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BEFORE THE

CALIFORNIA ENERGY COMMISSION

In the matter of,	)
	) Docket No. 19-DECARB-01
Draft Building Decarbonization	)
Assessment	)
	)

DRAFT BUILDING DECARBONIZATION ASSESSMENT

REMOTE ACCESS ONLY VIA ZOOM

FRIDAY, MAY 21, 2021

11:00 A.M.

Reported By:
Martha Nelson

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PUBLIC COMMENT

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P R O C E E D I N G S

MAY 21, 2021 11:03 A.M.

MR. ROSALES: Good morning, everyone. Welcome to the Commissioner Workshop for the AB 3232 Staff Building Decarbonization Assessment.

Hello, my name's Heriberto Rosales, I'm an energy specialist with the California Energy Commission. I'll be facilitating today's workshop.

Commissioner and leadership joining us today on the virtual dais are Chair Hochschild who will be joining in a minute, Commissioner McAllister, Commissioner Gunda, all with the California Energy Commission. In addition, we've got Commissioner Rechtschaffen from the Public Utilities Commission joining us today.

I'd also like to welcome our partners from the California Air Resources Board and the Public Utilities Commission, their collaboration on this project has been really instrumental. I want to thank them all and recognize them.

Okay. A few housekeeping items before we start the first presentation. As a reminder to all attendees and stakeholders, this workshop is being held virtually consistent with Executive Orders N-25-20 and N-29-20 in

recommendation of the California Health, Department of Public Health encouraging physical distancing to slow the spread of COVID-19. The public can participate and observe the workshop consistent with the direction of the executive orders.

This workshop is being recorded. A full recording and full transcript will be posted on the Decarbonization Docket 19-DECARB-01 and the CEC's Building Decarbonization Assessment webpage.

The Building Decarbonization Assessment resources and materials are docketed under the same proceeding number, 19-DCARB-01 and may be accessed on the Building Decarbonization webpage as well.

Brian, next slide.

This is today's agenda. During the workshop, staff will -- staff will brief you on the draft staff proposal or respond to your questions and encourage everyone to submit written comments by or before Friday, June 4th.

This workshop contains three staff presentations. The first one will be an overview of the draft assessment and its components. The second one will be an explanation of the scope of the Building Decarbonization Assessment. And the last presentation will be a dive into the Building Decarbonization to

narrow impacts included in this assessment.

After each staff presentation we will pause for public questions and comments. We advise -- we will advise when the Q&A sessions are starting and ending that way folks can participate however they'd like.

After the presentations and the public comment period, the CEC Commission may provide closing remarks and then we will adjourn the workshop. At the end of each presentation and again at the end of the workshop, we do have a set aside time for some public comments.

So thank you for your time and your participation today.

Commissioner McAllister, if you're ready, you may start with opening remarks.

COMMISSIONER MCALLISTER: Okay. Well, thanks, Heriberto, I appreciate that.

Welcome, everyone. I'm really excited about the -- this report of the draft report that's out for AB 3232. I really want to just communicate that this is the product of a long effort at the Energy Commission that has taken a few twists and turns as we really sort of appreciated how important it was and then also considered the analysis and made some changes to it along the way and really ended up, I think, with a very robust product. And really interested in what folks

have to say about it today.

Obviously, buildings are a huge part of the solution that can be, that must be a huge part of the solution for decarbonizing our state, our economy, and our energy systems. And we know that -- that it's a relatively complicated sector compared to, you know, the electric sector is actually decarbonizing relatively rapidly and it's helping us get there. And it's something now we can rely on for decarbonizing energy sectors more broadly.

And so that comes across in the report and really looking forward to the staff presentations and the Q&A and the public comment today because I think that's going to be critical to incorporate into the final draft and get it to the legislature here in the next couple of months. So, this is kind of a milestone.

I want to just put in a little bit more context. In the IEPR this year, one of the main thematic tracks is also building decarbonization. Now this workshop today is not part of the IEPR but on next week, next Tuesday, we are having, the 25th, we're having the opening workshop on building decarbonization within the IEPR and so really looking forward to that.

That will be a broader treatment of the topic and really want to start, I think, talking more

concretely and pragmatically about solutions at that time and how programs and how we might be making proposals to really solve, to crack the various nuts that need to be, you know, worked out to really attack this sector.

So, we know a lot. We know we have a lot of good technologies to decarbonize the building sector and we need to figure out how to really scale them up as rapidly as possible. So, there are a lot of good minds thinking about this, including here at the Energy Commission, but certainly out there in the world doing great projects. And from, you know, contractors and local governments through to the manufacturers and the builders and everyone else. You know, we really are needing a team effort here, over many years, actually.

I want to thank Mr. Rechtschaffen for being here from the PUC. The collaboration on this report and just on so many fronts these days, it's very close between the Energy Commission and the PUC and also on various themes with the Independent System Operator, with ARB, we've got four agencies really are working together well. And that's important because we have some big problems that we need to -- we need to solve.

Also, I would like to thank staff, actually. This was a team effort across two divisions at the

principally, at the Energy Commission. It's kind of an example of the matrix organization that the Energy Commission is building around some of these analytical topics that really do integrate technologies and conversations that typically sort of fit better into one division that were more autonomous solely on this is the age of integration.

And so the Energy Assessments Division, and I'm really glad to have Commissioner Gunda here with us who leads that -- that division, really drove the analytic piece of this. And then the Efficiency Division pulled it together and really, I think, much of the document including the policy context and many of the solutions that we're talking about, they're responsible for those.

So, I just want to acknowledge Michael Kenney and Nick Janusch for leading sort of in those two divisions, respectively, Efficiency and Assessment and Ingrid Neumann, Mike Jaske. Heriberto, thank you too, he was a project manager for this, sort of pulling a lot of threads together. Jen Nelson, who leads our Existing Buildings office. Matt Coldwell, who leads our Demand Analysis office. They really were the two office managers that helped marshal all the resources and get this done. And then the two Division Deputy Directors, Mike Sokol of the Efficiency Division, and Aleecia

Gutierrez in the Assessments Division.

The analysis I think is very robust. I -- we -- you'll hear how -- sort of how it ended up. But I think it's, you know, taking two different perspectives from what decarbonization actually means was a good approach. And so on the one hand we have paths, depending on how you define it, this problem looks pretty different. And so, we know that there's a steep curve to decarbonize, invest in technologies, to shift marketplace, to heat pumps, and this report lays that out I think pretty starkly. So, a number of policy initiatives I think can help work -- and work together to make that happen.

So rather than get to the punchline, I want to let staff do that. But I think this is just to say that this has been a big team effort and I think we all know that building decarbonization is central to our climate response.

The last thing I'll say is that it's not just about the putting in of electric technologies or the efficiency piece of this, it's also about the load flexibility. So buildings not only need to decarbonize, they need to be good citizens on the grid. And that goes well together. Those two things go well together. They really are still at the top of the loading order in California and so we shouldn't forget that.

There's a lot of untapped potential for load flexibility and there's more and more effort going into that. So very happy about that. And, you know, the end of the day, we need to end up with an affordable decarbonized and reliable energy system or group of systems in the state.

So, with that in mind, let's think about buildings. And I'll pass the microphone to Commissioner Gunda and then Commissioner Rechtschaffen.

Thanks everybody for being here.

COMMISSIONER GUNDA: Thank you, Commissioner McAllister.

I'm so glad to be here as well. I think this is an incredibly important topic and thank you for your opening remarks. And I can't agree with him more.

I also want to start by thanking the staff on their incredibly hard work and kind of trying to weave a number of different pieces together, the public comments together as they stitched the analyst for the report. So, I'm very grateful for their openness and thoroughness on this issue. As you pointed out, it's been a pretty long effort and I appreciate the persistence in making sure we completed this effort.

I also wanted to take a moment to thank you, Commissioner McAllister, for your leadership and

guidance in this process, especially given in decarbonization. You know, I think you have been a leader over the last decade in thinking through, you know, how we decarbonizing the buildings. Whether we called it efficiency, whether we called it load management, whether we called it something else, I think your thorough leadership and your steady hand has been vital for the state of California and more broadly the country. So just thankful for your leadership and guidance throughout this process.

You know, I just want to reiterate a couple of points I think we all know but I think it's good to set up the context here. You know, as Governor Newsom mentions many number of times, we are in a climate emergency and kind of in a meeting of challenge of climate change. And, you know, going through this process of decarbonization in an equitable fashion over the next couple of decades is not going to be easy, it's going to need a lot of partnerships, a lot of open and trusting conversations, and without us as being able to construct analyses that become the underpinning of policy decisions that is robust, transparent, and diverse.

It's hard to do that meaningfully so I really appreciate this process and the venue and way and we

have members of stakeholders joining to provide their diverse opinion in that spirit. I just want to thank the 194 participants I'm seeing on the call here today for being -- taking the time to really be a part of this conversation and providing us useful and sometimes critical feedback to enhance our analysis to really help address the climate change and specifically in this topic of building decarbonization in a meaningful matter.

So, I know there's plenty to do. And I know Commissioner McAllister is going to work on the building decarb as a core trajectory this year in the IEPR process. I'm very much looking forward to the work.

Thank you everybody for take -- for putting this workshop together and everybody in attendance.

COMMISSIONER MCALLISTER: Okay. Commissioner Rechtschaffen, did you want to say a few opening comments?

COMMISSIONER RECHTSCHAFFEN: Yes, I did. Thank you very much --

COMMISSIONER MCALLISTER: Great.

COMMISSIONER RECHTSCHAFFEN: -- Commissioner McAllister.

And it's a pleasure to share this stage with you and Commissioner Gunda, our colleagues at CARB, and

Chair Hochschild if he -- if he comes, when he comes. And I very much appreciate what you said and share the spirit of unprecedented collaboration among the agencies.

You've been a longstanding leader, Commission McAllister in all these areas, you continue to do so along with your colleagues and it's a pleasure to work with you as we sort through these difficult issues. As you said, the path forward is not straightforward but it's complex and challenging and exciting and important.

Decarbonization in the building sector presents crosscutting issues where our work at the PUC will be informed by AB 3232 and other analyses you're conducting at the Energy Commission.

Just wanted to take a couple of minutes for those of you who may not be familiar with it to talk about the PUC's work in this area to give some context. So, a big point of what we've been doing is to develop incentive programs for building electrification. And collectively through various programs we've earmarked, bid out to close a half billion, half a billion dollars, four hundred forty, forty or fifty million dollars between now and 2024 for various initiatives.

We, of course, have been working with the Energy Commission to implement the BUILD program for all new --

for new all electric low-income residential buildings and we have another pilot known as TECH that will try to jump start the market for heat pump technology through market transformation strategies.

So that's one piece of what we're doing. We have a dedicated proceeding to address building decarbonation -- decarbonization challenges and my office has been working very closely with Commissioner McAllister's office on this initiative. We hope and intend to achieve in that proceeding a policy framework for building decarbonization to give us some structure and framework for what we're doing more broadly beyond the immediate incentive programs and other specific issues.

Of course, building decarbonization and transitioning away from our reliance on gas are part of the same set of transitional issues that we as a state will face as we move toward our decarbonization goals. All of the agencies, all four of the ones that Commissioner McAllister mentioned recognized the need for a plan to phase gas transition and we're working on how we best do that, how we think about long-term strategy while in the meantime ensuring reliability and safety. So, you know, that's part of the effort and I'm the lead on gas -- a proceeding at PUC that looks at gas

transition issues.

Finally, the last thing I want to highlight is that building electrification is a very serious equity challenge. Low-income households may not be able to afford the upfront cost of electrification. They may be more heavily challenged as electricity bills rise, as we electrify other uses, including (more EVs. We recently released an affordability report that looks at the bundle of utility services that consumers face from broadband, water, electricity, and gas. And a significant portion of the state, over 10 percent where low-income households spend one-third or more of their disposable income on utility bills. That's an extraordinary amount. Obviously poses serious challenges for us as we push forward on electrification.

We know also workers in the gas industry will be impacted by the gas transition of building decarbonization. So, it's very important that we consider these real world and equity impacts. Very big topic.

One step we are taking at the CPUC, we've opened a clean energy financing proceeding where we're looking at developing financing tools such as on-bill repayment and on-bill tariffs. Other sustainable funding sources, which segments to target so that we make this transition

more affordable for low- and moderate-income consumers.

Again, thank you for having me. Thank you for hosting this. I very much look forward to hearing the staff presentations and the discussion today.

COMMISSIONER MCALLISTER: Thank you very much, Commissioner Rechtschaffen. And I can't agree enough with your comments about equity and also those of Commissioner Gunda.

I think any solution that really is going to be serious has to in many ways begin with low-income consumers and really focus on disadvantaged communities. And really, you know, segmented in a way that it does help move the market at the same time that it attacks the pieces of it that are in most need.

And so I think we can do both and it's going to take a broad conversation including what the legislature and the administration to try to figure out how to prioritize that approach because I think there is an emerging consensus that we really do have to start there. So thanks for those comments.

And I'll pass it back to Heriberto. I believe we're going to start with staff presentation from Michael Kenney.

MR. ROSALES: Thank you, Commissioner. Thank you all for your remarks.

Michael, if you are ready, you can start.

MR. KENNEY: Okay. Thank you all. And good morning. I am Michael Kenney, an energy specialist in the Efficiency Division for the Energy Commission. And today I'm presenting an overview of the Assembly Bill 3232, Draft Building Decarbonization Assessment.

The work presented today represents about two years of staff effort and is an important first step in understanding the state's potential to meet building decarbonization goals by 2030 and beyond.

So, Assembly Bill 3232 tasked the Energy Commission with assessing potential to reduce greenhouse gas emissions from residential and commercial building stock by at least 40 percent below 1990 levels for January 1st, of 2030.

The Bill also requires the assessment to consider a few other elements. Evaluation of the cost per metric ton by producing a carbon dioxide equivalent from residential and commercial building stock relative to other statewide greenhouse gas emission reduction strategies.

The cost-effectiveness of strategies to reduce greenhouse gas emissions from space heating and water heating in both new and sustained residential and commercial buildings. The challenges associated with

reducing greenhouse gas emissions from low-income housing, multifamily housing, and high-rise buildings, load management strategies to optimize building energies in a matter that reduces greenhouse gas emissions, and the potential impacts of emission reduction strategies on ratepayers, construction costs, and greater liability.

Assessing the impacts on greater liability, the Commission also needed to account for both the 2019 building energy efficiency standards requirements of solar energy systems on all new single family and low-rise residential dwellings to increase load and impact on electrical infrastructure due to transportation electrification.

So, throughout the presentations today after mine, you'll hear from staff about how these elements were included in the assessment and how some will need to be addressed in upcoming Integrated Energy Policy Reports.

So, California has around 13.7 million residential units and well over 7,300 million square feet of commercial space. By 2030, there will be hundreds of thousands of new homes and millions of new commercial square footage.

This report highlights the importance of

buildings to advancing state's greenhouse gas reduction and mitigation policies. As currently, about 25 percent of all greenhouse gas emissions can be attributed to buildings. (Indiscernible) emissions from off-site electricity generation, on site field combustion, refrigerant leakage, and behind-the-meter gas leaks. In focusing only on the on-site or direct emissions for buildings, their contribution is around 10 percent. So buildings make up a significant portion of emissions in this state yet there is currently no coordinated plan to decarbonize or targets for reducing greenhouse gas emissions.

Because buildings are responsible for 25 percent of all emissions from a system-wide approach and responsible for 10 percent of all emissions from a direct emissions approach, the Energy Commission assessed the 1990 baseline using both approaches. The 1990 system-wide baseline is equal to 124.1 million metric tons of carbon dioxide equivalent. This dropped to 79.9 million metric tons of carbon dioxide equivalent as of 2018.

The 2030 target under this approach in the 74.4 million metric tons of carbon dioxide equivalent leaving 5½ million metric tons of carbon dioxide equivalent to reduce by 2030. And this information is

shown at the table at the bottom of the slide on the first row.

The 1990 direct emissions baseline is equal to 54.4 million metric tons of carbon dioxide equivalent. And as of 2018, the direct emissions were slightly higher at 54.7 million metric tons of carbon dioxide equivalent. The 2030 target under this approach is 32.6 million metric tons of carbon dioxide equivalent which leaves 22.1 volume metric tons of carbon dioxide equivalent to reduce.

To assess the greenhouse gas reduction potentially buildings, staff identified seven major strategies through which the reductions can occur. These strategies include building electrification, electricity generation, decarbonization, energy efficiency from electricity, gas, and envelope efficiency. An important role also played by codes and standards for homes and appliances. Refrigerant conversion and leakage reduction, distributed energy resources which at this time are primarily through rooftop solar and battery storage. Decarbonizing the gas system using renewable gases in place of fossil gases and demand flexibility which at this time primarily assessing as load shifting. So, using these strategies, staff assessed several greenhouse gas

reduction scenarios which will be presented in more detail later today.

So, to ensure to require greenhouse gas reductions from buildings, the state will have to address a wide array of challenging variables. So, staff researched and qualitatively assessed how these variables impact building decarbonization efforts. The issues at hand can be broadly grouped into two categories: Customer and consumer impacts, and building and technology impacts.

So, customer and consumer impacts are those that inhibit participation and decarbonization efforts at the individual level. This includes the availability of project financing, how programs are designed, scheduling retrofits in multifamily and commercial spaces, the cost of retrofitting existing buildings, consumer awareness and preferences, especially related to electric technology, the possibility of utility bill increases, and existing programmatic and regulatory restrictions to decarbonization, the ongoing training of a clean energy workforce, and the dueling interest of tenants and owners in buildings.

Building and technology impacts are physical or technical limitations that prevent decarbonization progress. Variables that need to be considered include

the age of the building, which may dictate the amount of work required to decarbonize. The current new construction practices that may prevent quick implementation of decarbonized buildings. The availability and cost of global warming potential or refrigerants and heat pumps. The available and cost of renewable gas in the building sector. The scale on which electric panel upgrades are required in existing buildings. And the availability of fast reliable broadband internet, especially in rural and low-income communities.

So moving on to some results from the assessment. We're looking at the results of the various scenarios. So starting on the left, we see incremental gas energy efficiencies followed by four different electrification scenarios, a renewable gas scenario, incremental electrical energy efficiency, incremental rooftop PV, and accelerated renewable electric resources.

You also see two horizontal lines across this figure. The red line represents a system-wide baseline goal. Remember that includes electricity generation emissions, on site fuel combustion, refrigerant leakage, and behind-the-meter methane leakage. This means if we were measuring success relative to the system-wide

baseline, then a successful scenario must avoid 5½ million metric tons of carbon dioxide equivalent by 2030. We see that each scenario achieves this goal assuming the success of HFC leak reduction efforts mandated by Senate Bill 1383 which also falls along the same 2030 timeline.

So, the patterned region on top of each bar and that kind of hashed lines presents the success of Senate Bill 1383 which is equivalent to 7½ million metric tons of carbon dioxide equivalent by 2030.

The horizontal black dash line which is equal to 22.1 million metric tons of carbon dioxide equivalent is the goal that must be achieved if scenarios are measured relative to a direct emissions baseline.

We can see that only the aggressive and efficient aggressive electrification scenarios with assistance from HFC reduction achieve that 40 percent reduction.

Moving on now to some cost results. The figure shows the total net cost and the cost per metric ton of each scenario on the X-axis. We see the same scenarios as described on the previous slide. On the Y-axis, we have the total net cost and the cost per metric ton. So, energy efficiency and rooftop PV scenarios show negative total net cost whereas electrification

scenarios and renewable gas scenario show positive total net cost. The cost per metric ton is also negative for the energy efficiency and rooftop PV scenarios while there is a positive cost for metric ton for electrification and renewable gas scenarios.

These results support what we already know that energy efficiency is cost-effective. And the total net cost for rooftop PV reflect the current energy metering structure.

Electrification scenarios have costs ranging from $39 per metric ton up to $142 per metric ton. The most expensive scenario that we estimated was the renewable pipeline gas, 20 percent of that gas being renewable by 2030 at $343 per metric ton. Cost for metric ton and total net cost of accelerated adoption of renewable energy were not calculated in this assessment.

So, moving on, I'm going to walk you through the conclusions that were drawn based on the qualitative and quantitative portions of the assessment. More details can be provided during the Q&A session following this and you'll hear more details as well in the presentations to follow.

So first and foremost, based on this analysis, California is on track to achieve a near 40 percent emission reduction in residential and commercial

buildings by 2030 when looking at a system-wide baseline. Aiming for a higher greenhouse gas reduction target for 2030, we would put California buildings on a more aggressive path to reaching 2045 climate goals.

We'll also note that newly constructed buildings have the lowest decarbonization costs and that the energy code will continue to advance efficiency in those newly constructed buildings. However, reducing greenhouse gas emissions in existing buildings will require coordinated efforts and large investments.

When planning these investments, equity considerations are paramount. Regulators, program implementers, local governments would need to collaborate with utilities, tribal governments, building owners, workforce training organizations, and community groups.

Decarbonization initiatives must also directly involve environmental justice communities and reflect their needs and priorities. Continuing the conclusions of assessment as -- found that efficiency efforts provide emission reductions most cost-effectively.

Efficient electrification defined as replacing all electric appliances with the most efficient technologies available can achieve the greenhouse gas reductions in buildings. Additionally, staff found that

an information campaign to familiarize consumers with electric appliances as the use of electric and uses grow is needed and a loss of important to understand and document any reliability impacts due to increased electrification.

Staff also conclude the success of an existing refrigerant leakage reduction policy is essential to achieving building decarbonization. The assessment concludes that the role of the gas system in decarbonizing buildings needs further research and the role incentives play in adding new gas infrastructure for buildings must be reviewed.

California must continue to expand and train this clean energy workforce. This ongoing effort in the state discussed in this report and in the joint agency Senate Bill 104 both make it clear that meeting the state's 2045 climate goals depend upon the state having a strong clean energy workforce. Building decarbonization efforts should also work in harmony with the state's response to the ongoing housing crisis.

So, following the workshop here today after all comments are received, Energy Commission staff will begin addressing comments and making edits to the draft assessment. The deadline for comments is June 4th, two weeks from today. Once comments are received and

updates are complete, the final version will be published and will be presented at an Energy Commission business meeting for consideration of adoption. If adopted, the assessment will be delivered to the legislature likely sometime during December 2021. The CEC will continue to update and expand parts of the assessment in the 2021 IEPR.

So, with that, I will take any questions that have come up. Thank you.

MR. ROSALES: Thank you, Michael.

Brian, can you go to Slide 3 before we start the Q&A?

And Michael, while we wait, there's a question in the chat box regarding Slide 10, if you could take a look at that.

MR. KENNEY: Okay.

MR. ROSALES: Great. Let me -- let me walk the public through the Q&A session before we start getting questions.

So as a reminder, the public -- this workshop is being recorded. There is a court reporter present recording the workshop and will produce a transcript at the end. Recordings will be posted to the docket and all statements communicated today will become part of the public record. All attendees will be muted during

the presentations.

So reading comments, we encourage attendees to use and type them into the Zoom Q&A before or during each Q&A session. So, you can start doing that now. Our team will review your questions and respond to them in real time where appropriate or (indiscernible) during the Q&A sessions.

For live verbal questions or comments online, use the raise hand feature during any of the Q&A sessions and we will open your line so you can speak. And then just remind everyone if you could provide your name and organization before you start your live comments.

If you are calling by phone today, please also use -- make sure you push star 9 and the host will open your line to speak. And then push star 6 to mute and unmute yourself.

And just so you know, we will take questions from folks online first and then we'll move it to auditory. So, anyone on the phone, we'll take those questions after that.

So, our team will review questions and respond to them in real time. Once we have completed all the written questions, we will open the phone lines for oral questions. So I invite anyone who has questions, please

raise your hand and we will unmute your phone.

Okay. We have a few questions here. Thank you for submitting your questions. So let me start with -- Michael, if you're ready, I'll read out the first question to you. And excuse me if I mispronounce their names.

From Calum Chong (phonetic). Slide 10, does the first bullet only refer to system-wide scenario or both system-wide and direct emission scenarios?

MR. KENNEY: So that our first -- the first bullet on Slide 10, if -- so the on track for nearly 40 percent reduction by 2030 --

COMMISSIONER MCALLISTER: Could you pull up that -- could you pull up that slide, please? Just so people know what's being asked.

MR. KENNEY: So the on track for nearly 40 percent reduction by 2030, that refers to a system-wide based on approach for call on the prior slide. So, the red line which is the system-wide approach, nearly all of our scenarios get there due to the fact that California is very close to reaching that level by 2030. The direct emission is a much loftier target by 2030.

MR. ROSALES: Thank you, Michael.

I'll go to the second question now. It's from an anonymous attendee. Again, I encourage everyone to

type their name and also state organization if they can, it's very helpful for the record.

But the question is: Will the CEC produce a building decarbonization forecast?

Do Commissioner McAllister or Commissioner Gunda care to touch on this?

COMMISSIONER GUNDA: Yeah. Thank you. I think the answer is yes in the sense that we are developing fuel substitution forecast which is also called (indiscernible) fuel substitution cases. So those are the cases we are going to work on this year, continue to better the methodologies. Along with that, we're also thinking through how best to gather up scenarios beyond the forecast. So, the answer is yes.

COMMISSIONER MCALLISTER: Yeah, not much to add but we already have done energy efficiency, behind-the-meter efficiency forecasts, additional achievable efficiency, and then for the first time, the forecast will include fuel substitution forecast. We already did also behind-the-meter solar forecast all of which, you know, all of those take the gross demand and basically subtract off of them to get met demand. And then, yes, so translating all of this over to carbon is definitely part of the MO at this point and moving forward.

And we're also doing a 15-year forecast instead

of just the normal 10-year forecast to get us out to 2035 which, you know, is also where some of the other goals of this state fit, you know, where they land even though this one is by 2030.

MR. ROSALES: Commissioner McAllister, thank you. Commissioner Gunda, thank you.

Going on to the third question here. Do the system-wide emission include gas leakages associated with delivering gas to buildings? If not, why?

Michael, do you -- can you touch on this one?

MR. KENNEY: Yeah, I can -- I can briefly and if others on the panel wants to jump in as well.

So, it does not include gas leakage those considered upstream of the buildings. And it's not included in the system-wide or direct emissions baseline. And there was none included partially due to some boundary conditions we're drawing and the uncertainty around what would be the impact on the actual, you know, amount of gas leaked in the broader system just due to buildings. So yeah, it's something that we will continue to explore but was not included in this.

MR. ROSALES: Thank you, Michael.

So again, we've got some questions coming in. Again, I encourage anyone who wants to provide a live

question to just raise your hand and we will take the question live.

I will -- I'll continue to the next question here. This is from another anonymous attendee in terms of the name. Can someone provide a source for the statistic that one-third of household income for low-income customers use for the utility bills. I'm not sure I heard that correctly.

COMMISSIONER RECHTSCHAFFEN: I can put something in the chat. What I was referring to is a report that the PUC recently issued on affordability of utility services using new affordability metrics that we developed and it shows the variation and affordability among regions in the state and among different income classes. And as I said, about 11 percent of Californians pay bills. That for them, the utility services combined represent one-third or more of their disposable household income.

I'll put a link in the chat room or the Q&A room, whichever is easiest so that you can follow up on that.

We also have an affordability page on the PUC's website that you can follow up on but I'll make sure to post that.

MR. ROSALES: Thank you, Commissioner, I

appreciate that. Thank you for answering that question.

I'll go to the next question here, we're getting few coming in now. And thank you for staff on answering those. So, we'll move over -- in the Q&A, we're moving answered questions over to the answered column.

So, there's a few more open questions. The next one is from Calum Chong. System-wide scenarios show that California's close to AB 3232 target minimal electrification efforts. Does direct emission scenario ask for aggressive electrification which costs a lot more. Does CEC have a position of which baseline scenario should be used to address 3232 targets?

Michael, you're on the line if you wanted to provide a -- address this one real quick?

COMMISSIONER MCALLISTER: Actually, I'll step in and address this one. This is Commissioner McAllister.

So, the legislation asked -- the legislature asked the Commission to tell them what a trajectory would look like to get 40 percent below. The legislation actually basically mentions both of these possible baselines and so that's why we took this approach. And the -- it's really, the report back to the legislature will lay all this out for them. And then we will likely have a dialogue but the legislature will see if they want to direct a slate of programs,

investments, and that sort of thing working together with the governor's administration to, you know, adopt one of these scenarios or just target, you know, programs that this report lays out or some hybrid of them.

So I think this really is an informational report to the legislature asked by AB 3232 or requested by AB 3232 and the policy decision, actually, based on the information we're giving the legislature will be theirs.

MR. ROSALES: Thank you, Commissioner McAllister.

I want to remind some of the --

COMMISSIONER MCALLISTER: One other --

MR. ROSALES: -- some of the (indiscernible) -- go ahead.

COMMISSIONER MCALLISTER: One other -- actually, the, so, you know, Commissioner Rechtschaffen is on with us now and the PUC has, you know, a number of initiatives that intercept with this analysis. And, the Air Resources Board does as well. And so, they are beginning a process of their scoping plan. And so, this information we're already in dialogue with them of how this analysis can be helpful with them for including these scenarios and potentially others in the scoping

plan.

So the technical underpinning that's been created for this report is intended and I think will be useful for a variety of policy development activities both here at the Commission and at the other agencies, you know, meant to inform the actual policymakers which are the governor and the legislature.

MR. ROSALES: Thank you. Thank you, Commissioner McAllister.

Matt, do you -- Matt Coldwell, are you still on the line? Feel free to answer a question live if you'd like.

MR. COLDWELL: I don't think I have any responses to any of the existing questions. Anyone -- one thing I'll just note is some of the questions that are coming in will be addressed in the afternoon presentation that Ingrid Neumann will be given. So stay tuned I think for some of that additional information.

COMMISSIONER MCALLISTER: I wanted to just chime in and just thank staff that is answering questions in real time and just encourage more of that. I think there's a -- there really is a lot to talk about with decarbonization. And, you know, folks are at different levels of learning about what the possibilities are for it. And I think this is a great opportunity for us to

have some dialogue between staff and stakeholders and certainly encourage that.

So thanks, staff, for working through the questions in real time with people and having that back and forth.

MR. ROSALES: Thank you. Matt, I'm going to read out some more questions. And some of these I -- if we feel they're going to be answered in the outgoing presentations, I'll just read it out and then I'll note that.

So, the next question is from Tom Payne. Electrifying existing homes generally will require electrical upgrades at significant costs. We know that most HVAC change up go unpermitted. Is there any plan of support or avoid these added up costs in order to encourage, presumably encourage buying higher efficiency equipment?

Michael, do you want to address this real quick?

MR. KENNEY: Yes. So, I think yes, we recognize that there's a lot of unpermitted installations that go on. And I think the Energy Commission and others already have ongoing efforts to try to address those problems and to work with stakeholders to make sure that there is a, you know, an incentive to the pulling permits for things like HVAC systems.

So there's nothing specific in this report that ties to it but many of the goals we're talking about here and establishing, you know, a robust clean energy workforce (indiscernible), you know, be most effective if people are going through the permitting process.

COMMISSIONER MCALLISTER: I'm going to jump in here as well. Thanks, Michael. So there are really two questions there, one is about the panel upgrades. And I believe those costs are included in the electrification scenarios, if I'm not mistaken. But staff can confirm that.

And so, yes, that is a significant cost. I know that there are stakeholder groups like the Building Decarbonization Coalition and others, too, are looking at how to, and we're funding some research at the Energy Commission looking at how possibly existing 120-volt circuits can be used for some of these retrofit devices in existing homes and to avoid some of this panel upgrade needs. But that's an ongoing question. You know, there isn't a great solution to it. It does cost money to do that.

On the HVAC, we actually are incorporating the work that has partially done to produce the report under AB 1414 and -- or SB 1414, rather. That is about how to better the permitting situation with respect to HVAC

systems. So, we will have a conversation during this track of the IEPR later -- later on in the summer that includes that same.

So, yeah, we've -- over the years we've had a lot of conversation about how to improve permitting of HVAC changeouts and, you know, there isn't an easy solution to that. You know, the building departments need help. And, you know, there are a lot of chefs in that kitchen.

And so, you know, we need to figure out how to align the incentives for that to take place. Much, much greater scale. But the question's a good one.

Thank you.

MR. ROSALES: Thank you, Commissioner McAllister. And I think you're right, the cost for that are imbedded into the electrification scenario.

I'm going to go one more question and then I'm going to pause and give it back to the dais.

Commissioner Rechtschaffen, if you're still on the line. It looks like you wanted to take the next question.

The next question is from Evelyn Loya. She's asking: Does the heat pump, does heat pump technology program include gas heat pumps?

So if you would like to take that one live --

COMMISSIONER RECHTSCHAFFEN: No.

MR. ROSALES: -- feel free.

COMMISSIONER RECHTSCHAFFEN: If you're referring to the incentives that we have for decarbonization that I'd mentioned, no, it does not include the gas heat pumps.

I'm not trying to make a broad definition of what's a heat pump or not and step into territory that I'm not qualified to answer for. But in terms of our incentive programs, no.

MR. ROSALES: And then let me key the next one up for you, Commissioner Rechtschaffen, if you you'd like to take this one. It's from an anonymous attendee.

What considerations are currently in place or planned to address the increase electrical load of this initiative with the existing aging electrical infrastructure and the inefficiencies of electrical distribution?

So, if you'd like to take that one, feel free to do so.

COMMISSIONER RECHTSCHAFFEN: That's a subject -- that could be the subject of a whole other couple of workshops or proceedings, so I don't have a specific or probably helpful answer -- satisfactory answer. It is something that we clearly know we have to think about as

we move to broader levels of electrification. It's -- will I have an increased load, we'll have increased loads in certain segments. You have to make sure the distribution system is upgraded and continues to be safe and reliable.

MR. ROSALES: Thank you, Commissioner.

So, I'm going to do just a quick time check. We are almost at noon and a lot of questions are coming in. The staff will address a lot of questions in the Q&A box.

I'm going to ask the Commissioners if there's any questions they have after the last presentation or any comments they would like based on the last presentation before we move forward with the agenda.

Commissioner McAllister.

COMMISSIONER MCALLISTER: Yes. Commissioner McAllister. I don't have any questions, I'm pretty intimately familiar with the report. But I did want to just to layer in another answer to the -- to Commissioner Rechtschaffen' s points just now.

So we do have -- I don't think it's been mentioned yet, but we do have a number of initiatives around load flexibility and that's one way that we mitigate the impacts on distribution grids and above for -- of all this electrification. So, you know, we

have to include transportation in that and also little things.

And so having load flex capability natively and as much of this equipment as possible will enable it to function in a way and, you know, obviously customers have to opt in, you know, there's a whole system that partially exists but really needs to be built out for harnessing that load flexibility. And so that is a challenge but we have time and, you know, this electrification will come online sort of, you know, year after year. So, I think there's certainly a plan and discussion about, you know, how to approach that with all the different tools we have in our toolboxes across the agencies.

MR. ROSALES: Thank you, Commissioner.

Commissioner Gunda, would you like to make any remarks?

Commissioner Rechtschaffen, have you got any questions or comments before we move on with the agenda?

COMMISSIONER RECHTSCHAFFEN: No thank you, no comments or questions from me at this point.

MR. ROSALES: Thank you. We -- what we're going to do since a lot of questions -- a lot of questions are kind of general questions and some of the questions, some of the more specific questions will be answered

from the upcoming presentations by the EAD staff.

I'm going to pause now on the public Q&A. We will answer most of the questions in the Q&A box.

But Ingrid, if you're on the line, if you could queue up your presentation so you can get prepared. And then we'll continue with the -- Ingrid.

So, we'll move on with the second staff presentation, Defining the Scope of Assessing Building Decarbonization. Ingrid, you're on.

COMMISSIONER MCALLISTER: Ingrid, you might be muted.

MS. NEUMANN: Yes. Yes, indeed I was. All right here I am.

So thank you for the opportunity to present today. I am -- sorry, I'm having -- do you see my presentation correctly?

MR. SAMUELSON: Yes, we do.

MS. NEUMANN: Okay. Cool. All right. So thank you for the opportunity to present on our work today in support of the AB 3232 California Building Decarbonization Assessment.

I'm Ingrid Neumann and I'm presenting today both on my behalf as well as on my colleague Nicholas Janusch' s behalf who regrettably cannot be here today.

Nick and I are both from the Demand Analysis

Office in the Energy Assessments Division. Angela Tanghetti is from our Supply Analysis Office in the same division and will be presenting after our late lunch break.

I would like to begin by summarizing the scope of the assessment as outlined by the legislation. So, the legislation asks us to assess the potential for the state to reduce the emissions of greenhouse gases in the state's residential and commercial building stock by at least 40 percent below 1990 levels by January 1st of 2030.

The AB 3232 analysis is informational and explores one or more scenarios within numerous possible decarbonization strategies. Our team's goal was to investigate which scenarios could meet or exceed the 40 percent GHG reduction goal.

All right. So, we needed to define the scope and there were three steps there before we could start our assessment. The first step would be to define what the 2030 baseline case or business-as-usual case would look like as the counterfactual that we would use to measure any decarbonization scenario impacts against. Then we also had to define a 1990 GHG emissions baseline to determine what the 40 percent GHG reduction goal would look like in 2030 or need to. Lastly, we could

define one or more scenarios to analyze within the broad building decarbonization strategies.

So, first question is what exactly is being assessed? So, my colleague Michael Kenney already laid the seven-broad building decarbonization strategies which are listed on the left-hand side here. So the first being building end use electrification. The second, decarbonizing the electricity system. Third, energy efficiency both on gas and on the electric side. Four, refrigerant conversion and reduction. Five, distributed generation and storage. Six, decarbonizing the gas system. And seven, demand flexibility.

So in order to determine the impact of any given scenario within a building decarbonization strategy, we need to define what our reference baseline is. Basically, what's forecasted to occur in our business-as-usual case in the year 2030?

So in order to do that, staff relied on the 2019 IEPR or Integrated Energy Policies Reports California Energy Demand Forecast to establish that reference baseline or the annual 2030 GHG emissions for the AB 3232 analysis. What are they expected to look like without any additional building decarbonization efforts other than some of the ones that are already in place?

So, the 2019 forecast already has several of

these building decarbonization strategies included. For example, Energy Commission staff routinely develops manage forecast which adjust a consumption baseline for AAEE which is additional achievable energy efficiency. And those are energy savings that are going to result from efforts that are, you know, they're reasonably expected to occur but they lack firm funding commitments or implementation plans. So, we develop those for a range of scenarios from conservative to aggressive. And we use a moderate one or a mid-mid case for our actual forecast here, our baseline.

The same is occurs for photovoltaics. So there for Row 5, the distributed generation and storage in yellow, there are some behind-the-meter PV such as those on new construction because of Title 24 and other programs that exist and those are included in our business-as-usual or 2030 baseline forecast.

So, in the decarbonizing the electric system in orange, there's no estimate there in our baseline forecast. And then for demand flexibility, there are some traditional nonevent base load management programs that are included in our business-as-usual examination.

So then if went back up to line 3, energy efficiency, right, that we have that modest case that's included already both for gas and electric energy

efficiency. And if we go one line above that, decarbonizing the electric system, we do include a 60 percent renewable portfolio standard by 2030 as required by SB 100 and our business-as-usual baseline assumptions.

And there is a little bit of all electric new construction that's in both the residential and commercial building sectors as part of our AAEE but it's very small. So, it's nothing compared to the electrification scenarios that we'll be presenting shortly. So, this is our 2030, what's 2030 going to look like without any additional efforts that we haven't taken already.

So, then the second part here is we need to define what to include in the 1990 GHG baseline. So, Michael had already shown, you know, the system-wide emissions and the direct emissions and they're quite different what you include in that baseline and what that 40 percent reduction actually ends up looking like.

So, I believe Commissioner McAllister mentioned, you know, the legislation really doesn't specify the use of a specific GHG metric, but it does suggest two approaches. And these are the two approaches that we did explore. So, the direct emissions approach and then a more holistic system-wide emission approach.

So as you can see on the chart on the left-hand side, you know, they both account for incremental electrical generation emissions from any electrification or fuel substitution efforts behind-the-meter leakage, gas combustion as well as non-gas combustion, et cetera. And really the difference is in bold. So, the difference is whether electric -- the electric generation systems attributed to buildings in the residential and commercial sectors are included in the baseline set for 1990.

So, what we can see in this table here is that the baseline really matters. Right? The direct emission baseline's approach requires much more reduction in GHG emissions. So on the very right-hand column, the amount of GHG emission reductions needed from now to 2030 would be 5.5 million metric tons of carbon dioxide equivalent under the system-wide baseline but would be almost four times more at 22.1 mm tons under the direct baseline. So, we'll see a little bit more graphically what is going on here.

So of course there is the portion where we -- if we're not including the electric generation system, we're also not including the vast efforts that have been made on that supply side by incorporating more renewables. So that's one piece. But then the other

portion is that HFC emissions really have been rapidly increasing over the past few years. And so, in 1990, there weren't actually HFCs, it was a negligible amount of HFCs but because most refrigerants at that time were actual ozone depleting substances which have fortunately been declining. So we had to do a back cast to be consistent with the SB 1383 CARB 2013 baseline there to include the refrigerants that did occur, that did exist in 1990 in that baseline.

So, let's go look at a little bit more here. So some more thoughts about why it might make sense to bring in the electric generation system into our AB 3232 residential and commercial building analysis. So, SB 100 does require major changes in the electric generation system that greatly reduce its carbon emissions through time. Under a business-as-usual demand assumptions, the residential and commercial building sectors are about 70 percent of the total electric system load.

Then emissions from the generating system are directly influenced by changes in electric consumption by the building sector. So, what we're saying here is if we change how much residential or commercial buildings, how much electricity they're using, we actually change the emission intensities of the electric

generation system. So that might make sense, then, to include the electric generation system.

So for example, the reductions in electric consumptions such as what occur with electric energy efficiency or, you know, behind-the-meter rooftop PV which are included in our baseline forecast for 2030 or a new building decarbonization strategies that we could add on top of that, they'll actually reduce electric generation system emissions.

On the other hand, increases in electric consumption through building electrification will increase electric generation system emissions in all years. And they don't just do that during the study time period where we're actually maybe installing new equipment from 2020 to 2030, but it does exist throughout the lifetime of that equipment. So given an approximate lifetime of 15 years, it would go out to 2045.

So here we have a visual of depiction of the emissions using the system-wide emissions target. So, on the very left-hand column, we have the 1990 values and we can quickly see that emissions have declined since 1990 to 2018. And most of that is from the brown column in the electric generation sector by having incorporating more renewables and so on.

So, we can see that projected continued decline when we look at our 2030 baseline case on the very right-hand side. Right? That brown hash column is shorter again. What we don't see is a significant change in the blue column, the gas combustion. And that's not because we don't have a lot of efficiency efforts but because of California's building stopped growing. So, in some sense the efficiency efforts are just keeping the gas consumption stable.

So compared to the 2030 reference baseline or business-as-usual case, the system-wide GHG emissions target setting which is by the purple dotted line here across the bar would require an additional 5.5 mm tons of carbon dioxide equivalent to be avoided in order to meet a 40 percent reduction if we use that system-wide GHG metric.

So, I'm going to show you a similar picture here for the direct emissions and that looks a little different. We can see that more aggressive action would be required. We can see from 1990 to 2018, right, we don't have the electric generation system there so there's no gain here. It's -- you can see a little bit more clearly that, you know, maybe energy efficiency and gas consumption is winning out a little bit against growth so that's nice to see. And then we can see that

non-gas fuel combustion is also diminishing in the orange bar and we do have flatline forecast from that 2018 value from the last CARB inventory to 2030.

And then the behind-the-meter gas leakage in green scales with the gas consumption. And HFC leakage as we mentioned before is actually increasing. So, what we see is that these bars are not too different. Right? It's actually slightly higher projected in 2030 than what we had in 1990 despite all the growth. Right?

So, what that means is that we would require an additional 22.1 mm tons of carbon dioxide equivalent reduction. So that's a much more aggressive goal. And then if we considered, you know, electrification as one of the strategies, then that would actually add more HFCs. Right? Because those refrigerants are the ones that are predominantly used in heat pumps today.

All right. So lastly, we get to the fun part. So, then we can start defining one or more scenarios to analyze within the seven-broad building decarbonization strategies. And we had impact scenarios versus electrification scenarios that we studied in more detail that we actually develop a tool to analyze for it and we'll talk about that in a moment as well. But there's still not nearly an exhaustive set of scenarios. There's just some that we chose to kind of start

illustrating what these efforts might look like. And they were all analyzed independent of each other. So, we can see exactly what kind of potential might exist where.

All right. So, on the left-hand side we have our column of building decarbonization strategies, right, the seven that we've been talking about. Then we have the specific decarbonization scenarios analyzed in the second column and what we used in those decarbonization scenarios. So, as I mentioned, we had developed a specific tool for this. We are presenting four decarbonization or electrification scenarios here. The minimal, moderate, aggressive, and efficient aggressive scenarios. And what they do is they incorporate a broad range and combination of electrification. So not just in new construction but throughout existing buildings. So looking at appliance burnouts and early appliance replacements.

So, then we have the second row, decarbonizing the electricity system. We have an accelerated renewable electric generation resources. So, we increase the RPS requirement to 65 to 70 percent by 2030. And energy efficiency we did something similar. So we picked our more optimistic more aggressive energy efficiency scenarios from gas and the electric side

separately and analyzed what those, it added incremental efforts would do compared to our business-as-usual baseline.

Then we did not look at -- we did not assess refrigerant conversion and reduction. We looked at specifically incremental added rooftop solar PV systems for the distributed generation and storage. We looked at the IEPR high penetration PV scenario. And then for decarbonizing the gas system, we examined what it might look like to substitute 20 percent of fossil gas in the pipeline with renewable gas by 2030.

Lastly for demand flexibility, we looked at what an automated system that could take advantage of curtailment so that could adjust consumption by avoiding that peak consumption according to some (indiscernible) and take schedules would actually do, how much load that could shift and how that could help.

So to summarize how we mapped the broader building decarbonization strategies to the analyzed scenarios and how those compared to the baseline. The AAEE scenario is a mid-mid did contain a very low penetration of all electric new construction. But for our AB 3232 decarbonization scenario, we are including replace on burnout, early retirement, and everything at much higher rates than elsewhere.

Then instead of having a 60 percent renewable portfolio standard as set by SB 100 in 2030 for our decarbonizing the electricity system scenario, we raised that up to 65 to 70 percent by 2030. And for the AAEE scenarios, we went with our most optimistic scenarios and we looked at what additional impact, additional energy efficiency would have beyond the portion that's already included with the Scenario 3 in our business-as-usual 2030 baseline.

So, as I mentioned, Strategy 4 is not assessed. Strategy 5, we used the high penetration rather than the mid-penetration, we look at that incremental impact. And the renewable gas substituting for 20 percent of fossil gas headlines were put is not incremental to anything because there is no fossil -- there is no renewable gas considered in our baseline case.

And then for demand flexibility, right, we are including traditional nonevent base load management programs in our business-as-usual. But here we would like to look at what automated systems that could take advantage of curtailment and avoid net peak consumption could do.

So now I'm going to move on to an overview of what our field substitution scenario analysis to our FSSAT did in order to evaluate the electrification

scenarios.

So, we start with the Integrated Energy Policy Report Gas Demand Forecast. So, we have gas consumption and we use the 2019 vintage. So the gas and electricity demand forecast in the IEPR are updated every two years so we will update that as part of our 2021 IEPR process as well but the last full update would have been in 2019, so that's the most recent vintage.

So, we take that gas demand forecast and then we decrement it by our business-as-usual assumption for AAEE, an additional achievable energy efficiency and gas. So that reduces the consumption of gas to our business-as-usual case.

Then we take that end use consumption for the residential and commercial sectors and we have specific end uses that we just aggregate down to the technology level so that then they can be eligible for fuel substitution, right. So electrification at that end use and technology level.

So first, specific gas technology, we then have an array of electric technologies that could be substituted for that gas technology and still provide the same service. So one could have a furnace, you know, gas furnace that could be replaced with various efficiency levels of heat pumps, for example. And those

different heat pumps, you know, maybe a much more efficient heat pump might be more expensive than a slightly less efficient heat pump.

So once we define a specific electrification scenario, we can then run that substitution using this tool and we get annual outputs that give technology stock, cost of substitution, the incremental electricity added because we are adding electricity when we're displacing gas. And most importantly our net GHG emissions. And we're hoping that those go down. Right.

So then with -- we also have an hourly calculation that can take the annual values and match those to the appropriate end use consumption load curves and then we can get hourly electric consumption increases, as well as hourly GHG emissions. And those will become important when we look at how that interacts with the electric generation sector and also some people had some questions about like planning and reliability. You know, this is where we can start looking at what this might occur -- what might occur. And we'll talk about that a little bit more this afternoon.

So first, what are these scenarios in fact? Right? So, we define minimal, moderate, aggressive, and efficient out aggressive here. They're all aggressive when you look at new construction. Right? We assumed

100 percent of residential and commercial new construction would be all electric by 2030. The replace on burnout rate so once, you know, your furnace gives up, then you replace it with a heat pump. Maybe there's an attractive incentive program, right. So, the 15 percent replaced on burnout rate for the minimal 50 percent for moderate and all the way up to, yes, as the name implies, aggressive at 90 percent for those two scenarios.

Then early replacement, 5 percent for minimal and moderate and 70 percent for aggressive might be a little harder to convince people to give up a fully functioning device and we wanted to be a little bit more moderate in those assumptions while still trying to achieve these goals.

So the technology efficiency. So, like I had mentioned when we were talking about the technology base substitution that would occur in our electrification scenarios, there might be more than one electric technology that could be substituted for a specific gas technology.

So, when there was more than one, then we would have to choose how we weight that mix. You know, does -- is any, you know, efficiency equally likely to occur or did we weight it to the higher efficiencies,

you know, we're more likely to choose higher efficient electric technologies. And that's what the high efficient weighted mix did. And that's what we use for the minimum, moderate, and aggressive scenarios.

So, what defines a difference between the aggressive and the efficient aggressive scenarios is that we're really trying to look at the single best efficient technology that could be reasonably substituted for a specific gas technology in that case. And there will be some consequences for that which do motivate the idea of quantitatively of efficient electrification. I think it should make sense.

So, then the last bit in our tool here is our SB 1383 toggle because we saw that HFC emissions actually can contribute quite a bit to our GHG and reducing them would be very beneficial. So, CARB has the SB 1383 work that they're doing, and we just looked at a very extreme, you know, bookend, you know, of either completely on or completely off. And of course, realizing that that's not an entirely accurate portrayal of what one might expect to occur. But they give us bookends, they give us ideas about how important SB 1383 in fact is.

All right. So, let's say a few more things about how the electric generation analysis was done and

how our supply office was involved. Angela will give you more details in our afternoon presentation. But for each of the electrification scenarios as well as any other scenario such as electric energy efficiency that would change the total -- the total electric load from both residential or commercial buildings, we developed annual electric consumption impacts and then use the hourly load shapes to develop (indiscernible) load impact.

So, these changes in electricity consumption due to whatever scenario would then have to be added to the 2020 to 2030 baseline hourly loads from our business-as-usual forecast.

So, then we handed over those hourly values to the supply office and they developed resource additions, renewables in this case, to satisfy RPS requirements and added battery storage to satisfy planning reserve margin requirements. They then needed to translate the revised resource mixes into PLEXOS production simulation inputs and ran those for benchmark years 2020, 2025, and 2030.

Finally, those results were postprocessed into annual GHG emissions and interpolated to create GHC emission intensities for the time period of 2020 to 2045.

Lastly, we had to take those electric generation

emission intensities and scale those so that we were only including the portions from residential and commercial buildings and then we could figure out what that electric consumption would -- what, you know, what those electric generation GHG emissions would be for those two building sectors.

All right. So that's it for now. And after questions, I suppose we can all have lunch.

MR. ROSALES: Ingrid, good job --

MS. NEUMANN: At least I'm the only one looking forward to it.

MR. ROSALES: -- thank you.

MS. NEUMANN: I don't know.

MR. ROSALES: I think we all are. Thank you, Ingrid, good job.

Brian, can you start on my slide 3?

Ingrid, I'm going to help you facilitate the Q&A. So one second.

Okay. Everyone, this is another, our second Q&A session and public comment period. So, if you got written questions, feel free to type in again into the Zoom Q&A. If you would like to have a -- provide a live question, please use the raise hand function and we will get to questions in the order they come in.

But to begin, let me turn to the dais.

Commissioner McAllister, other commissioners, do you have any questions or comments you'd like to start us off with?

COMMISSIONER MCALLISTER: I'll just start off by thanking Ingrid for the presentation. That was a really dense presentation. And I certainly -- so we will be, if they're not already, we will be posting the -- all the presentations from today. And so I think there's a lot of food for thought here and it's going to be very important not only to, you know, get your sort of clarifying questions answered today, you know, as we can given the time constraints but also submit questions and comments and any uncertainties you might have, you know, in your comments to the docket during the comment period. So that will be helpful, and potentially you can ask some staff back and forth for clarifying if there's ongoing uncertainties.

So, I just wanted to say that. But just acknowledging there's a lot of content here. A lot of analysis went into this and, you know, expect that people take a little while to get their heads around it.

But yeah, thanks again Ingrid for that.

COMMISSIONER GUNDA: Commissioner McAllister, this is Siva. I think I just want to integrate that that is a very robust presentation, with a lot of nuance

to it.

Ingrid, thank you. I think you did an excellent job trying to convey that the boundaries, the current analytical boundaries and the scope and I do agree with Commissioner McAllister that it's for people who might be listening to this for the first time, it might need some time to digest. And so, I'm glad we're going into a lunch break so people can think it through and come back with any clarifying questions they might have.

MR. ROSALES: Thank you, Commissioner.

Commissioner Rechtschaffen, do you have any questions?

COMMISSIONER RECHTSCHAFFEN: I don't have any questions, thanks.

MR. ROSALES: Okay. Thank you.

Let's go over to the public Q&A. There are two questions -- two questions, they're both from Matt Horowitz.

The first one is, does 70 percent early retirement mean that 70 percent building stock is electrified by 2030?

Ingrid, if you're on the line, do you want to take this one, answer live?

MS. NEUMANN: Well, it means every time that something burns out, right, so it reaches the end of its

useful life, that 70 percent of the time it's replaced by an all-electric from that spectrum of technologies that we can chose from.

So, I guess, I mean, does that mean that by 2030 everything is going to be -- or 70 percent of existing building stock is going to be all electric? And I think the answer would be no because you probably don't have -- I mean, with -- if you have an existing useful life of 15 years, it's not all going to burn out in that projection time period of 2020 to 2030.

So maybe that's the best way to answer that.

MR. ROSALES: Thanks, Ingrid.

The second question also from Matt Horowitz. Are all new kilowatt hours sales from electrification met with new solar PLEXOS or is it based on electric generation proposal mixed in that year?

Ingrid, do you want to take this one as well?

MS. NEUMANN: Yeah, I think it's more the latter. I mean, if Angela is on, she would be able to answer that better.

MS. TANGHETTI: Hi, I am here. Thank you. Thanks for that question, Matt.

And the answer to that question is each AB 3232 scenario we looked at with increased electrification, we looked at the portfolio not only with solar and

batteries included, but it was out of state resources as well as in state when those were some of the -- and some, small amount of geothermal. So those were the candidate resources in our portfolio to meet the additional electrification.

The storage was added simply for reliability from each scenario. So, if there were additional reliability resources needed, there was storage added.

MR. ROSALES: Thank you, Angela.

Going to the next question.

Karen Christiansen. Great presentation, Ingrid. She's asking: Does the report look at ways to combine elements of these individual scenarios? If not, is this a planned future effort?

MS. NEUMANN: So this report does not. Everything is evaluated like each scenario within a given strategy is evaluated independently. I mean, I think there is a desire to look at, you know, of combining that but that's a very, very involved process. And there's a lot of things. There are a lot of things that we can work on, and then there are other things where there's just less data available. So, it's not included in this report.

MR. ROSALES: Thanks, Ingrid.

COMMISSIONER MCALLISTER: Yeah, I just want to

express that there -- you know, this report is kind of a development of an analytical tool and, you know, the scenario work that you've just heard about. The IEPR will explore this further and you'll, you know, certainly the energy efficiency in the near term, the energy efficiency, you know, at negative cost is obviously something we would want to go first and kind of going off that cost curve.

So, it's really good point that, you know, the various scenarios working together is probably what the optical path ends up looking like. And the report actually does talk a little bit about that. But the analytical piece needs to come going forward to integrate some of these scenarios.

COMMISSIONER GUNDA: Commissioner McAllister, if I may, just want to add to I think to your point, I think just want to note, take the opportunity that this question that -- the analytical underpinning, the methodological kind of framework has been an important part of the development of 3232 process. And I think just as Commissioner McAllister noted, not just the diversity of kind of how we combine these different measures but also what's happening on the analytic side, what's going to happen on the distribution side.

All of that will play into that idea of demand

analysis as well as supply analysis and we have to come together in this domain of building electrification and building decarbonization. So, I think we really have our work cut out for the future, it's just the beginning.

MR. ROSALES: Thank you, Commissioner.

Ingrid, I think this next question is for you. It's from Marcus (indiscernible).

For replace on burnout, does the study account for the fact that most residential and commercial HVAC equipment lasts well beyond the stated useful life of 15 years for gas furnace? Will stop gas packs are optical in 20 years.

MS. NEUMANN: It -- right now we're pretty much looking at most things at 15 years. I think some of the -- for residential. I think some of the commercial HVAC is longer. We're -- I mean, one of the things we're looking at is kind of a giving a little bit more of a curve to that. You know, not having everything cut off in one year, though that does give us an average, you know, kind of approach. So, it's not at that detail yet.

MR. ROSALES: Thanks, Ingrid.

Next question here from Mabel Garcia-Payne.

How far will TECH incentive get us toward the

building end use electrification goal?

I'm not sure if there's anybody in the staff who can answer that more directly. But, Ingrid, it looks like you might -- do you have anything to add here in terms of one answer?

MS. NEUMANN: Yeah. I was just smiling because it would be nice to get some preliminary data once some of those programs go out and then we could incorporate that in various analyses. So that would very exciting to figure out where that would get us. Right? And I think it depends on what, you know, what types of things are being incented.

We are looking at breaking up our -- I mean, we have done that now. Broke up the residential sector to include not just, you know, single family, multifamily as the segment but actually have low-income single family and low-income multifamily so that we could better represent any then what then becomes historical data and kind of expand this analysis from being, you know, what if we did this replacement to oh, there's this program in place. And if that continues, what will that look like? So that's kind of that pending work that's going to be pretty exciting.

COMMISSIONER MCALLISTER: I wanted to just address Mabel's question there as well. So, the TECH

and build programs, in particular the TECH program that you're asking about are both funded by the Public Utilities Commission. We are administering at the Energy Commission the build program. The TECH program is being overseen and administered through the PUC itself.

Those -- if I'm not mistaken, both of those programs add up to about $200 million, something along those lines. And that really -- that sounds like a big number but that's really just a drop in the bucket in terms of what would be necessary to get to scale that we need to really move the needle on, you know, getting to our existing buildings regularly, but you know, shifting the marketplace to add some scale.

So those programs could, you know, be a pipe for much more -- for more resources. But, you know, at the moment we have those programs to kind of get the market moving and change the paradigm a little bit. But the scale really needs to come, you know, there needs to be a much bigger scale to get to our goals.

MR. ROSALES: Thank you, Commissioner.

Next question, Ingrid, I think this might be best suited for you.

This is from Evelyn Loya. She's asking when you calculate the 87 60-hour load impact, how did you

address weather demand variabilities? Was the 87 60 profile based on a standard or average year? And lastly, how are you addressing peak demand periods for space heating requirements?

MS. NEUMANN: Yeah. So, I mean, these are fully calendarized and they're -- I can put a link in for most of the load profiles that we used. They were from our efforts in the forecasting unit to update load profiles. So, there's a report on that and it includes all of the information there.

And then there was something -- went away. It was something on -- we did separate for heat pump load profiles, we did separate between cooling and heating. On an average, we were -- okay, so it asked how are you addressing peak demand periods for space heater requirements. Yes, so we can see that. I mean, if we're addressing it, I don't think we've gotten that far. But we can see that the winter peaks and we'll see that in the afternoon, actually grow more than the summer peaks. So that is something that would have to be considered if one did have any concerted electrification effort in the state. As far as system reliability and, you know, perhaps having a winter peaking system in some places instead of a summer one. So that's a really good question. But I can find

that --

MR. ROSALES: Thank you, Ingrid.

NS. NEUMANN: -- with the load profiles and drop it in here.

MR. ROSALES: Yeah, thank you. Appreciate that.

Matt, do you want to take the next question live? It's from an anonymous attendee. Will the supporting data substantively made public? And if so, when?

MR. COLDWELL: Yeah, thanks, Eddie. I was actually intending to type the answer and I hit the wrong button. But I could just answer it live.

So yes, the supporting data is publicly available. I think the building decarbonization assessments webpage was posted in the chat box with a link. And if you look at the docket, all of the report and the appendix and the supporting data is all included in the docket. So, you can find it there.

MR. ROSALES: Thank you, Matt. That's right. All the leaks are on the -- are felt throughout on the proceeding webpage, the supporting documents in the docket. And they posted it on the chat box.

If anyone has any issues accessing any of the links, let us know. Okay. They have been posted and shared.

Okay. And then we've got one more question here from Bob Gramer (indiscernible). Will the final session regarding ratepayer in fact given the proceedings going on at PUC? And the fact that this data moved into TOU rates, will CEC AB 3232 report investigate various scenario impacts on electric ratepayers in new homes?

If electric use in new homes with EV charging will be increasing threefold in the coming years. This is a very critical issue to investigate.

Ingrid or Michael, do you -- are you interested in addressing some of this right now?

MS. NEUMANN: I mean, I could say maybe we don't -- sorry, the allergies are not doing me any good. Okay.

I mean, we haven't -- this is a really good question. It's one of those things where one would have to consider it. We did do some analysis but -- and that could be found in the main report and more in the appendix on rates. But there were some things that weren't included there.

So, it's -- it's a work in progress, really. And I don't think we have anything definitive to say that this is how it's going to work. You know, but this is one direction that things could go and then see how that works out at the CPUC and that sort of thing.

COMMISSIONER GUNDA: Go ahead, Commissioner McAllister.

COMMISSIONER MCALLISTER: Oh, sorry. Yeah, I would just say that's a broad question and for example, the transportation piece is broader than just AB 3232 work. But it is certainly, you know, as we know the electric load is going to go up and certainly those costs have to be considered. And, you know, the typical way that's done is through the essentially the ratemaking process. But the -- yeah, so I guess I'll leave it there for now.

But Commissioner Gunda, did you want to chime in?

COMMISSIONER GUNDA: No, Commissioner, I think you actually said what I was going to say. I think we -- as Commissioner McAllister pointed out early on, this is a very integrated approach as we move forward. So, I think it is analysis and vision to integrate these ideas of sectors and the impacts of demand and supply and emissions. But as they pertain to the rates, I think this is wonderful to have the collaboration that Commissioner Rechtschaffen' s here and I think we're going to work with PUC closely to think through how best to download those impacts and synergize the efforts.

COMMISSIONER RECHTSCHAFFEN: Thank you. This is

Cliff Rechtschaffen at the PUC.

Bob, it's an important -- it's an important set of issues and we are thinking about the rate impacts of various types of electrification as Commissioner McAllister said that your question goes beyond the building sector. It's complicated like a lot of these things but it is something in our mind that we -- as I said in my opening remarks, we want to make sure that as we go to deeper and deeper penetrations of electrifications, ratepayers can bear the cost of the increasing electricity use. And of course, we're changing to time of use rates and there's other considerations out there.

So no answer, no clear proceeding to point to but it is something that we know we have to work through going forward.

MR. ROSALES: Thank you, Commissioner. Thank you, Commissioners.

The next -- the next statement is from Janet Burman (phonetic). Not a -- doesn't seem like a question.

Commissioner McAllister, you had commented you would like to answer this live. I don't know if that was a mistake or if you'd like to make it --

COMMISSIONER MCALLISTER: No, no, no. Jim is

just pointing out that I was too reductive when I was talking about the source of funds for TECH and build. They're actually ratepayers and actually they're gas ratepayers that are funding both of those programs. So it was, you know, the PUC has dominion over those funds but they actually do come from gas utility ratepayers. So thanks for that reminder, Jim.

MR. ROSALES: Thank you, Commissioner. So, we are all through the posted questions. We don't see any raised hands. I'm taking that that no one has any live questions. And also no one's -- doesn't seem like anyone's calling in by phone.

So, Commissioner McAllister, I'd just like to check with you on time. So, it's 12:47 right now. We are -- we're almost a full 60 minutes ahead of where we had expected to be. So we can either continue with the next presentation. Sorry, Ingrid, I know you wanted to take a break. But this might allow us to get through the next presentation and then take a break or we can start our break now.

Commissioner, I'll give you the option.

COMMISSIONER MCALLISTER: I'll ask my colleagues. I'm included -- I mean, this is, this seems like a reasonable lunchtime to me given that it's almost 1:00. So, I think we'll just chock it up to efficiency.

I think we ought to start, though, earlier in the afternoon, if that could work. Rather than a 2:30, perhaps we can convene at 1:30.

MR. ROSALES: That sounds okay by me. Let's do that, we'll put up a -- we'll put up a slide and remind folks that we're going to restart, reconvene at 1:30. And so we'll wrap up the Q&A and we will go into our break. Is that okay?

COMMISSIONER MCALLISTER: Yeah, I think that's good. Let's -- I'm just worried that if people that planned to be only here for the afternoon that we would need to make sure that they know we're starting off the agenda at 1:30 instead of 2:30. So let's put, you know, that information and just let it stay over the break. So, if people do log on at some point they'll know.

If they come in at 2:30, they're going to miss what they wanted to say. Anyway, we --

MR. ROSALES: Yes.

COMMISSIONER MCALLISTER: Let's see, I guess I'm just wondering if -- if the process really ought to be time certain for 2:30 like you said.

Sorry, I'm going to change my mind here. I think we're going to start at 2:30. If we start at 1:30, we run the risk of people being left out who had planned on only being for the afternoon session.

So, I think let's start at the planned time at 2:30.

MR. ROSALES: That's fine, Commissioner. We'll put up a slide and remind folks that we will keep the Zoom open and let them know we're going to restart the workshop at 2:30 as planned.

COMMISSIONER MCALLISTER: I think that's the best solution. Unless my colleagues disagree, we'll just go there.

COMMISSIONER RECHTSCHAFFEN: I'm fine with -- Commissioner McAllister, I'm fine with your suggestion.

COMMISSIONER MCALLISTER: Great.

COMMISSIONER GUNDA: Same here, Commissioner.

COMMISSIONER MCALLISTER: Okay. Great. Okay. So, we'll see everybody again at 2:30.

So thanks, everyone for tuning in this morning. And thanks to staff for all the great presentations. Looking forward to Ingrid's and Angela's presentation in the afternoon.

Thanks, Eddie, for emceeing.

MR. ROSALES: Thank you. We will reconvene.

(Off the record at 12:49 p.m.)

(On the record at 2:31 p.m.)

MR. ROSALES: Let's see. We'll -- maybe we'll just get started with the afternoon. Really appreciate

everybody chiming back in. 125 and climbing there, so that's great.

Let's begin the afternoon session with Ingrid Neumann and Angela Tanghetti talking in more depth about the decarbonization scenario impacts.

MS. NEUMANN: All right. So, I trust you can see the title side that says Builder Decarbonization Scenario Impact.

MR. ROSALES: Indeed.

MS. NEUMANN: Great. Okay. So good afternoon and welcome back. I'm Ingrid Neumann and I will be presenting my colleague Nick Janusch' s work. I will do my best to service his voice for the GHG emission impacts and cost analysis that he performed. So, let's start with looking at the emission impacts occurring in 2030.

So, these are the GHG emission impacts, right, that we're interested in here for the residential and commercial building sector. So, there's a lot of information in this figure. And this figure is the one that's in the main report and we want to walk you through it. So, what's presented here are the nine scenarios, those specific scenarios that we chose and examined, and the amount of emissions reduction that

each one provides in the year 2030.

The black dashed line at the top is the amount of reduction that would be needed using the more aggressive direct emissions baseline. And the red solid line is the emission -- system-wide emissions target for that more holistic view.

So, our goal is always to surpass the 40 percent target lines. And we can see that the green bars in the middle that present the electrification scenarios in fact do that for the system-wide emissions. Of the five impact scenarios, we separated them out in the way that we did here by moving three off to the side, those are the three on the far right, that are electric based and they can only really be looked at in the system-wide baseline. And so incremental electric energy efficiency incremental rooftop PV, and accelerated renewable electric resources.

COMMISSIONER MCALLISTER: Hey, Ingrid, this is Commissioner McAllister just chiming in quickly. It looks like we're missing the 1383 impacts on the top of each column. So maybe there's a --

MS. NEUMANN: That's correct.

COMMISSIONER MCALLISTER: Okay.

MS. NEUMANN: Yes. So, Nick wanted me to build it up and these are --

COMMISSIONER MCALLISTER: Okay.

MS. NEUMANN: -- the slides that he created.

COMMISSIONER MCALLISTER: Okay. Oh Okay.

MS. NEUMANN: Yeah. Yeah.

COMMISSIONER MCALLISTER: Okay, got you. Got you, sorry. Because it doesn't look like we're meeting it in this framing. So. All right, I'll end this thought. So just --

MS. NEUMANN: Right, right.

COMMISSIONER MCALLISTER: -- wanted to be clear about that for folks who might have been confused. So thank you.

MS. NEUMANN: Exactly. It's I think -- it's just a lot of information in one chart and I know it just, it takes, it's best to look at it step by step and so that's what I was trying to channel Nick there and do that.

COMMISSIONER MCALLISTER: Sorry about that. Yeah, go ahead, that's --

MS. NEUMANN: No worries, no worries.

COMMISSIONER MCALLISTER: Yeah.

MS. NEUMANN: Yeah, yeah. So here we go.

First, right, we wanted to go through the -- kind of walk through what the scenarios do. So, we chose the gas energy efficiency on the very left-hand

side in the kind of dark or dark pink, light red color. And then the minimal electrification scenario, that's right next to it on the left-hand side.

So, the top percentage for the both, so for the gas energy efficiency is 36.8 percent, and for the minimal electrification scenario, it's 41.2 percent. Those are the ones if we choose the system-wide emissions baseline. So that's the red line. Then the bottom percentage in parentheses actually is the percentage of the target reached under the direct emissions target. So, it's only 2.2 percent for the gas energy efficiency and 12.3 percent for minimal electrification.

So, the minimal electrification scenario does achieve at least the 40 percent reduction in the system-wide approach, but it does not in the direct emissions approach.

So, then we can investigate the impacts of SB 1383. And we are advised to be careful about the -- how we interpret those impacts because SB 1383 is a short-lived climate pollutant legislation that actually covers several emissions in all sectors. Right? Whereas in AB 3232, we're only looking at the residential and commercial building sectors.

We're also only referring to HFC emissions of

refrigeration and air conditioning in those sectors. And as such, the pattern bars stacked on top of each one of these scenarios are unique estimated case of whether the refrigeration, air conditioning, HFC emissions from buildings decline 40 percent from 2013 levels by 2030. So that was the benchmark year for SB 1383.

So, it's not a binding target because SB 1383 is really economy wide and as measures are developed, efforts are taken towards meeting these targets they may shift between one sector to another and that sort of thing. But it does give us an idea and we can see that this assumption reduces the emissions by an additional 7.5 million metric tons of carbon dioxide equivalent. So, it can change the narrative.

What we see here is that then the aggressive scenarios actually do meet the direct emissions target, the aggressive electrification scenarios. So, for the blue numbers here that are on the left-hand side, the ones in the 42.8 percent for the gas electric -- or sorry, that makes no sense. The incremental gas energy efficiency, the 42.8 percent now reaches the system-wide baseline. The minimal electrification scenario now goes further beyond the system-wide baseline at 47.2 percent. But both still fall short of the direct emissions target in the black dotted line. So those are at 16 percent

and 26 percent right now, if we consider SB 1383 success, whatever that means, in those particular sectors. So, we have these bookends. Right?

So, if we look at the entire picture, right, the narrative certainly still depends on which baseline is chosen, either the direct baseline in the black dotted line or the system-wide emissions baseline in the red line. That extends for all scenarios. But it also depends on the extent that HFC emissions are reduced. And we are just looking at extreme cases here.

So, like I mentioned before, the aggressive electrification scenarios are the only ones that can achieve the much more aggressive direct emissions baseline target at 48 percent and 49.8 percent when SB 1383 is also quote, unquote, met. So that's the chart that's actually in the report in its full glory.

So, this figure is a little bit different. The previous figure reported potential emission reductions. So, we were trying to reach a line. In this graphic, we're going back to when we set the 1990 GHG baseline. So, in the very left-hand side that might look familiar. And we're really trying to diminish these bars so that they go below the red line here.

So, the red dotted line here are the system-wide -- is again, the system-wide emissions baseline and

that's the one, we're going to show you the same picture for the direct emissions. And this is the one that includes the share of electricity generation emissions attributed to residential and commercial buildings. So the far left, once again, shows the 1990 baseline as we set it in the scoping and then the second one, the 2018 baseline, gives us an idea of where we were the last time there was an inventory. And then we can project for 2020 where we think we were when we started this analysis. And then where we think we would be without any of these building decarbonization scenarios for the 2030 baseline. So that would be the fourth column from the left.

So that's the 2030 baseline without any SB 1383 included. And then the fifth column from the left is a 2030 baseline with SB 1383 efforts fully included.

So, in the middle we have our electrification scenarios. Right? Minimal, recommended, aggressive, and efficient aggressive. And, you know, they, as expected, diminish. You can see some fluctuation in the brown bars from the electric generation system. So, indeed, the added electricity -- the added incremental electricity need does affect the system-wide emissions. And we can see that here.

Of course, the blue bars for the fossil gas

consumption diminish as they should if we are displacing natural gas -- or displacing fossil gas. And then the five impact scenarios are shown on the right-hand side. And so there we can see what the accelerated renewable electric generation system. We see with the higher RPS, we see a diminished brown bar as well, as expected. The electricity energy efficiency, it's not quite as noticeable on the scale. The gas energy efficiency, I think we can see that the blue gas consumption -- fossil gas consumption has diminished, and so on. And certainly, we can see that with the renewable gas on the very right-hand side.

And then there are the stock HFC leakage emissions in the gray stacked columns. And then the lighter hash gray are what the difference would be between not completing any efforts towards SB 1383 versus meeting those efforts fully, as we broke down those percentages for the residential, commercial building sector.

So similar as to the last figure, it does show that electrification scenarios do reduce emissions by at least 40 percent and they, you know, as they are expected to do with having a lot less fossil gas consumption.

So, then we want to show the same picture for

the direct emissions baseline. So there are fewer scenarios to examine here, right, because we can't look at electric energy efficiency or a different RPS standard or behind-the-meter solar, right, because those affect the electric generation sector and not the actual -- which is not considered in this direct emissions baseline.

So, the brown bar across this chart gives that baseline that we're trying to go beneath, and we can again see that only the aggressive electrification scenarios in the extreme case that SB 1383 is in effect, actually meet the target.

Okay. So, we showed you the GHG impacts occurring in 2030 and now we would like to discuss the costs and cost-effectiveness of those scenarios.

So there are many definitions of cost-effectiveness and our definition is specifically adopted from the 2017 CARB Scoping Plan which reads: Under AB 32, cost-effectiveness means the relative cost per metric ton of various GHG reduction strategies which is the traditional cost metric associated with emission control.

So, what that means is that we're strictly looking at the cost side of abatement and we're not including anything such as nonenergy benefits, health

benefits, or the social cost of carbon. So, this is not a benefit cost analysis. We're just comparing the relative cost per metric ton of each of these scenarios against each other. The calculated dollar per ton estimate reflects the average costs of activities occurring between 2020 to 2030.

So for electrification, you know, that actual substitution of a technology or for energy efficiency, you know, installing a more efficient appliance or HVAC system, what have you. So that all occurs in the 2020 to 2030 time horizon. But because the useful life extends beyond that, the emissions reductions from that are measured out to 2045 and the costs that occur for the new equipment subtracting then the equipment costs that were replacing it are included out to 2045. Right. So emission reductions and costs continue past 2030. So, we'll break that down.

So first some things about cost calculation assumptions. So we are assuming an annual inflation rate so that all dollar amounts, of two percent, so that all dollar amounts are compared to the same year. And so, they're all in 2020 dollars. There's a 10 percent discount rate applied which is the same as the one that's used in that 2017 CARB Scoping Plan and that's benchmarked in the documentation as roughly reflecting

the historical average of real credit card interest rates.

So, when looking at costs to customers, prices are fixed and are based on the rates in the 2019 IEPR forecast. So, the retail rates in the 2019 IEPR forecast. And prices are not updated in this analysis based on electrification penetration. For electrification, there are three components of cost. There's the incremental cost of the technology relative to the -- or of the electric technology, relative to the baseline gas technology costs. And for incremental technology costs, we should note that the FSSAT does consider the effective air conditioning costs, if those are added to the baseline gas technology cost based on the input of proportion of buildings that have air conditioning, existing buildings, and those that do not. And that's included here.

So, we also include the net fuel costs, right, and those are the ones that would be incurred past 2030. So, there's a comparison of the operating expenses of the electric and gas technologies again based on the 2019 IEPR retail rate price -- or retail price forecasts. The electric panel upgrade costs are also included. The way that's done is it's at an aggregate level based on the percentage of natural gas removed due

to the electrification efforts. It's not yet at the specific building level.

So, here's an example how the costs are disaggregated for the moderate electrification scenario. So, this is the split up by sector. So commercial, residential, and then combined. So, the first two bars, the blue are the electric technology, and the red are the avoided gas technology costs. So here we're showing what it is for residential net.

Then the next set of bars are the, so the third and the fourth set, are the net fuel costs. So the electricity added and then the avoided gas costs. So, we're showing that here for residential. And then the last bar, which is, you know, I can't see it very well because we're here on a scale of billions, right, versus millions for the panel costs, is the costs for residential panel upgrade costs. So, it's -- panel upgrade costs are included here.

So, then the last set of bars include the net costs. Oopsie, that went -- okay, here we are. So, the last set of set of bars in green shows the net costs and for residential electrification, it's $11.52 billion for this particular electrification scenario. And then there's the summation of all of the above on the right-hand side cluster where we have combined residential and

commercial. And that total net cost is the very most right-hand green column at $6.24 billion.

So, this table here combines both the GHG and cost information so that we can start getting, you know, cost per ton. The top four green rows are the electrification scenarios and the bottom five rows are the impact scenarios. The first column for each are the annual avoided GHG emissions which without parentheses would be the ones that we would have without any SB 1383 efforts. And then the ones in parentheses are those including the added efforts of SB 1383.

So, the last column then shows the cost per metric ton over the 2045 time horizon and we can start comparing scenarios using that cost per ton. The electrification scenarios vary from around 40 to 140 dollars per metric ton. Of course, it makes sense that the cost increase with deeper electrification penetration, so more effort. And the renewable gas scenario has the highest cost per metric ton.

Many of the impact scenarios have negative abatement costs, right, the energy efficiency on the PV. And we want to caution to keep in mind that, you know, though there might be some negative costs, these scenarios might not be as scalable and many economists can be skeptical of such high negative abatement costs

because it does imply that consumers and businesses are not acting in their best interests. And sometimes that appears to be a very active debate and if you want to know more about that, then Nick Janusch is the person to ask and I'm still learning about that as well. Because I look at that, too, and I say negative cost, you know. That's pretty enticing.

All right. So, then we translate this information into creating useful curves called marginal abatement cost curves. The definition of a marginal abatement cost curve is one that plots the marginal costs of achieving a cumulative level of emissions abatement in order from least to most expensive scenario, measure, or technology.

So, there are different ways that we can look at that data. Then the MAC curves are commonly used in policy analysis to indicate emission abatement potential and the associate abatement costs and provide a simplified and useful tool to illustrate the complex issue of cost-effective emissions reduction. So, to provide a visual that's maybe easier to process than the chart that we were looking at before.

So, here's the marginal abatement cost curve for the moderate electrification scenario. It shows the relative cost, so the height in average cost per metric

ton; and then the width which actually gives a measure of the abatement. So how much GHGs are removed or abated out to 2545 for each of these different scenarios. So, we have the residential electrification portion in green. Right. Then commercial electrification is in blue and it's below the axis so it means it actually has a negative cost. So that was something that I was asked to point out that the commercial electrification in the moderate scenario had a negative cost.

Residential electrification has the highest potential meaning it's the widest, but it does have a positive cost. Renewable gas also has potential but it does have the highest cost in the most right-hand side because that's how the marginal abatement cost curves work is that the highest cost is always furthest to the right and then if there are negative costs, they're furthest to the left. And there we see our incremental electricity -- or incremental electric energy efficiency savings showing up.

So, this is a similar chart for the aggressive electrification scenario. Here we can see that once we've dug deep into the whole electrification maybe the costs are not as negative anymore. Residential, again, has larger abatement. We're also showing the

residential panel upgrade costs on top of that residential piece adding to the cost. And it really shows that aggressive electrification has an enormous abatement potential compared to some of the other impact scenarios, even if those do end up being less costly, for example.

So, with our analysis, we can also look at the abatement cost curves by end use. So maybe looking at the most promising end uses on a cost metric. And this is done here for the moderate electrification scenario. So, note that these costs don't include the panel upgrades because for this analysis, we didn't attach them to a given end use or building. So that's not included on this marginal abatement cost curves.

So, our observations are as follows. The commercial water heating and HVAC have very negative costs, right, there the most -- on the most left-hand side of this chart. And residential HVAC, you know, has a small negative abatement cost so that looks good here, at minus 17 dollars -- or, yeah, per metric ton. And then HVAC and water heating are more cost-effective compared to other end uses. Perhaps the high appliance plug which encompasses cooking and laundry costs could be attributed to assuming very expensive replacement appliances for those end uses, if one switches from gas

to electricity.

So, then I would to continue on the electric system impacts and grid implications of these electrification and impact scenarios. So, we'll start with the -- well, it's all a summary of our results. We did need to consider the interaction between electrification and electricity generation system emissions when accounting for the electric generation emission impacts. Right. It did matter what the total electricity demand was.

So, this is where we worked with our supply analysis office staff to run PLEXOS for the various scenarios to get those GHG impacts. So what we see in the figure as the middle bar which includes the baseline case that has -- so this is the baseline case for the 2030, what we would think 2030 would look like without these electrification or impact scenarios. And we have in the brown the electric generation system emissions and those are computed using PLEXOS. And then we have before the building electrification scenario example in the most right-hand column. We also have that baseline demand that's included in addition to the incremental added demand. And both of those pieces have to go through this process with the supply office and all their PLEXOS modeling.

So, I am now going to hand that off to Angela Tanghetti who will be speaking about the work that she and her team did about the -- on the electric sector GHG emission impact.

MS. TANGHETTI: Thanks, Ingrid. So, I guess I'll start sharing my screen here. Okay.

MS. NEUMANN: Or you can just tell me to click, Angela.

MS. TANGHETTI: I'll be telling you to click a lot, but that's okay. That's okay.

So before -- I just wanted to say good afternoon. And before I add any specific data and analysis of this slide, I want to describe the axes shown since I'm attempting to show projected electric sector emissions for all AB 3232 scenarios on one chart.

But first, I refer to these scenarios as AB 3232 scenarios, but after listening to Commissioner comments and stakeholder questions this morning, I'm ready to embrace and begin using the acronym AAFS when we get there to get myself and stakeholders familiar with that term. I like it. I like that term a lot. It'll be real helpful.

So first off, what I'm going to describe today, again, is just the electric sector or the electric generation system emissions as Ingrid has been sharing

with us.

So, the left axis, again, is labeled MMT and this will display the million metric tons for the total electric sector or also known as gray emissions. These data, again, were calculated using simulation results from the CEC's PLEXOS data set developed in support of the 2019 IEPR, and that was our basis. So, the AB 3232 team was able to provide not only annual energy increases but also hourly AB 3232 scenario projections for use in these PLEXOS simulations results. And the hourly results were real -- I mean, the hourly input from this load impacts of the scenarios were important.

On the next slide is a link to one of our presentations and you can -- we'll get to that in the next where we get into the specifics of using PLEXOS results to calculate electric sector emissions. It was -- we've presented it numerous times before so I'm not going to go into that description of calculating it with PLEXOS. So, again, I'm not going over those specifics today, but I'll be happy to answer questions and there's links on the next slide.

Okay, so let's see, the left axis. So, what the PLEXOS team did for each of the AB 3232 scenarios is develop a unique portfolio for each scenario. The 2019 IEPR adopted mid-scenario with our basis or as we're

going to show here on the legend, it's the business-as-usual case. And to that case, we either added or removed additional RPS resources.

So, there's two cases that removed RPS resources where the increased AAEE and the behind-the-meter PV scenarios. Since those two cases -- oh, don't move. (Indiscernible.) I want to describe those axes before I start throwing the data out there first. So, the axis is in the data.

So, again, the two cases that removed RPS resources were the ones that increased the additional achievable energy efficiency and behind-the-meter since those scenarios decreased the load which then decreased the RPS target. So, all other scenarios increase the amount of RPS resources that were needed to meet the RPS target, as well as the battery storage was also needed for reliability for those AB 3232 scenarios that increase load. So, again, we either added RPS resources or in two cases took away RPS resources based on their impact of to the load. Battery storage was, again, needed for reliability for those AB 3232 cases.

And then the right axis what we're going to present there is electric sector annual average electric grid emission intensity. And this is a simple calculation of the grid emissions that are -- I'm going

to show on the left axis divided by the total annual energy generated from the grid for each one of those scenarios. Even though it's a simple calculation, annual average results may mask some of the hourly average details. But still, it's a good metric to start with. But, again, with building fuel substitution, the hourly implications are critical as well. But for this slide, I'm just going to show annual.

Again, the bottom axis is going to display both sets of data from an annual perspective for the years 2022 and 2030. I didn't think it necessary to busy this chart with additional years since in my opinion it only showed the data right in the middle of these two projected scenarios.

So now finally let's get to the results. So, for, we're going to show is first off the IEPR 2019 mid-case or what we're calling the business-as-usual case. And as you can see, the emissions are declining over time.

And then with the next scenario is the accelerated energy efficiency case so we just had additional AAEE. There wasn't that much in 2022. By 2030, there was probably 20,000 gigawatt hours of additional achievable by 2030. So that's why we see a more significant drop in grid emissions in the year

2030.

The next case is a rooftop PV. Again, very little impact in 2022 and it's hard to see on this chart, but there was impact in 2030. This case added about 3500 megawatts more of behind-the-meter PV which is only about 6100 gigawatt hours of additional energy. So, again, the results are really hard to see from a statewide perspective but they were slightly lower.

The next case, the accelerated renewable -- the accelerated RPS target, we added about, it turned out to be about 70 percent RPS, needing a 70 percent PRS by about 2030. 2022, again, it was just on a simple trajectory so it did lower the RPS -- I mean, raise the RPS target in 2030 as well as 2022. So that's why you can the decrease emissions from the base case.

And then the last three scenarios are AB 3232 additional load scenarios. So, again, the minimal and moderate, the efficient, and then the aggressive. So, you can see over time all emissions are in a downward trajectory from a total emissions standpoint.

So now the next interesting metric, we're going to start looking at the emission intensities from each one of these so if you can go ahead and click to the next slide.

Here is our emission intensity from the

business-as-usual or IEPR 2019 mid-case. Again, you can see grid emission intensity going down over the forecast period on the next scenario is, again, the additional EE which, you know, I'm calling it very similar. It's on the same trajectory over time. Those are very different, small changes in 2030. The next scenario is behind-the-meter additional -- behind-the-meter PV. So, again, all very similar. All declining over time as far as an emission intensity metric.

The next one is more interesting. So this is definitely different than the previous three cases where is if you accelerate the RPS by 10 percent, you are going to see a significant drop in emission intensity between the two cases. Because what happens is you're basically just having lower emissions but you're dividing by the same number because, again, emissions intensity is just a simple calculation where the denominator stays the same in that case, as a base case, but the numerator, the emissions are increasing, excuse me, decreasing in that accelerated RPS scenario.

And then we can go ahead and put the three electrification scenarios up which are all very close. So, again, we're seeing emissions increase in the electric sector over time with the emission intensity, again, is decreasing and are very much in a similar

range.

So that's kind of throwing a lot of stuff on one slide for the electric sector but I think it's important to show the grid emissions changing over time for all cases. And then the emission intensity and how they're very similar. But the significant change is with the accelerated RPS. So, again, that's what we have on this slide.

The next slide is just the link to the presentation where we go in much detail about how we take PLEXOS simulation results and calculate emissions intensity and overall emissions using those simulation results and some of the inputs that go into there.

So please have a look at that presentation and I'm happy to answer any questions offline of that.

So thank you.

MR. ROSALES: Thank you, Angela. Thank you, Ingrid. That was a great presentation.

Okay. Let's go -- Brian, can you queue up -- yeah.

MS. NEUMANN: I'm sorry, we're not done.

MR. ROSALES: Thank you (indiscernible).

MS. NEUMANN: No, we're not done.

MR. ROSALES: Oh. You call it. Sorry, we'll pull back and then Ingrid, you can take over.

MS. NEUMANN: Yeah. Okay. All right. So, let's go in here. Let's see, am I sharing the right screen now?

MR. ROSALES: Slide 41 of 54?

MS. NEUMANN: Slide 41, yes. No?

MR. ROSALES: Yeah, just go in presentation mode.

MS. NEUMANN: Let's see, what have I done? It hides my Zoom, then, once the -- let me -- I need to redo it. Okay. Stop share and go back here. Okay. Sorry, we seeing my slide now? Statewide Annual Gas Demand by 2030?

MR. ROSALES: Yes, Ingrid.

MS. NEUMANN: Okay. Cool. All righty, then. It's Friday. I know we're all ready to be done. Almost there.

So, here's the projection of statewide annual gas demand by 2030 for our electrification scenarios. So for each of the electrification scenarios in -- that we use, we use first the 2019 mid-mid AAEE Scenario 3 which is the planning forecast used to adjust the 2019 mid IEPR baseline cast -- forecast to our business-as-usual before we applied any end use fuel substitution. So, before any electrification efforts were undergone, we adjusted the baseline gas forecast with that

additional achievable energy efficiency, our business-as-usual forecast.

So, you see that there is some gas displaced by the assumptions of energy efficiency that we have here. But 94 percent of gas consumption still would remain in that 2030 projection, business-as-usual projection.

So, in the next -- in the minimal electrification moderate electrification, and aggressive electrification scenarios, of course as expected, we see reductions in those gas consumptions rates. So, we have 76 percent of the baseline or business-as-usual. That remains. 62 percent all the way down to 28 percent in our aggressive electrification case. So, a lot of gas end use consumption is displaced.

So, it is broken up by the three gas utilities in California. And -- or at least the largest. And we concede that it's also broken up in the residential and commercial sector to it turns out that the gas consumption that we considered displacing is 87 percent of the combined residential and commercial sector end use consumption. That was the amount that we decided (indiscernible) down to a technology level based on available technologies.

So, 77 percent of that gas consumption is in the residential sector which is why we see more of that

being displaced here in our electrification scenarios in the three columns on the right. 87 percent of the residential consumption that's eligible for electrification is split between HVAC and water heating. And that's similar in the commercial consumption eligible for electrification, that's 84 percent split between HVAC and water heating. So those are the biggest end uses that we considered for electrification.

So, for each of the electrification scenarios shown here, they do meet or exceed the AB 3232 target if we're looking at a system-wide GHG baseline. And that means that if we're still providing the same service, so you still have heating in your home or you still have hot water, that means we have to add electric consumption. And this is the incremental electric energy that's added due to these electrification efforts.

So, it's not too big in the minimal. Right? It ends up breaking down to being three percent amount of the baseline commercial consumption, that's added on top of it. And the total annual basis in 2030.

Then we have for the residential sector, it's nine percent of baseline consumption that's added on top. So, this is just the added or the incremental electricity due to the specific electrification

scenario.

Of course, it grows the more electrification we apply in each scenario. The 4 percent and 19 percent for the moderate and then all the way up to be adding 40 percent of baseline consumption for the residential sector. So what that means is that we would be saying in our business-as-usual our 2030 baseline, we would have a certain amount of electric consumption estimated for our forecast. And we're saying that literally over in that year 2030, we'd be adding 40 percent of that on top of it from this aggressive electrification effort. So that is something to consider when planning.

Now what we do see here on the very right in the efficient aggressive electrification scenario is that the percent of incremental electricity added in the residential sector drops down to 31 percent in that scenario. And it's for the same amount of gas being displaced.

So that's attractive and that is what really we're looking at and thinking about when we say something like efficient electrification. That we need to be mindful of what electric technologies and their efficiencies that are actually being used to replace gas technologies.

So as shown on the previous slide, the

aggressive scenario added a total incremental electricity of 47,600 gigawatt hours in 2030. And if we simply change them, mix up technologies to being the most efficient ones, then we actually only need to -- we can reduce the amount of added electricity consumption by 19 percent. So that means that there's 19 percent less incremental electric consumption added in the efficient electrification scenario as compared to the aggressive electrification scenario. And they both displace the same amount of gas.

So this is where we start thinking about something other than just, you know, how much is being used on an annual basis but rather when we're using this electricity. Because that matters a lot for electricity planning purposes and system reliability and that sort of thing.

So here in this graph we're showing both summer and winter incremental loads for all of the -- for the electrification -- or the aggressive electrification scenario study for the five largest utilities. And then a statewide portion, of course, only for residential and commercial sectors because that's all that we are including in the AB 3232 analysis.

What is -- needs to be pointed out here really is that the blue winter columns are larger than the

green summer columns. So that means that winter loads increase more than summer loads. And that's in all utilities. It's different amounts depending on where those utilities are located but the winter load increases more than the summer load. We define winter as the four months from November through February and summer as June through the middle of October.

Now the full impact of this added energy system -- so the added energy system loads resulting from these electrification efforts can only be assessed when we measure those against the baseline loads and how they might change the baseline loads.

So, this is similar to our business-as-usual case where we have various load modifiers like in this mid-mid managed IEPR demand forecast. And we need to do that on an hourly basis then. So, I'm going to walk through that on the next slide here.

So on the very last -- and this example is for PG&E. We had in our forecast, we have the hourly loads, the managed hourly loads for all CAISO-managed territories so it was easiest to pick out PG&E here. And we then we'll show you how this may break out between Northern California and Southern California with PG&E as a proxy for Northern California and SCE with SDG&E as a proxy for Southern California and utilities.

So here we have our PG&E example. We have the electrification of peak load, so that's the load in the peak hour of that season in 2030, under the aggressive electrification scenario.

So, the winter load in dark blue on the left-hand side is bigger than the summer peak load added in green. So, this is the incremental electrification peak load, like when does that peak. Then we have the baseline or business-as-usual peak load without the electrification scenario. And, you know, this is something that should be familiar to all California residents, right, we usually have a summer peaking system so that's when we have worry about weather-related reliability and that sort of thing.

So, then we would have -- what we're trying to look at is how does the electrification peak affect the business-as-usual peak because they don't occur at the same time. So you can't just go in and take the dark green incremental electrification bar and place it -- and stack it directly on top of the light green summer peak, right, because they're not occurring at the same time.

So, for example, if the electrification peak is September 2nd at 6:00 p.m. in PG&E territory in 2030, and our business-as-usual managed peak is at 8:00 p.m. on

July 2nd. So, we actually would have to add these on an hourly basis and then find the new total projected peak load which is in the gray shaded columns behind. And it's the same thing here for the winter peaks. And we can also, you might notice that the winter baseline -- or business-as-usual peak actually has shifted from 6:00 p.m. to 7:00 a.m. and we'll see that a little bit more.

So incremental fuel substitution additions are not coincident with managed peak load dates, so the emphasis really has to be on when we have the net or total projected peak load and what that looks like. So, it certainly grows but it does some more important things other than growing, it can actually change the dates and the times of the total projected peak load once we add electrification.

So what we need to do -- so the -- for the gray shaded columns is we would find on an hourly basis, once we've added everything on an hourly basis for the electrification impact on top of the baseline, where that new peak is. And that turns out to be July 2nd at 5:00 p.m. in the summer and January 3rd at 7:00 a.m. in the winter.

So then we could pick out those appropriate amounts here so you can see that the left-hand two

columns here, the green column on the top left is bigger than the green column on the bottom left and that's because the electrification peak load occurs at a different time -- or is different in megawatts for that hour than the electrification incremental load added at the total projected peak load. So we determined, right, that the total projected peak load was here at those times in red, in italic red on the right-hand side, July 2nd, 5:00 p.m. for summer; January 3rd at 7:00 a.m. for winter. So, one would have to pick out those incremental electrification load at that total peak load, as well as the business-as-usual at that peak load and then those would correctly fit into these columns. So certainly, the peak load increases, but it's a little trickier than that because everything's time dependent.

So, what we see, to summarize, is electrification increases peak loads which grow in magnitude by 2030. So here we're showing the Northern California versus Southern California as the IOUs, using the IOUs as proxy when we see that growing from 2022 to 2025 and out to 2030. And we see that in Southern California on the very right-hand side in the winter, there is a significant portion of electricity at -- during that peak. So, because those -- so I mean, we can see that that blue incremental amount from

electrification is almost as large as 43 percent of that baseline that's being added on there. So, it does a little bit more.

We see that those impacts actually become -- because they're so sizable and they're not coincident, they actually change the time of the total peak if we include that electrification. So, for example, for PG&E in the winter, the peak has shifted from our business-as-usual case from November 13th at 5:00 p.m., to December 2nd at 6:00 a.m. So, you know, the 13th -- November 13th to December 2nd might be a little easier to plan for but there's a fundamental shift in the timing. Right. Instead of having an evening peak, one might have a morning peak, maybe due to space heating. And we also see that –

COMMISSIONER MCALLISTER: Ingrid, I'm going to -- I'm going to just jump in real quick. If you could -- we're a little bit past time so if you could –

MS. NEUMANN: Oh.

COMMISSIONER MCALLISTER: -- move forward and wrap it up, please?

MS. NEUMANN: I don't credit for finishing earlier on the other one? Not on a Friday afternoon, right? Absolutely, okay. I don't have much.

Okay. So and then -- and we see that in the

southern utilities as well, right, the peak, it shifts from 6:00 p.m. to 7:00 a.m. So that's something one would have to take into account if pursuing aggressive electrification strategies.

So, the last bit that we wanted to present was about load flexibility. Load flexibility was very specifically analyzed as load shift according to the CPUC's definition. We -- so for this analysis in support of AB 3232, we used the LBNL Demand Response Potential Study that was released in summer of 2020. We used those take and shred schedules in order to shift 20 percent of hourly end-use demand. We only studied additional load shift potential of newly electrified end uses. And then we further limited that to HVAC and water heating because we thought there were too many behavioral issues with appliances.

These were the values on the bottom three rows that staff found for the electrification scenarios when shifting 20 percent of those HVAC and water heating demands and that's in comparison to what LBNL found for commercial HVAC. So, they're pretty conservative estimates.

But they still showed significant impact on system reliability, perhaps. We saw that what would -- the amount of battery storage that would need to be added without this load shifting effort in that

electrification scenario are all the blue columns here for each month in the year 2030. And if we applied the load shift, then those columns were all diminished due to the orange columns -- the shorter orange columns. So, what that means is it reduced the battery storage that needed to be added by 1250 gigawatt hours in 2030.

We also looked at renewables and the renewable curtailment that would occur without load shifting is shown here in the blue columns and the renewable curtailment that would occur with load shifting is smaller. So that's good, we're getting to use some more of that renewable energy, and it reduced curtailment by 350 gigawatt hours in 2030. And yes, that does assume load shifting every day of the year.

So here is some more background material that folks wanted me to share, and I will leave with this slide here. I want to thank you all very much for giving us the opportunity to present our work and we can be reached here for further questions. Nick, especially, our environmental economist, welcomes any questions regarding, especially the costs and GHG impacts. And I am here today. Thank you.

COMMISSIONER MCALLISTER: Thanks so much, Ingrid. I really appreciate it. I'm sorry to hurry you along. They're so dense -- so much density to these presentations today and I know people's heads are kind

of spinning probably.

But please do -- for everyone who's listened in, please do feel free to contact Ingrid and Nick and, you know, we'll try to make sure that -- to, you know, walk you through if that -- as necessary, as needed, right.

And so, with that -- so thank you so much, Ingrid. You've carried a large burden today on a Friday, so thank you very much.

And thanks to Angela as well, that's super interesting. And we -- you know, as you all can tell, the Commission staff has brought, you know, some pretty, you know, heavy-hitting tools here to this task. And the idea, as we talked about this morning was -- really is to continually be able to, you know, tweak the scenarios, improve them, make them more complete, and change as reality changes as we go forward. So that's why we put, you know, this effort into initial analysis.

With that, I think we're ready to -- well, let me ask if Commissioners Gunda and Rechtschaffen have any questions or any comments to make before we move into public comment.

COMMISSIONER RECHTSCHAFFEN: Thank you, Commissioner McAllister, I don't have any specific questions at this time.

COMMISSIONER MCALLISTER: Great.

COMMISSIONER GUNDA: Yeah, Commissioner McAllister, I don't have any questions. But just in a way of comment, again, thank you for this wonderful discussion here. And it's really -- I wanted to kind of call out one specific point on the change in load and the time of the load and kind of winter peak system, potentially.

And then the second issue of like just even the summer peak moving to earlier hours again, rather than kind of staying the worst in that peak time. So just really interesting insights that could -- you know, will definitely benefit from further discussion and analysis. Thank you.

COMMISSIONER MCALLISTER: Yeah. Thank you very much, Commissioner Gunda.

Yeah, it is remarkable and, you know, it's counterintuitive in some ways but California -- much of California has a heating-dominated climate. Even though it gets hot in the summer in the Northern and Central Valley, it's still a heating-dominated climate zone. So, you know, I think we'll continue to get these insights that'll give this rich and the staff keeps working on it.

So, with that, I think we can go on to -- we do have a few questions. Maybe we can dispatch with the questions and then go into public comments.

MR. ROSALES: Absolutely. Thank you, Commissioner McAllister.

Thank you, Ingrid, and Angela, that was a great presentation. I believe the Chair has joined us now. I just -- before I go to the open questions, I want to check in with the Chair. Chair Hochschild has joined us. Welcome, Chair Hochschild.

Do you have any comments or questions you'd like to make?

(No response heard.)

MR. ROSALES: Okay. I don't know if he's on mute, but I'm going to move with the questions and feel free to jump in as we go through.

So, it looks like there's only three questions, so I encourage anyone who would like to submit a written question to go ahead and use the Q&A feature on Zoom. If anyone would like to present a live question, please use the raise hand function and we will get to you after we read off the questions here.

Ingrid, Angela, if you guys could stand by so I could read off these questions. First one is from an anonymous attendee.

For the max life, does residential electrification costs factor into rooftop PV?

Ingrid, do you want to take this one?

MS. NEUMANN: Yeah. So, I would say no,

right, because we're analyzing each of these scenarios independently. So, our impact scenario for PV would not include any electrification; it would only include additional behind-the-meter PV. Whereas electrification scenarios would only include the replacement of gas technologies with various electric technologies.

MR. ROSALES: Thank you, Ingrid.

I'll go to the second question here. Ingrid, if you could stand by, I think this is referring to your Slide 24.

Do you see a different reduction percentage across the three different utilities?

And maybe you want -- can you pull up Slide 24, as well, if you have time.

MS. NEUMANN: Yeah, let me do that. So, let's see. I have too many screens --

MR. ROSALES: And the question is --

MS. NEUMANN: -- from --

MR. ROSALES: Yeah. And the question is from Calum Chong.

MS. NEUMANN: Okay. So is it there?

MR. ROSALES: Yes --

MS. NEUMANN: Can you see this --

MR. ROSALES: -- 24.

MS. NEUMANN: Okay, cool.

I'm trying to think. So, do we see a

different reduction percentage across -- so a different GHG reduction percentage? And I would say we did everything on a proportional basis. So as we get data in for on-the-ground, you know, say electrification programs from all the utilities, then we could like -- or at least we're working to build the capacity to be able to analyze those. Right now, our assumptions are uniform statewide. So, if -- you know, if there's a program that causes 100 percent electrification and, you know, 80 percent replace on burnout and PG&E, the same would be true of SCE and so on.

So, we wouldn't be able to see those differences because right now it's still rather speculative, you know, what if we did this. Right? There is no actual program -- it's not a forecast of what would look like -- what it would look like with specific programs implemented yet.

MR. ROSALES: Thank you, Ingrid.

MS. NEUMANN: I hope that at least starts to answer that question.

MR. ROSALES: Thank you. And I'm going to stay with the same attendee before I get to the next question.

So, Calum is also asking: For the increased peak load, was it assumed that incremental demand will be supplied from renewables in 2030 or only 65 to 70

percent renewables?

MS. NEUMANN: Yeah. I see Angela Tanghetti would like to answer that and --

MS. TANGHETTI: Okay.

MS. NEUMANN: -- that's the right person.

MS. TANGHETTI: Thank you. Thank you. And the increased peak load -- and I think you're talking about all the electrification cases. And so what we did is we added a mix of resources to meet the RPS first. So when you add a mix of resources, you can have out-of-state renewable resources, and you can have in-state renewable resources, and wind and solar. So, it is a diverse mix and some of them have more impact during the peak than others.

And then what we did from there is from a reliability perspective, if the reserve margin was dropped below a certain percent, 15 percent, we did add battery storage. So all the impact of -- to peak, where we added battery storage, also helped meet the increased demand in the winter. So, it was a mix of resources. And it was all the other cases except for that one individual case had 60 percent RPS by 2030.

MR. ROSALES: Thank you, Angela.

MS. TANGHETTI: Sure.

MR. ROSALES: Ingrid, Angela, I think if one of you want to take this next question. It's submitted

by Marcus Fink (phonetic). He's asking: Does the negative marginal abatement cost (MAC) for commercial electrification is surprise -- well, the negative MAC for commercial electrification is surprising. Can you provide more details on the assumptions behind this result?

Do you want to give a brief response on that? I know we don't have Nick here, but can one of you guys take this one?

MS. NEUMANN: Right. I would suspect it has something to do with -- I mean, you put together all of these pieces based off of equipment costs, right, installation costs, and then the gas and electricity rates. So maybe some of that equipment isn't so expensive or the difference isn't so big, or perhaps it's even negative. I mean, that's speculative on my part because I didn't break that down myself.

MR. ROSALES: Thank you, Ingrid.

Okay. Two more questions. Next one's a big one. It's from an anonymous attendee, so bear with me.

What did the cost for the measures, including the renewable gas include; service cost of resource acquisition, extraction, distribution, and any end use equipment first costs, including installation labor costs, and/or life cycle operating costs? And for operating costs, what were the assumptions? 15 years?

20 years?

And I'll pause there because there's some more but I'll let you -- Ingrid, if you want to sort of address that before we break up the second half of this question.

MS. NEUMANN: Yeah, so this might be a good one for an email too. But I would say that we looked at the cost of the actual renewable gas that would go into existing gas pipelines. And I don't believe that one would need, you know, different pipelines or different end use equipment for any of -- for this renewable natural gas, you know, gas system decarbonization scenario.

We did do the costs a little bit differently because if you're considering that you're buying this renewable natural gas and putting that into the pipeline, you would have to continuously purchase more gas, so it doesn't really have an existing useful lifetime, it's just on a year-for-year basis. So, we did that cost out to 2030 and also only the emissions reductions out to 2030. Right? Because there was new equipment in that scenario.

MR. ROSALES: Ingrid, and the second part of the question is on rates and costs. The question is this: And what were the rates used in any of the assumptions? How were any demand charges or electric --

all electric rates or different rate schedules modeled, if any?

MS. NEUMANN: Yeah, if any, right? So, we used the rates from the 2019 IEPR forecast. I think there was some discussion earlier about how some of these rates might change with rulemakings or how they might be changed to encourage all electric and -- but we didn't model that, per se.

MR. ROSALES: Thank you, Ingrid.

All right. The next question here is from Evelyn Loya. She's asking: Since projected annual gas demand decreases, how did you model the PVAC loop of electrifying consumers -- of customers, excuse me? And how that affects customer costs in the gas system when the cost of maintaining gas system are distributed?

I think you kind of touched on that right now, but Ingrid, do you want to follow-up on this?

MS. NEUMANN: Well those are the million-dollar questions, right? And that's I think why this -- or part of the reason why this is also an equity concern. Right? Not just the cost of electrification, but -- and that perhaps not everyone would be able to access that, but then also for the customers that are stranded using gas because they didn't electrify, do their rates go up, right? Because there are those stranded costs for the utilities and how is that going

to be dealt with. And again, I think that's something that all the agencies are working on right now and considering.

MR. ROSALES: The last question I see posted here, Ingrid -- thank you for that answer by the way -- is also from an anonymous attendee.

Renewable gas cost rates would be higher than regular natural gas for consumers -- and they're saying right, so just checking in with us.

MS. NEUMANN: I -- yes, I mean, renewable gas is a lot more expensive than fossil gas. I mean, it comes with the benefit of reducing GHGs. I mean, personally I'm thinking of it as recycled gas. Right? But yes, it is much more expensive and that's totally what you see in the cost per ton.

MR. ROSALES: Thank you, Ingrid.

That finishes up all the questions. There was a comment from Michael Jonae (phonetic), excuse me, asking if the slides are going to be made available. So, thank you for that question and for everybody attending, yes, the presentation slides will go up on the docket -- the Decarbonization docket and they will be noticed to all the LISTSERVers that are associated.

That -- this seems like this is a good wrap up for the Q&A. If any questions come in or if there's any raised hands, we will take them. But at this point, I'm

going to pause and I'm going to turn back to Commissioner McAllister for closing remarks.

Commissioner, if you're on.

COMMISSIONER McALLISTER: Great. Let me first ask my colleagues on the dais if they have any wrap up comments, and then I'll -- I'll shut us down after that.

COMMISSIONER RECHTSCHAFFEN: I don't have any substantive comments. I appreciate the rigor, care, and thoughtfulness of both the report and the presentations today. It was great to have Ingrid and others walk through so carefully and deliberately.

I, for one, am always struggling to keep up with the presentations which race through technical issues and assumptions and jargon and I valued and appreciated that today's presentation allowed time to -- for the presenters to go through more systematically and slowly. So, I thank you and commend you for that.

But I look forward to our continued work on this and discussions; more work in the IEPR more work in our own proceedings. And just a great thanks to staff for your presentations and all your work today.

COMMISSIONER MCALLISTER: Thank you very much, Commissioner Rechtschaffen. And thanks for sticking it out the whole day. You're a champ.

COMMISSIONER RECHTSCHAFFEN: Where else would I rather be? What are you talking about?

COMMISSIONER MCALLISTER: Yeah. But let me -- you know, I was reminded by a comment here that we probably need to just ask for straight public comment. You know, we've had a lot of interaction with stakeholders, which is great on a topic like this and -- but I think we do need to have just straight public comment.

So if anybody wants to make a public comment about this, the workshop, the report, topic, now would be your chance, I think.

Maybe we should -- unless Commissioner Gunda, do you want to make some wrap up comments before we listen to public comment or would you like to wait until after?

COMMISSIONER GUNDA: I was just going to -- you know, I don't have much to add. I would just say thank you to the team and (indiscernible) team, this is really, really helpful workshop and I will follow up.

And thanks to Commissioner Rechtschaffen for his interest in collaborating and continuing this conversation across the many proceedings that he is working on, so. And thank you, Commissioner McAllister, for your leadership and Commissioner Rechtschaffen, for your partnership and the entire awesome staff. So, thank you.

COMMISSIONER MCALLISTER: Yes, so while that

comment -- if anybody wants to raise their hand to just do a straight comment or otherwise signal to staff. I'll just remind you that stakeholder comments, the deadline for the on the staff draft is June 4th. And then we'll have a look at every comment that comes in and modify the report as necessary in order to get the final off to the legislature. So looking forward to reading what people had to say about this and about the -- yeah, just about the topic.

This is -- this topic reaches across many, many areas in both commissions really and across the state actually, even into the housing agencies and other agencies. So, it's vitally important and you asked already a bunch of good questions, those of you who've been on the chat and the Q&A. So thank you for those and keep them coming.

I don't see any straight comment, so I think with that, we will -- so I will just make my final comments and we'll just wrap up.

So, thanks, Eddie for emceeing us today and all the staff for -- especially Ingrid for really shouldering much of the presentation burden today. I want to also just recognize Nick Janusch for the really phenomenal analysis that he led in the Assessments Division.

And then I want to encourage people to look at

the acknowledgments page of the report as well because there are a bunch of staff advisors at the -- and advisors at the Commission and elsewhere actually that participated in this, and sort of helped inform and certainly the Commission staff write this draft.

And we had a workshop more than a year ago to kind of kick this off, actually, and ever since then there's just been a lot of work and good faith effort. So, I want to just thank everybody on that list of participants.

And yeah so, I think with that, I don't have anything to add, I just want to thank everybody for being with us today, both in the morning and in the afternoon. We -- please pay attention to the IEPR docket and the schedule as workshops get fleshed out and get posted. We will have more about this. Yesterday we had a workshop with the IEPR about natural gas and some of these themes also came up there.

So, you know, I think there are just a lot of forums here for people to both learn and to be heard. And so that's really what we're here for as state agencies and public servants just to make sure that that happens and that we have for that to take place. And so, your input is really the lifeblood of the process. So thanks, everyone, for being here.

And with that, if there's nothing else, I

think --

MR. ROSALES: Commissioner, I'm going to --

COMMISSIONER MCALLISTER: All right.

MR. ROSALES: Looks like there's one --

COMMISSIONER MCALLISTER: There's one hand raised, right?

MR. ROSALES: Ingrid took care of that question and she wrote the response, so she addressed that.

COMMISSIONER MCALLISTER: Right.

COMMISSIONER GUNDA: There might have been one raised ahead in the loop. I think it was CEC Zoom Number 1, I see them at the top. A hand raised right now. A comment.

MS. ROBINSON: Hey, sorry.

MR. ROSALES: Okay.

MS. ROBINSON: Taylor Robinson on behalf of the Building Decarbonization Coalition. I just wanted to thank the Energy Commission for all of its hard work on this assessment and today's workshop.

You know, the data in this report and assessment is clear and confirms the findings of past studies that, you know, basically say the state needs to move off of the gas in buildings to meet its climate goals. And I just -- I think the state needs to be clear about this and set a schedule so the market can

begin to adjust.

So thank you so much and look forward to continued discussions.

COMMISSIONER MCALLISTER: Great. Thank you very much for being here. We appreciate that.

I -- do we see any other -- does anyone see any other raised hands?

COMMISSIONER GUNDA: This is another hand, Kristi Chu. I'm not sure if --

COMMISSIONER MCALLISTER: Let me see here.

COMMISSIONER GUNDA: Okay. It's raised down. I think it was accident. We're good.

COMMISSIONER MCALLISTER: Oh great, okay. Oh, there we go, I'm seeing it.

I also see Gabe Taylor there, but I think he's been on the back end answering questions. So yeah.

So, with that I think we'll call it a day. Thank you all for your perseverance and your stamina. And please do get us your comments by June 4th and that will really help us get this thing across the finish line. And really, I think it's going -- it will be a kind of foundational document for how we need to move our building stock forward, or at least telling the legislature what they asked us with AB 3232. You know, that's really what this report was -- is for is to inform the legislature about what it would take to get

to 40 percent, below 1990 levels, by 2030.

So, you know, hopefully they will see this as a job well done and be able to use it for policymaking in their forum. So thank you very much and looking forward to the next opportunity. Thanks, everyone.

MR. ROSALES: Thank you, Commissioner.

Thank you, (indiscernible.)

Brian, can you put up Slide 6, just so I can sign everyone off with the reminder of when comments are due?

So thank you, everyone, for attending the workshop today. Before you dismiss yourself, I just want to remind everyone that the deadline for submitting written comments to the staff draft is Friday, June 4th, so it's two weeks from today.

With that, I want to thank all the Commissioners for their participation and their attendance and their leadership on this project. Thank you, everyone who's attended today and for your participation. Reminder, the docket for this workshop is 19-DECARB-01.

With that, this workshop is now adjourned. Have a good weekend.

(Adjourned at 3:47 p.m.)