corporation. I just posted my question also, and I was wondering, maybe comment about the difference in costs between new construction battery storage installations versus retrofits. I was wondering if you have any data that you can --

MR. SHIRAKH: You know, I think NORESCO is going to get into the construction costs for new construction, and that would include -- these are all for nonresidential, so they're going to be looking at small commercial to medium and large.

I can tell you that what happens in a retrofit, you know, you have additional costs because -- and I actually experienced that myself -- that's associated with adding a subpanel. In some cases, you have to isolate the circuits, you have to find walls and, you know, run conduits, which could increase the cost by a couple or three thousand bucks.

The subpanel itself might cost, you know, someplace around $900, $950.

So, let's hear what NORESCO is going to be presenting on the costs for the various commercial buildings, and we haven't really done a deep dive in retrofits because that's not part of our mission. We know that retrofits always cost more. There's economies of scales and there’s also complexities of modifying the circuitry in an existing home to be compatible with the battery storage systems and backup power and all that.

So, let’s give NORESCO a chance, and then we’ll try to answer any more questions.

MR. PUREKAL: Okay, thank you.

MR. STRAIT: Tom Kabat, this is another one I might not be understanding the question fully, is asking, “In the interest of providing flexibility to cities that wish to pass local ‘lag codes’ that avoid allowance of gas-fired heat and gas-fired water heating, will the lag codes do that, if they can show that they’ll save energy and money?”

MR. SHIRAKH: I do not understand the term “lag codes.” I’ve never heard of it.

MR. STRAIT: Yeah.

MR. SHIRAKH: I hate to venture. Can I ask the commentor to please email it?

MR. STRAIT: They’ve raised their hand, so --

MR. BOZORGCHAMI: Please state your name and affiliation, please. Thank you. And unmute yourself. I apologize.

MR. KABAT: Hello. My name is Tom Kabat. I'm an independent energy consultant. So, my question, first, I was noticing that the base code looks like it can be greatly simplified by just avoiding the allowance of gas-fired heating and gas-fired water heating, you know, to help the state pursue its climate goals as well. And then I note the Energy Commission has expressed an interest in providing flexibility in the code, and so I'm asking can -- with an electric base code can flexibility be provided to cities? Instead of having reach codes, let those who want to still have gas in their code pursue a lag code where they would try to show that gas still saves energy and money for them.

MR. SHIRAKH: This will be part of Part 11, and I think the way Part 6 works is that, you know, we establish targets for both TDV and source energy. Again, that would be know, we establish what the performance levels should be, and through performance standards people can have all sorts of alternatives -- alternative designs. They can use different equipment, different efficiencies, mix and match as long as they meet those performance thresholds.

So, I mean, that's the general approach, and, you know, if there are ways that the local jurisdictions can meet those requirements, yes, it is allowed.

And, also, at the local level, you know, they have flexibility to create their own packages, too, for the reach code. And as long as they do not violate the Part 6, the mandatory part, or the base quoted in Part 6, as long as it's not less stringent than that, then they can create any package that meets those requirements or go beyond.

So, I hope that that answers your question. If not, again, send us an email and we'll look at it. And this relationship with Part 6 and 11 can be complicated, so, we'll try to provide you with a more comprehensive answer.

MR. STRAIT: Enrique raised his hand and put it back down, so --

MR. SHIRAKH: Okay.

MR. BOZORGCHAMI: It's back up.

MR. STRAIT: Enrique Rodriguez with the California Building Standards Commission, and can also speak a little bit to the interaction between Parts 6 and 11. Try to tell us what they are. I'm going to -- I permit you to speak if you're willing to unmute yourself.

MR. RODRIGUEZ: Thank you, Peter. Enrique Rodriguez, Building Standards Commission.

So, Mazi, when you're talking about local jurisdictions having the ability to create their own, I guess means of complying with that as a voluntary measure, I'm assuming that in order to do that they would potentially amend -- would they have to amend Part 6 in their ordinance?

MR. SHIRAKH: No, they cannot amend parts. They have to comply with Part 6.

MR. RODRIGUEZ: Okay.

MR. SHIRAKH: At a minimum, but they can go beyond that if they wish.

MR. RODRIGUEZ: Okay. So, in order to go beyond it, normally if the jurisdiction is trying to enforce something like that, they'd have to file their local amendment with the Building Standards Commission.

MR. SHIRAKH: Correct.

MR. RODRIGUEZ: And, then, it's specifically amending an element or a code within Part 6, then we would actually then require findings and proper filing.

MR. STRAIT: Right. So --

MR. RODRIGUEZ: And the same thing would occur with an amendment to Part 11, you know, any amendment to Part 11 would have to be filed with us as well. And if it's something that's amending something that is proposed by the Energy Commission then we normally -- we'd send out to the Energy Commission for review.

MR. STRAIT: Yeah. There is a process for implementing local amendments, and what we're saying is that the code as written right now establishes performance targets, and inherently that means there's a level of flexibility baked into that code, and within that flexibility the code provides if local ordinances wanted to move forward being more stringent with relation to carbon or having packages that permits use of gas equipment, that's a decision that there should be room for on the local level.

We are still looking at and working through what exactly these targets are going to look like in 2022, but that's the answer. If we are at a very, very strict target for something, we might have to have that conversation at that point, but at the moment we can say that the inherent nature of a performance target is that it provides flexibility and it creates a territory that local jurisdictions connect with.

MR. RODRIGUEZ: Okay. Thank you.

MR. BOZORGCHAMI: Peter, hold on one second. Megan has her hand raised and I want to let her talk. Go ahead, Megan, state your name and affiliation.

MS. CORDES: Thank you, Payam. Megan Cordes with SunPower. Hi, Mazi. So, TDV, EDR credit for electrification of water heating and space heating, have you considered adding onto that if folks do electric cooking and just completely avoid gas to the site at all?

MR. SHIRAKH: No, not at this point. And one of the reasons is that switching to gas cooking doesn't really enhance the EDR or TDV credit performance of the house. So, that doesn't really have a big impact. It might have some marginal impact, but it's about half an EDR point. But this doesn't preclude the builders on their own to actually do that. I mean they can switch to a heat pump water heater and space heater and get, let's say, about three EDR or three-and-a-half EDR credit if they put a T4 heat pump water heater. And they can switch the cooktop, too, and that credit is still available. It's just not part of our base requirement.

And the reason is that a lot of folks out there, they like their gas cooktop, and this is one of those market transition things that, you know, we need to do.

And builders are interested in building homes that they can sell, and whether it's real or perceived a lot of people think gas cooking is superior. I personally don't share that, but I'm not the greatest cook on the planet either.

So, because of that, you know, we thought we should leave the cooktop out of this and not making it a requirement, but the credit is certainly available to the builder, if they decide to go basically all the way.

And, by the way, they can also put a, you know, maybe a heat pump clothes dryer, and we're thinking about creating a credit for that and get additional credit for that. But, again, we're not making that a requirement. It's an option that is available. I hope that answers your question.

MR. STRAIT: I'm noticing that a lot of

questions that are now coming in are kind of going into the weeds in terms of level of detail.

MR. SHIRAKH: Right.

MR. STRAIT: Do we want to --

MR. SHIRAKH: I suggest because, again, this was supposed to be a 40 minute and I think we're past that. I suggest unless there's a specific question we move to the next presenters.

MR. STRAIT: I think the only general question that we have is Dennis Peters is asking, "Will community solar be an option for the PV requirement?"

MR. SHIRAKH: Where they're available. Not very many places in the state, we only have SMUD that has community solar. They may extend it to nonres., but we don't have any community solar option available within the IOU territories or even other communities. So, if they become available, yes.

So, I really think we should move on.

MR. BOZORGCHAMI: Mazi, we have to stop for one minute. Apologize. We have our public advisor as a panelist right now, and she has a few letters that she has to read.

MR. SHIRAKH: Okay.

MR. BOZORGCHAMI: So, I'm going to ask her to unmute herself. Noemi, would you please unmute yourself and state your affiliation and please read the documents.

MS. GALLARDO: Thank you, Payam. Hi there, Mazi, good to see you. Hi there, public. My name is Noemi Gallardo. That's spelled N-O-E-M-I. Last name is G-A-L-L-A-R-D-O. I am the public advisor for the Energy Commission, and I have three comments that I'd like to release, and this is on behalf of members of the public.

The first one is from Stephen Pallrand. That's spelled S-T-E-P-H-E-N, P-A-L-L-R-A-N-D. He's from Homefront Build. He says:

"We are a design/build firm in Los Angeles and currently design all our projects as all-electric homes. We have proven that this makes sense financially as well for reducing the effects of climate change. This is a critical issue and it needs to be implemented. Thank you."

"The car industry has seen the future and is heading in all electric direction. The building industry needs to catch up."

The second comment I have is a little

longer. It’s from Paulina Souza. It’s spelled P-A-U-L-I-N-A. Souza is S-O-U-Z-A. She’s a partner director of Sustainability at WRNS Studio. She says:

“As a partner of WRNS Studio, an architectural and planning firm with headquarters based in San Francisco, I am writing to ask that you consider much clearer and stronger language and benchmarks to direct the building industry to design without fossil fuels. As a lifelong practicing California architect, I have seen the tremendous benefit from California code leadership in areas of fuel efficiency, air quality and health. Please take this opportunity to continue to lead by requiring the quick phasing out of fossil fuels given the short timeline we now have to make positive change.”

“In the last five years, our firm has designed numerous public and private projects that did not depend on gas for building systems. The results have been award winning, and more importantly, healthy and comfortable for the user and community. While there is often initial pushback, the pushback we have experienced often disappears when the client or developer understand the cost benefit of a simpler set of utilities and the availability of market ready systems for heating, cooling and cooking. In order to leverage this experience, and the numerous other projects designed and built by others in our area, we ask that you support a single electric baseline for all buildings, sending a message of commitment to combating climate change and an understanding that the technologies are already in the market to support this goal and result."

"Building new mixed fuel buildings is creating more buildings that will need retrofits to meet our 2045 carbon neutral goals. Retrofits are more expensive and are difficult in occupied building. Since buildings are long lived assets with 50-75-year lifespan versus approximately 12 for cars and appliances, we need to get started on building with all electric right quickly. Our office is currently designing an all-electric affordable housing project near the San Francisco Civic Center. If a project that is typically budget stressed can make this commitment, I believe other clients and program types can too."

"Please consider clear language that supports a just transition from fossil fuels with policies that protect workers and low-income communities."

"Thank you for consideration and your time."

The final comment is from Marc L'Italien. Marc is M-A-R-C. Last name is capital L-apostrophe, capital I-T-A-L-I-E-N. He's a design principal at HGA.

"The time has come for our energy code to have a much stronger approach to climate change. As a Bay Area resident for over 30 years, I am acutely aware of the changes in our regional climate, and my industry has a capacity to do more in advocacy and in the design of our buildings. It's time to stop burning fossil fuels inside of buildings and shift to all electric, or at minimum, for heating and cooling. I have designed two notable all-electric buildings in the Bay Area. The Exploratorium at Pier 15, and the David and Lucille Packard Foundation Headquarters, that we found to be cost effective, reliable and robust. It's encouraging to see this trend increasing."

"HGA supports CEC's expansion of rooftop solar to more building types. HGA designed the all-electric Science Complex at Los Angeles Harbor College with roof-mounted PV's, and we recently completed the Net Zero Energy Westwood Hills Nature Center in St. Louis Park, Minnesota, which will not only operate electrically, but share this story and its use of rooftop solar with the local population through interpretive exhibits.”

“We support a single electric baseline for all building, and most of our clients are headed in this direction. It’s generally less expensive to go all-electric due, in part, to utilizing only one energy infrastructure rather than two. The time to act is now, as Title 24 2022 would go into effect in 2023, but it can take years for permit through construction, so new buildings will still be opening with gas as late as 2026. Building new mixed fuel buildings only puts off the inevitable. Design right now in alignment with our 2045 carbon neutral goals to avoid far costlier and more disruptive retrofits later. Ratepayers are still subsidizing new gas infrastructure, yet the State of California is committed to 100 percent clean energy by 2045. This infrastructure will not be paid off by then. Let’s also not forget that far more damage occurred in the 1906 earthquake as a result of fires caused by gas line breaks. As earthquakes pose a constant threat, let’s eliminate this infrastructure liability now with a safer approach.”

“Fires aside, California tops the chart

for most polluted air in the U.S. and buildings are significant contributors to this problem. Buildings in California use more gas than powerplants, but building don't have pollution controls, and so they emit seven times more pollution. We need to align our thinking with the Governor's recent announcement to phase out gasoline powered cars by 2035 and put that same urgency towards our electricity consumption in our built environment. We can no longer pick and choose the industries to which we make this effort and need a cohesive approach to reducing fossil fuel dependency and shifting our energy sources in all departments and levels of government."

"Lastly, safety and welfare of building occupants is of paramount concern to all practicing architects. Recent research has shown that combustion inside the home is particularly concerning for health impacts and the pollution generated disproportionately affects low income and communities of color that are already over-burdened with pollution. We support a just transition from fossil fuels with policies that protect workers and low-income communities."

"We advocate for a stronger approach, investing now in building the right way for the future."

That's the final comment. Thank you so much, Mazi, for enabling me to deliver those at this moment. Apologies if that interrupted your flow. So, that's it. Thank you.

MR. SHIRAKH: Thank you for reading those so eloquently. I appreciate that. So, yeah, we understand the urgency.

So, unless there's other questions, I really urge to move on. I think this concludes the easy part of the workshop. Now we're going to take a deep dive into some of the details. I think next up is NORESCO, and they're going to talk about multi-family heat pump baselines.

And I would ask each presenter to actually turn on their video so people can see that. I think that makes it a little bit more personal. It's better.

So, Payam, take it away.

MR. BOZORGCHAMI: Sure. And, folks, I know there's a lot of questions and raised hands coming up, and we will get to you one way or another. Your questions are saved and we will be evaluating, looking at those, and, if needed, we will be having a communication dialog with you.

MR. SHIRAKH: Yeah.

MR. BOZORGCHAMI: So --

MR. SHIRAKH: We will respond to all questions one way or the other. We may not get to every single one of them today. Again, this will be a long day, so --

MR. BOZORGCHAMI: Yeah. If we keep going the way we're going, we'll be here until dinnertime, so yeah.

I think is it Roger or is it Nikhil who is going to be presenting?

MR. HEDRICK: It's going to be Nikhil. Nikhil, you need to unmute.

MR. KAPUR: Can you hear me now?

MR. BOZORGCHAMI: Yes. Excellent.

MR. SHIRAKH: And you need to take over the screen.

MR. BOZORGCHAMI: And, Ben, you're first in line when we get back, and I will unmute you after Nikil is done.

MR. KAPURA: Can everybody see the screen?

MR. SHIRAKH: Yes, I can.

MR. KAPUR: Good morning. This is Nikhil Kapur. I’m from NORESCO, one of the contractors supporting the Energy Commission with the 2022 Code Cycle. And I’ll be presenting here on the heat pump baseline analysis for high-rise residential buildings. As Mazi and Bill pointed out, there’s a lot going on in that area, so we decided to look at the 2022 ACM baselines for the performance for the high-rise residential buildings.

Oops, sorry. So, one of the main objectives here is to identify an all-electric HVAC system for consideration for the 2022 ACM baseline.

The main criteria was to evaluate performance relative to our current ACM baseline which use gas heat. And one of the factors for once we do that, switching to electric heat, it would -- there would definitely be an increase in TDV, and that’s the metric Mazi pointed out that we will be looking at for this presentation right now.

As -- in addition to the switch on the HVAC system we would also will be looking at improved performance options, particularly glazing options, for inclusion into this baseline to see where we land in terms of the overall metrics.

For our analysis we're using the CEC prototype. It's a 10-story high-rise residential building which has a nonresidential component on the ground floor with some offices and some retail. So, that's the prototype we'll be utilizing.

For our analysis we kept both the service and the domestic hot water systems as electric only, and these were kept constant across all the analyses.

So, the analysis was compared against a baseline of a single-zone air conditioner with gas furnace heat. And initially we did consider a couple of systems to be analyzed for this all-electric baseline, a single zone heat pump, a single zone heat pump with gas supplemental heat, and a variable refrigerant flow, VRF systems, and a water source heat pump with an electric boiler.

The ventilation for the residential units, the dwelling units in particular, was kept as a balanced ventilation, so supply and an exhaust, and that was kept as well for all the options that we analyzed.

All the nonresidential space occupancies in the model, those were kept constant as electric options so that we would be only looking at just the electric systems and the baseline systems for the dwelling units for comparison.

So, based on that, on our initial result we selected the single-zone heat pump for our analysis. As I mentioned in my slide earlier, the baseline for the high rise residential dwelling units is a single-zone air conditioner with gas furnace which we analyzed against the heat pump, single-zone heat pump.

You can see on the graph the single-zone heat pump gives results close to the baseline in terms of the TDV margins, but there are some climate zones where we do see a negative, and especially in climate zone 16.

So, we come pretty close to the baseline, the current baseline, in terms of the TDV margins, but we don’t really get past that hurdle in all the climate zones.

We did another analysis with the same single zone heat pump, but we switched the electrical supplemental heating to gas, and as you can see with the blue bars, in most of the climate zones, we kind of, you know, meet or exceed the current TDV savings compared to that baseline. Again, climate zone 16 is still a misnomer there, but it's pretty close compared to the red bar where we have the electrical supplemental heating.

So, like I mentioned, we did include some envelope options, especially like the glazing options that we thought we should try and see how they impact the overall results, just looking at the single-zone heat pump. Our current baseline demonstration for a fixed window is a .26 U factor and a .25 SHGC, and as an argument over the gas supplement, improving this envelope was an option that they looked into.

We did our analysis using U factors less than .36. We went all the way down to .2, and as you can see, all the results in all the climate zones became positive in terms of the TDV margins, except for climate zone 16. That only achieved the savings with a U factor of .2, which is pretty close for a triple-pane window.

We also ran the analysis with the gas supplemental heat, but just with a U factor of .3

and .23 which also brought us over the margin there for the climate zone 16.

So, based on this analysis, what we are looking at are heat pumps with electrical supplemental heat in all climate zones with a couple of different options. These are still going to be, you know, worked up on for the next workshop, but we looked for these U factors for some climate zones changing the -- you know, keeping the current requirement in climate zones where we already plan on meeting that gas baseline TDV savings, but then changing the U factor for the climate zone, standard zone 1, 2, 4, 5, 10, 12, 13, 14 and climate zone 16 maybe going even lower off a U factor to a .2.

Alternatively, we could look at climate zone 16 only with a requirement of a heat pump with gas supplemental heat and a U factor of .3 glazings.

Now, some of these options on the envelope and other options are being considered under a separate case effort which is being led by TRC, and I believe there will be a separate workshop that will happen to kind of look at these a little bit more in detail.

That kind of concludes my presentation here. Any questions?

MR. SHIRAKH: If you have any questions for Nikhil, please raise your hand.

MR. STRAIT: The only question in the Q and A box is about the timing of the agenda, and actually what I'll say is we want to get through these presentations before we take any general commentary. We think a lot of the kind of overarching commentary is going to apply across the topics that are being presented. That way, we're going to use the Q and A to make sure we answer any technical questions about these presentations, then open up to general commentary on the topics supplied.

MR. BOZORGCHAMI: Thanks, Mazi, Peter. We also had Ben Davis you had you hand raised earlier on? Do you still want to -- there you go. State your name and your affiliation, please.

MR. DAVIS: Ben Davis, California Solar and Storage Association. My question actually was back on Mazi's slide, but it so much relates to this presentation which is the two TDV points credit, I'm hearing two different things if we could have some clarification on. One is that it looks like every -- all the assumptions are for heat pumps, heat pump water heaters, but then also I'm hearing that the Energy Commission is technology agnostic, which makes it sound like solar hot water could also be added for the same TDV. Could you folks just clarify possibly?

MR. SHIRAKH: So, the point here is to actually move the market towards heat pump. Now, if the solar hot water can be coupled with the heat pump water heating scheme, the answer is obviously yes. So, that's basically for low rise, the slide that I showed previously.

Here for multi-family we haven't really explored that option, but I don't know if Nikhil or Roger have any insights into if solar thermal can be helpful.

In general, if you look at -- I mean the HVAC is the problem here more than water heating. So, the solar thermal might help, but it's not going to really, you know, like, you know, the big red you see there related to climate zone 16. It's mostly HVAC dependent. So, I don't know how solar thermal would have, but I'll let Roger or Nikhil.

MR. HEDRICK: Yeah. So, this is Roger Hedrick from NORESCO. And, so, the analysis we’re looking at here is aimed at possible modifications to the baseline that’s used in the performance approach compliance. So, anything like solar thermal or any other kind of thermal storage, those would all be part of the compliance actions that are available in the CBECC-Com software. And some of those things are currently available. There are some thermal storage options available now. Solar has not historically been good in CBECC-com, but we’re expecting that it will be added in the future.

And, so, then as people add those kind of design features they can potentially get credit and, so, that’s the path we expect to be following moving forward, and details and all those options will be worked out as we move along.

I also noticed the question coming up had to do with the issue of the hot water. Right now, our -- for residential buildings the fuel type used in the baseline service hot water system is based on what’s used in the proposed design. We intentionally ignored that effect.

We wanted to focus on the impact of changing the heating -- the space heating type and, so, we're holding the hot water -- we held the hot water systems constant to not confuse the results. But how that baseline will be defined in the future for hot water is to be determined as well, if there will be any change at all.

MR. BOZORGCHAMI: Thank you. Peter, do you want to take it on the Q and A?

MR. STRAIT: Sure. So Nehimaih asks, "As a practical matter gas and oil heating in climate zone 16 is going to be performed by propane which results in health risk and danger near your high snow loads. Were those addressed in NORESCO's analysis?"

MR. HEDRICK: No.

MR. STRAIT: Brian Finn asks, "What central heat pump efficiency values were used in these iterations and have they included the reduced efficiencies from current manufacturers?" I'm not sure what's meant by reduced efficiencies.

MR. SHIRAKH: So, just one second. Let me address a little bit more on Nehimaih's question, and then we can go back to this.

So, yeah, we were struggling with climate zone 16 to come up with a heat pump baseline and so we're basically turning every stone. And so, the choices that you see here, there's basically two. There's one to couple the heat pump technology with triple pane windows, which may or may not be a feasible alternative, or we go with gas supplement. And if you don't do that we may not have an option for climate zone 16.

So, yeah, it is true that in many cases they use propane, and propane has a different TDV profile than natural gas, so that's an additional complication we need to consider.

So, sorry, Peter. Can you go back to the other question?

MR. STRAIT: No worries. Actually, Brian Finn was able to clarify what they were referring to. So, two equipment suppliers, Nile and Cul-Mac, reduced their stated efficiencies for their equipment by 30 percent -- or by up to 30 percent across all source temperatures in April, 2020. So, were those central heat pump efficiency values used in our iterations is, in fact, what they're asking.

MR. HEDRICK: So, we're using the federal minimum efficiency values for whatever capacity is being looked at in this presentation for the high-rise residential as well as the upcoming analysis for nonresidential buildings. So, we're using the federal standards minimum efficiency values in there.

MR. KAPUR: I would just like a clarification. You mentioned central heat pump work -- central heat pump already does; is that correct? I just want to clarify.

MR. HEDRICK: No.

MR. KAPUR: Okay.

MR. STRAIT: Pierre Delforge asks, "Can you please clarify your comment by using electric domestic hot water only and would it apply to the mixed fuel baseline too?"

MR. HEDRICK: So, right now as I mentioned, the baseline fuel for service hot water heating is based on the fuel used in the proposed system. And when it's electric the baseline gets heat pump hot water heating. When it's fuel, gas or propane, then you get gas storage water heating.

Whether that baseline system will be retained in the next -- for the next code cycle has not been determined and, you know, there's no -- we haven't looked at the impact of switching the baseline to electric in all cases, at least not yet, and, so, I really can't say anything definitive about what we'll do in the next code cycle regarding that.

MR. BOZORGCHAMI: Thank you, Roger. Sean Armstrong, you had your hand raised and you lowered it. Do you -- are you still okay or should we move along? If not, let's go to the next presentation. I think, Mazi, we're good. We could go to the next presentation.

MR. SHIRAKH: Okay. So, if you have any questions we'll still have opportunity, and, so, the next up is heat pump baselines for selected nonresidential buildings, again, by NORESCO. Thank you.

MR. HEDRICK: Okay. Thanks, Mazi. Thanks, Payam. This is Roger Hedrick from NORESCO. I'm a principal engineer. So, I'll be looking at the impact of possible changes to the ACM baseline for nonresidential buildings.

So, what we wanted to do here, our objectives were to identify, ideally, heat pump or other electric HVAC systems for use in the

2022 baselines under the ACM. And we wanted to evaluate the performance of those options relative to the current baseline which used gas heat.

Our expectation going into this was that the switch to electric heat would increase TDV consumption, and so we were concerned about identifying options that might mitigate that effect.

We wanted to identify systems that have lower TDV consumption, but with only a minimal increase in stringency. So, we don't want a huge reduction in TDV consumption because that would have a dramatic increase in stringency that was undesirable or hard to cost justify. But we did want to reduce TDV consumption because if we switched to a baseline that had higher TDV consumption, you're talking decrease in stringency and we didn't want that.

So, the results that I'm going to show in the slides coming up, I'm really only showing the results for the systems where we were close to the TDV consumption at the baseline, and I'm excluding any system options that had large changes.

We used a number of different CEC prototypes. These are three office variants, small, medium and large. I'll give you a little bit of a description of these as I go through the slides coming up.

There are three variants on retail buildings, small, medium and large, a small restaurant, a small school, meaning an elementary school type of building, and then a nonrefrigerated warehouse.

As with the high-rise residential case analysis, we are leaving the domestic -- service/domestic hot water systems constant throughout. In most cases these buildings have electric baseline hot water systems anyway, so we're not changing those. In some cases, the restaurant for example, they get a gas baseline normally, but we are leaving them unchanged so we're not going to see any effect of service hot water in here.

We did adjust the performance of -- where we have similar types of cooling to what's in the baseline we adjusted the performance of the cooling in the proposed case to match that in the baseline case, so we're attempting to take the effects of any cooling impact out of this analysis.

However, in some cases there may be differences in the federal minimum efficiency for the cooling side of a heat pump system relative to an air conditioning system. We will need to be looking at that in the future, and we haven't addressed it in what we've done so far.

We've also adjusted the fan performance to match the baseline where there's some more types of systems, and, so, we're seeing the effects of heating only for similar system types. Where we're changing the system type dramatically, then there are other effects that will be showing up as well, but that's just how -- that's the nature of the beast.

So, for the small office building, this is a single-story approximately 5,000 square foot office, this uses a series of single zone rooftop systems with gas furnace heat in the baseline. And, so, we looked at various heat pump options with constant volume or variable volume fans, and then with electric or gas supplemental heat. And we also looked at a variable refrigerant closed system with a dedicated outdoor air system.

For the medium office the baseline is a package VAV rooftop system, but with -- the heating is going to heat boxes as reheat coils in the VAV boxes in the different zones. Those are hot water reheat coils fed by a gas boiler.

And, so, we looked at replacing that hot water reheat with either -- with electric resistance coils, electric resistance coils with parallel fan boxes. We looked at a heat pump boiler to provide hot water for the reheat coils, and then a VRF system as well as a water source heat pump system with an electric boiler. Both the VRF and water source heat pump systems included DOAS.

And then for the large office building, this is built up VAV systems with chill system, chiller, electric chillers, and then hot water reheat with gas boilers. Again, we looked at VAV systems with electric reheat, electric reheat with parallel fan boxes, a heat pump boiler and then a water source heat pump system for this building as well.

For the retail buildings we have a small -- oh, I forgot to mention, so, the medium office is a three-story office building that's about

50,000 square feet. The large office is 12 stories that's about 250,000 square feet, and so those, I think cover the range of buildings pretty well for offices.

The small retail is essentially a strip mall kind of a building. It actually includes four units, four separate stores. One is twice as large as the other three. And the baseline is a mix of single zone and single zone VAV rooftop units. When you get to a certain capacity, the baseline switches from constant volume fans to variable volume fans. And, so, the large store gets a variable volume fan, the small ones get constant volumes. They all have gas furnace for heat.

For medium retail this is more of a Target kind of a store, so it's a standalone store. It's a larger, you know, much larger than the small retail, but it's not into the big box kind of a range. Again, this is a mix of single zone variable -- constant volume and variable volume single zone rooftop units with gas furnace heat, again, depending on the size of the particular zone.

And then the large retail is getting more into the big box store kind of a situation, and these have -- all the zones in this building have variable volume rooftop single zone units, again, with gas heat.

And for all three of these retail stores we looked at variations on single-zone heat pump systems with constant volume or variable volume fans with electric or gas supplemental heat. So, that was the basis of what we compared there.

And we also looked at a small restaurant. This has variable volume rooftop units serving the kitchen and a constant volume fans for in the seating area. Same kind of alternatives that we looked at for the retail.

The small school has mostly constant volume single zone units serving the classrooms in most zones, but the gymnasium multipurpose room has a variable volume system. And we looked at the same kinds of single zone options there, but we also looked at package VAV with electric reheat options, VRF system or a water source heat pump system.

And then for the warehouse, the nonrefrigerated warehouse, the baseline here is a single zone VAZ system, not VAV, that serves an office area but then just heating ventilating systems that serve the storage areas. Again, these all have gas furnace type heating.

Systems we look at here, were there are heat pumps, but in storage areas there is no cooling capacity, so it’s just heat pump heat only in the storage areas, but we do have the cooling enabled for the office.

So, going to results, what you’re going to see here is actually -- so this is the small office, so I didn’t get into, so I guess they will be changed to a straight single zone heat pump case as well as a single zone heat pump with gas supplemental heat. The red bars here show the electric supplemental heat case, and as you can see, as with the residential we see negative TDV effects the higher the TDV consumption in several climate zones, while some climate zones actually show positive savings. But if we switch to gas supplemental heat, then we get to positive savings in all zones, all climate zones. So, that’s sort of our neutral case there.

Medium office, we don’t really have a good heat pump option for this. VRF systems and water source heat pump systems, which are the sort of lavender bar at the right-hand side of each climate zone and the orange bar at the left, they actually are fairly poor performers and have fairly dramatic increases in TDV consumption. The water source heat pump that's mostly or partially viewed to an issue with how Energy Plus, which is our simulation engine, models those.

But that's the reality of our modeling results which, you know, we're looking at changing the baseline for modeling analysis, and, so, we can't really use that as a baseline.

Our electric heat, the heat options, all showed negative TDV performance in every climate zone, and, so, we don't really have a good electric heat option here for this medium office.

Similarly, when we go to -- sorry -- when we go to the large office we see similar results with the exception that in climate zone 8 our electric reheat or electric reheat with parallel fan boxes we do show a positive savings but that's a quite small amount and for every other climate zone it's negative.

When we go to the retail we, again, show fairly good savings for every climate zone except

1, 16 and 14 for the single zone heat pump with supplemental heat.

Now, the baseline has mix of constant volume and variable volume, and, so, we did a case where we mixed -- when I say single zone mixed I am -- that's a mix of some constant volume and some variable volume as would be represented in the baselines. So, where the baseline gets VAV, so does this proposed case. Where the baseline gets constant volume, we get constant volume.

So, this has surprisingly good TDV results. So, only in your cooler climates do we see negative effects with gas supplemental heat or electric supplemental heat. Changing that to gas supplemental heat gets positive savings in every climate zone.

For the medium retail, again, this is a mixed VAV and constant volume, and so we see similar results. With the electric supplemental heat, we show only a very small negative in climate zone 1; climate zone 14 is positive, but climate zone 16 is still quite negative. But, again, if we switch to gas supplemental heat we can get positive in every climate zone.

And then for the large retail we see more of a mix between different climate zones and, so -- and even with gas supplemental heat we've shown negative results in multiple climate zones, so this is a little bit more difficult. This is all variable volume and, so, you know the performance is just slightly -- it's going to vary in the constant volume cases, and, so, we do see some negative results here.

For the restaurant we see positive TDV savings for the electric supplemental heat everywhere except 16, and, again, gas supplemental heat corrects that.

The small school, we see some negative results with electric supplemental heat in one and 16 as well as on five. Gas supplemental heat gets you positive savings everywhere except climate zone one, and we're not quite sure why that happens here because it does show positive in 16 which is in every other case the more difficult case.

And then for the warehouse the heating and ventilating units we don't have a direct heat pump alternative to those. You know, we're using heat pump, you know, rooftop type units. And, so, when we're looking at the constant volume case we show negative TDV savings -- sorry, electric supplemental heat we show negative TDV savings in every climate zone. Switching to gas supplemental heat mostly gets us positive except in climate zone 15, which given the relatively low cooling, heating role there it's a little bit surprising to me, but that's the way it is.

And, so, our conclusion from all this is that for cases where the baseline uses gas furnace heat, switching to a heat pump baseline appears to be viable and meet our criteria of not reducing stringency.

We will probably need to do additional investigation to identify additional options to avoid -- to address the cases where we are getting are higher TDV consumption. Gas supplemental heat will mostly do that, but may or not be a desirable option for some of the reasons that have been mentioned by various commentors already. So, we may want to look at additional envelope stringency or do we want to go to climate-zone specific requirements for our baselines.

For the two office buildings where we're using hot water heat, we don't really see a good electric alternative at this point, and we still need to do some further evaluations to make sure that we will not end up with a penalty on the cooling side due to the federal minimum efficiency requirements that they find can't be more stringent than those federal minimum efficiency levels.

And then we also will be looking at the possible inclusion of dedicated outdoor air systems as a further alternative to some of these cases. We've done some very preliminary looks at that, and that may offer some savings that will allow us to offset the cases where we have higher TDV consumption.

And so that is the end of my presentation. I'd be happy to answer questions.

MR. SHIRAKH: Roger, this is Mazi. You know, for your medium and large office, that seems to be the more problematic areas, did you consider gas supplement for those occupancies or is it not an option?

MR. HEDRICK: Well, we don't really have good heat pump options for those because, you know, with a heat pump you have to have a place to reject the heat to the -- reject the cold to the outside, and that's not -- we don't really see that as particularly viable for those buildings, so we don't have like a normal air sort of heat pump option that we looked at. So, we're trying to identify ways to generate electrically -- generate the reheat electrically, whether that's through heating the water, the reheat water with an electric-type boiler or direct electric resistance coils in the boxes. And, so, the heat pumps are just problematic in those kinds of buildings.

MR. SHIRAKH: Thank you for that explanation.

MR. HEDRICK: Sure.

MR. SHIRAKH: Are there any other questions, raised hands?

MR. BOZORGCHAMI: Yeah, we have a couple of questions here. One question is from Brian Finn. "Was 140 or 150 supply temperature used?" And he's saying that 180 is not going to work, so --

MR. HEDRICK: Right. So, I think we're talking about when I was looking at the heat pump boiler case, and we used a I believe a 130 or 135 hot water supply temperature in that case. I hope that's what you're referring to.

MR. STRAIT: Sorry, I was muted. I can pick up from here. Did you have another -- Payam, do you have more to say to Brian Finn?

MR. BOZORGCHAMI: No, no. I was going to go to Ted Tiffany's question.

MR. STRAIT: Okay. I can pick up. Ted Tiffany asks, "Can we go --" Actually, it's addressed to Roger. "Can we go into more details on limitations for modeling the heat pump boiler and the assumed coefficient performance and the simulation results, or is the limitation modeling just an electric resistance boiler at 1.0 COV?"

MR. HEDRICK: So, we did try to model a heat pump boiler, and the -- you know, we have a method to do that. I'm not entirely comfortable with that method. It actually is using an EnergyPlus heat pump water heating object or series of objects. And, so, you know, I have a lot of questions about the reality of how that was modeled. You know, this is sort of -- we're going to be switching to a newer version of EnergyPlus in future versions of CBECC-Com, and in that newer version of EnergyPlus there is a new heat pump central plant object, and so we will need to be looking at that object in the future as well, and, so, -- you know, so I think that the heat pump boiler needs more investigation and more checking against reality of how such a heat pump central system would be designed and installed. So, yeah, that's part of our future work I think. Is that handwavy enough for you, I hope?

MR. STRAIT: Tom Kabat asks, "What are the heat pump performance characteristics for these cases that coefficient performance, heating seasonal performance factor, et cetera? What is the federal minimum standard? Do you or can you also look at modern available economic heat pumps that designers would tend to select?"

MR. HEDRICK: Right. So, we have a couple of limitations for -- as I mentioned previously -- for use in the baseline we're limited to the federal minimum efficiency levels, and so that's -- for the smaller units that's generally stated as an HSPF, and then we have to -- to actually model that we have to convert it to a COP at a rated condition, so that's a single-point COP, and then it's combined with the performance curves that are built into CBECC-Com.

An issue has, you know -- CBECC-Com has prescribed performance curves for most equipment, and the validity of those performance curves for modern heat pump equipment has been questioned. I think it’s a valid question, but it’s also a larger effort to try and come up with replacement curves because those need substantial backup to make sure they’re valid and to make sure that we are treating all classes of equipment fairly.

So, it’s a complicated question, but the performance of the heat pumps is represented by a COP that is calculated based off of the federal minimum HSPF and the CBECC prescribed heat pump curves.

MR. STRAIT: Randall Higa asks, “For the water source heat pump case is an electric boiler used to provide heat to the loop, and, if so, is that boiler electric resistance or heat pump?”

MR. HEDRICK: The answer is yes, and, yes, it is electric resistance. From previous analyses that we’ve done we know that that boiler actually runs very little. In general, for these larger office buildings because you have many zones that are cooling almost all the time a lot of that heat can be provided by -- you know, as the heat is removed from those cooling zones and then can be used to keep the loop warm enough. So, the boiler doesn't run very much. So, when we looked at gas boiler versus electric boilers in the past it's virtually indistinguishable, so --

MR. STRAIT: Alice Sung actually has a couple of questions related to schools. First, she asks, "For small schools did you model heat pumps with electric backup instead of gas supplementary heat?"

MR. HEDRICK: Yes. So, we have both electric resistance supplemental heat as well as gas supplemental heat cases. So, the school -- so, the orange bars here are electric supplemental heat and the blue are gas supplemental heat.

And, so, you can see in most climate zones here for the school the electric supplemental heat is -- works just fine.

MR. STRAIT: She also asks, "Have you modeled comprehensive high schools with larger centralized systems on some buildings, or community colleges with a large central plant?"

MR. HEDRICK: No. So, you know, remember that our purpose here is to identify potential changes to the ACM and particularly -- and so we're sort of assuming that the system math that's built into the ACM that's used to determine for a given building what the baseline will be. The ACM determines the baseline system type based on building floor area, number of stories, and in some cases the building type, so, for example, the warehouse gets a special case.

So, if you take one of those school buildings and they get large enough or tall enough where they would switch over to central plant type systems, then I would expect that you would run into the same kinds of issues that we were seeing when we were looking at the larger office buildings, medium and large office buildings.

So, any type of central plant baseline case I think will run into the same difficulty with going to an electric baseline that we saw there. If they are small enough or low enough where we can put rooftop unit or heat pump systems on the roof, then that would be my expectations that those will work similarly well to some of these other schools. I mean, thermionically there is no significant differences.

MR. STRAIT: Shaojie Wang asks, "What are the EER and COP of water to air indoor units for water source heat pump systems?"

MR. HEDRICK: I don't recall offhand. I would have to dig back into that. I don't know the answer to that.

MR. STRAIT: So, if there are technical details like that that are in the proposal materials, then I think rather than -- since we have more presentations, these are available if people download these reports, correct?

MR. HEDRICK: Well, we haven't put together a report as yet, so there's nothing beyond what I've shown in this presentation to download yet. So, all that kind of -- you know, as I've said, there's more work for us to do, and so when we get to, you know, a complete analysis, then, yeah, there will be a report that they can download.

I think the issue with the water source heat pumps, though, is not the details of the efficiency of the units that we're modeling, but rather, the way EnergyPlus models water source heat pumps relative to air source, heat pumps or air source cooling -- DX cooling coils, and there's really nothing we can do about that. It's an EnergyPlus issue, and unfortunately I just don't have a good answer for the water source heat pump case.

MR. STRAIT: Okay. That's all the questions at the moment other than a question about what time we're breaking for lunch.

MR. SHIRAKH: So, this is Mazi. We're coming up to 11:00 o'clock, and I suggest -- it's 11:10 actually. I suggest we go to our next segment. We're probably going to go to about 12:30 or so and see, you know, what kind of progress we're making. And then I've got to make the decision if you want to halt for about an hour.

So, next up I think is NORESCO, John Arent, and he's going to be talking about the cost of fillable tanks and battery storage systems. Take it away, John. You're muted, John. Still muted. Can't hear you. No can hear.

MR. STRAIT: It looks like you're not

muted according to the software, but we're still not getting any audio from you.

MR. SHIRAKH: Your own mike may be muted.

MR. ARENT: How about now?

MR. SHIRAKH: Oh, good, loud and clear. Thank you.

MR. ARENT: Okay.

MR. SHIRAKH: Take it away.

MR. ARENT: Sorry about that, everyone. Well, thank you. My name is John Arent, and I'm a mechanical engineer at NORESCO, and I'm working with the team, and my role for this project is to look at system costs for both commercial and fillable tank systems as well as on-site battery storage systems.

So, I don't know, Mazi, whether you or Payam can assist with bringing up the presentation or whether I can just take control myself.

MR. BOZORGCHAMI: John, I think it would be best if you take control and run it. If you need assistance, I can do it from here.

MR. ARENT: Okay. Payam, can you see the screen?

MR. BOZORGCHAMI: Yes, we can, but it's

in the -- it's not in presentation mode. It's in formatting mode.

MR. ARENT: Okay. All right. How about now?

MR. BOZORGCHAMI: Perfect. Good.

MR. ARENT: Now I lost it. Okay.

MR. BOZORGCHAMI: Would you like me to bring it up?

MR. ARENT: Sure. I saw it for a second and then it went away. Sorry.

MR. BOZORGCHAMI: Here we go. I have it. I'll just share. Here you go. Can you see my screen?

MR. ARENT: All right. It was the delay, sorry about that. Okay.

So, as I mentioned, we're looking at costs for commercial fillable tanks systems as well as storage, meaning battery storage systems, so, onsite systems for commercial buildings.

So, we're looking at -- the focus of this presentation will be on the first costs, but we are, of course, looking at any maintenance costs and replacement costs as well for these systems.

Our next slide. Thank you.

The objectives are to determine the costs for inclusion in the economic analyses and the energy savings analyses that are being performed by E3 for this project.

For fillable tank systems we're looking at installation relative to the array size, so we're looking at costs.  One way they're often expressed is in terms of dollars per watt.  And for the purposes of this presentation, when I refer to PV systems I'm referring to effectively the entire installation, so not just the modules themselves.

And then for battery systems we're looking at the installation costs as well as -- for different capacity storage systems as well as the duration.  So, we have effectively a 30-year lifecycle that we're looking at for this analysis.

So, for battery systems we're assuming that there would be potentially two replacements over the expected life, so, one at year 10 and one at year 20.

So, for both these systems the costs are gradually coming down.  So, we want to look at both the current costs which we've developed as well as cost trends over time.

Next slide.

So, the methodology to get representative costs, we looked at -- contacted over 50 of the top installing contracting firms with commercial projects in California. We contacted MEP and sustainability firms that have experience working with PV projects on their buildings. We also contacted facility managers of large corporations to find out what their perspective was on system costs. And we distributed a cost survey to respondents for to obtain PV and commercial storage prices.

We also did -- along with this there's a large body of collected data, the NEM, the net energy metering interconnected data set is available publicly and we've parsed through that and sorted through to determine current prices as well as price trends for PV.

For storage we contacted battery storage manufacturers and turnkey providers, and also reviewed sources of existing data, both for California as well as nationally.

Next slide.

So, I won't stay long on this slide. Hopefully, it will be available. This will be a lot to read. But these are some of the sources we've used. There's a lot of good work done by both LBNL and NREL, the national labs on pricing and cost trends. They've developed kind of a bottom-up analysis as well as trying to unpack the costs and understand what are the cost drivers. So, we've been primarily getting top-down costs to supplement the literature view that's out there.

For battery systems, similarly, we're getting -- looking at cost data that's available from literature, but we're getting -- placing a greater emphasis on the locally collected cost data for projects in California.

Next slide.

So, this one is a summary with a correlation of the costs that we have to date. So, these were the combined sources that I mentioned above. And then for the NEM data what we did was we sorted through the data, we filtered out, for example, project tracking PV or projects that don't have roof mounted PV, and so forth, so that we could get a fair comparison. And with that resulting data we took three or four different size bins of system capacity on the X axis and determined median costs. So, that's added to -- it's a supplement to the cost data that we gathered directly from sources in California for this year.

The other thing you'll notice, the third kind of, well, bullet on the left is that -- so, what we did was we wanted to gather costs that are relatively recent costs. 2020 is still going on. So, we have data beginning 2018 through 2020 that is represented on this summary graph or chart. And what we've done is we've taken projections of future price drops in PV and installed costs and applied those to the 2018 and 2023 costs to determine what the cost would look like in 2023, January 1st, when this regulation and proposed change would be adopted potentially by the Commission.

One minor note. We haven't yet quite applied an inflation to these numbers, so we may adjust slightly, but the shape of the current should still fly. The quite obvious thing if you look at it is that for very small projects, say below 50 kilowatts of fillable tank panel, the costs per watt are much higher, and that's somewhat of an expected trend, but it's quite a sharp increase from the data we have, below 50 kilowatts, so it’s something we will looking at a little bit more closely, but we feel strongly that this is a good set of data that represents what current costs actually are for these systems.

Next slide.

So, there was a mention earlier, I’ll get to the question of the batteries and the difference between an existing building and new construction costs.

For PV we’re trying to determine that distance as well, and there’s limited direct information out there available.  But one thing we found is that there are some modest but significant customer acquisition costs, so sales and marketing related efforts of 18 cents per watt for commercial projects that would mostly be avoided with new construction projects. Interestingly, the residential acquisition costs are quite high, or can be.  They’re reported as high as 40 to 60 cents per watt for those.

Other soft costs include permitting inspection and interconnection, procurement and construction.  There’s also costs with shipment and delivery, getting the panels transferred to the site. So, soft costs are -- even for commercial projects can be -- they're stated as approximately 50 percent, sometimes as high as 60 percent, of the total project costs. Those costs are coming down along with everything else, but it shows that there's a much lower importance on the cost of the actual modules which tend to be currently approximately 40 to 45, 50 cents per watt on the high side for the PV modules.

So, it's important moving forward looking to reduce these costs obviously to reduce all of the soft costs, the balance of system costs. We're looking into this a little more closely to see if new construction projects can avoid some of the balance of system costs if there's infrastructure already in place.

Next slide.

So, this one, the third data field on this graph is a little hard to see probably, but basically what we did there were different forecasts scenarios that NREL has for estimating drop in price, and again, a reminder that this is -- we're looking at the total installed cost, not just the drop in the PV module itself.

So, they're forecasting drop installed cost to 2023 from 2019 between three, 15 and 20 percent. What this analysis is deemed as somewhat conservative. It takes the conservative reduction, which is the lowest reduction, and then the moderate scenario and then averages them and uses that to develop -- just to project outwards towards 2023.

So, again, this exercise is just to project costs to the date of adoption. For a lot of technologies that are a little more mature where the price is less fluctuating, such as, say, insulation, we don't really worry too much about forecasting that a few years. But in this case even a few years could have a significant difference in the prices.

Next slide.

For further study, these small commercial systems, as I mentioned, seem to have a much higher cost than larger systems. We want to make sure we're characterizing those appropriately, and as I mentioned already, we're looking to further differentiate between new construction, retrofit prices. Some of the costs that we go through the surveys were actually new construction costs, but a lot of the data that's available from them is existing buildings. So, we want to make sure we're not conflating the two and have those appropriately -- that any kind of adjustments are "unpacked" or accounted for.

Next slide. So, for battery storage this is commercial batteries, and this is the I would say mediumish to large batteries as far as being onsite commercial batteries. So, these are costs from our discussions with battery storage manufacturers that have projects in California, as well as some MEP firms that have had done battery projects in the past.

And what we found is that the cost range is $600 to $800 per kilowatt hour, that's installed. And this is for systems on the lower side of the -- smaller side is going to have a higher installed cost per kilowatt hour, so on the 800 end, and then it goes down to about 600.

You'll see that two points at -- a couple other quick notes. The two data points at 2,000-kilowatt hours capacity are from another study, Lazard, so that shows a range of I think there was $380 or $377 to $830 per kilowatt hour. So, there's quite a wide range. These are also decreasing in cost over time.

The other two notes is that the cost of four-hour storage is generally a little bit lower than the two-hour storage, which is pretty common right now because of its alignment with the South Generation Incentive Program, but as I mentioned before, the expected life we're assuming is 10 years, maybe a little bit conservative. Many of these systems are warranted for 10 years, so it could last longer, but they might have a decreasing effectiveness.

The replacement cost should be at least 30 percent lower. There's some soft costs that are avoided as well as infrastructure costs on the replacement.

And then the battery itself is projected to drop by 30 percent cost at year 10. So, those two factors together result in a replacement cost at year 10 that's about 50 percent lower than the first cost, and I have that on the subsequent slide.

Next slide, please.

Yeah. So, those were for systems that have a capacity of generally 100 kilowatts or greater, so 200 to 400 kilowatt hours. The footprint of these, just a couple design notes, takes up roughly the size of a whole parking space. These systems because of some aspect of the fire code, the systems are typically installed outdoors, and rooftop is possible, but because of the weight this would have to certainly be accommodated for.

And then, as I mentioned just now, the systems are available typically in a one to four-hour discharge duration period. So, the systems that have a -- can discharge up to four hours are lower per kilowatt in cost than the systems that have a two-hour discharge.

Next slide.

This shows -- this is a graph from NREL. It shows long-term battery storage projected costs, and it’s normalized so it’s one at I believe 2018. And the study shows a pretty -- especially through 2030 a pretty significant drop in prices for these systems, between anywhere from 11 percent to 45 percent to on the low -- the low, it’s funny, is the aggressive one. The low costs are the most aggressive forecast, would have a 67 percent drop by 2030. So, what we are looking at right now is the average of the conservative and the moderate scenarios right now as far as forecasted.

So, recall that this doesn't affect the first cost, but it would affect the replacement cost, so we want to have a reasonable value for that.

Next slide.

So, the other storage costs were for fairly large systems, reasonably large systems, but the Energy Commission is looking at incorporating the possible storage requirements to supplement the PV to limit exports and looking at that for small buildings as well.

So, for small buildings there's a little bit more limited options, but what we did was we gathered some cost data for the Tesla power wall. There is at least one other system similar that is available on the market, but the power wall is one of the more common ones.

The leftmost column you'll see different quantity numbers, so this just illustrates that with the -- there are some kind of fixed costs for getting an installation in place. There's going to be a little bit of economies of scale as you increase the quantity of these.

So, the last -- so we're getting about similar estimates initially $780, $800 dollars per kilowatt hours, similar cost to the small more commercial storage batteries of the 100-kilowatt size. But we also got a recent estimate for a Davis residence of $610 per kilowatt hour installed. So, these are a little bit more common on the residential side, so we'll have to see how the commercial costs play out for these systems.

Next slide.

So, these are the preliminary recommendations. I think we feel pretty good about where we've ended up. We're looking on the top small chart there for the fillable tank system costs we're looking closely at the smaller systems because a lot of the -- you know, the small office, the small school, standalone retail, these may end up having -- requiring small systems, so we want to make sure we have the costs represented appropriately. So, say that 10 to 20 kilowatt-size system, currently we have it at 2.84 per watt to up to $3.16 per watt.

Some of the NEM data that we gathered is a little bit higher than some of the other sources, so we're also trying to make sure we fully understand why that is. But these are the costs that we have, and as you can see, for the large systems the cost comes down quite a bit because of the fixed costs get spread out over the system.

For the battery installed costs, as I mentioned, there's two replacement costs, so for the smaller system just using the forecasted values and as well as the elimination of some soft costs, we're looking at a reduction of a little over 50 percent by year 10 and a little bit further reduction for the second replacement by year 20.

So, for the large system of over 100 kW that has a first cost of $600 per kilowatt hour we're looking at a replacement cost of 284 year ten and at year 20, $200 -- sorry, $258 dollars per kilowatt hour.

The numbers for the battery storage, they are a little bit higher than some published estimates, but these are -- we've gotten these numbers from at least three different sources and types of sources per actual cost within California, so this is what we have right now for the storage costs.

So, with respect to a gentleman had a question on new construction cost versus retrofit, I think there could be some elimination of some of the soft costs on the new construction project, but that's something we want to kind of further develop because there's little direct data on that so we would need to have some direct data to be able to claim a further reduction in costs.

Next slide, please.

So, the next steps are to collect feedback from the attendees here or those who have comments who have looked at our initial recommendations. Refine the costs for small systems, particularly below 25 kilowatts and investigate the cost differential between new construction and retrofits. There's obviously more data for existing buildings, but we have some information for PV and we want to get a little bit more information to make sure we've characterized that differential appropriately.

Next slide.

Acknowledging the team, Roger Hedrick, Silas Taylor and Rahul Athalye. And also, just to mention that we're working with and for E3 who is doing a lot of the high-powered analysis to determine how these systems work, how they save energy, how they interact with the grid and how the exports and valuation of those exports can be incorporated into the analysis.

Thank you, and I'll take any questions now or afterwards.

MR. SHIRAKH: So, this is Mazi. Thank you, John, that was a really good presentation.

So, any questions for John? I should have noted that the data that he's providing here will feed directly into E3's analysis that's just coming up. So, it does impact the benefit cost of PV and battery storage systems. So, it's important for us to have a solid information here, and I think John has done a great job.

Any questions for John?

MR. STRAIT: So, we have technical questions and one about cost effectiveness. I'm going to take the cost effectiveness one last.

First, Steven Rosenstock asks, "Do the estimated commercial battery installed include the cost of meeting the most current fire code requirements?"

MR. ARENT: I believe they do. We haven't like -- as I mentioned, some of the costs we have received should include all of that. These are recent estimates from projects over the last year. We haven't -- as I mentioned, we haven't tried to do what is sometimes referred to as the bottom up analysis where we're trying to cost out each component and build that up into a single estimate, but we're getting overall estimates from a number of sources, so yes, it should include those -- the effective of those regulations.

MR. STRAIT: All right. Ben Davis asks, "What assumptions were made about incentive programs. Is it just ITC or SGIP when calculating future system costs?"

MR. ARENT: Yeah, good question. So, we don't include the tax credit, nor do we include any generation programs when we're looking at these costs. E3 may have a further comment on that on if or how those play. So, these are just the costs of the systems, themselves absent any incentives.

MR. STRAIT: Last, Tom Paine asks, "Nonresidential buildings are commonly not occupied by the building owners. How do you plan to support building owners forced upon solar projects that they cannot benefit from, and what of scenarios where there are multiple building occupants? How do you ensure equitable delivery of on-site generation among occupants?”

And if other staff would like to step in on this I’m also happy to speak to this one if need be.

MR. SHIRAKH: Go ahead, Peter.

MR. STRAIT: So, cost effectiveness in terms of disaggregation on tenancy, I know there are some submetering questions that are raised by how to coordinate that these benefits are delivered to tenants, and, you know, costs and benefits appropriately designed. Overall, we would expect any costs imposed on building owners to be passed on to tenants, obviously, and if we’re talking about a slightly larger rent but slightly smaller utility bills, the total package goes down in cost. We’re still seeing a cost effectiveness there. That is, it is on the building owner to figure out what the best way of recouping those costs would be and whether that’s some sort of cost sharing, there’s a lot of options to get there. It's something that we do need to take into account when we're looking at these, but it's not something that we're doing here with this underlying technical information about the technology, itself.

So, at the moment we're looking more at what are the feasible and cost-effective levels and how can they be integrated, these kind of accounting side questions of how these benefits accrue to the right individuals we will be looking at, but it's not really going to be the content of this presentation.

MR. SHIRAKH: If I may add, that is correct, Peter. Thank you.

You know, we look at cost effectiveness from the entire building perspective and in general and how those benefits and costs are distributed amongst the occupants, you know we don't really get involved in that. You know, we currently look to the building owner and the tenants to sort that out. But, you know, it is -- if the system is cost effective at the building level as a benefit/cost ratio than more than one we deem that to be cost effective. And as long as the building that is being constructed complies with those requirements, then the building complies. And the benefits can be distributed to the tenants in many different ways, but that's outside of our purview.

So, any other questions or comments on cost?

MR. STRAIT: Not directly on -- there's one question, "Am I to understand that PV costs are forecast --" I'm sorry, this is by Tom Conlon. "Am I to understand you are assuming PV costs are forecasted drop by 30 percent over three years and storage costs by 30 percent over 10 years?" Then he clarifies, nine percent for PV over three years and 10 percent for storage over 10 years. So, is that correct?

MR. ARENT: Yeah. The nine percent was more, I believe -- I might need to double check, but for the PV drop was I think from 2018 to 2023. So, what we did was we looked at the price drops here every year between 2018 and 2023. So, in other words, estimates that were received this year provided to us for 2020 estimates were not discounted as much as the 2018. So, there was a small discount for PV, and, yes, the storage was, I believe, about 30 percent by -- they say by year 10, so by 20 -- that would be 2033 if this measure is approved and adopted in the year 2023.

MR. STRAIT: Brian Finn asks, "If the interactive benefits or the synergy benefits of having heat pump water heaters, storage and fillable tanks in the same project are incorporated into the financial analysis?"

I'm not sure this question makes the most sense. What they're saying is that heat pump water heaters increase the value of storage, which increases the value of the fillable tank system, which increases the value of heat pump water heating, et cetera. So, there's an interactive benefit to having all three of those components. And they're asking how the analysis will incorporate those we call them retrofit questions, but how it accounts for those effects in the financial analysis.

MR. ARENT: Yeah. Well, I think it's something we can look into. I don't think we've gotten that far. So, I'm presenting just the costs at this point, so we'll have to see whether having a heat pump water heater will provide some synergies with fillable tanks and storage.

MR. SHIRAKH: So, I mean, this question

has come up before and, in general, heat pump water heater is part of the building load, just like any other load, and is not really a separate load than all the other loads like lighting, plug loads and all that. So, the PV's and the battery storage must meet all the loads, regardless of where they're coming from for a particular hour. So, TDV accounts for all of that because, you know, we have an hour-for-hour profile of loads for the building and the associated TDV values and how its impact is already basically calculated through the simulation.

Any other questions.

MR. STRAIT: There's a fairly trick one. We have a question from Alice Sung about analyzing the costs and benefits from the economies of scale are both purchasing for public school districts. That is, instead of costing out one system for solar storage for one small school, aggregating all school sites for an entire district. They say that that kind of aggregation would make sense, so it would be good to see those productions capture the analysis.

MR. SHIRAKH: I think that John's analysis actually showed that when you go to larger systems there's a reduction. Go ahead, John.

MR. ARENT: Yeah. So, I think that effect would definitely be true. I think if you're talking about kind of applying something district-wise, you know, that could involve a lot of existing buildings, and our focus, as least with this particular measure and analysis is new construction. So, I don't know that there would be the same opportunity for economies of scale in that sense.

MR. STRAIT: I would add this. We are making some conservative and "worst" case assumptions about some of these costs because we can show that it works or that it is cost effective in these isolated cases, then obviously when you have an additional benefit of being able to purchase at scale for an additional benefit for interactive effect. You've already made the base case and that only makes it better so --

MR. PRICE: Hi, y'all. This is Snuller Price. Can I chime in real quick just to -- because a lot of questions are coming up around cost effectiveness, so stay tuned because our next panel, Michael Sonntag and E3, is going to be walking through in a lot of detail for a lot of building types, the cost effectiveness, and a number of these kind of questions are going to come up and be answered.

Just a couple off the top that we've already discussed. One I think was mentioned around tax credits, and we do account for the tax credits. Michael will be talking about how we do that. John stated sort of the base and self-cost, and then we're also factoring in benefits such as the tax credit.

I just wanted to sort of plug the next call and maybe we should shift some of the cost effectiveness questions until after we talk about or show those results.

MR. STRAIT: We can do all this. There's a remaining question here. Ken Jonah asks, "You made reference to the 2014 Friedman article in your slides. Can you say why you used that article?"

MR. ARENT: Yeah. So, I think we're looking for to try to tease out the difference between cost of existing buildings and new construction, and there could be several potential reasons why the new construction would be lower, so we're looking at that one as far as some of the customer acquisition costs and trying to identify those for commercial buildings. There's a little bit less information available on commercial as compared to residential PV. So, I think this is an example like, as Peter is mentioning being conservative, so we're trying to get the cost as accurate as we can, but if there's some -- a little bit of unknown in any area, and in this case the question of how costs will vary between retrofits and new construction, we want to a little kind of err on the side of caution, be a little bit conservative, so that was why we used that source for that particular assumption. If there is more recent or better information on that particular area, we'd love to see it.

MR. STRAIT: So, I think that's it for the questions, so we can move to the next presentation.

MR. SHIRAKH: Okay. So, this is Mazi. We have a decision to make here. We're at about 11:49. You know, we've got about at least an hour-and-a-half of material to cover, and the most important one is E3's PV storage cost effectiveness. That might take about an hour. And it doesn't make sense to do that and then break because then we don't really have much stuff after that. My suggestion is that there are 183 people on line here, and I'm sure more than half of them are hungry. My suggestion is to break until 12:45 and come back promptly at 12:45 and resume with E3, and then the clean up language, and then the only thing after that is public comment. So, if everyone is okay with that, we'll see you at 12:45.

MR. BOZORGCHAMI: Okay. So, I will not shut the Zoom down, but I will stop recording, so we will not be taking any comments at this time until we come back at 12:45.

MR. STRAIT: Do we have something to put on the screen to show that we're --

MR. BOZORGCHAMI: I'm going to figure this out al quick --

MR. STRAIT: Okay.

MR. BOZORGCHAMI: -- and put it up. Thank you, guys.

(Off the record at 11:50:14)

(On the record at 12:45:49)

MR. BOZORGCHAMI: It is time to start the afternoon session. Michael Sontag with E3 is going to do his presentation. But before he does so, I just want to encourage everyone to really participate and provide questions, comments to us, if not just in the question and answer box, but also in the docket. We really want to get this right for this code cycle, and with your assistance we could probably do so. So, please, the sooner you guys start the dialog with us, the better.

I apologize. This is the best we have right now with the Zoom, and we're trying to answer all questions and answers that come through, but it's probably not the most ideal, but it's the best we have right now. So, with that, I apologize and I'm going to pass it on to Michael.

MR. SHIRAKH: Before we start with Michael, related to the last presentation by NORESCO and Roger Hedrick, if, general public, you have any other ideas about how to model these and how to switch the baseline to heat pump, please do let us know, and it would be nice to have it in writing and docket it.

So, with that, we'll hand it over to

Michael Sonntag. Thank you, Michael.

MR. SONTAG: Thank you. All right. Can everybody hear me?

MR. BOZORGCHAMI: Perfect, Michael.

MR. SONTAG: And can everybody see the slides?

MR. SHIRAKH: Yeah, we can see it. Thank you.

MR. SONTAG: Hello, everybody. My name is Mike Sonntag. I'm a managing consultant here at E3 and I'm speaking today about the cost effectiveness results for the nonresidential PV and battery we were looking at before.

So, to start off, just to cover what we're going to talk about today, I'm going to start with some background and context for this analysis. I'm going to talk a little bit about the various dimensions to be covered in the scope of our analysis. We're going to take a deep dive on medium office for the various cost effectiveness scores, first, looking at PV only, and looking at storage only, and PV plus storage as a combination. We did a quick sensitivity on storage duration that we're going to cover.

We also have some preliminary results on reliability and resiliency that we're going to talk about.

We also did a quick framework starting to look at how we could be using daytime EV charts using the compliance option.

And then other methods we have are pretty extensive as further input assumptions as well as some further results that were relevant but, you know, did they make the final cut for the slides that we're seeing today.

So, the goals of this analysis, you know, first and foremost you want to evaluate the participant benefits and cost effectiveness both behind the meter PV and storage in high-rise multifamily and nonresidential new construction.

You know, again, cost effectiveness is focused on participants, so, while grid impacts are certainly a part of this and are represented by TDV, the focus for this is really on participant cost effectiveness.

To do so we studied multiple configurations and combinations thereof of both PV and storage. And the focus on this is really limiting grid exports, touching on what Mazi was speaking about earlier with the Duck Curve.

And the way we're going to look at cost effectiveness is measured both under TDV-based rates, and also we tested these on current retail rates, too, just to have a really robust sense of how cost effective this is.

And within the TDV rate analysis we had a couple configurations of the TDV cost components to help found the potential future rate design. You don't want to the -- CPC is about to start and then 3.0 public proceeding. We really don't know where, you know, we're asking to go at this point, so, you know, our best hope in this is just to, you know, within right sensitivities, you know, cover it, not more than cover the bounds we'd like to go and if that, you know, takes effect before this code cycle would come into place.

We also -- you know, this evaluation also, again, covers, you know, many of these prototype buildings for nonresidential and high rise multifamily, and we did test each of the 16 climate zones separately.

And then, lastly, I wanted to call as a goal of this analysis that we wanted to present our data inputs and methodology in a transparent matter, and echoing what as Mazi was mentioning before, you know, if any stakeholders, you know, particularly trade associations, or utilities, or technology companies, or installers that do have, you know, better data that they can provide to help us hone in on what realistic assumptions are, realistic control options, realistic technology characteristics, we're happy to consider those in the next analysis.

I'd like to start off, just, you know, talking about the key findings that I'm going to walk through.

First and, you know, I think most importantly we did find that PV and storage as a package and the smaller configuration of storage facilities is cost effective for most building categories, you know, due to the cobenefits of the combined system.

You know, beyond just the cost effectiveness tested, you know, I think is more strictly measured for the building codes there are additional benefits, including reliability resiliency that, you know, would, you know, just be an additional value proposition for anybody that owns systems.

For PV cost effectiveness we did look at this, again, for PV only and found that it's, you know, cost effective across all scenarios from the participant perspective, except under the most significant rate reform.

We found, you know, kind of beyond that that minimizing exports allows for, you know, harvesting a lot of significant PV benefits while also maintaining a pretty robust cost effectiveness across rates sensitivities. And then what the most significant rate reform would be that's analogous to buy all, sell all on avoided costs of rooftop PV which we think it's, you know, pretty beyond what would happen in a cycle of the 3.0 CPEC.

For storage only we found that it did present large grid benefits, but given our assumptions which I'll go into, it's generally not cost effective for the first (indiscernible). Since it's not cost effective on its own, I think that means that it wouldn't be a required option, but I think the benefits do provide grounds for it to be a compliance option, you know, to hone that in in the next steps.

And, so, we're going to present a lot of different combinations and iterations today. Our next steps from here are to, you know, start collecting more additional relevant data from stakeholders and then start to refine and optimize the size and configuration in the context of the building codes and standards to see what, you know, the really clear recommendation is going to be going forward.

So, with that, I'm going to dive into our modeling inputs and dimensions. First, to start out, our general modeling framework. We did rely pretty heavily on the solar and storage optimization tool. This is a tool that E3 developed under a CPUC -- I'm sorry, CEC EPIC grant. So, it's publicly available. There's a lot of documentation and a couple of summary slide decks on line if you follow the link below from the document that it was developed in.

This tool is, you know, pretty handy. It can do a number of things. First and foremost, we use it to calculate life cycle cost effectiveness both from, you know, going back to the TDV impacts. It can spit out avoided costs, you know, both for PV and for storage. More relevant to storage, it can do optimal storage dispatching control, and it also has optimal sizing functionality that we started to get back into, but not so much yet.

And so, we funneled our many iterations and combinations of inputs to the tool to, you know, more or less get a cost effectiveness for various combinations.

Moving on to the sensitivities that we analyzed in this. We looked at a number of different rate scenarios, as I mentioned before. Looked at a couple different PV sizes, as well as couple different storage sizes, and then the combinations of, you know, PV only, storage only and PV plus storage.

We had two storage dispatch options that we developed. You know, one is an upper band, and one is a lower band, and we looked at this for the following building types. Your most (indiscernible) is retail, schools and high-rise res.

We looked at them both for mixed fuel and all electric, though we did size all-electric PV systems to the size of mixed fuel which is consistent with what was done for the residential buildings in the last code cycle.

We did look at all 16 climate zones, and then we had this additional sensitivity for reliability and rezoning. You can combine these in many ways and, you know, it adds up to, you know, many thousands of different end results. So, a lot of data only a fraction of which is presented today.

Going on to rates. So just start off with the background on, you know, what are TDVs, because a lot of our rate sensitivities are based on this. TDVs are time dependent value. It's what the State uses to determine cost effectiveness for building codes and standards which is required by the Warren-Alquist Act. It's meant to be a long-term forecast of energy costs to building owners, you know, specifically for cost effect analysis.

It has a number of different cost components as you can see in the chart at the bottom right here. In our TDV-based rates use various combinations of these to kind of get at where we think, you know, potential rate and performance scenarios could go.

This chart specifically is an average of all the days in the year, so, at noon, for example, it would be the, you know, the average TDV for noon for all 365 days. So, if you were going to assign on an hourly or daily basis then it is much more volatile. This is kind of our sample days here.

So, to dive a little bit more into the rate sensitivity is being considered. First, we did look at existing utility retail rates. We have some pretty extensive mapping of each building in climate zones.

So, the climate zone is a way to determine what utilities is used. We looked at -- the three that are used are LED, WP and SMUD. And then building size we used to determine that, you know, an appropriate utility rate for that based on the zone.

These are all NEM 2.0 rates. They're typically TOU rates with 4:00 to 9:00 p.m., or somewhere thereabouts time of use window. And, you know, as part of this they self-utilized electricity which is what you generate and consume behind the meter. It's compensated roughly the same as what exports are compensated. So, there's a small nonbypassable charge from NEM 2.0 that's on the self-utilization side and not on the export side.

Going to our TDV-based rates, listing these in order of increasing NEM rate reform. So, first, is our NEM 2 analogous rate which is full TDV. We remove a little bit of nonbypassable charges, but you're effectively getting compensated the same for self-utilization and grid exports. This is why most of the other codes and standards cost effectiveness studies are going to be evaluated on. This is what Roger was showing earlier, you know, this is the full TDV rate and kind of what the legal minimum amount is for what the cost effectiveness analysis would be based on.

Since there is some -- you know, the NEM 3.0 proceeding is about to begin, we did want to try these additional sensitivities just to make sure wherever that lands is within the bounds of this study. So, we looked at this both for self-utilized on full TDV with exports on avoided costs, which is all TDV except for the retail rate adder. And, then also, with exports on wholesale costs, which is avoided costs except for some of the emissions, value streams that don't have an immediate (indiscernible).

And then, lastly, we looked at where self-utilized electricity and exports are both on avoided costs.

I just wanted to illustrate what these look like for the TDV-based rates. So, we see in the bottom left this blue line here is the full TDV. That includes the retail rate higher. When we remove that to get the avoided costs and the wholesale cost it goes down a pretty significant amount, particularly in the middle of the day when TDV is generating the highest. The gold line in the middle is TDV generation. And, yeah, avoided costs are only a little bit higher than wholesale costs are, but they are, you know, both quite a bit smaller in magnitude than full TDV, just to get a sense of how much exports might be confiscating.

I do want to call out as well that different climate zones are going to have slightly different TDV shapes based off of local transmission and distribution peaks. For example, climate zone 8 here, which is in the inland valley basin, just, you know, because of the mix of energy consumption profiles there has -- still has a little bit more of a midday peak that changes the value in the middle of the day. I think it only creates a small difference as we'll see later. There is, you know, a difference between climate zones.

Moving on, so some of our inputs for PV. We did look at three different PV sizing options. The first, which is the largest is, max. NEM compliance system. That's where our annual solar generation is equal to the annual total building consumption, and on an annual basis they, you know, net out to each other.

You know, the rule of thumb on this, it does vary between building type, but we see about 40 percent of the annual PV generation is being exported to the grid.

The next size down is self-utilization. This is a little bit of a convoluted definition, but it's sized to generate the amount of PV that is self-utilizing the max. NEM compliant case.

So, from the max. NEM compliant if where exporting 40 percent of our annual PV generations to the grid, that means we're self-utilizing about 60 percent of it, and so the self-utilization size will generate about 60 percent of the annual, you know, PV output at the max NEM compliant case that does.

You know, as a bit of a rule of thumb, and this does vary by building type again, we do see about somewhere on the order of near 20 percent exports of PV in this case.

And then lastly, we cite the smaller option where it's just sized to export five percent of annual PV generation.

And then lastly, we have this gray bar in the bar charts here. It's a roof constraint. NORESCO looked into this. They didn't present on this today, so it would be, you know --

Further results just to do, if anything, a sanity check to make sure there's enough space. We see in many cases for the prototype buildings there might not be enough space for a maximum compliance system, but there is feasibly enough space for the smaller configurations we're looking at. And this chart doesn't include large office because it changes the axes pretty dramatically, so there is results for that.

Moving over to some key PV inputs. So, as John touched on earlier, the capital cost there was met before. We're just pretty strict CAPEX numbers not counting for inflation.

So, assuming those were in 2020 dollars, we calculated the lifetime at present value costs in 2023 dollars which is what, you know, the dollar rate that TDVs are reporting in for this code cycle. You know, assuming inflation rate to get there, and, you know, this covers all the replacement costs, fixed costs, and it does incorporate a 10 percent ITC for your top PV.

A couple of other details in the weeds that I wanted to make sure made it into the bulk presentation, but I don't think we can touch on these so much right now.

Next, looking at our storage sizing options. We ran two primary cases for storage sizing. These both are assumed to be four-hour duration. I will show two-hour duration later, the sensitivity, later. But the larger size of these is what we call max. storage. So, this is sized, both of these, in relation to the self-utilization PV capacity size. So, for max. storage we just set the storage capacity and kilowatts is equal to the PH capacity in kilowatts, and it's a 4-kilowatt hour battery. And then for this minimizing solar export size, it's a little bit smaller and changes based on the building type, but the nominal goal of that was to reduce PV exports from 20 percent annually to about 10 percent. And, due to coincidence of building loads and what not, you know, it's not always possible, particularly for office buildings that might have lower occupancy on the weekends, to balance if off during the course of the year.

So, key storage inputs. You know, again, we took the capital costs from NORESCO and turned it into a net present value lifetime cost, accounting for, you know, inflation and everything. We did assume a 10 percent ITC again, and, you know, primarily because we'll be charging on solar.

And, again to reiterate, we do have your 10-year storage lifetime, so you do have major cell replacements at year 10 and year 20, which, again, we think is a pretty conservative assumption.

I do want to touch on SGIP incentives as we felt, you know, for the context of building codes and standards, SGIP, would be double counting if this was a code requirement. Certainly, if this was required, having an incentive for storage might not make quite as much sense as if it's an option. So, for this analysis we just assumed that it assumes no extra for the storage cost. Some of the storage only costs might be, you know, different than we might see in a buildup cost.

The next key assumption for storage is the levels of battery control. The two big factors that we see in this typically are, you know, with the control scheme that we use to operate the battery, and then the pricing of the battery it's dispatching off of. We tried to bound this problem by having, you know, high and low, you know, complexities or sophistication levels of the control scheme, and then looking at, you know, what we think is more of the near-term signal which is retail rates, and then further out in the future which would be a, you know, full TDV base rate signal.

And, going on, you know, just to cover, you know, what does optimal dispatch look like. This is the, you know, perfect foresight feature in our solar and storage tool. So, it's able to look, you know, infinitely farther in the future to determine what the, you know, cost optimum way to dispatch the battery is and dispatch it accordingly.

As a demonstration here I wanted to show what this looks like in an actual building or in an actual prototype building. Just to correct myself there. So, these plots here show the gross load in red and then the blue dash line is on the left, the full TDV rate, and on the rate it's PG&E B-10 TOU. Both of these are for medium office in climate zone 12.

And in addition to the two-year period for the PG&E B-10 rate, we do also have an extra demand charge that doesn't appear on those charts, and certainly affects the storage dispatch as you'll see later. And, again, these are averaged over the course of the year. This is an average. These might not look quite as, you know, volatile or be as much of a spread between the midday TOU and the EP TOUs might expect.

So, adding on to these charts we see there are, you know, PV output happens, you know, where the -- our rate signals are typically at their lowest which is consistent with the Duck Curve and kind of how things are evolving in that direction.

Adding in storage dispatch from the solar and storage tool, you can see on the left where we have our TDV base rates that we are trying to, you know, charge in the middle of the day when we either have exports or when the energy prices are the lowest, and then we dispatch in the evening for the evening feed. I know this kind of, you know, a bit on TDV view. We do start to see a peak in the winter, and as this is an annual average, this morning peak gets dispatched to one of those spots as well. You have a summer peak. In the evening we dispatch time.

For our actual retail rate, we also charge in the middle of the day, but we dispatch more of the optimal dispatches to cover more of this, you know, shoulder peak before some of the TOU periods start to pick up some.

And we see what the net load looks like between these -- on the left when it’s TDV-based rates it does let the net load increase a little bit while TDV rates are a little bit lower, and then it discharges when the TDV rates are the highest.

And then on the right for the retail

rates, because it does have a demand charge component and peak demand clipping is a prominent economic benefit of behind meter storage. It's really optimizing to flatten the load to reduce the, you know, total demand for the month or the year.

And these new 4:00 to 9:00 p.m. TDV periods certainly have better alignment than previous time of use periods did, but there's still a little bit of a mismatch between -- you know, what we see is that third-year lifetime grid impacts and what's actually be discharged to (indiscernible) and retail rates.

So, going on, we also have this basic dispatch option. So, this was borrowed from the residential PV setting from three years ago. This -- the basic scheme for this is, you know, this ignores a lot of the price signal and, you know, discharges as soon as we start exporting PV and then discharges as soon as there -- as soon as we stop exporting, so, storage, itself, can't export, but it, you know, it does cover as soon as the solar backs offline.

Having got a little more time with the results of this, we think this is being a little bit too conservative and are looking for what the right lower bounds on dispatch options would be, and we're open to hear more about that from any technology providers or anybody else. We have a couple ideas on how to better model this, but it's still newer.

Great. So, that was all of our key inputs in modeling assumptions. We do have some other detail inputs in the appendix.

Now we're going to touch on the cost effectiveness of this over, you know, various configurations.

So, first would be PV cost effectiveness with the full TDV rate. These charts here show the benefits and costs, as well as the benefit cost ratio for each of the configurations. There's a lot going on in these.

So, this green column on the left here is the total benefit from the system. The yellow box is the total cost, you know, total lifetime benefit, total lifetime cost. The B/C ratio is simply the benefit divided by the cost. And then each of these boxes is for a different PV size, and these are all for medium office in climate zone 12 with the mixed fuel load, and again, on the full TDV. This box is optimal dispatch. There's no storage in this, so it's just PV and optimal dispatch is irrelevant at this point.

And we see in this that, you know, all of these are -- have pretty strong cost effectiveness, which is important. Due to the economies of scale that NORESCO pointed out with PV costs reduce even the largest system has the highest B/C ratio. And this is, you know, especially true when we have our full TDV rate where self-utilization and exports are compensated pretty nearly the same.

If we go to a rate where exports are compensated to a lower amount and self-utilized like (indiscernible) is, we see that the trend kind of flips where the size with the smallest exports has the highest B/C ratio. And that benefit is different for each of these, so, I think still the maximum compliance system would have the largest net benefit, but (indiscernible) just the amount of exports.

And, yeah, I forgot to mention this before. You're thinking about like what bar do we need to clear in this analysis. We think that exports on avoided costs is a pretty conservative assumption for what potential, you know, NEM-3 compensation might look like, so we're really targeting this export on avoided cost rate to see if it's cost effective or not.

So, next, looking at utility rates we do see that it's even more cost effective than what TDV-based rates were. We do see a small demand charge component in this, and, again, since we have self-utilized electricity and exports being evaluated to a similar extent. The larger system size is able to take advantage of the economies of scale, and when you get higher benefits because of that.

So, bundling these altogether, this chart shows our four size options on the right here, so max. NEM compliant, our self-utilization or 20 percent exports, and then our five percent exports case.

The different points on these show the different rate scenarios. So, yellow at the highest is utility rate, blue is the full TDV that I showed previously, this tannish color, which is oftentimes coincident with wholesale cost, is avoided costs or export on avoided costs. In the screen below is where we've self-utilized and export on avoided costs. You know, I think it is important to call this out, but, you know, when you self-utilize in export on avoided costs you have a net cost. I think these are really the realistic grade scenarios, and this is a participant benefit calculation.

So, expanding this out, across all climate zones -- these charts are going to get very busy very quickly -- so we have all 16 climate zones along the base here, and again, this is net benefit. And then the various colors represent the -- correspond to various rate scenarios. And the different shapes correspond to different sizes, yeah, there we go.

And so, we see in this that basically for all of our sizes everything has a net benefit in the export on avoided costs as well as several of the other rate scenarios. And the self-utilizing export on avoided costs is nearly cost effective in some climate zones that generally do not happen nowadays. And then I wanted to call to your climate zones one and sixteen are slightly less cost effective than most of the other climate zones are. And I think that's a function of, you know, PV output to a large extent.

Great. So, bundling this up one step further, this sheet map here shows the net benefit in dollars per watt for the self-utilized PV size with export on avoided costs, the TDV rate scenario where it self-utilizes full TDV and export on avoided costs. And, again, this is for all the mixed fuel loads.

And, so, we see in this that all these show a positive net benefit which means that they are all cost effective. Some building types are more cost effective than others are. You know, typically it’s a function of, you know, if they are larger and, you know, do you get the economies of scale for the PV costing.

The smaller ones have a little less cost effectiveness, and then there will be some minor differences between climate sensibility types based on how much correlation there is between building load and how much it coincides with the PV generation.

We ran this test also on the utility rates and again found positive net benefits across all 16 climate zones and all the utilities. In the appendix I have a slide, the same slide that also incorporates rates LAWPE and

SMUD where relevant.

And, yes, so bundling this all up, you know, we see the PV related cost and effect across all building types for our TDV rates with exports on avoided costs, which we believe is a, you know, conservative computation assumption.

The larger buildings have this economies of scale with lower PV costs that makes them slightly more cost effective, and there is a, you know, slight further variation based on building loads and PV generation, and the utility rates do impact cost effectiveness in PV depending on the utility and most likely rate tariff, and we pulled a lot of these rate tariffs without much fall into optimizing if there were multiple options for a given building size with, you know, the best option for PV would be, but since they're all cost effective in this case we think that that, you know, wouldn't necessarily change our results.

Moving on to cost effectiveness of storage-only configurations. We see that the costs are -- you know either outweigh benefits a little bit or are pretty along line with our current cost projections. This is under optimal dispatch, and this is full TDV, so this kind of the upper bounds of what the storage-only cost effectiveness might look like. So, if you start to introduce more realistic dispatch or, you know, things of that sort, you'd see how cost effectiveness would, you know, begin to dip below this ratio of one.

Again, we see this, you know, economies of scale. You know, this sizing in particular -- the size on the left is above 100 kilowatts, and the size on the right is below 100 kilowatts, so they get costed differently for the data from NORESCO, and again, these are both four-hour batteries.

Doing a sanity check on -- as to how utility rates value these compared to our TDV rates, this utility rate happens to be much less cost effective. We do see that most of the storage benefit does come from demand charge savings, which is pretty consistent with other utility rates. You know, again, we didn't totally optimize for which utility rate might be best, so there could some fluctuation in this.

And, you know, again, I don't want this to be an indictment of all behind the meter energy storage because there's a lot of cases where it is cost effective, particularly in real-world buildings that will be -- you have a much more PV load than our prototype buildings will, as well as potential to, you know, participate in local demand response programs or, you know, look past the programs. And, also again, this doesn't include SGIP incentive because we're -- you know, in this context there's a code requirement.

So, in, you know, kind of in both these cases we see this not quite cost effective, so, you know, that (indiscernible-skip in audio).

Expanding this to the various climate zones, the findings are mostly the same. We do have a couple of cases where, you know, one might have some net benefit, but most of our sensitivities have a net cost to them, so it can be classified as, you know, largely not cost effective.

Moving over to cost effectiveness of the PV and storage combined. Looking at our full TDV rate, you know, again, for our self-utilization PV size and our two storage configurations we see that the -- both are cost effective, and the smaller configuration, despite the, you know, difference in pricing is -- has a slightly higher B/C ratio and the net benefit is fairly similar.

If you look at this for our exports on avoided costs, which again, is, you know, the bar that we're looking to clear for cost effectiveness, we see that the smaller size has a higher B/C ratio again, and I would say, therefore, is a little bit more insulated to potential NEM rate reforms.

Looking at this for our, you know, PG kind of use rate again, the larger size is a little less cost effective and the smaller size is more cost effective. This is, I think, largely due to a dynamic with the demand charge benefit that the smaller size is able to capture most of the same demand charge benefits as the larger sizes, and, so, we've got this, you know, diminishing return on the larger size.

Looking at our basic dispatch just for transparency sake, we did see that this, you know, limits cost effectiveness in a pretty significant way compared to our outgoing dispatch. So, that's why we're going to continue our search for a better, realistic middle ground we feel. The larger sizes, you know, less cost effective than the smaller sizes, and, you know, it may be another takeaway from this that the smaller size is more or best for cost effectiveness if the controls are a little bit off.

Bundling this up for medium office across all 16 climate zones we see, again, that the cost effectiveness is pretty consistent across the board for our three, you know, higher TDV-based scenarios as well as all our retail rates. You know, again we see that we have a net cost under the self-utilization index for on avoided cost scenario. Again, we think that's not, you know, not realistic in the near term.

And, again, we also see that climate zones one and 16 also have a little lower cost effectiveness.

Bundling up to all of our building types, this is for our smaller storage size and our -- again, our self-utilization PV size, and, also, our self-utilized on TDV export on avoided costs rate scenario which, again, is the bar trying to clear on this. We do see that most of these combinations have a B/C ratio higher than one, and again, this key map is different than the one we showed before. The previous one was net benefit. This one is benefit/cost ratio, so if it’s greater than one, it’s a positive benefit. If it's less than one it’s a net cost.

And, so, we do see that we’re, you know, greater than one mostly across the board on here, under pretty conservative compensation assumptions, albeit with the optimal dispatch which is, you know, a little higher.

Looking at this for the utility rates we see that this is a little bit more cost effective than the TDV-based rates we were just showing, so there’s a higher benefit. And, you know, again, this is pretty universal across the board regardless of the -- which utility and which rate cost. And, again, we see the larger buildings have a higher B/C ratio, again, due to the economies of scale and the lower cost for that, the larger systems.

All right. So, wrapping up the PV and storage cost effectiveness you can see that with the exception of some cases that the smaller configuration of PV and storage is cost effective across building types in climates zones, even what we consider conservative compensation assumptions.

We see the basic dispatch diminished as a cost effectiveness across building types, yielding some noncost effective combinations. We're going to continue looking into this in the coming weeks. The larger buildings, again, have slightly better cost effectiveness due to the economies of scale.

And then under TDV rates, depending on how coincident the building load profile is along with the PV and storage dispatch profiles there is a little bit of variation in cost effectiveness between building types, and, you know, using the utility rates that we analyze in this, the cobenefits of PV and storage yield a generally cost-effective solution for prototype buildings.

All right. So, that's our main results. I did want to show this quick sensitivity on storage duration and size.

So, we're looking at four-hour batteries. This is pretty consistent with a lot of resource adequacy programs and what not, but we are aware that two-hour batteries are a little bit more commonplace in nonresidential applications, particularly because of the structure SGIP funding right now begins to taper off if you size a battery larger than two hours.

And we found, you know, the two-hour batteries are a little bit more cost effective kind of across the board than a four-hour battery would be for the prototype buildings. I don't believe it really, you know, changes the sign or changes the results in any of the uses. We can explore this deeper in the coming weeks as well. That seems to be the right configuration based on, you know, a little more research and feedback from stakeholders.

Looking at our sensitivity on reliability and resiliency, so we do have some detailed inputs about this in the Appendix, but essentially what we did, so for reliability we define this as your ability to use your behind the meter PV and storage to cover an unplanned, short duration power interruption from things like, you know, transition and distribution interruption. You know, a substation goes down in your neighborhood or, you know, a car hits a power pole or something like that, so it would be like a one- or two-hour line power outage. And we valued this based off of the system's ability to cover this in any given hour, and then, also, we used this value of loss load that was developed through a market survey which was run by LBNL. And those numbers are pretty high. It's, you know, in the order of hundreds of dollars per kilowatt hour.

And, so, where this benefit is valued for customers who find this important, this doesn't really prove the cost effectiveness across the board for all of our storage options like, you know, intermittent backup power. We think it is highly dependent on the customer, though, how much value do they really truly place on that. These are median numbers, so it could be much higher and it could be much lower as well.

We also wanted to take a stab at this looking at the resiliency benefit. So, resiliency we define as the ability to cover, you know, a portion of the load, with the critical loads during planned outage days, such as public safety power shutoffs. These are going to be much longer in duration than the previous ones, and so the value of loss load dollar, you know, cost or however you want to frame it can really add up, and if you're able to cover that with, you know, a reasonably sized PV and storage system, there is significant benefit there.

And, you know, again, this doesn't -- I don't think this necessarily applies to every building type or every climate zone in the state. You know, it's certainly more in the areas that are impacted by the public safety power shutoffs. And (indiscernible) results in this as well. You know, if the participant does place a lot of value on this there's really substantial benefit to this.

And, lastly, stretching on, you know, what we're thinking for compliance option for EV charging. So just high levels. We haven't done all that much analysis on this yet, but ARB is estimating there's going to be essentially a very large need for public and workplace level two EV charging to meet our 2025 ZEV goals. You know, again, this is never much further beyond the forecast for current building codes and standards.

We are aware that Title 24, Part 11, which is the CALGREEN code, requires that about six percent of a building's parking spaces be EV capable. It's essentially all the infrastructure, you know, the panel, the wiring, except for the charger, itself. And, so, there's a bit of a gap that we can fill with compliance credits through the Part 6 of Title 24, so we would be able to give credit to building owners for installing EV chargers there, electric vehicle supply it's also called.

We want to make sure that we're not double counting any benefits in this with other LCFS credits. I think that's mostly applicable to how it interacts with onsite PV charging or onsite PV generation. And, you know, the high level of the compliance credit is based on charging during daytime hours compared to charging in the evening and not having a lot of good benefits with the Duck Curve and what not.

So, a more clear example of this, so, this chart on the bottom left here shows the TDV in the green area. This light blue profile is, you know, all the charging shape generated by E3 that represents workplace charging. And then the dark blue line is what represents more typical residential EV charging. And we can see that, you know, EV -- residential charging is pretty coincident with, you know, at least for folks that commute by car. You know, this is coincident with the evening peak, and this is, you know, a pretty well documented issue for EV charging and the need for control of that, you know, whereas workplace charging if one is commuting via car and the car sits at the office all day and there's workplace charging available, they're able to, you know, just have, you know, a structural ability to use lower costs, lower emissions, electricity to charge. And, you know, it's pretty easy to quantify, just looking at the difference between the charging profiles as they relate to TDV.

This chart on the right here shows the EV load ship credit in KV2s or, you know, KTVDs, and the red dot is the percentage of that credit is a percentage of gross building load for medium office, and, so, you know, it's somewhere around .1 percent of the total TDV one would be able to get a benefit for under this really preliminary framework, for example, if you had a hundred or let's call it 50 chargers on, say, that would be about five percent of the gross building TDV that could potentially be enabled as compliance credits. And, yeah, you know, again, this is really just because, you know, this middle of the day where we have a lot of excess PVs is just a much cheaper electricity to serve than the evening peak when folks get home and plug their cars in right away.

All right. So, that's all of our findings for today. Just to reiterate for the key findings again we found that PV and storage as a package in the smaller configuration is cost effective for most building categories. There are the additional benefits we did not include in this cost effectiveness equation for reliability and resiliency.

We saw that PV is cost effective across all scenarios from the participant's perspective, again, except under this most significant rate reform.

And, you know, I think that there is good grounds for, you know, being conscious about exports and trying our best to minimize those to, you know, help, you know, better grid benefits and just grid harmony in general.

And, again, storage only does have large grid benefit which, I think, makes it a good candidate for compliance credits, but it’s not -- you know, under the current storage cost projections we don’t see storage only being cost effective and it’s, yeah, in our current inputs.

And for next steps what we’re looking at in the coming weeks, we’re going to continue to refine our size and configuration. Again, we’re kind of, you know, landing at this self-utilized sized PV with our smaller battery size.

Once we have this, you know, more specific size and start to develop a draft code language around it, we’re going to look at the source energy and emissions impacts of this.

In the coming weeks we want to refine our battery controls, and again, we’ll look into any data from stakeholders that we can incorporate to help refine that as their basic dispatch is a little bit too conservative.

So, you know, any helpful data on that would be things like how well batteries actually perform compared to, you know, perfect foresight or optimal dispatch in the real world.

And then other data that, you know, we would be, you know, like to see from interested stakeholders would be things like capital and operating costs, if there's any technology characteristics that, you know, seem not reflective of actual installations in our assumptions. And, again, better battery control schemes, more common storage duration, or if there's any notes on future rate design we are happy to look at that as well.

And with that, I will open it up to questions.

MR. SHIRAKH: Thank you, Michael. Pretty cool stuff. Pretty fascinating.

MR. BOZORGCHAMI: So, I'm going to unmute Beverly. Beverly, please state your name and your affiliation. Beverly, you're going to have to unmute yourself.

MR. STRAIT: We're giving permission to speak but then the person also has to unmute themselves. It's a two-step process. Folks should be aware of that when it comes time for public commentary as well.

MS. DESCHAUX: Are you unmuting me?

MR. BOZORGCHAMI: Yeah, you're unmuted, yes. You had your hand raised.

MS. DESCHAUX: I did, oh. That was an accident, but because I was writing it in. Okay, it’s fine. I’ll ask it because I wrote it in.

So, were you saying that you thought people were charging a lot --

MR. BOZORGCHAMI: I apologize, Beverly. I am sorry. I need you to state your name and your affiliation for the record.

MS. DESCHAUX: I’m sorry. I’m sorry. Beverly DesChaux is my name. I’m with the Electric Auto Association Central Coast Chapter of California as well as an advocate for a community choice aggregator.

Are you saying that when you think that when people come home from work they start charging their car, because really we don’t? We charge late at night, overnight, and when we’re home we charge during the middle of the day exactly to handle the Duck Curve.

And, also, I wanted to have someone here address the idea of using natural gas as an okay thing to keep using because one thing I think is not being considered is the cost of the methane leakage, and depending upon the scientist, they say that there’s 24 to 100 times the heating capacity of methane compared to CO2 and approximately 11 percent leakage throughout the production cycle of natural gas, so, it's really not such a -- I just wanted to repeat what somebody else said is that this is really a crisis and we need to eliminate that as a backup source except in perhaps the zone 16 or zone 1 where the other options aren't available yet, but options are available here and we need to eliminate that as a backup source. Thank you.

MR. SHIRAKH: So, this is Mazi, Energy Commission. There were several questions in there.

As far as the methane leakage from the natural gas, our natural gas TDV actually does capture within building leakage. So that is already incorporated and will also be part of the source energy metric that we'll develop later based on this.

So, any other questions I'll defer back to Michael.

MS. DESCHAUX: I don't know if I'm still unmuted, but I'm talking about during production, during the whole production cycle.

MR. SHIRAKH: We have only authority for building and, you know, we really can't go back within the building code back to the wellhead.

So, again, for buildings that’s where we have the authority and the enforcement mechanisms. So, you know, we are capturing the methane leakage.

MS. DESCHAUX: Okay. Thank you.

MR. SONTAG: Yeah, and just to go on the methane leakage that we incorporated into the natural gas TDV is consistent with CARB’s greenhouse gas inventory, so to the extent that that captures some production leakage, we have that captured, but we’re aware that, you know, it's only within state so it might not capture some of the out-of-state leakage.

Anyway, so addressing your questions on electric vehicle charging, this is based off of your kind of -- not any one driver’s profile. We try to represent a full, you know, fleet or population that, you know, EV charging and driving behavior. And, so, you know, while some folks might be better about, you know, charging in off hours and what not, we found that, you know, based off of current driving behavior and charging behavior that we do have a little bit of an evening peak from that still, too.

You know, this is going to be better managed in the future. That will certainly help.

You know, I think it's important to recognize that there is a need for EV charging. You know people are going to be parking their cars in a given location during the day. That will always be cheaper and easier to serve with solar power if you can charge in the middle of the day, so that's all we're really trying to capture in this.

MR. STRAIT: All right. Moving on to the written questions, there are some that are general questions relating to TDV rather than to the technical content of the slides, so I'm going to do the technical questions on the slides first and then circle back to some of these general TDV questions.

First, a question from Tom Paine. "How feasible is it for a high-rise residential building to have 200 kilowatts in a high-density area?" They're specifying, "It does not seem possible without either offsite or community solar."

MR. SHIRAKH: So, maybe I can answer that, too, and then Michael can chime in. This is Mazi. We are actually very mindful of roof constraints. So, we will write the code language in a way that will accommodate what available soar access is on the roof and account for situations where there may not be enough effective solar -- annual solar access.

So, Michael, do you want to add to that?

MR. SONTAG: Well, Mazi, these are all, I think -- you were asked about the roof area constraints on these and it was based off of the geometry of the prototype buildings, and as Mazi said, the actual code is going to consider where, you know, a taller, skinnier building might not have enough effective solar access area.

MR. SHIRAKH: Again, we're going to write the language in a way that to exceptions or just the structure of the code that will take care of situations where they may not be available -- enough available annual solar access.

MR. STRAIT: As a follow up, Sean Armstrong asks -- this just moved around. I'm sorry. Sean Armstrong asks, "Did you perform a roof constraint analysis using canopy solar arrays that go over plumbing vents and other rooftop obstructions? They mention that these will add about $800 per kilowatt to a rooftop array, so $2,600 per kilowatt installation would go to $3,400 per kilowatt if they were on canopy array."

MR. SONTAG: I believe we've got the roof area constraints, and again, NORESCO, if you have any more insights on this please do chime in, but this was just based off on not directly on the roof.

MR. ARENT: Yes. These were directly mounted on the roof, so either positive attachment or ballasted systems. But I think their roof analysis does indicate and incorporate the effects of constraints of rooftop equipment shading and what not.

So, some of the cases mentioned, like a true high-rise apartment building that's 20 stories certainly would have a lot of constraints to meet the load, so that that would be accounted for in some way.

MR. SONTAG: Yeah. And also on this as well, since Sean mentioned the additional cost to mount, one of the handy things with these net benefit charts for the PV only is that this is in dollars per watt, so in an example we have a net benefit of, you know, $2.00 per watt, if you add an extra 80 cents of cost, for example, you could see if it's still cost effective or not.

MR. STRAIT: Neihimiah asks, "It appears that the analysis value, itself, uses electricity at the same rate as imported energy. Can you clarify why you assume the same price for self-used as for imported?"

MR. SONTAG: Yeah. That is consistent with how a lot of rates were structured currently. It's all based off of your electricity meter rates, so unless you're able to separately meter your PV and storage the meter is going to be, you know, effectively indifferent to whether importing yourself you get a rise in electricity.

It's by -- if you're spinning your meter forward, for example, for imports and then you have some amount of self-generation that spins the meter forward to your last (indiscernible), that's all that would be able to be seen from the building standpoint.

MR. STRAIT: Tim Kabat has two questions. I'm going to ask them both. First, "For the cost benefit of --" I'm sorry. One question is about the cost of PV and the other is about avoided costs. Their cost benefit of PV question is, "For the cost benefit of PV without and with storage what is the basis for establishing the cost of PV? Costs continue to drop, so is that downward trend captured in the analysis?"

MR. SONTAG: I will refer to Don that question, but we did capture some cost declines John was mentioning in the previous presentation, you know, kind of treating now like 2023.

MR. ARENT: Yeah, that's right. So, we're looking at costs projected out to the first year that this could be adopted, 2023, so that we did assume a minor cost decline. You know, there is a fair chance that costs will continue to decline after that, but we haven't considered anything beyond that for PV, itself, given its expected life. For batteries we are looking at a steady cost decline through year 10 and year 20 for the replacements.

MR. STRAIT: And I can add a little bit as well, that we need to prove that it's cost effective basically the first day it goes into effect. So, if someone goes in for a building permit January 1st of 2023, it needs to be cost effective at that moment. If it becomes even better over time, that's gravy, that's nice. But we cannot adopt a law that is not cost effective when someone would be held to that law. So, that kind of sets that basis, and then if we come back in 2025 and costs have dropped even further, then we might come back with another analysis showing that we can increase the standard or shift to a different position at that time.

Tim also asks, “For high-rise residential how are avoided costs calculated? Are we assuming each residential unit would have its own battery storage system or would battery storage be distributed via a virtual net metering meter?”

MR. SONTAG: I think the -- given the way we’ve modeled it, it would be, I think, more analogous to a virtual energy metering system in that we had one, you know, (indiscernible) building profile both for the building consumption and PV generation and then the storage would be dispatched between those.

MR. STRAIT: Mike Hodgson asks, “How is the building owner’s solar net benefit calculated when the tenant is paying for the utility costs?”

MR. SONTAG: I think I’ll refer back to -- did answer about this previously. You know, we’re just looking at the total costs, and so I think it would come down to the building owner and the tenants splitting the benefit on this.

MR. STRAIT: Yeah. Let me mark that. Let’s see, some of these are shifting around because when people hit that like button it changes the order, but we want to go through in the order they were submitted, so it’s a little tricky and I apologize.

Karl Aldinger of the Sierra Club asks, “I’m confused how home storage is described as having two hours or four hours of storage. Is the duration of home storage not based on varying home load?”

MR. SONTAG: So, clarifying that, that was a good question. So, this might be an odd naming convention saying -- if we say four-hour duration we mean it can discharge at four hours if it’s ready at capacity, so if it’s a 100-kilowatt battery, a four-hour battery would have 400 kilowatt hours in storage, and, similarly, a two-hour battery would be able to dispatch full capacity for two hours.

MR. STRAIT: Okay. So, a bit of a term of art there. Let’s see. I’m scrolling up. Not that one. Alice Sung asks, “Most of the examples you gave are for medium office buildings. Can we assume you did separate individual analyses for each of the other nonres. types such as educational in your report, and is that report out now?”

And I think we’ve clarified these reports are being developed and they’re not ready yet.

MR. SONTAG: Yes. The reports here, this is only for climate zone 12. You know, it shows the small school building profile. So, we do have results for this in our slide deck that is public, and then our sheet maps here do show that the small school size in these that -- for the different building types.

MR. STRAIT: Yeah. I think part of the answer, too, we aren’t -- we didn’t look at each and every individual category of commercial structure that’s currently included in the building code. We made some assumptions for some of them where they made sense. So, we are conducting the same in-depth study for all of them, so some can be seen right away to have additional challenges.

Alice also asks, “Is the E3 developed tool for solar plus storage that you developed for the Energy Commission publicly available yet?”

MR. SONTAG: I believe it is. If you go to the docket site, let’s see, bring that up here, there’s a link you can follow that has the reports on it. I’m not aware that if the model, itself, is presently available for download, but you can double check on that app. after the meeting. Certainly, the intent is that it would be publicly available and downloadable.

MR. PRICE: It’s downloadable already, Mike.

MR. SONTAG: Okay.

MR. PRICE: So, we can close that.

MR. STRAIT: Tom Conlon is following up on earlier clarifying question. Let’s see what this looks like. “Is it reasonable to assume that the PV and storage cost reductions will remain similar to one another over time, even though storage is a much less mature technology?”

MR. SONTAG: I --

MR. STRAIT: I can add that I don’t think it’s necessarily so relevant what the long-term projection of cost is because, again, what we’re interested in is it cost effect gen. one in 2023, but, nonetheless, if you have some additional input to share.

MR. SHIRAKH: That's the premise, that it is cost effective in gen. one 2023 given the state of the technology. And then we can also look to the future, and I think John Arent demonstrated that if we need to replace the equipment after 10 years, which in my opinion is very conservative. These batteries will probably last more than 10 years. But even if we replace them after 10 years, you know, we can project what those costs might be at that time.

So, we are using the cost at the points in time that are relevant to this analysis, and even with the conservative assumptions you have PV plus battery storage is cost effective on the effective date of these standards.

MR. STRAIT: Let's see. We've got some of these jumping around a little bit. Some of these are just comments rather than questions, so I'm trying to pick out the technical questions.

Shraddha Mutyal asks, "Will load management benefits be considered to be included in the cost effectiveness analysis?"

MR. SONTAG: I'll assume that load

management would be for, you know, there are flexible loads and what not outside of battery storage. And in the present framework, you know, our scope isn't going to look at battery storage for this. Certainly, you see benefits from that could be applied to other flexible loads. I'm not sure, Mazi, if you have a better sense of how that would be actually be -- or how that would come into play for the actual codes.

MR. SHIRAKH: I mean, again, you're correct. We're using, you know, TDV and actual rates to demonstrate cost effectiveness. And if there are additional benefits we can incorporate them, but it seems like in a -- using the tools that we've always used we can demonstrate that these are cost effective at this point in time.

MR. PENNINGTON: So, this is Bill. I'd like to add to that.

MR. SHIRAKH: Please go ahead.

MR. PENNINGTON: The TDV values are essentially addressing that hourly value of the load shift that's occurring from -- by using the batteries. So, it inherently is evaluating the load management benefits of the batteries. So, I think that's what the questioner was asking about.

MR. SHIRAKH: Thank you, Bill.

MR. STRAIT: And I apologize. I'm turning off the ability to upload questions, only because it rearranges the ordering of them and as much as I do want to make sure we answer all the questions that people find to be valuable, I want to be fair about answering in the order that we received them, so I apologize for that.

Shraddha also had the question, "Sorry if I missed this, but what is the building type used for the TDV analysis you showed?"

This was asked pretty early on in the presentation, so I think it might have been covered, but could you speak to that?

MR. SONTAG: Yes. So, most of the results I was showing are for medium office. But the key maps below do show for this one configuration all of the building types, and then we do show each of the building types in climate zone 12, if anyone is curious to look at this after the slides are published.

MR. STRAIT: All right. Now we've got a couple of questions that are really about TDV, so I'm going to get into those. The first is, "Are the CPUCs new social cost of carbon values included in TDV yet?" And these might be questions for Mazi.

The TDV that we established was done back in March, so this isn't a presentation that's on updating or altering that analysis, and that is -- all of that information is available.

MR. SHIRAKH: That was -- actually our first workshop on TDV was about a year ago this time.

MR. STRAIT: Yeah.

MR. SHIRAKH: October of 2019, and we had, I think, one or two more subsequent workshops, actually two more. And the last one was March 27 of 2020 where we presented our final workshop for both natural gas and electricity, which included several enhancements on both sides. So, those all have been posted. The reports and everything are on line, so that's what we're using from here on.

MR. STRAIT: Yeah. We have a similar question. George Nesbitt is asking, "Has the retail adder been changed to reflect the time of use schedule?"

MR. SHIRAKH: Actually, if you look at

the graph that's in front of you, you'll see that the retail adder, which is the blue, is actually changing. In the middle of the day it's dipping. It used to be a flat line across, so, yes, that has been changed.

MR. STRAIT: Brian Finn is asking, "Does natural gas TDV account for increased methane admissions from certain technologies like tankless water heaters?"

And I believe there was, as you said, the leaks in buildings are accounted for the TDVs, so I believe that's already been answered.

MR. SHIRAKH: Yeah, the leaks in buildings are accounted for, so --

MR. SONTAG: Yeah. The numbers aren't specific to a given appliance.

MR. STRAIT: Oh, Kelly Cunningham actually has a question, "On the proposed framework for nonres. EV for compliance credit slide what does the acronym LCFS stand for?"

MR. SONTAG: My apologies for not defining that. LCFS stands for load carbon fuel standarding, and that's the program run by the California Resources Board to incentivize, you know, in electric vehicles and other low carbon fuels.

MR. SHIRAKH: It would be good to spell that out, Michael.

MR. STRAIT: Tim Kohut with American Institute of Architects asks, "What was the time of use rate used for the cost effectiveness analysis?"

MR. SONTAG: Yes. So, the TOU rates we used for the actual utility retail rates. So, the TDVs were one side of this. And next we do show a table for each climate zone and building type of what -- so this table shows which climate zone corresponds with which utilities. If there are multiple utilities such as, you know, climate zone 12 has both PG&E and SMUD, we ran both and then this defines in the Appendix, again, for each building type. This is the peak load of the buildings and then we sized the relevant retail rates off of that based off of what was most recently available as of a couple weeks ago.

MR. STRAIT: Okay. I'm just going to take -- there are four questions left here. I'm just going to take a few of these. We do need to keep moving on.

Beverly had a follow up. "Can you tell

me how methane is captured from buildings?”

I just want to clarify what we’re saying is that the effects and impacts, the costs of the leaks in buildings is accounted for in TDV, or we’re not talking about physical capture in any sense. And if you’d like detail about how it does that, it is in the published TDV report that Mazi was referring to.

Ted Tiffany asks, “Will you publish these results with greenhouse gas or time-dependent source energy results?”

MR. SONTAG: Yes. That’s one of our next steps to do. That’s a great question. Thank you. So, as we refine the sizing, we’ll publish that in the next round for the next workshop.

MR. SHIRAKH: This is Mazi again. We need to nail down the baselines first in we talked about the previous sections. And then I think Michael suggested that we are kind of settling on a NEM scenario with exports on avoided costs and a couple of options in there for, you know, where to keep the export, at what level, five or 10 percent. Once we kind of settle on those then we can start developing numbers for the source energy based on those numbers. We'll present them in the November 19 workshop.

MR. STRAIT: Tom Kabat has a suggestion for changing TDV, and I just want to reiterate that the TDV has already been set in prior hearings, so this isn't something that we're going to be discussing at this workshop.

MR. SHIRAKH: I agree.

MR. STRAIT: And Beverly was asking what we mean by -- like are we saying for EV charge the charging rate goes up in early evening. I think what's being said, and I'm just going to get a little bit in front of this, is we know that the behavior of people varies as not always -- while rates are a motivating factor, it's not the sole factor.

So, there are likely going to be folks that as soon as they get home from work will habitually plug in their vehicle to charge either because they're less rate sensitive or they have additional needs.

So, if you want to go into a little more detail about how the behavior components were determined for EV charging, you could do so for Beverly's benefit.

MR. SONTAG: Yeah, I'll do the best I can. Modeling is down by some of my colleagues here, but we take a lot of driving behavior from I believe it's the -- one of the, I believe, one of the National Transportation Associations. There really isn't a lot of great data on -- public data on EV charging generally, so we assume a lot of, you know, typical driving behavior, you know, length of trip, time of trip during the day, and then couple that with how large the batteries are, and, you know, allow some amount of price sensitivity in it and some amount of, you know, the population that's not as price sensitive. And, you know, this is spread out over, you know, tens of thousands, if not hundreds of thousands of PVs.

So, you know, there certainly are, you know, many -- a lot of UV charging in this model that does happen in residences in the middle of the night and during the day, you know, given less price sensitivity currently and less controls which I think reflects the state of the market currently. There is a little bit expected UV charging for residences in the evening.

MR. STRAIT: All right. That handles the

questions that have been typed in on this, so I think we can move on.

MR. SONTAG: Thank you for the questions, everybody, and thanks for your attention and interest.

MR. BOZORGCHAMI: So, this is Payam again. So, Mazi, will you be sharing some slides on the cleanup language which is coming up for 2022?

MR. SHIRAKH: Yes.

MR. BOZORGCHAMI: Sure.

MR. SHIRAKH: Just one second, and let me do one more thing. Can everyone see this?

MR. BOZORGCHAMI: Perfect, Mazi.

MR. SHIRAKH: Okay. So, this is the homestretch now. And the last thing we're going to do is do some cleanup of our language.

You know, we developed a PV and related -- battery storage and related documents a couple of years ago that was adopted, and at the time, you know, we worked with the stakeholders and tried to do the best that we can to develop a language that works. But, you know, now we've had some experience with the code actually being implemented.

So, with that, you know, I think we are ready to go back and revisit the language and make some changes that will make these requirements easier to implement and, also, avoid awkward situations.

So, one area that we're going to actually make some changes, I go with the order. Number one is make sure PV sizing equation is consistent with 2022 TDVs. You know, the sizes that we came up for 2019 standards, we're using the 2019 TDVs. Now that we have new TDVs, we're going to rerun the equation and that might change the size slightly. I don't think it's going to be a big change, but it will be some change.

Number two is new exception for PV systems that are less than two-kilowatt DC per building. And the reason for this is that, you know, our research is showing that below 20 kilowatt the cost of the PV system actually goes up significantly because of soft costs and the fixed costs that are associated. And, also, in fact, some installers have indicated they may not install PV systems that are less than two kilowatt per building.

It also may address the issue we have

with the auxiliary dwelling units, or ADUs, may resolve that issue.

We have several exceptions in the current language, and I think they need revisions and clarifications and maybe we could even get rid of some of them.

For instance, exception one is basically we're going to change that to say that PV systems are not required to be larger than what can be installed in the available effective annual solar access areas. It gives the intent of that exception, but it's not very clear. So, you know, there's been a lot of debate. So, we're going to make that clear that, you know, if there are rules in there that you cannot -- you can count internal shading, like adjacent buildings, hills, trees, you know, that kind of obstruction, if they cause a situation that the effective annual solar access areas are limited, then -- and it's greater than 80 square foot, then you'll be installing as much PV as available on the roof.

Things that will not count toward this limitation are things that are under a builder's control like chimneys, skylights and things like that.

Given the changes we're proposing under subparagraphs two and three, we may be able to get rid of three exceptions. Exception two currently is for climate zone 15 because it has an exceptionally large PV requirement.

Exception three is for two-story buildings. Exception four is for three-story buildings. And we think that we can actually eliminate these three exceptions if we implement paragraphs two and three correctly. So, that language will be presented in the next workshop.

We probably need new exceptions, one for occupied roofs, as they are flat patio areas that are very common and popular in some multi-family buildings, and the current language doesn't really address that really well.

And, also, we may need a new exception for areas that have snow loads. We do have some certain areas of the state up in the Tahoe area, Truckee where there's very high snow loads and we need to address that, too.

Section 10-109 (k), that's the PV determination. This language was in there for 2019 standards which allows certain situations where the PV's cost effectiveness is determined to be different than what we had envisioned. You know, we had, for instance, one jurisdiction in northern California, Trinity, where they have -- their power comes from largely very inexpensive hydro in a region of six or seven cents a kilowatt hour which makes PVs not cost effective. So, you know, we created this for those situations, but, you know, I think we can improve that language a little bit further.

Another important section was 10-115. That's the community solar. You know, we had one applicant that came forward so far, that's SMUD, and through interactions with them and some new potential applicants I think we've learned a lot. And we had very extensive public comment when we were considering SMUD's community solar exceptions about the limitation on the total PV amount that can be available to this option, and also the location of PVs relative to where the end use may be.

So, you know, we'll be considering those comments and revising this language. And we're also open to any other changes that you all may propose.

We have two documents that are -- they're related, JA-11 is the requirements for PV systems, and again, you know, we've learned through experience that this can use some clean up. On system orientation there's some confusion between prescriptive and performance requirements. We'll eliminate that.

The solar assessment tool, the amended language based on lessons learned from prior approval of solar. You know, we've approved several solar assessment tools, and in the process, you know, we have interacted inherently with the people who have developed these tools and the comments we've received, and we think we can create a clearer list of functions that people can use for approval of their systems.

We also -- you know, you've been seeing these terms being used in these and other presentations: annual solar access, effective annual solar access, and effective annual solar access areas. They kind of look familiar, but they each mean a little bit different things, and they haven't been clearly defined in Part 6. We have some language in the compliance manuals to explain these, but we think we need to move them into Part 6. And, again, if you all have any other suggestions related to JA-11, we'll be looking at those, too.

JA-12 is the installation requirements for battery storage, and, again, you know, we have learned some lessons.

One thing we'd like to explore is allowing credit for stand-alone battery storage systems. For buildings that end up not having a PV system, currently we don't allow any stand-alone battery storage systems, but maybe it's time, you know, we revisit that assumption, because battery storage system, even without PV, if it's controlled properly it can definitely bring advantages to the grid, and maybe even the homeowner.

We may revisit round-trip efficiency requirements in JA-12, but the biggest thing is probably number three. You know, we have three control strategies currently in the standard, the basic time of use and advanced DR. I think Michael in his presentation he mentioned several times, you know, another strategy that may actually bring more benefit to the grid.

So, we will be looking at improving or

enhancing these control strategies, or perhaps even adding one. One possible additional control strategy is one that actually optimizes around carbon emissions. So, we'll be looking at that, too. And, again, any other suggestions that people might have.

So, I think that basically concludes the formal presentation, and I'll be happy to take any questions on the material that I just presented, and then we can move to the general public comments.

MR. BOZORGCHAMI: Mazi, we have Nehemiah who has his hand raised. I'm going to unmute him. Nehemiah, please state your name and your affiliation, please. You have to unmute yourself, too, Nehemiah.

MR. STONE: Can you hear me now?

MR. BOZORGCHAMI: Perfect.

MR. SHIRAKH: Yeah.

MR. STONE: Nehemiah Stone, Stone Energy Associates. Mazi, can you bring up slide 12? I think it's 12.

MR. SHIRAKH: Slide 12, let me see.

MR. STONE: It was the one that had items seven, eight, nine, ten on it.

MR. SHIRAKH: Okay.

MR. STONE: The one before JA-11.

MR. SHIRAKH: The one before --

MR. STONE: That's the one.

MR. SHIRAKH: This is the one.

MR. STONE: Right. So, item seven there, you know, I urge you strongly not to delete (indiscernible - skip in audio) that weakens the language. On the one that I know that was approved, Trinity, as you mentioned, much of their power currently comes from hydro, but a deeper examination shows that they have a second choice -- a second place on that, and they could at any time no longer get nearly the hydro that they're getting. So, it's an iffy situation.

And if you look at the history on what they've gotten, where their power has come from, it has not always been primarily hydro. So, if anything, I would urge you to tighten up the language so that exceptions like that where it's, you know, the last five years, yeah, they've gotten a lot from hydro, but before that they didn't always, and in the future they clearly won't always. So, again, tighten it up, don't loosen it.

MR. SHIRAKH: We're not talking about loosening it, Nehemiah, we're just trying to see if we can write it in a way that it's easier to understand, implement and enforce.

MR. STONE: In that case, add a longevity element to it so that it isn't -- you're not looking at a short snapshot, but, you know, to clarify that this has to be a long-term sustainable energy cost that they're comparing.

MR. SHIRAKH: To be clear, actually, I didn't do this analysis, Chang did, but Bill Pennington is on line. We did look at the whole 30-year performance. We did look at the rate forecasts over the life of the project, so we already have that element in there. But again, we're not talking about loosening this up by any stretch.

MR. STONE: Thank you.

MR. BOZORGCHAMI: We have a comment by Ted Tiffany, and it says, "Mazi, what do you consider battery storage control types for heat pump water heating or other thermal storage technologies?"

MR. SHIRAKH: Yeah, I mean, you know, we are interested in any and all strategies that help us maximize self-utilization. So, you know, we will provide the tools through our software so other technologies will have an opportunity to compete. But, you know, each technology has its advantages and disadvantages. The battery storage is more expensive, but it also is a very effective tool for shifting load.

We have other strategies like thermal storage that are lower cost but, you know, they don't impact the entire load of the building. They just impact the segment. So, I mean, an ideal situation would be where we have all these options in there, we define what the performance targets should be, and the building owners and the architects, designers will decide which tools to use to comply with the standards, and we are striving for that.

MR. BOZORGCHAMI: Mazi, there's another comment by Laura Rosenberger. "Is electric induction for cooking stoves more precise or give the highest temperature under the burning point of cooking oil?"

"According to the UCLA study, noxious emissions from gas stoves when stovetop and oven are used simultaneously had violated outdoor pollutant standards, especially in small apartments."

"Also, I measured with my own air monitors unsafe levels of PM 2.5 near a few grills. Let us extend that to restaurants. A few Mexican restaurants have unsafe outdoor air quality at 1.5 to two times the outdoor PM 2.5 emissions. The corn oil on the grill was emitting fumes. One said they do not charbroil."

So, that was a comment that came to us. Thank you.

Michael Malinowski, "I would like to comment on Part 11 CALGREEN reach codes for both low-rise residential and high rise.

Michael, would you like me to unmute you?

MR. SHIRAKH: If he's muted how is he going to say yes?

MR. BOZORGCHAMI: Yeah, I don't know.

MR. MALINOWSKI: Thank you. Can you hear me?

MR. BOZORGCHAMI: Yes. Could you state your name and affiliation, please?

MR. MALINOWSKI: My name is Michael Malinowski and I'm an architect speaking on behalf of my firm Applied Architecture today. In our work over the last 40 years we've seen the dramatic shift in the last couple of years away from what seemed like some solutions like instant gas hot water heaters toward electrification. And I believe in the last year-and-a-half or so there are now products in the marketplace that make it completely feasible and cost effective to use all electric designs for basically all single-family projects and, certainly, any one- or two-story new office or commercial buildings. And I would encourage California Energy Commission to include consideration for that as a requirement.

But I do understand that there's the possibility that electrification will end up still in the reach code, and I would encourage the California Energy Commission in two areas. One is to support the integration of the zero-code amendment that's been proposed by AI California as a tool to create greater consistency across the landscape in California where we have three dozen cities currently using reach codes to achieve decarbonization and many more dozens considering it. And I would also request that the California Energy Commission consider development of a reach code for use for those communities that want to use electrification as a climate action tool.

And again, the goal is to create consistency because as dozens more cities and counties adopt reach codes, having them each write their own reach code creates an environment where costs are higher, compliances more difficult. We have less consistency and we have a lot of effort being spent without much -- so I'd like a little feedback on what the plan is in regards to reach code development in CALGREEN and potential for electrification, at least on some entry level building types.

MR. SHIRAKH: I did present a slide earlier this morning what our suggestion is going to be for reach codes for Part 11, and that's this paragraph down here is that, you know, we're proposing to include heat pump water heater and more efficient windows in the standard design, which can be met with either this option with heat pump water heater and more efficient windows or heat pump water heater and heat pump space heater. This could be considered like a Tier 1 approach. The Tier 2 could be basically heat pump water heater and space heater, both as a requirement.

Again, we do have pre-emption issues here to worry about, and, so, it's not entirely clear that, you know, we can require heat pump water heater and space heater in a way that doesn't allow any gas appliances in that building. So, we've got to be a little bit mindful of that.

So, I don't know, Bill Pennington, Peter, if you have any additional thoughts on this.

MR. STRAIT: Sure. I'd say one of the trick things about providing a cost effectiveness assessment for local jurisdictions is that if we have a robust finding of cost effectiveness we had available then we would probably at this moment say let's put it in the code.

A lot of what we propose are things that we expect as people are talking about falling costs over time. Things we think are likely to become cost effective after the code is in force that the local jurisdiction can say as of today we're able to make this finding and we've done some of this leg work, and we only have to look at our particular climate zone. We can really carve ourselves out and say this is where we are.

But that type of general analysis is what feeds into each iteration of the building standards.

And it is kind of frustrating to wait those three years every time and know that we never have benefit to do everything that we would like to.

What we're trying to do with CALGREEN specific to electrification is really start it up because we're looking at what the local jurisdictions that did that have done, and we're trying to see, you know, what their lessons learned are, bake those into some of the model language they can pull off the shelf.

But there is a reason why we've said that if you really want to move all the way to a ban, if you are going to do so as an efficiency measure, then you are going to need to stay inside the box that (indiscernible) has spelled out for what an efficiency measure looks like.

If you are looking to do so on using police powers on an air quality basis or some other factors, then that might be a route where instead of interacting with us you're interacting with some other entities and that might be a smoother path forward for that. But just switching fuel types absent some changes in how the market and how the legislature, you know, values these things, balances the cost to the consumers.

In addition, you know, every time CPC changes rules, then compensation changes, incentive programs, tax incentives change, we have to be very conservative to make sure we're not creating a regulation that harms people. Local jurisdiction we've found can be more nimble with regard to those.

So, it's very -- we are interested in working with local jurisdictions to do that, but it is very challenging to put together those analysis in a way that really stands that test. So -- I'm sorry. I was a little bit rambling there, so I apologize.

MR. MALINOWSKI: Thanks for the feedback. It's helpful.

MR. SHIRAKH: Any other questions, Peter or Payam?

MR. BOZORGCHAMI: I just had Joe Cain raise his hand. I'll unmute you and then we'll go back to the questions and answers. Joe just shut down. Okay.

MR. STRAIT: All right. I can hop into the Q and A. Tim Kohut with the American Institute of Architects, and I believe that's who the AIA is. I know there's also a lighting group of AIA, but I don't think that's them. "Induction cooking. The current standards do not provide a means for gaining credit. Will this be changed in future standards for multi-family residential code or a credit for built-in plug loads?"

MR. SHIRAKH: Yeah. That's on our to-do list, to create s compliance credit for induction cooking.

MR. STRAIT: And I'll also say that for a lot of things that are basically modeling and software-only changes we can always improve our software to accurately model something that it currently doesn't have a lot of information about.

For example, if we are looking at improving our model of how the presence of an induction stove impacts the energies of the building. We don't necessarily have to wait for a code update to make some of those improvements, but again, it's just a matter of making sure the software is accurate.

When we look at providing credit that's kind of more of a yeah kind of a thing, that's where it goes to the regulatory process. But we are looking at every opportunity we have to incentivize some of these measures without departing too far from a physics-based assessment of the impact and energies that that measure has.

MR. SHIRAKH: Two things that we have on our to-do list is the compliance credit for induction cooking, and the other one is a credit for heat pump clothes dryer.

Currently the only alternative to a natural gas clothes dryer is an electric resistance which doesn't do well on TDV. But if we can come up with a heat pump water heater alternative, then you'll do really good both on TDV and source imaging basis, although it's kind of a rare appliance and more costly, but, you know, things change.

MR. STRAIT: Beverly DesChaux asks, "Are you considering load shifting by slowing electricity going to heat pumps, thermostats and bi-directional charging on electric vehicles?"

And I can step in a little bit on these

topics if other people -- but I want to give other folks a chance to answer first.

MR. SHIRAKH: For nonresidential buildings, yeah, we are thinking about providing the credit for the recharging. I didn't quite understand the other part of the question. Can you repeat that?

MR. STRAIT: As typed it says, "Are you considering load shifting by slowing electricity going to heat pumps, thermostats and bi-directional charging on EV?" Bi-directional, I believe, meaning that they're also grid accessible and acting as battery storage.

MR. SHIRAKH: Well, we haven't considered that option. It came up before. The problem is we can't grant compliance credit to a device that can drive away. We want it to be bolted to the wall or something.

So, you know -- and we've got to keep in mind that when you grant compliance credit they can use that to trade away your wall insulation, attic insulation, roof deck insulation or put in, you know, not such good windows.

So, if that is going to happen, we want to make sure that those benefits will stay with the building. And you cannot guarantee that when a car is involved because it can drive away.

So, yeah, it's a -- you know, it's a good idea but, again, we are trying to protect building envelope as much as possible and only provide tradeoff opportunities if it really is warranted, it's reliable, and you'll stay there for the duration of the building.

The thing about insulation is you'll be there for 50, 60 or how many years that the building is going to be there. And, so, we've got to be really careful what kind of tradeoffs we allow.

MR. BOZORGCHAMI: Peter, I'm going to transition over to Joe Cain real quick.

MR. STRAIT: Sure.

MR. BOZORGCHAMI: We've got a couple of raised hands here.

MR. STRAIT: Yeah. We can handle those and then come back to some of the things in the question box.

MR. BOZORGCHAMI: Go ahead, Joe. Please state your name and --

MR. CAIN: Hello. Joe Cain, Solar Energy Industries Association.

Mazi, on slide 11, which I think is your first cleanup slide, you have -- you had the idea of the two-kilowatt threshold for an exception. It took us a while to understand last cycle that the formulas and tables for prescriptive PV size were not a minimum allowable in a performance approach. So, I just wanted to know how much you thought through how would that two kilowatt be determined so that the threshold could be applied. Is that what the software says is the ideal size or the needed demand? How is the two kilowatt decided that you figure out which side of that threshold you're on?

MR. SHIRAKH: So, on the two kilowatt, I mean, this just could be an exception.

MR. CAIN: Mazi is muted.

MR. SHIRAKH: Am I muted? Can you hear me?

MR. STRAIT: Yes, we can hear you.

MR. CAIN: Yes.

MR. SHIRAKH: So, the idea would be to actually provide an exception that exclusively says, you know, for a given dwelling unit or a building the required PV size is less than two-kilowatt DC, then that building is exempt from the PV requirements.

The way we determine that is that -- and, again, we can maybe adjust this number slightly up or down, but the absolute minimum PV size is about one-and-a-half kilowatt, even for like a 200 square foot building. That's because the plug loads are fixed.

And, so, we ran into some situations where people had like a 800 square foot or 600 square foot dwelling units and, you know, the PV size for those buildings are, depending on the climate zone, about 1.8, 1.9, and people were saying that they were having a difficult time finding someone who would even come out there and install, you know, a one-and-one-half kilowatt PV system.

And the costs actually go up dramatically and we assume $3 a watt for our prescriptive size PV size, but as you go down in size, then the cost actually goes up significantly because of, you know, the soft costs and the fixed costs involved.

So, that's the general idea but, you know, we'll work with you, Joe, you know to determine what the proper size should be, and, you know, this is just a draft proposal at this time.

MR. STRAIT: On the Q and A, Pierre Delforge actually raises an important point. We are still, I think, at the moment looking at questions on the cleanup change that we're proposing. Cleanup changes are necessarily fairly broad category, so there's a lot of things that we could talk about in terms of tweaks, or amendments, or updates we might want to make under that umbrella. But I don't think we're in the phase of having just general open commentary quite yet, because I want to make sure that everyone's questions or comments on specifically the cleanup changes that have been presented, or at least in that arena, are heard before we get more general. So, thank you for asking that, Pierre.

MR. BOZORGCHAMI: And, Mazi, we have Ben Davis. Ben, I'm going to unmute you, and please state your name and affiliation, please.

MR. DAVIS: Ben Davis, California Solar and Storage Association. On the community solar cleanup I have a few questions.

The first one was, Mazi, you mentioned,

and I didn't quite catch it, that there was considering limiting location, and then you said something else that I didn't catch. I was wondering if you could --

MR. SHIRAKH: The size of the resource.

MR. DAVIS: Right.

MR. SHIRAKH: There was a lot of comments that we didn't have size or limit on the resource size that could have been a thousand megawatts. So, people were worried that, you know, we're really talking about utility scale systems, not community.

And the idea of community solar, people are commenting that, you know, it should actually be fairly close to the development and it shouldn't be a utility scale PV system. And, so, those were like two of the comments was make sure that this system that actually goes in that qualifies as a community solar actually represents the spirit of being a community solar, not a central utility scale PV system.

So, we heard that we think there's some truth to that, and we're proposing to consider those in the revised language.

MR. DAVIS: Great. Yeah, that sounds

right to me, and actually the meeting is -- you chose to have that meeting as your background, Mazi.

MR. SHIRAKH: That is the one, yeah. Actually, it's interesting. It was on the Google that somebody posted on Google.

MR. DAVIS: My other two questions on the community solar piece is are you considering adding a provision to allow customers to unenroll from the community solar program if they wanted to?

MR. SHIRAKH: Yes.

MR. DAVIS: Okay. And then my last question is for entities that have community solar programs up and running and then 2022 building standards come out do they need to make changes and resubmit their program or their community solar program, or will it be grandfathered?

MR. SHIRAKH: I think with each cycle of standards the applicants should come and put in a new application, and that's my understanding. But Bill Pennington is actually the expert on this area. Bill, do you have a different opinion?

MR. PENNINGTON: So, I think it's well taken that we heard a lot of comments in the SMUD project, in the SMUD application, and, you know, there was a fairly wide range of views represented there, and so, my perception is we're going to look at all those views and make proposals.

So, the topic areas that you've mentioned I think are topic areas we should think about, sure.

MR. DAVIS: Thanks, Bill. My question was more specifically, let's say some changes are made. Will SMUD then need to re --

MR. SHIRAKH: Yes.

MR. DAVIS: Okay, great.

MR. SHIRAKH: To comply with the 2022 standards they need to reapply, and, you know, determine that their community solar requirement actually complies with the 2022 standards.

So, my answer at this point is that, yes, they have to come back in. I'm again asking Bill if he has a different opinion.

MR. PENNINGTON: There's nothing express in our regulations that says this, but it makes sense that if the regulations change, the program should adjust, so, I mean, that makes sense to me. We should -- we need to talk it through and vet it.

MR. STRAIT: I would actually add that we can find ways likely to streamline their attesting to following any new guidelines that we put in place as a result of the 2022 rulemaking, so, this wouldn't be -- ideally, at least, this wouldn't be like starting from scratch. This would be more saying that the features of our program might have been changed to keep up with what the standard is now requiring, or saying that the structural program already does need these criteria that you've now added, and, therefore, we are still kind of cleared for takeoff.

So, we can work with folks that have community solar programs to try to find ways that streamline process, but there would likely be some attestation that they comply with any updates that we make going into 2023.

I do want to cut in. There was one question from someone. Margie Chen asks, "Can we still sign in to make a comment?" And the answer is yes. We have yet to open the floor to general public commentary. When we do, you can raise your hand and we will allow you to speak. You can also submit comments to us in writing. We're trying not to create too many channels here for written comments. We want to keep the written question and answer log about questions on the presentations, but we are -- there are still upcoming opportunities to provide public commentary, so, these are coming in.

MR. BOZORGCHAMI: So, next, I'm going to open up Jean. I'm going to do the raised hands and then we're going to go back to the Q and A's and then we'll come back to the raised hands again. I'm trying to keep a balance going.

MR. SHIRAKH: Are we on the general question and answer or are we still on this topic?

MR. BOZORGCHAMI: On this topic, I believe, Mazi.

MR. SHIRAKH: Okay.

MR. BOZORGCHAMI: Go ahead, Jean. Please state your name and affiliation.

MR. LONJARET: This is Mr. Lonjaret with the Sustainability Commission of La Mesa.

Just a brief comment about JA-11, and

interrupt me if it should be in the general comments and I'll do it then.

If I understand it well, JA-11 allows installation of solar panels facing north up to or maybe even farther than 50 degrees away from their optimal orientation which would be south and at 34 degrees. Within his own system, including a better -- including better oriented panels, to the owner it may seem harmless, but it's a massive loss in efficiency and it's a poor carbon abatement investment considering the high embodied carbon in fillable tank panels.

So, if we're serious about extracting efficiencies wherever we find them, and we're spooked by even single access tracking, then we still have easy options to save what's left of the capacity factor of solar panels.

For example, rather than discouraging pitch installations, we should encourage them, and we could incorporate south-facing roofs as possible into new building design and, if possible, 34 degrees.

So, presently JA-11 is really loose and we could make much progress there for such an important part of the State's climate action, which is PV. Thank you.

MR. SHIRAKH: So, maybe I can respond to that briefly and maybe Danny has something to add.

So, as, you know, as we have on the screen here there is some confusion, discrepancy within prescriptive requirements and performance requirements. I think JA-11 limits the prescriptive installation to, and I'm speaking from memory, pardon me, but I think it's 110 to 300 degrees from true north. Again, I'm speaking from memory, but give or take. But, as you mentioned, so prescriptively you can't deviate from that.

When you go performance, you can actually orient your PV in any direction you want. However, there is a heavy penalty to pay as you deviate significantly from south or southwest. The optimal orientation is about 200 degrees. This is all driven by TDV, and the value of TDV really drops significantly as you deviate significantly from 200 degrees. And also, the KwH production goes down as you deviate and go to north.

So, you know, yeah somebody could put

their PVs on a north orientation, but they have to put a PV system that's maybe twice as big. And, so, there's really a financial penalty for doing that. And I think users of the software will soon realize that the closer they stay to south or southwest, the smaller PV system and the smaller the cost.

So, you know, there is some mechanisms built into the software to discourage deviating from the optimum orientation, but I agree, that's the whole point of this exercise is to revisit these assumptions and requirements and see if we can do it in a way that makes more sense.

MR. HEDRICK: Mazi.

MR. SHIRAKH: Yes.

MR. HEDRICK: This is Roger, Roger Hedrick from NORESCO.

So, as part of our analysis that we were working with E3 is we looked at PV tilt and orientation tradeoffs, and what we found is that as you lay the PV panels flatter, you can actually get more production out of a given area of roof.

MR. SHIRAKH: Yes.

MR. HEDRICK: It requires more panels,

but if roof area is your limiting factor, then laying your panels flatter as low as zero degrees will get you the most production and TDV benefit from a given area of roof.

And, so, it’s a question of what you are trying to optimize on, you know. Clearly, that’s less optimal in terms of per panel production, but it’s better in terms of overall roof, you know in terms of per roof. And, so, it depends on what you’re looking to maximize.

MR. LONJARET: So, that’s when roof tilt, itself, roof pitch, itself matters so much, because if you already have a south 34-degree roof, then you can lay your panels flat. It’s cheaper and that’s really optimal.

MR. HEDRICK: Right, that’s true, but most nonresidential, you know, commercial building roofs are flat, and so the tilt -- any tilt angle that has to be built into the racking system that you’re mounting the panels on.

MR. TAM: This is Danny. I just want to clarify what’s actually in J-11. So, J-11 prescriptively it says if there’s a pitch greater than 10 degrees to 12, then it has to be between 90 to 300. So, if it’s flatter than that it could be any orientation.

MR. SHIRAKH: All right.

MR. TAM: And if it's also at that range then you need to do performance. But like Mazi said, you've got to take quite a bit of performance hit when it's north.

MR. SHIRAKH: Hello.

MR. BOZORGCHAMI: Sorry.

MR. SHIRAKH: Any other questions?

MR. BOZORGCHAMI: Yeah, we've got Tim. Tim, I'm going to unmute you and please state your name and affiliation.

MR. KOHUT: Thanks for unmuting me. Tim Kohut. I am the director of sustainable design for National Community Renaissance. We are a developer/builder of affordable housing.

I've got something for general comment, and I'll save that for later, but community solar, Mazi, if you would consider our goals in trying to design, build and then operate affordable housing are to lower the costs as much as possible, and we have been -- we've been building and we're starting to put online our first zero net energy buildings today in advance of the 2019 Energy Code because we figured out the economics of renewable energy a couple years ago.

But what would very much benefit us is if the door could be open for community solar to allow us or a consortium of affordable housing developers or any developer to tie deed-restricted land elsewhere in the utility territory to a project which would then allow us to actually place all the PV we need at ground level where it could be easily maintained and cleaned, lowering costs, lowering risk. And I know it doesn't exist yet. I hope the door could be open because we have some really nice, big parcels that are utility tied that we would love to be able to clean up and lower our costs further.

I'll save the rest of my comments for general comments later.

MR. SHIRAKH: So, let me comment on that. I think Bill may want to chime in.

So, you can put all your PVs on a plot adjacent to a development. The question is how do you deliver those electrons to the individual dwelling units. And --

MR. KOHUT: Mazi, how about -- I'm

talking about remote, so it would be in the same utility region. We would install a V-NEM meter for each --

MR. SHIRAKH: Okay.

MR. KOHUT: -- smaller section on that property, and then we would deliver the electrons to SoCal Edison's grid and they would then go around and be shared in the neighborhood, but we would pull our -- we would get credit on that 20 miles away at our property sites.

MR. SHIRAKH: So --

MR. PENNINGTON: So, this is Bill Pennington. I'm wondering if we could have a side conversation --

MR. SHIRAKH: Yeah.

MR. PENNINGTON: -- so we could understand what your thinking is and, you know, what kind of engagement have you had with Southern California Edison about this idea.

MR. KOHUT: Yeah, I'd be happy to do that, Bill. Thank you.

MR. SHIRAKH: Yeah, I think that's a good idea. There may be some opportunities here.

MR. BOZORGCHAMI: Thank you. Something has gone funny with my system, but somehow I unmuted Tanya. Go ahead, Tanya. State your name and your affiliation, please. You have to unmute yourself.

MS. BARHAM: Hi. Thank you. My name is Tanya Barham. I'm with Community Energy Labs and a member of the Building Decarbonization Coalition.

I just had some questions. I apologize. I was on another meeting so had to join quite late.

I'm seeing that you have a lot about battery storage ready, however, that's a pretty reasonable upfront cost for a lot of building owners. I'm wondering what other demand flexibility and sort of flexibility readiness updates there are in the draft?

MR. SHIRAKH: So, the requirements we have for battery storage is actually pretty minimal. It's this. It's some panel requirements, larger panel to accommodate all electric end uses and PVs and EVs and all that, and then identification and isolation emergency circuits and then making sure that these modifications will be compatible with both battery storage system and the backup generator.

So, this is pretty minimal, and our estimate for cost is less than $100 per building.

So, that's what we currently have. If you have any other suggestions, again, I think I've repeated this several times, is that our strategy is to use any and all technologies, load shifting strategies, storage strategies to maximize self-usage of the PV generation and minimize exports back to the grid. And we will give a credit according to its TDV performance on an annual basis, and then the building's owners, architects will decide which one of these strategies to use based on the cost and the benefit and all the other aspects of these technologies.

So, again, we're open to other strategies. We need to know what they are and what loads they impact, and we'll calculate the TDV benefits, and we can assign as credit and let people use from an assortment of technologies.

MR. STRAIT: And I'll actually add to that that we do have a separate office that's right now tasked with load management and grid integration standards following new language that was added to the Warren Alquist Act.

As their work becomes -- moves from the conceptual down to some specific guidelines for various products and circumstances, then we can expect to see those be the basis for associated credits in the software, if not for additional rule changes in 2025, but they're still spinning up some of their work.

So, yes, it is something that the Energy Commission as a whole is paying attention to. It is something we are going to be actively incorporating into the software as more and more of these techniques become creditable, but they're not at such a point where they're going to be directly informative of the 2022 amendments to more than the degree that Mazi has already shown.

MS. BARNHAM: Thank you. One comment I just have for sort of to have on your radar, and I'm sure that that group is probably aware. Due to the -- maybe it's we should say hopes or dreams of manufacturers and OEMs who, you know, if I think you were to look that up, a smart home or a connected home, you know, I don't know if it's just that Samsung truly believes that everyone will only ever want to buy their light bulbs and, therefore, all of their wireless stuff only works in their ecosystem, et cetera. All of these connected devices, there's a lot of waste in how we use energy, particularly with heating and cooling, as we all know. But if we're forcing flexibility to each go through private OEM's API, that's a very expensive, time consuming and fragmented way to try to cost effectively control or shape loads.

And, so, looking at open standards for data, data categorization command and control gradients that should be integrated into controls such as CTA 2045, I think are very, very key and important pieces to making nonchemical, nonmined energy storage or flexibility a much more cost-effective means of flexing.

And we've seen at the CAISO level that load flexibility, when people just turn stuff off, even if it's manual, can have a huge impact on the resource adequacy mix. And, so, being able to do that autonomously has a lot of promise, but it will never be done if every single device in the building has to be connected through its own proprietary app or API. They all use different data structures. They all use different communication protocols. They all use different command protocols. And that's something that can be fixed. We've done it with USBs. We've done it with other ports and standards, and I hope that the State will take a close look at applying a similar communication control and data transmission standard to demand flex. Thank you.

MR. TAM: This is Danny. We recently approved a compliance credit for demand flexible heat pump water heater JA-13. So, in there this code requires CTA 2045 as well as being compatible to open ADR.

So, we are aware. We are trying to make it compatible with open center as much as much as possible.

MS. BARNHAM: Wonderful. Thank you.

MR. BOZORGCHAMI: I'm going to unmute you, and after Tom we're going to go right back to the questions and answers and then maybe open up for open discussions.

MR. CONLON: Can you hear me?

MR. BOZORGCHAMI: Yes, go ahead, Tom.

MR. CONLON: Thank you. I just wanted to draw our attention back to --

MR. BOZORGCHAMI: I'm sorry. I have to ask you to state your name and your affiliation.

MR. CONLON: Tom Conlon, Geo (indiscernible). To go back to the cleanup items number two, Mazi was discussing the exemption being considered for solar systems PV systems below two kW and addressing the ADU issuing. And while I'm very intensely aware of the importance of State policy of building a lot more ADUs -- I'm, in fact, building one myself right now -- I'm concerned that if you were to go forward with an exemption as I see it described here, that you effectively kill in its infancy the market potential for an appliance that would be a standalone modular kind of micro PV system that could be coming to market between now and 2022. And I especially think that that could be compatible with your consideration of the credit for a standalone battery storage system as well.

I just -- I think that while the barriers you've experienced and some homeowners have experienced with the new 2019 -- new to them 2019 code implementation on these smaller units, it's because the industry, the solar industry is all tooled up to deal with a much bigger type of customer.

But if you -- if you throw this exception in you really will never get a product in that segment, and I think there's market potential for a cost-effective appliance, basically, that could fill that niche.

So, I'd like you guys to take a look at that issue before you implement such an exception. I hope that comment makes sense. Thank you.

MR. SHIRAKH: You probably need to give us more information about these products. I mean we need to know if they're available, cost effective and they'll be available actually on the effective dates. So, to the extent that you can provide some additional information to us we'd appreciate it.

MR. BOZORGCHAMI: Thank you. Thanks, Mazi. Peter, do you want to take over the questions and answers?

MR. STRAIT: Sure, I can do that. Some of the ones that are outstanding, we have two questions from a Barbara regarding how to ensure transition for any plumber whose work is reduced due to fewer gas pipelines in new buildings, and she suggests, for example, requiring piping for using reconstituted water for nonpotable purposes. I think that is outside of the considerations of this workshop, but, yes, we are looking at a lot of the equity questions surrounding a lot of this. Other than that, though, I don't have a specific answer that I think we can give.

Does anyone else want to try to speak to that?

MR. TAM: We constitute water. It's not actually measured as a water saving measure. It's in Part 11.

MR. STRAIT: We've got a question -- Tom specified a follow up on PV2 exception but does not specific what the question is. Tom, if you can type it in I can get to it, so I'll dismiss that.

Tanya Barnham is asking, "How can I be more involved in those conversations without" -- again, I'm assuming in context this made more sense, but, Tanya, could you be more specific and I'd be happy to answer it.

David Friedman is asking "Are we planning any additional electric-ready requirements such as for cooktops, electric clothes dryer and heat pump water heaters since the panel will be upgrading the addition plugs should have minimal additional costs?"

I can speak to that, or if anyone on the panel would like to speak to that?

MR. SHIRAKH: Go ahead, Peter.

MR. STRAIT: Sure. So, we actually are keeping a close eye on electric-ready requirements. We saw those as an element of several local ordinances, and we do see those as, in a certain sense, low hanging fruit. So, those will be driven in part by where we ultimately land on, you know, the electric baseline and the Title 24 options, but it's likely for places where gas equipment is allowed. We are looking at whether we can, given the cost effectiveness constraints that we have, pair those with outlets that can serve electric equipment in the future.

So, the current structure we're considering is something similar to solar ready requirements, so we already know roughly how to do that, but again, it's going to be driven by these bigger decisions about this equipment, and for those areas we are likely to incorporate some amount of electric readiness into the code.

MR. TAM: Heat pump water heater ready is already in the 2019 code. We require three conductors, 10-gauge wire mixed plug to the water heater if it's a gas water heater. So, that should be relatively easy to convert to 240 for a heat pump water heater.

MR. STRAIT: And Tanya is asking for demand flux open standards how she can make sure that open standards for demand flux are adopted.

I can -- if you reach out to any of our staff we can put you in touch with the folks that are part of our load management office and they can guide some of that since they're involved in some of their own activities. We can put you in touch in them.

Scott Blunk was asking a question, "Given that clothes dryers can also leave the home, as well as EVs, wire EV is different than clothes dryers."

You know, the question is a little bit oddly phrased, but, Mazi, do you want to answer that, or I can kind of talk about some of those differences if you think it would be helpful?

MR. SHIRAKH: That is actually a good comment. I mean, there is an issue because, yeah -- is this Scott Blunk from PG&E? Long time no see -- oh, TRC. I'm sorry.

Yeah, I mean that's a good question because in giving credit to appliances like refrigerators and clothes dryers, again, it is risky because they can walk. So, that is an asterisk when you think about it. By contracts when you're talking about a cooktop, I mean, that's more difficult. It's kind of fixed. It's set in some one place.

So, yeah, that is a good point.

MR. TAM: Another problem, EV at the time of permit. How do you know the owner is going to have it green? There's no way to know.

MR. SHIRAKH: There's no way to know, if you know, there is a dishwasher or a refrigerator but, yeah, those are all good comments and it kind of goes to our concern that, you know, you provide compliance credit for appliances that may or not be there or may or may not perform and then use that to strip away the roof deck insulation. That is always a cause for concern for us.

MR. STRAIT: So, Alice actually raises the point that -- a couple of people are asking if we can move to general comments. We don't -- this is the last of the questions we have on the presentation in the question and answer box, so I would be comfortable moving on if other people are.

MR. SHIRAKH: Okay.

MR. BOZORGCHAMI: So, let's open it up. I see Dana Paki already raised her hand. So, Dana, when I unmute you state your name and your affiliation, please. Give me one second. Something just happened. Here we go.

MR. STRAIT: I would add for folks that are -- have some time constraints, we want to be fair and make sure everyone gets a chance. We don't want to create a path for folks to jump the line. But we are able to receive written commentary. If you want to email comments to staff, we can then read those comments into the record, so there are opportunities to get your voices on the record and heard by staff and leadership, even if you can't stay on the call.

MR. BOZORGCHAMI: I apologize. Hold on one second. Something just happened.

MR. STRAIT: Do we want to move to the next commentator while we try to sort out what happened?

MR. BOZORGCHAMI: Brian Finn, please state your name and --

MR. FINN: Hi. My name is Brian Finn. I work at Bright Power in Oakland, California. We're an energy services retrofit contractor.

We're pretty much writing the book on multi-family low- and high-rise heat pump water heater retrofits, and then from there I'm moving on to full electrification retrofits, at least here in the Bay area.

And with that knowledge that we've accumulated I can't help but feel a little dissatisfied with some of the heat pump ready requirements and some of the anticipation about where our built environment is heading in this code. I find some of it to be lackluster.

I think electrical constraints are, of course, important, but there are a number of different factors that are excluded from the discussions that we've had today and previously that when a gas system is installed into a multifamily building tomorrow in code that is acceptable tomorrow, that means that I have to clean up trash in 30 years and pay an extra $200,000 to implement the world saving solutions that I work for every day.

And, so, I can't help but think that there is a disconnect between what it actually takes to do this work and what is being considered under a new construction code.

I've been working in Title 24 modeling since I was 13 in Micropas. I'm currently 29 and working on this for the rest of my life, so I'm not going anywhere. And I can tell you for my generation and my age group that it is disappointing that as the memories of our childhood falls down as ash around us that this is still being considered at all. Thank you.

MR. STRAIT: Thank you. One quick follow up question I saw on the Q and A. "How do we submit written comments?" If anyone needs to submit written comments, the instructions for doing so are in the notice for this proceeding. There's a portal on our website that can be used for that, or if you email any of our staff and request that we assist in docketing your comments we can assist you and we can do so.

MR. BOZORGCHAMI: John, go ahead. Jonny Kocher, go ahead and state your name and your affiliation, please.

MR. KOCHER: Thank you. Good afternoon. My name is Jonny Kocher. I'm with Rocky Mountain Institute in the Oakland office, an independent nonprofit working to shift towards a low carbon future.

All Californians have experienced a devastating impact to the climate crisis in the last two months, so we all know the need for rapid action to reduce our carbon emissions.

Luckily, California has been a leader on climate with statues and executive orders requiring California to reach carbon neutrality by 2045 and to eliminate the sale of new internal combustion engine cars by 2035. However, California still has no plan to reduce direct emissions from buildings.

Today's workshop highlights the need for the California Energy Commission to build up the State's climate leadership and the 34 cities that have adopted electrification reach codes and enact policies that will set the stage on a path to eliminate the combustion fossil fuels from buildings starting with new construction.

During the workshop today, analysis presented used the TDV metric which uses cost as the basis of analysis, not energy, so it does not properly account for the mission's impact for measures.

For years, time dependent valuation has disincentivized builders for fuel switch forcing many builders to install natural gas equipment for their buildings or risk not complying with code.

Using this as metric to analyze whether all electric measures are, in fact, to continue to give -- will continue to give natural gas an unfair advantage over electric alternatives.

It's time for the California Energy Commission to align analysis with reality and use time dependent source evaluation emissions evaluation to evaluate the impact of different design measures.  Such analysis would show that all electric buildings are far more effective than mixed field buildings in reducing emissions.

In addition to reducing emissions, an all-electric baseline would create safer healthier buildings for building occupants and would stop expansion of natural systems that would inevitably become a stranded asset when we eventually transition off fossil fuels. Therefore, the Commission would move forward with adopting an all-electric baseline in the 2022 code cycle. Thank you.

MR. BOZORGCHAMI: Thank you. Jonny.

MR. SHIRAKH: Let me just quickly respond to a few points that was brought up here.

During this workshop, you know, we mentioned several times that we have two metrics, source energy and TDV. We also mentioned that for this workshop we're going to be only considering TDV, but for the November 19 workshop we'll have thresholds for both TDV and source energy. So, you know, we just want to make clear that this is -- we have two metrics here and both will be used.

And the intention of having two metrics is to actually have a limit on the carbon emissions from the building using the source energy and then using the TDV to achieve those goals, those carbon goals in the most cost-effective way possible and in a way that is grid harmonized.

So, you know, we've made this fact known several times today and in previous workshops, and I just wanted to make clear that the final product is not just the TDV, and it will include source energy. Thank you.

MR. BOZORGCHAMI: Thank you, Mazi. Wes, I'm going to unmute you. Please state your name and

MR. REUTIMANN: Hi. Can you hear me?

MR. BOZORGCHAMI: Perfect. Go ahead, sir.

MR. REUTIMANN: Wonderful. Thank you. Hi, Wes Reutimann with Active San Gabriel Valley. We are a playspace nonprofit organization in the city of El Monte in East Los Angeles County. Our mission is to support a more sustainable, equitable and livable San Gabriel Valley. The central San Gabriel Valley includes a number of communities, including the cities of El Monte, South El Monte, Bassett, Baldwin Park and Avocado Heights that are among the most pollution burdened in the state of California according to Cali EPAs CalEnviroScreen 2.0.

Residents of these cities suffer from some of the worst air quality in the United States with devastating local health impacts and disparities, high rates of asthma and other respiratory illnesses, as well as cognitive impairments, some cancers and even obesity have all been linked to exposure to high levels of air pollution which are far too common in our region.

The economic costs of these health disparities is billions in associated health care and diminished productivity to Los Angeles County.

Equally troublingly, a recent study of indoor air quality among many older homes and apartments in our area found that indoor air quality was even worse within these environments and outdoors, particularly during the colder months of the year, when windows are more likely to remain closed. Making matters worse, after decades of steady improvements, air quality in the south coast air basin has been on the decline over the past decade, and climate change is expected to exacerbate this problem even further.

Currently the San Gabriel Valley averages about 32 days a year where daytime temperatures exceed 95 degrees Fahrenheit. According to UCLA researchers, this number could skyrocket to an average of 74 days per year by 2050 and an average of 117 days per year by 2100. That would be five months of the year.

A hotter future with less rain will make it harder to clean our air and improve the health of already disadvantaged pollution burning communities.

As a community-based organization that’s committed to improving the health and well being of residents of East LA County, Active SGB strongly urges you to require electrification of new buildings as an affordable means to create healthier homes and act on the climate crisis.

We also urge you to consider the health costs of not adopting a strong electrification standard and making people’s homes safer and healthier.

Thank you for your time and consideration.

MR. SHIRAKH: Thank you.

MR. BOZORGCHAMI: Thank you, Wes. Abby Young, we're going to unmute you. Please state your name and affiliation, please.

MR. TAM: One thing. I put up the comment docket website here. We will be posting all these and this information will be available at a later time. Unfortunately, I'm not able to make it happen right now.

MR. BOZORGCHAMI: So, Abby, go ahead.

MS. YOUNG: Great. Can you hear me?

MR. BOZORGCHAMI: Perfect.

MS. YOUNG: Awesome. Thank you. And I understand that you're going to be having another workshop on the 19th. I probably won't be able to attend so I'm happy to make comments here.

Great presentations. Thank you very much.

I'm the climate protection manager for the Bay Area Air Quality Management District. The Air District is very supportive of the state going to an all-electric requirement for new construction in this update.

As people have been saying, it's much easier to make the transition off of natural gas sooner if we're not continuing to extend the natural gas pipeline with new construction that will continue to use natural gas well past 2050.

So, as part of this will the CEC be demonstrating how continuing to allow new construction to use natural gas supports meeting the state's carbon neutrality target by 2045 and the 80 per cent reduction target by 2050. So, trying to see how, you know, these things align.

And, finally, wondering if the code, and perhaps this is for a different workshop, but if the update will also address high GWP gases and phasing out the use of fossil diesel backup generators.

Yeah. So, thank you.

MR. BOZORGCHAMI: Thank you, Abby. I'm going open up to Tim. Tim, go ahead and unmute yourself and state your name and affiliation.

MR. KOHUT: Tim Kohut. I am an architect. I am the director of sustainable design for National Community Renaissance. We are a regional developer/builder of affordable housing. We are the second largest developer of affordable housing in the state of California. I think we're the fourth largest in the United States.

My role is to identify strategies for achieving the energy requirements for Title 24 for our design teams in a way that drives down operational costs up front, the first costs, and increases operational revenues long term. And I work for a very financially conservative organization that will only make these steps when we can prove that it actually makes sense and doesn't increase costs.

And I would just add testimony that going to all electric solutions in affordable housing makes sense today. We have adjusted our pipelines so that all future projects are now looking at centralized heat pump water heating, now that updates are available for the compliance energy modeling tools, which is great, and they work.

But most importantly for us, we're looking at the operational economics of this, and if we are looking for cost effective solutions to get to zero net energy for hot water heating. It is much more cost effective and the payback period for a heat pump solution, whether it's individual heat pump water heaters or centralized heat pump boiler system for multifamily housing plus PV is much more affordable than a central gas boiler with a solar thermal system. The payback period for the heat pump plus the PV is probably in the area of six or seven years without any rebates. And the payback period for the solar thermal system in multifamily housing is 20 to 25 years at least.

So, I'm making the case today that there are no financial barriers to actually doing this today, that what the CEC is doing to, I guess, liberate us and give us more flexibility in performance modeling, especially when it comes to hot water heating solutions and electricity is going a long way and is going to pay dividends. I tell people in my industry that if you're not already on board with zero net energy you are either misinformed, you're a bit lazy or you're just late to the game.

So, I commend you guys for what you're doing. I'm happy to share any cost information that we have on the construction side, what we're doing, and we have systems in place. We instrument our buildings so when we occupy them we know that they're actually working.

MR. BOZORGCHAMI: Thank you, Tim. I've taken down your email, so we will be in contact with you. Thank you.

MR. KOHUT: Great.

MR. BOZORGCHAMI: Before I go to the next person I'm going to jump down to Jan. Apparently I may have accidentally, not intentioned, but I may have accidentally unmuted or taken you off the list. So, I'm going to unmute you know and allow you to speak. Go ahead and state your name and your affiliation, please.

MS. DIETRICK: Jan Dietrick. I'm chapter leader for Ventura Citizen's Climate Lobby.

We've been paying a lot of attention to our Ventura County General Plan Update and Climate Action Plan was just adopted with the reach code for prohibition of gas connection in new construction residential and commercial. We're extremely happy with that.

We face so much difficulty challenging really false narrative propaganda from SoCal Gas and their friends in the fossil fuel, very substantial power structure in our county. And, honestly, this is not right. I just can't -- there needs to be some sanction on this because it's so hard on our elected officials, planning commissioners, the staff. It's extremely disunifying to our community. They target people that don't have the time to begin to vet all the things that they're saying. We know that we have to end reliance upon burning fossil fuels. That was very well commented on by the representative from the Rocky Mountain Institute. Many people don't know about the pollution in their kitchens and the health harms from cooking with gas.

So, we don't just need the reach code statewide. I mean we need the all-electric building code statewide. We need to be moving on from that now, already like overdue to decarbonize existing buildings and looking particularly at the buildings near freeways and disadvantaged communities which we have here.

And, you know, how do we incentivize and support families to get that pollution out of their homes, and especially thinking about what are we looking at now with the vulnerabilities in this pandemic. We're just setting people up for the worst-case scenario.

So, we need movement on this, and we need the policies for fuel switching, you know, throughout our buildings. And, so, I urge you to move ahead as fast as possible with this, and also to regulate somehow the propaganda coming from at least I know personally from SoCal Gas that's tearing our communities apart trying to oppose this inevitable fuel switching transition. Thank you.

MR. BOZORGCHAMI: Thank you, Jan. So, due to the scheduling and time I'm going to implement a two-minute rule just to make sure that we capture everyone's concerns and comments. So, from here on I'm going to open it up for you, William, and please state your name and affiliation and unmute yourself.

MR. LEDDY: Can you hear me?

MR. BOZORGCHAMI: Yes, perfect. Thank you, sir.

MR. LEDDY: I'm William Leddy. I'm an architect and vice president of the Climate Action for the American Institute of Architects, California. I'm here representing AI California and its 11,000 architect members across the state.

As we all know, science tells us that we have only 10 years to radically reduce the carbon dioxide emissions of our buildings if we are to have any hope of mitigating the most severe catastrophic climate impacts.

As much as our energy codes already lead the nation we believe that they are not responding quickly enough to meet this greatest challenge of our generation. We must take more aggressive action to change codes rapidly now.

As Governor Newsom said a few weeks ago

about climate action, our goals are inadequate to the reality we're experiencing.

So, I'd just like to make a couple of quick points on behalf of AI California. We strongly support rapid electrification across the state. It's time to stop burning fossil fuels inside our buildings and shift to all electric. This is a rapid movement across the state as you know, and we feel that the State should take a lead in requiring all buildings to be all electric and phasing out natural gas.

Second, we strongly support the California Energy Commissions expansion of rooftop solar. We want to urge the expansion to all building types as quickly as possible.

Third, we urge the California Energy Commission to adopt the 2022 zero code for California as a statewide reach code. As you know, I hope, it was developed by Architecture 2030 to require all new commercial buildings to be net zero carbon through a combination onsite renewal energy and grid based renewable energy.

And then finally, I think it's been mentioned several times that we strongly support a just transition from fossil fuels with policies that protect workers in low income communities.

As the largest economy in the world and a global leader in climate action California must continue to push aggressively toward a zero-carbon future. Time is short. The world is watching what we do and how quickly we do it. AI California and it's 11,000 members stand ready to work closely with the California Energy Commission to advance this critical effort. Thank you.

MR. BOZORGCHAMI: Thank you. Deanna, I'm going to unmute you, and please state your name and affiliation. Thank you.

MS. PAURSAI: Hi, can you hear me?

MR. BOZORGCHAMI: Beautiful. Thank you.

MS. PAURSAI: Hi, I'm Deanna Paursai and I'm a volunteer with Mothers Out Front. I live in San Jose, California, and I'm the mother of two beautiful teenagers, and I'm so truly concerned about their future.

On behalf of Mothers Out Front, a growing grassroots movement of 35,000 mothers and others mobilizing for a livable climate for all children, I thank you for hosting this very important meeting.

We strongly urge you to adopt an all-electric building code starting in 2022. There is simply no good reason to continue to build with outdated, dangerous and climate destabilizing fossil gas when all electric buildings are safer, healthier, most cost effective and climate protective.

Only gas companies and gas utilities benefit from the continued use of fossil gas to power our buildings.

We hope that you'll listen to the scientists, the doctors, the nurses and the mothers to move forward to require that all new construction in California be all electric as of 2022. It's not sufficient to merely encourage or incentivize that new construction be all electric. Without an outright mandate, incentives are unlikely to result in any significant shift in new construction practices for zero carbon electric construction.

This risks the construction of hundreds of thousands more new buildings with gas hookups and the infrastructure to power them locking us into decades of climate pollution and indoor pollution. We simply can't afford for a livable planet for our health and safety of the housing affordability in California to build 300,000 plus new homes and millions of square feet of commercial space fueled by gas for another three years.

Thirty-four local California jurisdictions have already adopted local codes that require or strongly encourage electric new construction. It's time for the State to follow suit and blaze the trail for other states.

So, the four main reasons that they outlined, I know that we're limited on time, we as Mothers Out Front do strongly urge you to adopt an all-electric building code in 2022 to protect the community and the health and improve supportability, and most of all to preserve a stable climate future. Doing so will provide more affordable, cleaner, healthier and more resilient homes and buildings and protect the most vulnerable Californians. After all, our children will be living, and studying, and working in these buildings for decades. Please do it for them. Thank you.

MR. BOZORGCHAMI: Thank you, Deanna. Ron, I'm going to unmute you. Please just state your name and your affiliation. Thank you, sir. Ron, you have to unmute yourself.

MR. WHITEHURST: Thank you. My name is Ron Whitehurst. I’m with the Ventura County Climate Hub. We’re an organization that advocates for renewable energy, fights fossil fuel development, (indiscernible) food supply and develops community for resiliency

We’d like to -- we’re really proud that Ventura County’s new climate action plan includes the reach codes to prohibit gas connections in new residential and commercial construction, as well as benchmarking reductions in gas use by industrial rate payers.

Now that 10 cities in our county, such as thousand Oaks and Ventura, need to follow and adapt similar reach codes.

We’ve been facing so much misinformation and disinformation from SoCal Gas and the unions that they’ve convinced to come out that it’s not fair to our communities to be fighting this industry promotion. So, we’d like to encourage you on the state level to have an all-electric policy and prohibit gas connections on new construction so that it will make our job easier to promote all electric here in our communities.

Thank you much for your help and thank you for the opportunity to speak. Thank you.

MR. STRAIT: Payam, are you muted?

MR. BOZORGCHAMI: I'm sorry.

MR. STRAIT: Diane Bailey is going to be next to speak. It looks like you are already unmuted.

MR. BOZORGCHAMI: Yeah. Go ahead, Diane. Sorry.

MS. BAILEY: Good afternoon. My name is Diane Bailey. I'm commenting today on behalf of the Campaign for Fossil-Free Buildings in Silicon Valley and our 33 member groups working together to accelerate a phase out of fossil fuels from our homes and buildings.

I'm speaking in strong support of an all-electric Title 24 building code for new construction in 2022. We need much bolder action to avoid fossil fuel use and help transition our economy to zero carbon. This policy is a critical action to respond to the climate emergency that we're living in right now. Every breath of smoke that we inhale is a reminder that we're in a climate crisis.

And California isn't just vulnerable to the fivefold increase of wildfires due to the climate change. Many communities throughout the state also face severe flooding, more intense heat waves, and extreme weather disruptions. We need to accelerate action to cut carbon and get off fossil fuels.

Many other commentors have discussed the deeply concerning climate health and safety impacts of fossil gas use, and I know you're aware of these.

I want to point out the comments of Beverly DesChaux and Tom Kabat earlier and others about methane leakage were on point and they're important.

In addition, methane is a short-lived climate pollutant that makes it so much more of a priority to reduce and avoid right now, as we already have unsafe levels of carbon in the atmosphere driving catastrophic climate impacts. We're over 410 parts per million of CO2 and steadily increasing farther away from safe levels.

We should be focused on eliminating fossil gas use to help restore the carbon levels in our atmosphere back down to safer concentrations of $CO_2$.

New uses of fossil gas are extremely unwise, making an all-electric code paramount.

There are also important equity implications of continued fossil gas use. Pollution from fossil fuel combustion disproportionately affects low income and communities of color that are already overburdened with pollution, and that's especially important now in this era of COVID where the communities of color are also disproportionately suffering from that disease.

It's important to extend the all-electric new construction policy statewide from the more than 30 cities that now require it because a failure to act creates an equity disparity between the more affluent cities that have protective policies and the many lower income residents who do not currently live in these areas with the protections against fossil gas use.

We want to make sure that all new homes and apartments, including affordable housing, avoid using dirty and dangerous fossil gas.

Title 24 should require more efficient and safer all-electric homes for everyone and not just those in the reach code cities.

As more and more communities shift to all electric, gas rates are expected to rise sharply, leaving some residents paying much higher utility bills. The base Title 24 building code should be all electric to extend benefits to everyone more equitably.

As we become more vulnerable to the impacts of climate, our energy code needs a much stronger approach to address the situation. It's time to stop burning fossil fuels inside our homes and buildings and shift to all electric. This will save people a lot of money in addition to addressing climate impacts and providing safer homes.

MR. BOZORGCHAMI: I'm sorry, Diane, you need to --

MS. BAILEY: Thank you very much for this opportunity to comment. I hope you'll consider these comments in support of an all-electric Title 24 code in 2022. Thank you.

MR. BOZORGCHAMI: Thank you. Thank you. Scott, I'm going to unmute you. Please state your name and affiliation please.

MR. SHELL: This is Scott Shell speaking on behalf of the 70 architects and staff at THDD Architecture. We've been designing all-electric buildings for almost 20 years now, up to about a couple hundred thousand square feet, and found that it's an all-around better solution for our clients. It's simpler, it's healthier, it's safer and it's lower cost. So, we're trying to design all our projects now as all electric.

We also do about half our work as building retrofits, and this is our biggest concern, as they're much more difficult and much more expensive to fuel switch. Buildings last a long time. You know, they don't turn over every 12 years like a car does or a residential appliance does. So, we think it's especially important to quickly transition so that we build them right to start.

We don't think the proposals today are strong enough to lead to broad adoption of electrification in new construction in 2022, and so it will push it out to 2025, and, you know, as practicing architects for us that means it actually goes into effect in 2026. There's usually a year or so between submitting for permit and starting construction. Our projects take about two years to construct, so we'll still be finishing projects in 2029 that are mixed fuel. You know, we're still expanding the gas grid for almost another decade. 2029 is only 16 years until California's 2045 carbon neutrality date. We've already got a huge task to retrofit millions of buildings in California to fuel switch them to get to carbon neutrality, and adding hundreds of thousands of new buildings is not a good investment for California citizens and for the rate payers that are paying for that expansion of the gas grid.

In 2045 most of these new buildings aren't old enough to be ready for a major renovation, so you have an occupied building that's going to be even more disruptive and expensive to retrofit.

So, we believe we need a much stronger electrification signal in 2022. We're in favor of all electric wherever it's feasible. I understand this is a faster transition than is typical, but the alternatives are just not cost effective, and we're just out of time. We're up against our deadlines.

Finally, I'd just like to make a quick comment on the growing alarm about the health impacts of combustion inside our buildings, especially impacting low income communities of color. They have already experienced much higher levels of pollution and combustion in buildings just compounds on top of that both indoors and outdoors. It's fundamentally unjust. I think this year we've all raised our awareness of that injustice and we just really have an obligation to address that. Thank you.

MR. BOZORGCHAMI: Thank you, Tom -- Scott. I apologize.

MR. SHELL: Thank you.

MR. BOZORGCHAMI: Robin, I'm going to unmute you. Unmute yourself.

MR. MOLLER: Hi. This is actually David Moller, not Robin Moller, and I'm with the Marin Sonoma Building Electrification Squad, and that's part of the climate reality project. They are a chapter.

I want to thank you for this opportunity to provide a few comments. I'll be brief and to the point.

I think a few weeks ago Governor Newsom really said it best. It's a climate damn emergency. Simply put, we need emergency action, and the Energy Commission is squarely in the position to take such action. With gas use in buildings responsible for something like 25 percent of California's greenhouse gas emissions and electrification of these uses being totally viable as an alternative, you know, there really is no good rationale for further expansion of gas infrastructure or use. None of us can afford to make this climate emergency even worse by enabling the expanded use of natural gas.

We strongly urge staff and the Energy Commission to use the 2022 building code update as really the best opportunity to require full electrification of new buildings. Thanks for this opportunity.

MR. BOZORGCHAMI: Thank you, sir. Pierre, I'm going to unmute you. Please state your name and affiliation, please. Pierre, you need to unmute yourself first.

MR. STRAIT: I think we need to stop saying that we're unmuting people. We can authorize you to speak as we lift the thing on our side, but then it doesn't automatically make your microphone live because that wouldn't be fair to the speaker, so then you have to take a step to also make yourself live. So, we'll try to be better saying to you you're empowered to speak or something. Pierre, it looks like you were unmuted and you then remuted yourself. There we go.

MR. DELFORGE: Hello. Can you hear me now?

MR. STRAIT: Yes, we can hear you.

MR. DELFORGE: Hello.

MR. STRAIT: Yes, we can hear you. Pierre, are you able to hear us? Pierre, we are no longer able to hear you. I'm not sure what the technical issue is.

MR. DELFORGE: I can hear me, but I can't hear you. Let me make my comment if that's okay, and hopefully we'll solve these audio issues.

Let me start again. So, my name is Pierre Delforge with the Natural Resources Defense Council.

We thank the Commission for this public process and appreciate your efforts and proposal to abide compliance and standards to all electric buildings.

Compliance credits are a step in the right direction, but alone would be insufficient to shift the market to electric new construction without tightening the gas baseline and then showing that gas buildings do their fair share in reducing the climate emissions, the adoption of clean electric technologies will continue to be marginal during the 2022 code period.

In normal times we'd go one step at a time with incremental steps every two years and we'd eventually get to zero emissions within a decade. But even in normal times we already seeing massive and widespread wildfires that climate experts were only expecting by midcentury. With climate change accelerating under our eyes we have to accelerate our pace of action if we are to stave up its worst impact.

The 2022 code applies to permits that will be pulled from 2023 and buildings that will be built between 2024 and 2026, six years from today. Delaying electrification by another three years would allow buildings with gas until 2029. Can we afford to wait another decade?

The technology to power new buildings

with clean electricity exists today. It costs no more to install or to operate, actually less when including the compliance incentives proposed by staff and the coming financial incentives from the tech. and SGIP programs.

Thirty-four California cities have already adopted clean electric building codes today.

So, we support that policy, but public cautions stand in the way of protection. As the Commission prepares for the second workshop we urge staff to use the new source energy metric to set strong decarbonization requirements that actually will lead to broad adoption of electric new construction starting in 2023. Thank you.

MR. BOZORGCHAMI: Thank you, Pierre. Ben, would you like to unmute yourself and --

MR. GRANHOLM: Good afternoon. Can you hear me?

MR. BOZORGCHAMI: Yes.

MR. GRANHOLM: Great, thank you. My name is Ben Granholm with the Western Propane Gas Association. We appreciate the opportunity to comment and mention that WPGA supports decarbonization efforts.

WPGA is committed to 100 percent renewable propane in California by 2030. Renewable propane is derived from sustainable sources across all sectors.

Our organization supports efforts to address climate change. However, we encourage the agency not to adopt an all-electric baseline in the 2022 energy code. Adopting such a baseline is misguided from the standpoint of cost, reliability, and is the only strategy to achieve clean air goals.

We believe the strategy outlined today is a nice compromise solution, and we are pleased to see that the current plan will not impact the mixed-fuel baseline.

From a cost perspective electric heat pumps are more expensive to buy and more expensive to use. They take longer to disperse heat and cannot match the heating capacity of their propane counterpart. Electric heat pumps perform most poorly in the coolest climates in California which tend to be more rural.

An all-electric heat pump baseline in the energy code will fundamentally increase the cost of housing and the communities where cost will rise the most will be where those who are least able to afford it.

From a reliability perspective we have seen millions of Californians stranded due to public safety power shutoffs and rolling blackouts. These occurrences are a prime example as to why relying on a single power source is unacceptably risky and accentuate the need for both energy diversity and resiliency across the state, two things that residents will not receive from relying solely on electric. Propane can deliver on resiliency, sustainability and affordability all to effectively address needed admissions reductions.

Lastly, we submitted written comments on September 4th which dive further into detail on a number of these points raised today, as well as other issues critical to this discussion.

WPGA appreciates your work in this area and we look forward to working with staff on the roll of propane for clean energy security and decarbonization. Thank you.

MR. BOZORGCHAMI: Thank you, Ben. Sven, go ahead and unmute yourself.

MR. THESEN: Hi. My name is Sven Thesen.

I'm speaking on behalf of Project Green Home, by family and my wife.

Summary, we are in support of an all-electric base code for all new construction and renovation where feasible.

Second, we invite the California Energy Commission, its commissioners and staff to virtually tour home Project Green Home at your convenience. You can contact me to do so. We have had over 4,000 people tour the home to date, and we're not afraid to bring in another 10 or 20.

As background, for the past nine years my family has lived the all-electric life with an induction stove, heat pump water heater, a radiant floor with energy provided from that heat pump, an electric dryer, photovoltaic panels on the roof and an electric vehicle of different flavors in the driveway.

When we compare project green home as a chemical engineer and my wife as a physician we have determined that the all-electric life is, one, safer for us and our children both from an indoor air quality and in reducing the potential for burns, two, less expensive than the dual fueled home both on first and ongoing costs, more resilient during blackouts and earthquakes, more convenient and pleasant, and for the planet, for my children, for the grandchildren that are to come, it has a much smaller energy and carbon footprint than the dual fueled home.

And I've got to admit, back in 2008 and 2009 when we were planning the house I foolishly, because that's what the architect called me, had it plumbed for natural gas not knowing that these technologies that were in the toddler stage, again this is now 12 years ago, in the toddler stage in the United States were going to work or not going to work, and they all did. They all worked. And my wife, she will not let you take that induction stove out of her hands because it simply works.

We implore you to be strong. We are out of time. The world is watching what we are doing. Heck, if this was a movie there are clearly heroes and there are villains here. We need to go to all-electric construction.

It was really interesting to hear sort of, again, these partial truths about propane and natural gas being resilient. Today you can't turn on a propane stove without electricity. So, to say that it makes you more resilient is a falsehood, and spreading partial truths like that is not good for any of us. It's not good for the climate.

Building electric. I would have saved $10,000 if I had not been foolish as my architect said I was going to be in plumbed with gas. We need to move now. We can build our construction cleaner, cheaper and faster if we go all electric.

I really welcome you guys coming to virtually tour my home pretty much any time you want. I will put the website on the chat as I can under the question section and my email address. Please feel free to ping me for a tour. Thank you.

MR. BOZORGCHAMI: Thank you. Lauren, do you want to unmute yourself and tell us your name and your affiliation.

MS. CULLUM: Yes, hi. Can you hear me.

MR. BOZORGCHAMI: Thank you. Yes.

MS. CULLUM: Great. Lauren Cullum, policy advocate with Sierra Club California representing 13 local chapters in California and half a million members and supporters throughout the state. I've also been asked to state that NextGen. is aligned and supportive of our comments here today.

I wanted to thank you all for all the work that you're doing to improve California's homes and building, and thank you for improving the capability for modeling central heat pump water heaters to show the benefits of electrification.

Modeling shows improving the electric baseline will not only result in cost savings but also more reductions in greenhouse gas admissions. These findings demonstrate the benefits of electrification, and this is why we believe it is so important to make an all-electric baseline the standard for the 2022 code. Moving to an all-electric baseline across building types in the 2022 code is a critical step to enable the state to achieve its climate goals. An all-electric baseline in the 2022 code will ensure that any new homes that are built with gas after 2022 are held to the same greenhouse gas limits as the efficient electrical alternative and help us achieve those targets.

The evidence of rapid climate change is abundantly clear and it is devastating. We need our state leaders to establish policies that reflect the urgency of the climate crisis. That means an all-electric code for 2022 and not delaying until the next code cycle. The CEC should use this code cycle to stop digging deeper into the hole on our dependence on dangerous fossil fuels. Putting off an all-electric baseline until the 2025 code cycle means three more years of new gas buildings and infrastructure that will need to be retrofit later at great expense, and which will lock us into decades of climate pollution. At current emissions rates a three-year delay would result in over four million additional metric tons of carbon emissions by 2030 and cost California more than one billion dollars in unnecessary gas infrastructure. We simply cannot afford this.

In addition to emission reductions, an all-electric baseline for the 2022 code will improve public health by eliminating a substantial source of indoor air pollution as we learned during last week's workshop on indoor air quality.

Building electrification will cut the indoor air pollution and eliminate the health risks caused by gas appliances.

To conclude, all-electric new construction is the only feasible path to achieving California's climate goals. And the time to make this switch is now in the 2022 code. We urge the CEC to commit to prioritizing the health of Californians and put the state on a determined path to achieve its climate goals by committing to an all-electric baseline for the 2022 code. Thank you.

MR. BOZORGCHAMI: Thank you. Dana, I'm going to unmute you, but I want to also apologize. I don't know what happened earlier, so please state your name and affiliation.

MS. WATERS: Thanks, Pierre. Can you hear me now?

MR. BOZORGCHAMI: This is Payam, but that's okey. Yes, I hear.

MS. WATERS: Thanks, Payam. Yeah, thanks everyone. This is Dana Papke Waters with the California Air Resources Board. I'm really pleased to be working with you all and really appreciate each of the presentations today covering CEC's efforts to decarbonize buildings.

I just really want to reiterate the urgency provided in several public comments today. CAR recommends advancing mandatory building electrification standards in Title 24 as soon as possible.

It is critical for California to reduce our dependence on natural gas in buildings to meet our statewide climate net quality targets.

All-electric design of buildings reduces greenhouse gas emissions by 40 to 50 percent in most cases compared to mixed fuel design. Several carbon neutrality studies indicate that aggressive building electrification is required in the near term to really put us on track to achieve our midcentury climate neutrality target.

Rocky Mountain Institute estimates that delay of the code update until the next code cycle would result in an additional three million tons of greenhouse gas emissions by 2030, which is equivalent to putting 650,000 more cars on the road. RMI also estimates that a delay would result in more than one billion dollars of unnecessary spending on new gas connection infrastructure, which may become a strain on assets in the future.

If CEC adopted an all-electric baseline for new construction in the current 2022 code cycle would help California achieve the market growth of electric appliance sales at the necessary base to achieve carbon neutrality by midcentury. While CARB is working with CEC on kitchen ventilation standards, this alone does not provide enough health benefit.

A better choice is to update to all electric and enhance ventilation to maximize health benefits. Converting to electric appliances will provide larger, more immediate and more certain public health. Pollutants from gas appliances has been linked to various acute and chronic health effects, including asthma and other respiratory illnesses, cardiovascular disease and even premature death.

Since building electrification is one of the most cost-effective strategies to meet California’s climate and air quality target and it provides important public health benefits, CARB supports advancing mandatory building electrification standards in Title 24 as soon as possible. Thank you.

MR. BOZORGCHAMI: Thank you, Dana. Kevin, I'm going to unmute you.

MR. MORRISON: Well, hi, CEC, and thank you for having this forum. I'm Kevin Morrison from Green Nevada, a grassroots organization in Morin County.

First of all, thank you for your diligent work. It is much appreciated.

I want you to know that as our city goes through the process of defining a role in fighting for environmental protections locally we look to your leadership and it makes it easier for us to favor building electrification when you lead. It's kind of like building in general. Most jurisdictions don't like it when the State mandates additional housing, but we have to build more housing and, ultimately, it benefits everyone. It's the same with electric vehicle requirements, building electrification.

Ultimately we have to do these things. They benefit all of us, but it's a lot easier for our local officials to follow your lead, so, please, if you can require building electrification, stop relying on cost effectiveness and maybe start relying on something you could call climate effectiveness as the most important criteria, that would be great. So, thank you.

MR. BOZORGCHAMI: Thank you, Kevin. David, would you like to unmute yourself and state your name and affiliation, please.

MR. McCOARD: Hi, this is David McCoard, and I'm a volunteer with the Sierra Club. You know, we can see climate change all over, so I don't need to go into detail there.

I've been following the workshop most of the day, and the conclusions from the workshop are that building electrification with electric heat pumps, PV and plus storage are viable and cost effective. We also need to include energy efficiency in the building and construction with the window design and installation.

And, so, we need all these things in statewide building requirements, and now, at least in the 2022 Title 24 update. Thank you.

MR. BOZORGCHAMI: Thank you, David. Jean, I'm going to unmute you, so please go ahead and state your name and affiliation, please.

MR. LONJARET: This is Mr. Lonjaret again from the Sustainability Commission of La Mesa.

I'm also representing SD-350, and since no one else from SD-350 has spoken I will just -- you've heard all the arguments. I will just add that SD-350 and many organizations around San Diego support total electrification of buildings as fast as possible. And what didn't make sense eight years ago, perhaps, makes sense right now. And it's clear to everyone as has been stated by many architects and other professionals.

Nobody needs to lose his job because of building electrification. We shouldn't focus so closely on costs and figures. We should take a broader approach, a step back to watch the big picture, and the big picture is a climate crisis, and the Governor knows that. And if fossil fuels are not good enough to burn for mechanical power in vehicles, they're certainly not good enough to burn enough for heat only in a building.

As far as the intervention of the WPGA, good point, but as it was stated by someone else, when the power goes out, it's not taking a hot shower that will be my problem or cooking soup. So, a house does not need gas. And there's plenty of room for nonfossil gas such as propane and methane to replace fossil gas in other applications.

Thank you very much for the opportunity and the privilege to participate in this.

MR. BOZORGCHAMI: Thank you, sir. Chris, I'm going to unmute you. Go ahead and state your name and affiliation.

MR. STRATTON: Hi, can you hear me?

MR. BOZORGCHAMI: Perfect. Go ahead, sir.

MR. STRATTON: Great. So, my name is Chris Stratton. I'm not affiliated with any organization. I'm just a homeowner and a ratepayer in the San Diego Valley of Southern California. So, I apologize for repeating what others have said more eloquently. I'll be brief.

California does not meet its climate goals by allowing the construction to be operated using fossil gas, gas in construction equipment will lock our buildings into decades of pollution and bad indoor air quality and make it more difficult and expensive when there are eventual and inevitable conversion to all electric happens.

We have recently renovated our own home to be all electric and we love living in it. We found there are superior electric alternatives to every gas appliance, electric induction ranges, heat pump water heaters, heat pumps for space conditioning. The list goes on and on.

Electrification has allowed us to significantly tighten our building envelope which was crucial in maintaining good indoor air quality during recent wildfires here, and resilience, which was commented on before, is provided by onsite battery storage.

So, for California's health and safety and to have any hope of meeting our climate goals, new construction in California must be all electric in 2020.

Thanks for the opportunity to speak.

MR. BOZORGCHAMI: Thank you, Chris. Bruce, would you like to unmute yourself and --

(indiscernible)

MR. BOZORGCHAMI: Bruce, we're having a hard time hearing you. There's some connection issues.

MR. NAEGEL: Can you hear me now?

MR. BOZORGCHAMI: No, sir.

MR. NAEGEL: All right. Go on to the next person and I'll see if I can fix the connection.

MR. BOZORGCHAMI: Sure. Sure, sure.

MR. AARENS: Hello. Hello, can you hear me?

MR. BOZORGCHAMI: Hi, Eric, how are you?

MR. AARENS: My name is Eric Aarens, and I'm speaking for the League of Women Voters of California. Thanks for the opportunity to speak.

The league has submitted a paper for inclusion in the proceedings, and it has more detail, but I'd just like to say something for the League of Women Voters of California and actually, also for the league of the United States, that is, the very concern about global warming and a rapid reduction of fossil fuel use is needed.

California now produces more electricity in the daytime from the sun and wind that the whole state can use, and the problem can be solved. And with the price of the batteries and the other storage devices coming down, California will be able to run at nighttime also.

And the faster that California can electrify itself, the faster the rest of the world will do so, too. That's because California is a leader. It is imperative that CEC electrify California as quickly as possible for the sake of lives on land and in the sea as we know it and reduce wildfires, hurricanes, and all of the other happenings that are degrading life on the planet.

And, so, please make rules that will give almost everybody off fossil fuels as quickly as possible, and so electrification of new buildings and in future years of all buildings should be mandatory. Thanks a lot.

MR. BOZORGCHAMI: Thank you, sir. Bruce, I'm going to unmute you one more time. Go ahead and see if it works better this time.

MR. NAEGEL: Hi, can you hear me?

MR. BOZORGCHAMI: Beautiful. Thank you. Please state your name and affiliation.

MR. NAEGEL: Yeah. Bruce Naegel. I'm also with the Fossil-free Buildings and with Sustainable Silicon Valley.

I'm going to talk about a couple of personal things that have come up in terms of injuries, et cetera. First off, the Mayor of Mountainview passed a reach code, and one of the motivations for it was the fact that her two children were concerned about the fact that they wouldn't have a place to live when they grew up, and that moved her tremendously and it's a concern that we all have to be aware of. We talk about, you know, the fact that future generations may not have a place to live, and that's very likely.

In terms of indoor air pollution, one of the real concerns is nitrous oxide. And the reason is, is that it significantly aggravates asthma. In fact, asthma in homes that have gas stoves is 42 percent more likely than it is in ones that are electric. So, we have a real health crisis in terms of that and, in fact, one of the building officials in another town in this area has basically told his daughter do not put in gas, put in all electric for the fact that asthma runs in their family. So, we have these situations.

One of the financial situations that's very interesting is the fact that every time we put in more gas we're going to have stranded assets, so we kind of pointed at this, but there's millions, possibly billions, of dollars of gas lines that are going to be put in that are going to have to be thrown away. So, I think that this is the right time to move forward on this. We have the tools to be able to do it. We have, you know, the technology in terms of heat pumps has grown tremendously since that time, and we should start to move as quickly as possible and make sure the 2022 code is all electric. Thank you.

MR. BOZORGCHAMI: Thank you, Bruce. Mary, I'm going to unmute you. Go ahead and state your name and affiliation, please.

MS. DATEO: Hi, Mary Dateo, Carbon Free Mountainview. We've heard many good reasons -- great reasons, actually, to adopt an all-electric code for 2022. There are no real downsides.

All electric buildings are simpler, healthier, safer and lower cost when you build them from the start.

So, I converted my home to all electric and I am thrilled with the result. However, it took a lot of planning, and it was much more expensive to convert my house than if it had been all electric from the start.

So, every year we wait we're adding thousands of homes, and, therefore, homeowners like me and landlords who are going to have to be motivated to spend considerable time and money to electrify one by one. What a waste.

By your decision you can avoid all that unnecessary effort and cost. Because of climate change we know we need to electrify. We know we're going to electrify, so why wait. There is no advantage to our state or to our citizens to delay. Thank you.

MR. BOZORGCHAMI: Thank you, Mary. Joy, I'm going to unmute you. Go ahead and state your name and affiliation, please.

MS. ALAFIA: Thank you. Can you hear me okay?

MR. BOZORGCHAMI: Sure, beautiful. Thank you.

MS. ALAFIA: Good afternoon, Mr. Chair and Commissioners. My name is Joy Alafia. I'm with the Western Propane Gas Association.

And I simply wish to provide a correction. One absolutely can use propane when the power goes out. Propane is not associated with the electrical grid, nor is it tied to any natural gas lines or the corresponding infrastructures. I just want to clarify that point, and you review the comments submitted from citizens in rural parts of our state who use solar and propane and have seen the value proposition that propane provides for resiliency.

With all due respect to the prior comment of not needing propane when there's a power outage, I beg to differ. I think a lot of customers are very happy not only to be able to take hot showers and cook food when there's a power outage, but they can also keep the lights on. They can avoid food spoiling in the refrigerator, and for those most vulnerable citizens, they can assure that they have the power to keep life sustaining equipment in operation.

As was mentioned, our industry is committed to achieving 100 percent renewable propane in California by 2030. We already have displaced 10 percent of our transportation sector, and that's effective when it translates to taking 4,000 cars off the road.

We look forward to a comprehensive conversation that incorporates renewable propane that can be used at the site to generate renewable electricity, that includes new burner technologies, that can eliminate nitrous oxide emissions by up to 80 percent and other industry advancements. This is an urgent crisis. Let's come together, have that honest conversation and deploy all clean energy solutions.

Thank you so very much for your work, and we look forward to working with you in the future.

MR. BOZORGCHAMI: Thank you, Joy. Greg Nelson, I'm going to unmute you. Please state your name and affiliation.

MR. NELSON: My name is Greg Nelson. I am a consultant and recently the sustainability project manager at LESD, and I'm still working on a few county projects.

I just wanted to make a comment on the, you know, earlier this morning CEC staff commented that they were reluctant to cut the gas cord regarding cooking in the homes, and I get that. You want widespread public support. However, the problem is that that propagates continued expansion of very powerful greenhouse gas.

And, so, maybe the answer might be instead of that having some more educational outreach, discussing the benefits of induction stovetops. You've Michelin chefs who are, you know, saying it's better than sliced bread.

There was a great presentation at the USGBC's Municipal Green Building Conference back on August 22nd. I hope you can still find it somewhere on line about the benefits of cooking with induction stoves.

So, I just wanted to say that and address that, but, also, Southern California Gas has taken a few hits here today. I know you guys are out there. And I'm going to give you one more. You guys have been -- you know, the State is currently investigating you regarding improprieties and pushing fossil fuels in the ports of LA and Long Beach. You're funding a nonprofit that's pushing propaganda in the San Gabriel Valley regarding this cooking issue. Look, we get it. You guys are in an existential crisis. You need a new Paragon Bill. And if it takes going to the CPUC and getting new regulations to do this, then so be it. You need to help California in transitioning off of fossil fuel. And you're already in all our homes anyway. Actually, I like my gas guy, very competent, very cordial, and they have a lot of knowledge, and they can help us to stop -- to discontinue fossil fuels and please stop the sabotage. Thank you.

MR. BOZORGCHAMI: Thank you, Greg. Bret, I'm going to unmute you. Go ahead and state your name and affiliation.

MR. ANDERSEN: Can you hear me?

MR. BOZORGCHAMI: Beautiful, thank you.

MR. ANDERSEN: Yeah. This is Bret Andersen, and I'm a member of Carbon Free LL Bill.

I wanted to point first to the purpose of the CEC which I read from the home page on the website to be committed to reducing energy costs, curtailing greenhouse gas emissions, insuring safe, resilient and reliable energy supply.

So, in my mind that goes along with what California officials, CPUC and CEC, have already acknowledged, basically the fact that natural gas, essentially in a house, is a weak method of powering buildings.

So, it looks to me like the CEC and the CPUC should be helping everyone avoid wasting money on an energy solution that is obsolete.

We've got electric solutions, all-electric homes, already validated on all the counts that matter in terms of safety, comfort, performance, control, emissions. We know already from the studies done that they are cost effective. Even if you were to say we want to just be efficient using our natural gas, an all-electric home is so efficient that it actually uses less gas if powered 100 percent by a gas-powered electricity plant than you would use if you were to install a mixed fuel home with gas-powered appliances. So, essentially you use less gas by building an all-electric home and providing that electricity to natural gas.

And that goes for emissions as well, so, it just seems like there's really no case to support any more investment in what would basically be obsolete infrastructure.

And I think also that in the experience that we went through supporting reach codes, getting Palo Alto to adopt one, helping many other area cities with the Fossil-Free Buildings Campaign, that there's a lot of complexity and uncertainty out there about this transition. And we really look to the agencies like the CEC to kind of clear the path of it. And we use that uncertainty based on the science and the knowledge that is state of the art today.

So, if we want consumers, cities, investors and suppliers to invest in the training learning about these electric solutions which are commonly used around the world already but just not available here yet, then, you know, we need to say we've decided this is the path forward. We've acknowledged that electrification is the path forward, and that we just -- we won't allow or support any more investment in an obsolete pathway. And we need to help our consumers and cities to simplify this decision and get --

MR. BOZORGCHAMI: I'm sorry, Bret, I have to mute you. I have to, to give others time. Thank you.

MR. ANDERSEN: Okay, okay. Thank you very much.

MR. BOZORGCHAMI: Brad, I'm going to unmute you, sir. Go ahead and state your name and affiliation, please.

MR. JACOBSON: Okay, can you hear me?

MR. BOZORGCHAMI: Perfect. Thank you.

MR. JACOBSON: My name is Brad Jacobson.

I'm a practicing architect in California. I have personally led the design team in at least 10 all-electric buildings, including a number of buildings currently operating in net zero energy.

In our practice we found it cost effective and reliable to go all electric on a wide range of project types. In fact, generally it's less expensive to go all electric due, in part, for new construction to require that we can only install one energy infrastructure service instead of two.

We're currently strongly advising our clients to reduce their own risks and long-term costs by going all electric now to avoid potentially future disruptive and costly retrofits.

I wanted to especially to address a comment by a representative of the propane industry earlier who claimed that relying on a single energy source is less resilient. We have to stop this kind of misinformation. This is simply not true today as all gas appliances today require electricity for ignition, control, motors, fans, et cetera. Using gas simply does not improve resilience.

We need bold action today, especially code changes that mandate all electric new construction, and we need the CEC to support implementation of the zero code in the upcoming code update. Thank you.

MR. BOZORGCHAMI: Thank you, Brad. Josie, I'm going to unmute you. Please state your name and affiliation, please.

MS. GAILLARD: Sure. Can you hear me?

MR. BOZORGCHAMI: Perfect. Thank you.

MS. GAILLARD: So, my name is Josie Gaillard. I'm a commissioner for Menlo Park's Environmental Quality Commission.

For background, I have an MBA and I started my career in the solar industry when California was catalyzing the solar industry globally.

So, thank you for your work. The code that you seem to be proposing today, from my read of it anyway, will prevent the State from achieving carbon neutrality by 2045 simply because gas appliances installed new in 2025 will still be functional in 2055, which is 10 years beyond the State's zero carbon goal.

As a commissioner at city level we are

taking the State's goals seriously and really bending over backward to make our local code -- our reach codes align with the State goals.

So, I guess my question is why is CEC not doing the same or doesn't appear to be doing the same? The meeting is giving me the impression that CEC does not feel obligated to align policies with the State's greenhouse gas goals and in the same rigorous way.

For example, I wonder is anyone modeling just how much high GWP methane will be emitted in 2045 by equipment that's permitted in this code that you're proposing, and how will that impact the State's greenhouse gas inventory in 2055?

So, if CEC is not obligated to align its policies with the State's greenhouse gas rules, who is responsible for that? Thank you.

MR. BOZORGCHAMI: Thank you, Josie. Brad, I'm going to unmute you. Go ahead. State your name and affiliation.

MR. JACOBSON: I already spoke. Thank you.

MR. BOZORGCHAMI: Sorry, sorry. Okay. Tom, I'm going to unmute you. Go ahead and state your name and affiliation, please.

MR. KABAT: Hello. I'm Tom Kabat. I'm a longtime utility planner on the gas and the electric utilities at Palo Alto. I'm also an environmental quality commissioner in Menlo Park, working alongside Josie Gaillard, working on trying to do what we can at the local level to help the State reach its climate targets, trying to advance reach codes, and we would really appreciate it at the city level if the CEC would adopt an all-electric base code. That means that we won't have to go through the hard process again to do a reach code. We can direct our attention to the even harder problem of taking on existing buildings and helping get the equipment converted in those. And it is a much harder problem.

And, so, I urge you to think outside the box about how not to write a code that allows people to continue to invest assets into the gas system and having obsolete equipment. It is so expensive to convert.

So, please look at that. Please, if you -- you know I see the rigor, the engineering rigor of the economic analysis. If it helps, please include the retrofit costs partway through the cycle of the building life and see how the economics look then and see if allowing the gas path really is that economic. I think you'll find it's not.

And, so, you know, we're recommending simple fixes, but if you want the complex one it is to include the cost of retrofitting in there. It's also to look beyond the building at the upstream leakage of methane. You look already beyond the building at the upstream impacts of other things, like you're including things beyond your jurisdiction like the way utility rates are set and how large they are.

You include the impacts of utility rates in your analysis. Include the impacts of gas leakage upstream of the building. It's three to eight percent. And you will find that, you know, there's no more gas that makes any sense for California. It is all counterproductive and wastes our money compared to where we have to go.

We have enough obligations on our plate in the future fighting fire seasons, fighting sea level rise. We cannot also be stranding gas assets, then we give people bills five times higher than the original construction cost to do the retrofitting. And to make a slight agreement with the propane people, I do have propane in my camp stove as my backup for when the gas system went off. I definitely needed it before I got my induction stove, and I might need it some day in the future if we have a power outage. But propane camp stoves are a good option for producing resilience.

Thank you very much and good luck on the thinking outside the box.

MR. BOZORGCHAMI: Thank you, Tom. So, that's pretty much all the raised hands I've seen, and I don't see any more comments coming on the question and answer. So, I'm going to open it up -- we've got one more. Ann, I'll unmute you, and go ahead and unmute yourself and state name and affiliation.

MS. AMATO: Can you hear me?

MR. BOZORGCHAMI: Yes, we can.

MS. AMATO: Okay, great. Thanks. I'm Ann Amato. I'm a Carmichael, California resident. I'm a member of the Sacramento Climate Coalition, and I'm going to move because they're blowing leaves outside. Oh, my gosh, everything happened in one day.

I don’t want to repeat what other people have said. I have to turn on a light here. But we are -- the climate tipping points are already active, and locally, let alone globally, we are being smacked in the face with the evidence of climate change, heat waves, drought and wildfires, and as we speak, Hurricane Delta is charging the Gulf Coast. And, clearly, we have a climate emergency which is why I’m asking for bold action on your part and implementation of the mandatory clean electric technology as soon as possible.

Encouraging electric construction through compliance credits is unlikely to result in any significant shift of new construction practices leading to zero carbon, electric construction. Without bolder action we will continue to see gas buildings and infrastructure which locks us into decades of climate pollution.

We cannot afford for a livable planet and for housing affordability in California to build hundreds of thousands of new homes and millions of square feet of commercial space fueled by gas for another three years.

I’m asking you to join the many local

California jurisdictions that have already adopted local codes that require electric new construction. I would like to see the State of California to continue to be a leader and take similar action. As a state we need to lead the way for the sake of our children and our grandchildren, and we need to take action now. Let's work together. Let's give our kids and our grandkids a future that is livable. Thank you.

MR. BOZORGCHAMI: Thank you, Ann.

MS. AMATO: Thank you for your time.

MR. BOZORGCHAMI: Thank you, Ann. So, this is -- I wanted to -- I brought this website up, this link. We're going to be posting all of the presentations on our website, on our docket by tomorrow. Unfortunately, it's past 4:00 o'clock and our docket folks are probably gone for the day. So, please submit your comments, concerns relating to today's presentations that you've heard and the numbers that you've seen and we will look into these and get back to you folks.

We are scheduled to have another workshop on the measures that are going to be proposed for the standards for 2022 on November 19. So, within about 10 days prior to the workshop there will be a notice which will be submitted, which will be presented to everyone or listed where we will give you all the reports and all the information you need for this workshop.

With that I will conclude today's presentations. Thank you.

(Whereupon the workshop was concluded at 4:27:07 p.m.)

CERTIFICATE OF TRANSCRIBER

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 and a disinterested person.

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.

I certify that the foregoing is a correct transcript, to the best of my ability, from the electronic sound recording of the proceedings in the above-entitled matter.

_____________________ October 15, 2020

Linda D. Rinaldi