“Good Stewardship of the Panel” Webinar Transcript

We appreciate your interest in the “Good Stewardship of the Panel” Webinar. If you have any questions, please reach out to us at TECH.info@energy-solution.com.

TIP: Text PDFs are keyword searchable. You can press **CMD + F** or **CTRL + F** when using a computer to reveal a searchbar. The Table of Contents below features section hyperlinks.

Table of Contents

About the Presenters

Elizabeth Alvarez, San Diego Gas & Electric

Elizabeth Alvarez is a Service Order Team Advisor within San Diego Gas & Electric (SDGE)’s Design and Project Management Team. Previously, she was a project planner for both single family residences and multifamily buildings and now her work focuses on training the future service order planners and improving experience for both planners and customers while going through the service order process.

Susanna Thompson, Southern California Edison

Susie has worked for the last 26 years at Southern California Edison (SCE) both in Engineering and Planning. Before that, she worked for six-and-a-half years as a Planner at the Los Angeles Department of Water and Power (LADWP). With a Master of Engineering degree in Electric Power Engineering from Rensselaer Polytechnic Institute in Upstate New York, she is now a Professional Engineer in the State of California. Currently, she is a Planning Advisor in the Santa Monica District Local Planning office.

Chad Martin, Pacific Gas & Electric Company

In four-and-a-half years at Pacific Gas & Electric Company (PG&E), Chad is now a Supervisor with the Express Connections team, which is part of the Service Planning and Design division.

Sean Armstrong, Redwood Energy

As the Managing Principal of Redwood Energy, Sean led the design of more than 400 apartment complexes and subdivisions, including one-in-four of the all-electric, 100 percent solar-powered residences built in North America between 2010 and 2020. Sean also has co-authored six practical guides to building electrification and received the Grand Prize design award from the United Nations and the California Building Industry Association.

Tom Kabat

Tom Kabat is a mechanical engineer with more than 30 years' experience in utility program design, implementation, hands-on building science and utility resource planning. Tom partners with others in electrification design projects for dozens of homes, co-authors guides to electrification, developing a "Watt Diet" technique, and practices making electrifying buildings easier without upsizing the electric panel. He serves on the board of sunwork.org, where he helps install heat pump water heaters and solar photovoltaic technologies.

Larry Waters, Electrify My Home

Larry Walters is a 40-year veteran of the HVAC industry, spending his first ten years in Industrial and Commercial systems. Since then, he is now has a 30-year focus on residential heating and air as a service technician and sales professional. Larry has sold over 20 million residential HVAC units, including gas furnaces. In 2011, he began concentrating on high-performance methodologies as a BPI-certified building analyst. In 2014, he shifted focus again to replace gas with high-efficiency heat pumps, including design, implementation, and installation of 400+ electrification projects in the greater Bay area of California. Larry started his all-electric gas conversion company Electrify My Home (EMH) in 2019, EMH offers a unique approach to electrification they have dubbed, "Good Electrification." This approach considers the entire path of electrification for each homeowner planning for total electric conversion and employs the "Install Small" house as a system right sizing ideology. Larry's extensive experience has made him a noted authority within the energy programs of the State of California. EMH has been contracted through TECH Clean California, a state program to provide training to other contractors in an effort to speed up the adoption of electrification across the state.

Laura Feinstein, San Francisco Bay Area Planning and Urban Research Association

Laura Feinstein is the Sustainability and Resilience Policy Director at San Francisco Bay Area Planning and Urban Research Association (SPUR), the Bay Area public policy think tank. Laura leads SPUR's work on climate mitigation, adaptation, and environmental justice. Previously, she worked as a senior researcher at the Pacific Institute, a research scientist and project manager at California Council on Science and Technology, and as a fellow with the California Senate Committee on Environmental Quality. She holds a Bachelor of Arts from U.C. Berkeley in Anthropology and a Doctor of Philosophy from U.C. Davis in Ecology.

Brennan Less, Lawrence Berkeley National Lab

Brennan Less is a residential buildings researcher at Lawrence Berkeley National Lab (LBNL), and he is a national expert on the challenges of existing home decarbonization and home electrical infrastructure. He recently led the development of nearly 20 public inputs to the 2026 National Electric Code (NEC), and he serves as a voting member of Task Group Two in the National Fire Protection Agency (NFPA) process to update the 2026 NEC. He is a technical contributor to the Department of Energy's Equitable and Affordable Solutions to Electrification (EAS-E) prize for home electrification.

Travis Holtby, California Public Utilities Commission California Public Utilities Commission

Travis Holtby is the lead for fuel substitution in the California Public Utilities Commission California Public Utilities Commission (CPUC)'s energy efficiency branch, where he has worked for the last three –and-a-half years. He also led the 2023 Energy Efficiency (EE) Potential and Goals Study, which sets the mandatory EE goals for California's investor-owned utilities (IOU)s. Travis completed his Master's in International Environmental Policy and Applied Statistics at University of California San Diego (UCSD).

Symposium Transcript

The following text is transcribed as captured, not edited for copywriting, spelling or grammar.

Sandy Laube, Energy Solutions:

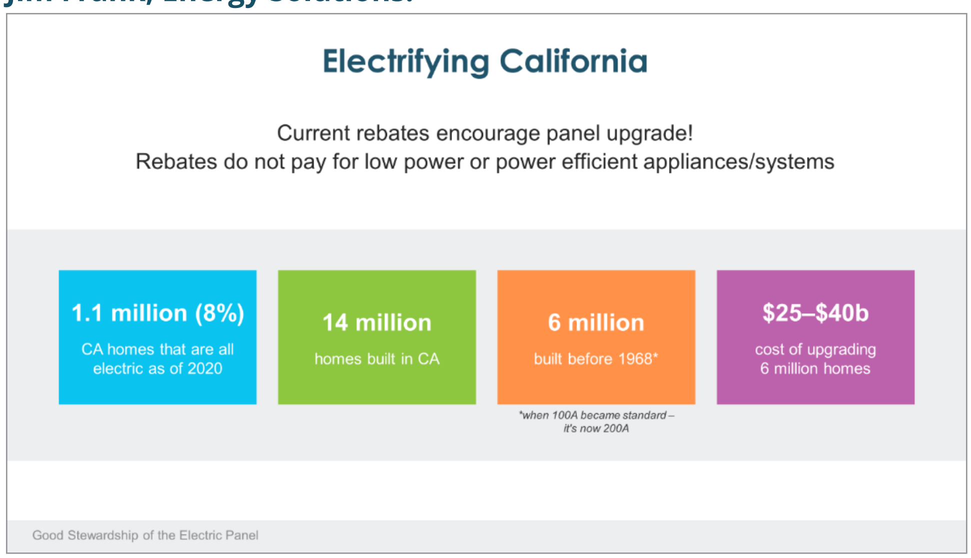
Good morning, happy Tuesday, and welcome to Good Stewardship of the Electrical Panel. I'm Sandy Laube with Energy Solutions. Our webinar today is sponsored by TECH Clean California. And would not have been possible without the support, vast amount of time and energy and expertise of the finest collection of subject matter experts ever assembled in the state California on this topic. Thank you to the California Energy Commission, the California Public Utilities Commission, Pacific Gas and Electric, San Diego Gas and Electric, Southern California Edison, Lawrence Berkeley National Labs, SPUR, Redwood Energy, Tom Kabat, and the TRC Company.

After a brief introduction to set the table, we will start in front of the meter with our team of electric utility experts to look at who owns what, proper processes for requesting upgrades, and why your electrical utility needs to know every time load is added to the grid.

In the second part of Session 1, we will talk about the customer, and if you take nothing else away from this webinar, it should be that the customer and their needs should come first. In Session 2, we will step behind the meter and delve into two different concepts to consider before upgrading a panel. Optimizing by managing load and optimizing through controls. And our final discussion today will be a look at policy, licensing, code, and the future state. Next slide.

The road to electrification runs through the service panel. To talk about that impact is my Energy Solutions colleague, co-pilot, and partner on webinar crime, Jim Frank.

Jim Frank, Energy Solutions:



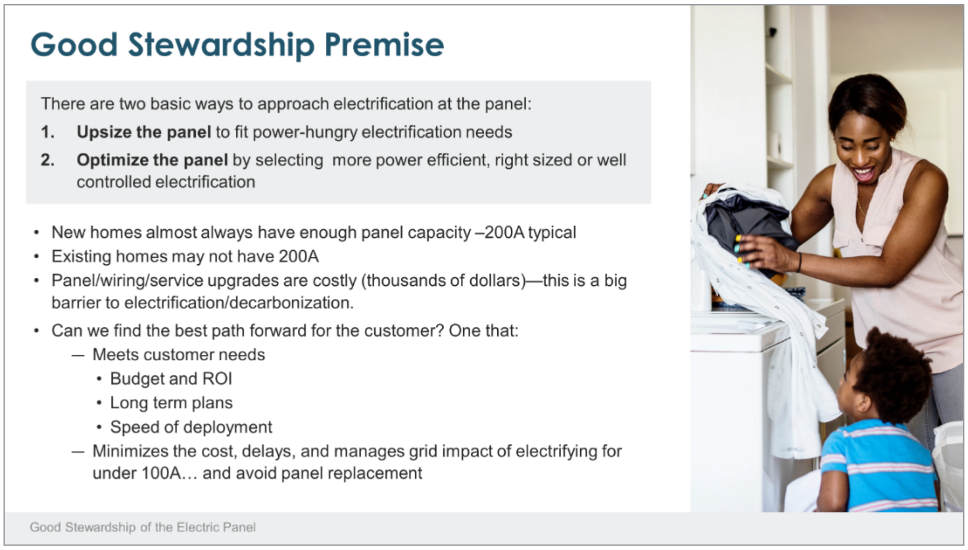
Thanks, Sandy. So, setting the stage a little bit here, we know there are 14 million homes in California, less than 10 % of them are electric, 6 million were built before 68. So, just focusing on those 6 million, if we had to upgrade them at an average cost of around $3 ,000, that'd be, you know, $30, $40 billion. So, a lot of cost and a lot of impact to the grid if We just upgraded all those panels, not to mention the ones after 68 that are potentially unsafe for me to be upgraded due to other capacity. Next slide.

So, Sandy touched on this a little bit, but there are kind of two ways to go about this. Right?

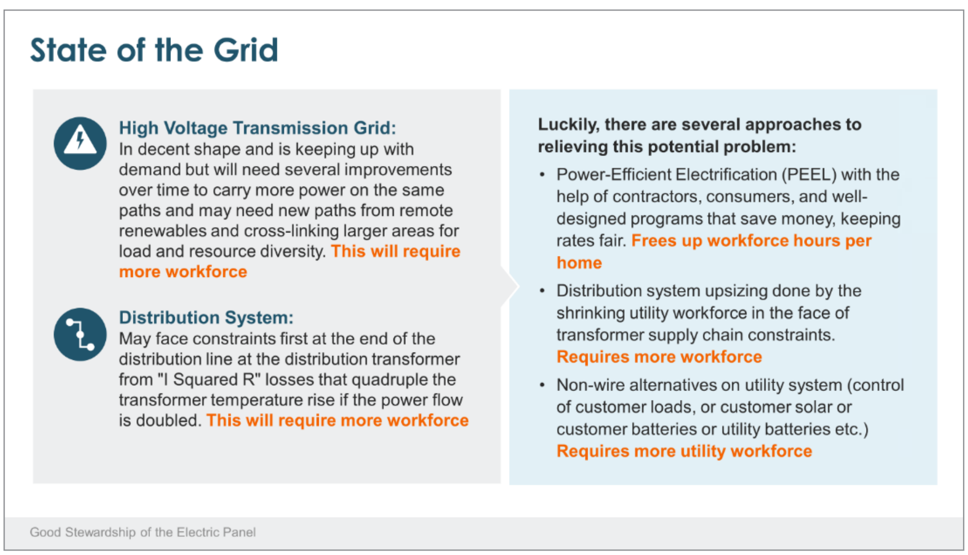
We can just upside those upsize those panels at a cost of $30 to $40 billion. or we can focus on the optimization, right? And see if we can avoid the upgrade if possible.

New homes usually, right, have all that capacity, the older ones don't, and there's wires and a lot of other infrastructure things to consider. So what we're hoping to kind of discuss today and put out there is finding the best path forward that meets the customer's needs, their kind of budget ROA, their plans, right? You know the infrastructure impact which just to make the infrastructure changes would require a ton of additional workforce right there's already kind of a lack of electricians and workforce folks in the market so we would need a lot of changes to be able to support.

There's several different possible outcomes. Just to kind of put this out there, it's nice to have a visual.



If we didn't do anything, we would have, you know, climate issues, right, and infrastructure issues. If we just upgraded all the panels, there would be a lot that would be better than the worst-case alternative, but it's possible to do a little bit more and make the transition smooth, right, without coming up against those bottlenecks. So, next slide.



Session 1, Part 1:

Utility Front of Meter Considerations with PG&E, SCE, & SDG&E

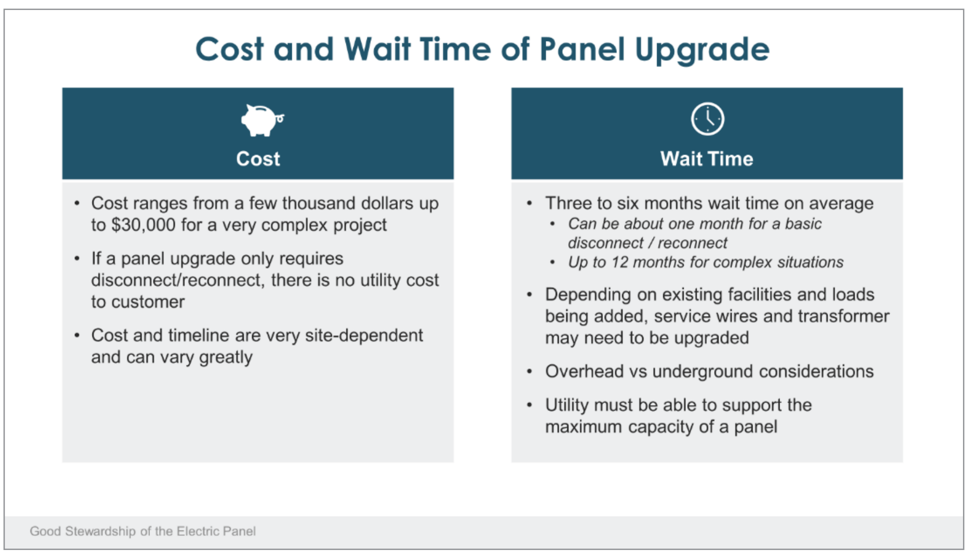
Okay. So, our next session, I'm going to transition into our next session a little bit with this slide, is utility perspective, right? So, on the right hand side there, there's a couple bullets on the bottom, three possible scenarios, right? One we talked about, but if we were to just update all the transformers out there, there's a supply chain issue on how quickly we can get transformers, not to mention the workforce impacts, right? We could do non-wire alternatives, but there's still some potential material issues and a lot of trained workforce. So that top option, PEEL, Power Efficient Electrification, where we just do what we can without upgrading the panel with the workforce that's there to do that work, to sell a heat pump, water heater, or whatever the electrification measure is, by using that workforce, right, and avoiding the expansion, that Elizabeth Alvarez is going to be speaking for SDG&E we have Chad Martin for PG&E and Susanna Thompson from SCE so I'll hand it off to Elizabeth to get that started. Go ahead, Elizabeth.

Elizabeth Alvarez, SDG&E:

Thank you, Jim. Good morning, everyone. From a utility standpoint, and next slide, Tim, please. When a panel upgrade is required, there's quite a few things that are important to keep in mind as you go through the process of that panel upgrade. Some of these items are going to include the cost and wait time for panel upgrades, possible transformer upgrades, and the cost sharing involved with that, how to best protect your project and when to notify the utility. Next slide, please.

The infrastructure that's affected by a panel upgrade is going to include both the utility infrastructure and customer-owned equipment. The front of the meter is going to include everything that the utility is responsible for, which includes installation and maintenance. That'll include the transformer, poles, service wires, and the meter itself. Behind the meter includes the customer- owned equipment, So that's the service entrance conductors, the weather head, any conduit that's installed, the meter socket, and the panel.

Next slide.



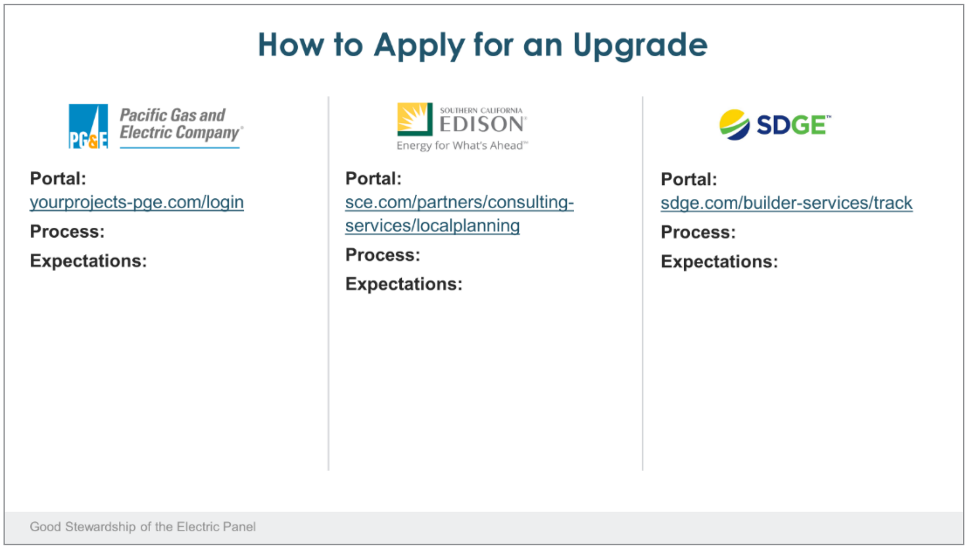
The cost for these upgrades can vary greatly from a few thousand dollars up to $30 ,000. If the upgrade is only going to require a disconnect and reconnect from the utility, there's typically no utility cost to the customer. The average wait time can be anywhere from three to six months, but can range up to a year or longer if the project is more complex. There are instances where the loads being added may require transformer or service wire upgrades and the utilities required to provide adequate infrastructure to support the maximum capacity of a panel, but overall both cost and time are extremely site dependent. Next slide.

The data in this table was pulled from a national survey and just demonstrates how wide the range of a panel upgrade cost is nationwide. Some costs are as low as $1,500, all the way up to the high end of $10,000 for a panel upgrade, and everything that's required with that panel upgrade. Next slide.

Depending on the load that's being added and the existing load on the transformer serving the home, transformers or other secondary equipment may need to be upgraded.

There are allowances for certain project scopes. PG&E has an allowance of $3,255 and SDG&E has an allowance of $3,981 depending on the project. Transformer upgrade costs can vary depending on the specific scenario for your customer.

Typically for transformers with multiple customers, the utility would cover the cost of transformer upgrade to meet capacity requirements. However, there could be possible shared costs depending on site conditions and the specific scenario. Next slide.



As far as notifying the utility of a requested panel upgrade, there are definitely some recommended guidelines. Don't notify unless you know the upgrade is required. But as soon as you know that it's required, notify your utility. If you don't notify the utility, there could be delays to your project. And if the work is completed without utility approval, there could be costly rework required.

How to apply for an upgrade. For SDG&E, the link to our builder services portal is shown here. You're able to track and submit all of your projects on one account. You're able to also obtain important documents as they become available and can check project status as needed. Typically, when a project is submitted with all the required information like loads, site and elevation plans, and the full project scope, it's processed by our intake team. And at that point, the point of contact on the application receives an email confirmation that your application has been processed, and the predicted timeline for the service order to be completed and assigned to a planner. Once it's assigned to a planner at the district based on the project location, the service planner will then field the project and write the order as long as they have all the required information to do so. And I will actually go ahead and pass it over to Susanna Thompson so she can go over the Southern California Edison process.

Susanna Thompson, SCE:

Southern California Edison also has a website that will take you through applying for an upgrade. The process starts by calling our customer service center and requesting its service. That service request is then transferred to the local district and will be assigned to a planner. The planner generally has between 5 to 10 working days to respond and depending on the type of project, they already may do a meter spot if this is an overhead project.

If the project is more involved, then there are more forms that will need to be filled out and your planner will be helping you with that.

It can take as quick as a few weeks to get a panel upgrade done, or it can take a longer period of time depending on if the service is overhead or if it is underground. So best thing to do is, like Elizabeth said, once you know you're going to be doing an upgrade, let the utility know as soon as possible. And now I will pass it over to Pacific Gas and Electric.

Chad Martin, PG&E:

Thank you, Susanna. Yeah, for PG&E, customers submit their applications for service through the Your Projects portal. You do need to have an account on the website. Once your account is established, you can submit applications for service through the portal.

In the Express Connections Department, we try to handle all applications for service within 30 days. It's sort of a fast track department that got separated out from our local service planning offices in order to try to serve residential customers with simple panel upgrades, panel replacements on a faster timeline.

In the event that anything comes up with the specific scope of work that makes it fall out of scope for the Express Connections Department, then the applications do get sent over to our local service planning department. In either case, you're supposed to be contacted within the first three days from your application submission by a rep who will work with you on gathering any additional information required to process the application and schedule the appointment for the disconnect and reconnect. I guess that's about the summary that I have here.

Jim Frank, Energy Solutions:

Chad or Elizabeth, yeah I was going to say Elizabeth you're typing an answer but if you We just want to go ahead and address the question. We can start just answering the questions verbally and talking through it. Sure, yeah. So there's so many different scenarios, and everything is so site-specific. But for example, one scenario where a customer could be required to pay some portion of an upgrade cost other than their specific service wire and panel would be if a handful is not the correct type for their panel amperage and the conduit required to upgrade that panel.

So I hope that answers that question.

Okay, there are a couple of other questions here. Looks like Dan is asking similar requirements outside of California. So, There are similar requirements. Most utilities require an application process, and it can take a similar amount of time, weeks to months.

Jim Frank, Energy Solutions:

Is there a specific panel brand that qualifies?

Any of our utility experts want to answer that?

Susanna Thompson, SCE:

For Edison, we have our electric service requirements manual, and the panel needs to meet the requirements for that that are in that ESR manual.

Chad Martin, PG&E:

Yeah, for PG&E, we go by the PG&E Green Book, which is all the rules for electric and gas service connection. The we don't have any specific brands that we recommend or prohibit. It just comes down to whether the panels have the right features and types of equipment that meet the requirements for the application.

Elizabeth Alvarez, SDG&E:

And I can go ahead and chime in for SDG&E. It's the same for us as well. We have our standards that the meter panel needs to meet, but we don't have a specific panel brand that we recommend. And I can actually answer the next question as well. I see, is there a cost to site a spotter? And when there's two properties in California, do they need to merge service? So as far as having a planner from SDG&E go out to the home, there's not a cost for that for the service planning team for SDG&E. And the two properties question is a little bit more complicated. We wouldn't really be able to answer that without going out to the home and seeing the specific site conditions.

Susanna Thompson, SCE:
And the answer from Edison is also the same.

Susanna Thompson, SCE:
Yeah, for both questions.

Chad Martin, PG&E:
Yeah, same for PG&E that would be a scenario specific result.

Session 1, Part 2:

Customer Considerations with Sean Armstrong, Redwood Energy

Sandy Laube, Energy Solutions:

Wonderful. There are no more questions we will move on to our next session. So, next slide please Tim. Okay, great. Thank you so much. Introducing Session 1, Part 2, Customer Considerations with our moderator, Tom Kabat.

Tom Kabat:

Thanks so much Sandy, Jim and the team from the utilities. It's great to put that into perspective about what is the workload and process for the folks who do end up having to upsize those electric panels and a lot of the talk today will about alternatives to going through that, it's my pleasure to introduce Sean Armstrong. He's got, since 2010, experience being the lead designer on more than 400 apartment complexes and subdivisions, including one in four of the all-electric, 100 % solar-powered residences built in North America in that time.

Sean, take it away and tell us about the customer impacts.

Sean Armstrong, Redwood Energy:

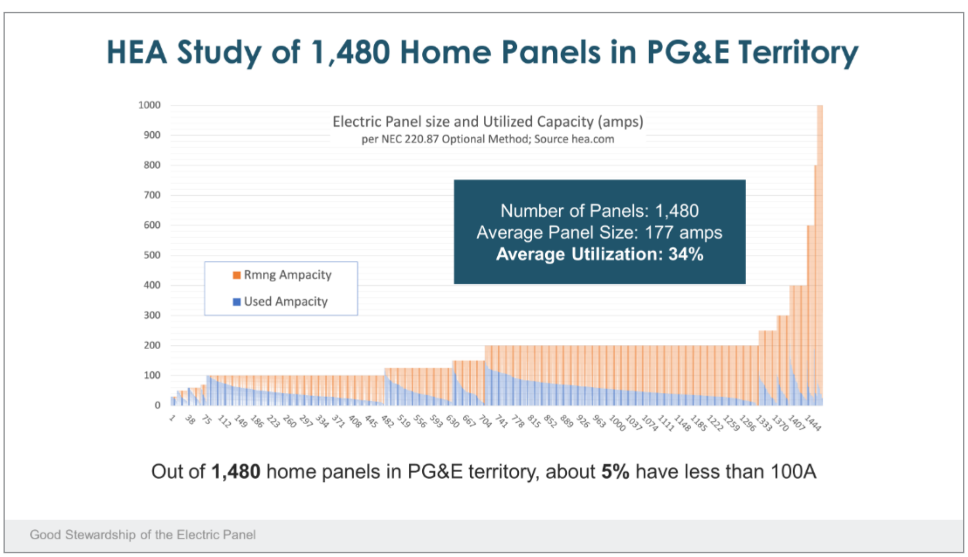
Hey, Tom. Thank you very much. Just want to do audio check. Can you guys hear me OK? Yes, we can. All right, then. So, I'll turn my video off just because you have to see me playing with my hair or whatever. Hey, folks.

So, let's just go to the next slide, and we'll dig right in.

So, first of all, what we're finding in the tech data is that about 4.8 percent of homes need a service upgrade. That's a relatively small number of homes, right? It's one in 20. If you look at the stats there, you can see that if the house is newer, less than 50 years old, then there's only a 3% chance that it would need a service upgrade and a little bit more, you know, 5.4% when it's a 50 years or older

So basically, what we're looking at there is, you know, in 1962 the National Electrical Code changed, and by 1968 every other municipality and county had adopted the new National Electrical Code, and that was the one that required 100 amps, which is generally enough. You're going to have tons of details into this today, generally enough to do a service upgrade. Just get a sense of what is the scale of the problem. Not that common actually.

If it's only one in 20, hopefully you too will be able to avoid this cost addition and hassle and all the rest of it. Next slide.



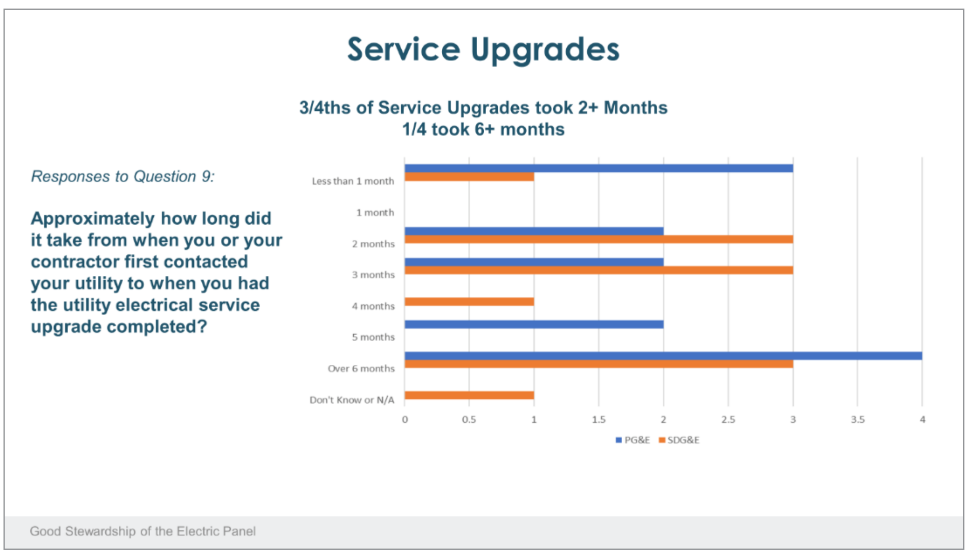
So, our friends at Home Energy Analytics, Steve and Lisa Schmidt, they studied 1,480 homes where they have a website essentially where it guides people through submitting photos of their appliances and their circuit breaker panel. So, then they studied the actual electricity consumption. So, the electricity consumption, that is in blue there. And this is the one-hour peak in a whole year is what those blue lines represent. So, this is the peak energy consumption over a year. And then in orange, that's the amount of electrical service that they have to their homes. So, on the left-hand side you can see a small number of homes that are less than 100 amps. And once again that's in the 5 % or less category. And then and everyone else, you can see their orange lines, they go up to 100, 125, 150, 200, and higher.

And I think this data is fascinating to see that almost all of these homes have capacity. If you look, for instance, at the 100-amp ones, you can see that there are some homes that are pretty much full, and therefore, you might need to put in like a load-balancing smart panel that we're going to see a little bit later.

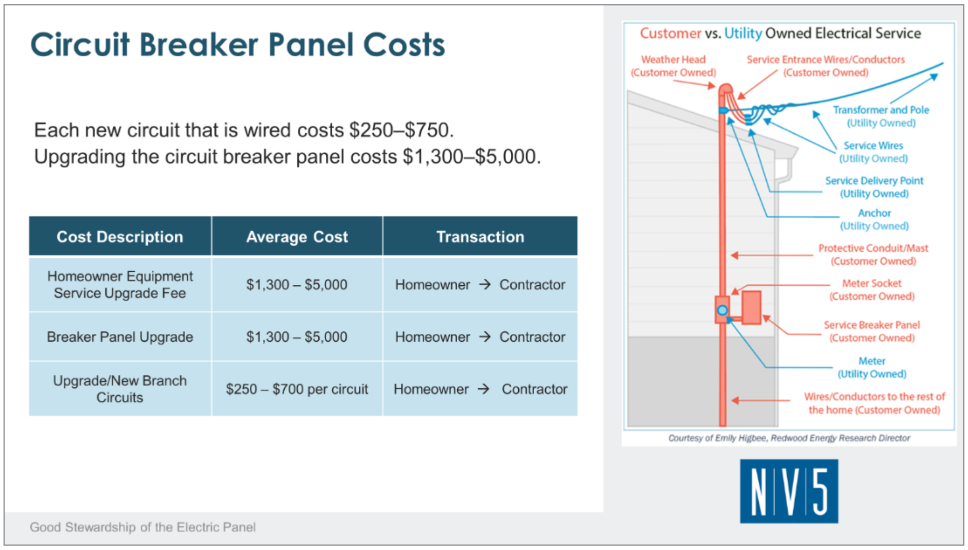
You can see that almost everybody has capacity. One other thing to note is on the right-hand side, those are service upgrades in the range of, you know, 250 up to a thousand those are not getting used.

And this is something for us all to pay attention to because there was an electrician who said, you need this. You know, you need to have a 400 amp panel or a 600 amp panel and service and such. And those electricians weren't right. That that was incorrect. Like the data here shows that people really do not need even a 200 amp panel. You can see almost nobody is ever getting to that 200 amps.

So that is the nature of the reality out there. Hopefully as you're doing your work, you can not raise the amount of costs and the amount of time and the amount of hassle, all these obstacles that get in the way of you actually electrifying the house, which is the bulk of the work that you're trying to do. So, here's a visual. Okay, next slide.



Now timing. So, we, my company, we interviewed, I think, well we tried, we called 350 electricians all over the state. We tried really hard and we managed to get about 33, 35 of them to stand for an interview for like half an hour, paid them money and etc. And then we also contacted about a hundred people had service upgrades. So, what we found is that three-fourths of the service upgrades took more than two months. And that one-fourth of the service upgrades that we're tracking down, they took more than six months. One in four, more than a half a year. We found that there were service group upgrades that took as long as 18 months. So, this is um, this is the time delay. I mean I think that all of us contractors would like to be able to show up at a job, get the work done, go home, go to the next job. And these service upgrades are the ones where you have to schedule a meeting with the electricians. It's a whole bunch of delays and hassles and busy work, things that ideally you don't have to do. So just keeping this in mind, if you can avoid the service upgrade time, I think that everyone benefits. Next slide.

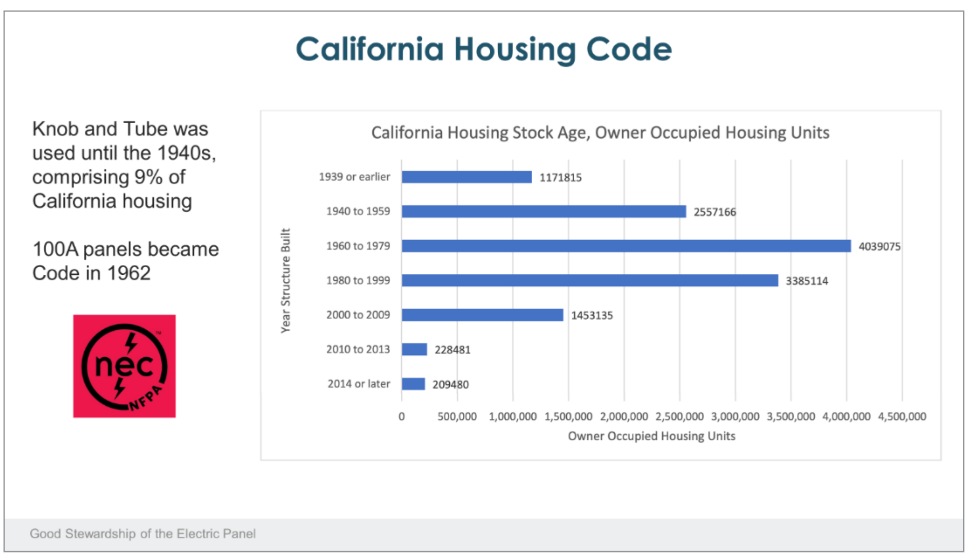


Cost Description	Average Cost	Transaction
Homeowner Equipment Service Upgrade Fee	$1,300 – $5,000	Homeowner → Contractor
Breaker Panel Upgrade	$1,300 – $5,000	Homeowner → Contractor
Upgrade/New Branch Circuits	$250 – $700 per circuit	Homeowner → Contractor

Now I'm gonna get a little bit into the cost that we found. This is the study that I'm mentioning. We did it with NV5, they were the prime, and then Redwood Energy, we did a lot of the phone calling and surveying, so we got a lot of the actual data. Here's what we found. On the left-hand side, you can see that the homeowner equipment service upgrade fee, which goes to the contractor, $1,300 to $5,000.

Pretty pricey as things go down. Then the breaker panel, which is not the service upgrade, right? The service is the wire that's coming to your house in blue. You can see there in the illustration on the right-hand side that that's the service wire. Then it hits the red wires that you personally own and all that red stuff is things that you own, including the breaker panel. The $1,300 also $5,000. You can spend a day or two there just rewiring everything. And then adding new circuits, that's pretty affordable. You know, running around underneath or up in the attic or you know doing some of those really long screw bits that you know drill three feet or whatever so you can get electrical lines in and through blocking and bracing in the walls all that $250 bucks to $700 per circuit.

So, as you're thinking about serving more customers and getting in and out faster, that's what I'm trying to just sort of bring to your attention here. Next slide.



Now, I was mentioning this earlier. I think this is kind of fun to get a handle on when houses were built in California and how that affects electrification. So, you can see in 1939 or earlier, I wish there were commas there, but basically what you're looking at is 1.17 million houses were built before 1939 in California. And I think you saw earlier there's about 13 million homes in California. So, a little bit more than 1 million, one out of

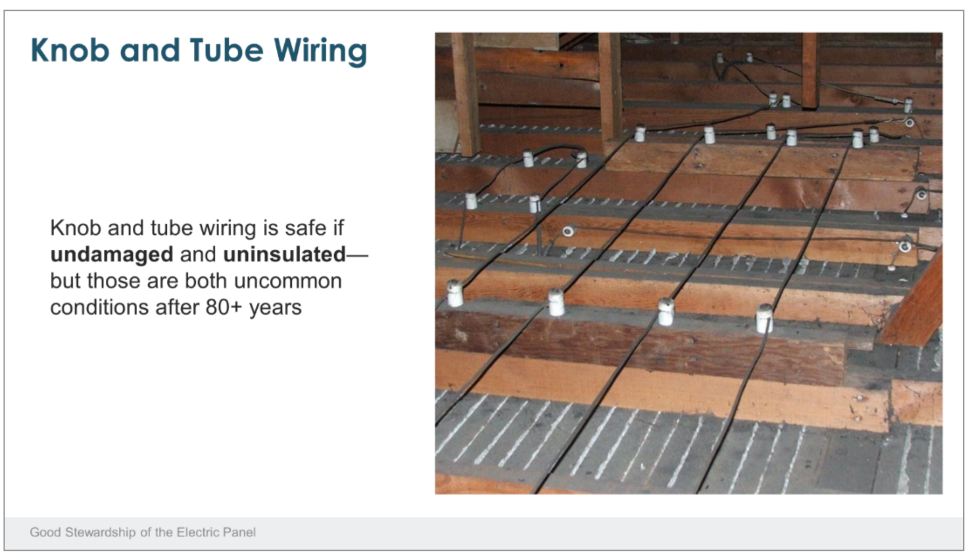
13 or so is an old house.

Before 1939, you might have like a 30 amp service to your house. And then in the 40s, they said, okay, now we're going to have a 60 amp service is the minimum requirement. And then in 62, after like 10 years of really intense public effort on, actually, it was the electric utilities that really worked hard with the National Electrical Code Agency, which is the National Fire Protection Agency, founded in the late 1800s to stop electrical fires. So, they collaborated together, and they said, we want to have the ability to have all electric homes, and they determined that a 100 amp service was enough. Keep in mind, homes built in 1960s, the average home was in the range of 1,400 square feet. So today, the average home that's being newly built is more than 2,000 square feet, new built, in a single-family home. But most of the houses, the average house in California, 1,500 square feet. I looked it up over and over, 1,450,

1,550 square feet, depending on what study you look at, 1,500 square feet, which actually works out just fine to do an all-electric house. You know, there's enough, that 100 amps is enough for the plug loads and the lighting load circuits and, you know, the garbage disposal and et cetera.

So that 1960, 1979, the big bulk there, sort of the baby boomer, you know, just building a bunch of houses, that's where it starts. You don't have to worry much about 100 amps after that period. And most houses have actually been upsized to 100 amps at this point. That's why you have only 5% that aren't. One other thing to note is that in that 5% you might find things like manufactured homes, but that analysis doesn't include apartments at all. About one in three residences in California is an apartment, and one in two residences being built brand new are apartments. So, apartments have an entirely different code than what you're looking at here. Apartments, they're always engineered, like an electrical engineer will look at the exact loads that this residence has, and instead of having just an allowance that you can fit within, like 100 amps, they'll say, oh this apartment doesn't need more than 65 amps to it, and so the service is I just mention that because it's always harder to electrify apartments than – you just don't have that 100 amps guaranteed to work with, and so instead you have to think more carefully about low-power appliances that other people are going to talk about in this presentation, power efficiency or power You're going to hear about that, too.

Apartments usually need more than one strategy, basically, to squeeze in an all-electric apartment out of, say, 60 amps, which is a very common thing to find. 60, 70 amps is what you see.

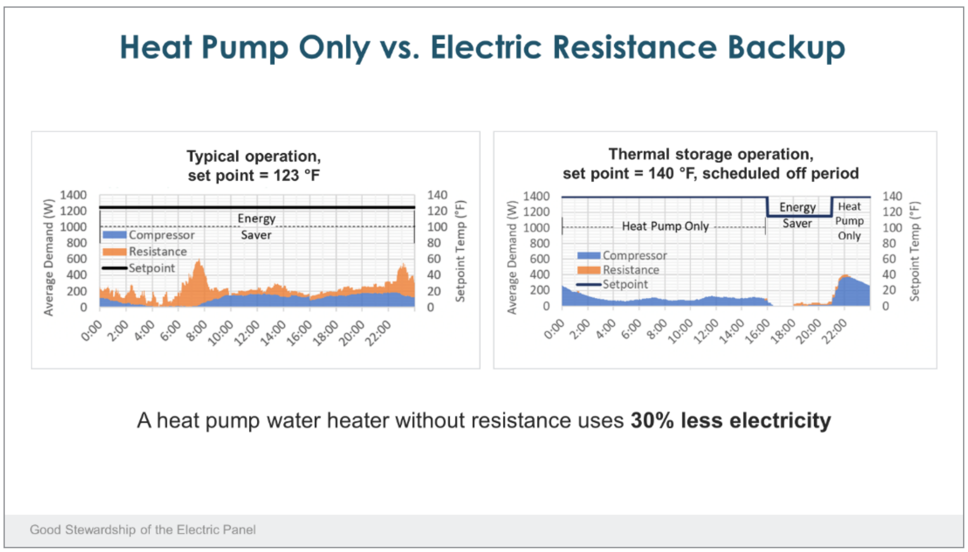


Knob and tube. This is actually a fairly tidy-looking knob and tube compared to some I've seen. Just things to know about it. First of all, if it's not damaged, then it's okay. I mean, it's wire inside that's metal. The metal doesn't, it's copper, it doesn't degrade. It's fine as long is that the plastic housing around it isn't broken and cracked. So, if that's the case, then you have got a good wiring system. But if it is somewhat cracked and damaged, like the plastic housing around it is getting a little friable, a little crumbly, that kind of thing. Or if you insulated, because keep in mind when they were doing this, Novantube is like 1920s and 30s and 40s and a little bit in the 50s, but knob and tube was of an era in which people didn't insulate their houses. So, if you dump insulation on top of knob and tube wiring, then the wires can start to overheat and that's the real fire danger is thoroughly insulating and then heavily using. An alternative to keep in mind is that as you put in LED light bulbs, that was the main demand on all the bedroom circuits, incandescent light bulbs, and LEDs which use one-tenth as much electricity, they don't heat up the wires. So, as you're looking at a knob and tube system and you're thinking carefully, should I leave this here or not? Is this safe or not? One of the things you can evaluate is say, well these wires look like they're in pretty good shape and I'm converting all this apartment or this house into LED lighting.

Okay, we can leave the knob and if that if that's what the homeowner wants or alternatively you can cut the knob and tube out where it's exposed like here in the attic this is what I did I said I don't want to be able to step on these walls where it was much harder to get access to. So now my attic is safe to walk in and I can insulate it, but I still have knob and tube in the walls. And that's working out fine.

So that's my little knob and tube talk there. Next slide.

So, I've been sort of thinking you through some of this planning process. Now I'm going to get a little bit into appliances. A little bit.



But what you're seeing here in these graphs, this is the result of like three years of research. We worked so hard to try to figure out how to take a heat pump water heater and make it less expensive to operate. So, we ran almost 30 different ways of setting up the controls on a heat pump water heater and we'd run it for a couple of weeks with these 22 apartments that we were studying, and they were ranging from like seven people in the apartment down to just one. So, we got to really see a full range of people and occupancies and everything else, and we tried so many different ways of running the water heaters with timers, and what we found is that really there wasn't a good strategy to try. If you have electric resistance in the water heater, and if you just leave it on in any mode, it ends up using about 30 % more energy than is necessary.

On the left-hand side, in orange, that's the resistance where it's just typical. You know, we got it set to like 123, 125 degrees, that's standard, and you can see a lot of orange there. That's all unnecessary electricity use. On the right-hand side, this is where we essentially turn the electric resistance element off. And then we turn the tank up to 140 degrees Fahrenheit. So, what we're doing there is we're making the water heater a battery for heat. So instead of being 125 it's 140. Now we have thermal mixing valves which means that we're not releasing 140 degree water into people's plumbing. We're only releasing 125. So, we have a lot of energy stored in the tank at 140 and then we bleed in a little bit of cold water into the mixing valve to deliver it at 125, that's safe, no one gets scalded and such, and it used 30% less electricity and to

The interesting thing is that when you're using electric resistance to try to catch up, like someone's taking their fourth shower in a row and your water here says, oh I'm running out of hot water, I'm gonna turn on the electric resistance element and start making up hot water. That's not as effective at getting hot water as it is to store the hot water at 140 Fahrenheit. And even though you have turned off the electric resistance element, so it's not gonna turn on and do backup heat, you'll only get the heat pump producing heat. Still, that produces more hot showers. Having the hot water stored is better, yeah, it gives you a better number of showers than trying to make up the heat in the moment that you're using it because you don't really have enough capacity.

The electric resistance element and the heat pump they can't produce enough heat to like do a continuous shower so you run out but if you have it stored you're not gonna have to run out per se it's there you know the water is there they're waiting for you um i just want to note uh dan i got all your questions here um let's address good questions during the q a so we have some audio content for the recording Okay that's what Jim is saying.

Okay I'm gonna I'll just save some of these questions to the end but I'll go back and I'll like go back to those slides.

The take home on this this slide here is that as you're putting in heat pump water heaters you've got two options that are energy saving. One of them is to put in a thermal mixing valve and then set the tank at 140 Fahrenheit in heat pump only mode. That works great. The other one is to get a 120 volt heat pump water heater with an integrated mixing valve, it's essentially the same idea. It has very little electric resistance in it, or none. The Rheem tanks have no electric resistance backup, the 120 volt Rheem brand tanks. However, the A.O. Smith tanks, the 120 volt ones, their Voltex's, they have a small electric resistance element in it.

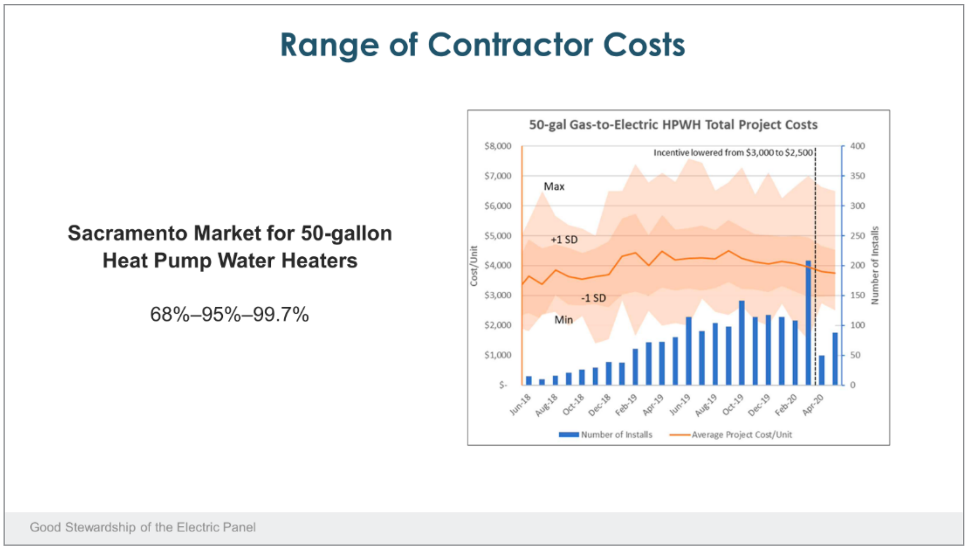
That's kind of nice because it means you can put them outside and they'll still do heating at night when it's really cold in California like you know if it's 35 degrees outside the electric resistance element can also add some heat in the A.O. Smith tanks and it's a relatively small So the upshot of it is that I would encourage you to try to go over to figure out how to do the right hand side graph how to get rid of electric resistance which is unnecessary and relying on it actually produces less you know hot showers in a row

That's what we found. Like I said, we studied the heck out of this and we were surprised this was the answer, but this is the answer. You should turn off the electric resistance element and store it at 140 Fahrenheit. That's the way to do it. This matters because there are two main loads that you're going to electrify, water heating and space heating.

On average, they consume about the same amount of gas in a house in California, everyone's different. I'm not saying it's never the same as the average. But on average, these are the two big gas loads. And unfortunately in California, you basically can't lower your bills by electrifying unless you add some solar. So knowing that you're going to increase their utility bills a little bit by electrifying, that's the reality. If you're in any investor-owned utility territories, PG&E, SoCal Edison, San Diego Gas & Electric.

If you're in those territories, then you want to be thinking about energy efficiency while you're doing your electrification work so that people see, you know, like a $5 utility bill increase on their bill as opposed to something larger or more distressing. That's just how it is. I'll note that in the rest of the country, it is cheaper to be all electric than gas. And California, because of our Public Utilities Commission and the nature of our utilities involvement at the PUC, we have not only the highest energy bills in the country, but we have energy bills that are a little weird, that make it so that it's not cost effective to electrify, even

That's how it is. But California is its own beast. Okay, next slide.



Thank you. So, this is also a water heaters, and now I'm showing you the range of contractor costs. I thought you'd find this interesting. So, Sacramento market, this is just, you know, one of the any, this is not the Bay Area, which is a little bit more expensive, or Los Angeles, a little bit more expensive, Sacramento being a smaller city, a little bit less expensive. But I'm not trying to show you exactly the cost, because this is data that came from 2018 and 2020 before COVID. As you know, COVID has raised the prices of water heaters by about $600.

However, what's neat is to see the orange line in the middle, that's the average. Okay, so it started at $3,500 and it went up kind of like $4,500 and then it started to drop. And there's a dotted line there that shows how they lowered the incentive $500 at that dotted line moment. Some might put that in thinking like maybe the incentive itself was causing prices to rise and if we remove the incentive or at least a little bit of it, it'll cause prices to drop. Maybe that happened. I don't know.

So, the orange line is the average. The dark pink around it, that is 68% of the sales.

Two out of three tanks were sold in that range, with the average being 35 to 45. And then the next lines are the light pink. That gets you to 95% of the data. So almost everything is within the boundaries of the light pink to the light pink. And this is like the way that the stats work, the one standard deviation or whatever. But basically, darker pink is two out of three, lighter pink is everyone else.

And that's how pricing goes. I hope that as you're considering your pricing, that you're trying to be in that band of two out of three, where the costs go up or the costs go down a little bit, depending upon the site installation.

I always hear these stories about, my water heater costs $8 ,000 to install. I don't know how that happens. It's only a $1 ,600 thing. How do you get charged $8 ,000? I, you know, I think it's because people didn't get three bids. So now you know. This is how sort of the range of pricing and maybe if you add $600 to this, it would make it, you know, really current. Okay.

Now, same thing over in heat pumps. I just gave you like a how to cost effectively install a heat pump water heater, both how operates and encouraging to look at, you know, keeping your prices close to averages. Here on the HVAC side, most people, the federal minimum efficiency of HVAC is the left- hand columns, the blue 14 and the green 8.2. These are under, by the way, the SEER 1 and HSPF 1.

They just changed the metric so these numbers would be a little bit lower. The new metric is more accurate. But anyway, using the old metric, The lowest efficiency systems out there are a 14 SEER and an 8.2 HSPF unit one. MID goes right up to 10 and 18 and 11 and 20 and 13 and 24 and 14 and

33. So I mentioned before how in California it can raise your bills to electrify, particularly adding the water heater, actually electrifying your space heating system, the utilities all have a program that says you get a little

bit more cheap electricity in the winter if you have electric space heating, but

So, side note, when you're electrifying someone's house, consider electrifying, if you're planning it out into the future, think, all things being equal, I should go after their HVAC system first, because when I get the HVAC system electrified, then their utility bills will drop.

But the reason I'm showing this range of efficiencies is because that's how you beat the system. So, you could go after a more and more efficient system, and if you're like most familiar with ducted systems, you can see that there's a 13 HSPF and 24 SEER. That's a Carrier product. It's also ones like that from Lennox.

And that is dramatically less energy being consumed, you know, almost half as much air conditioning energy and, I don't know, like 50% or so, 70% less space heating energy. It's a lot. So, if you are, if you're able to go to a higher efficiency system, it benefits the folks that are installing it. The difference in the cost of the product is, say, a heat pump that's federal minimum efficiency, that's three tons. That might be a $3,000 thing to go purchase. And the super-efficient one that you can get, instead of being $3,000, it might be $4,000 or $4,500.

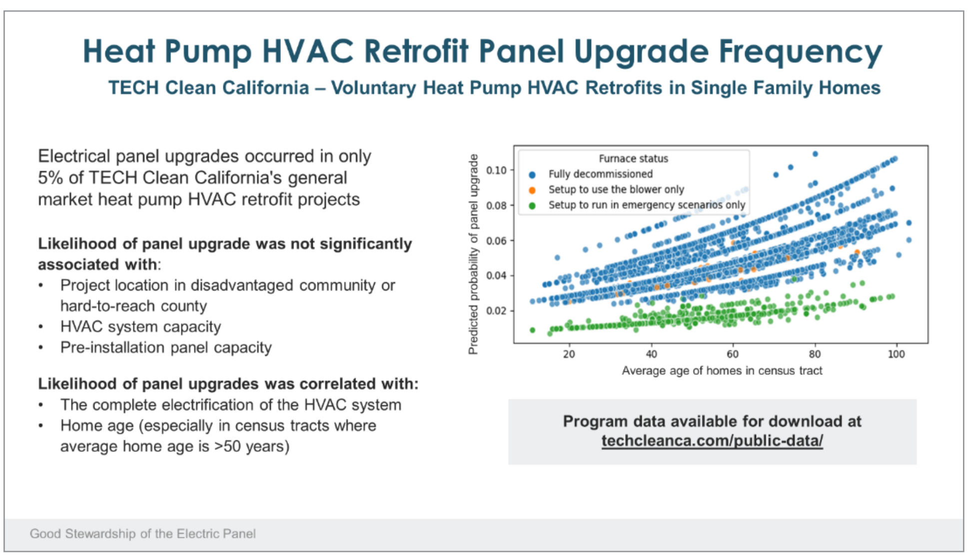
Significantly more expensive, but as we all know, after you've installed it and everything's done, you've charged them $15,000 to $25,000 on their HVAC system. So that extra $1,000 that you get for a really efficient system, that is not the big expense, right? It's your labor, it's your duct work, all that kind of stuff is what costs a bunch of money. So, I think you should try to invest in more efficient heat pumps because it really benefits the customers at the end of the day, keeps people coming back if they get their bills lowered.

Sort of future-proofs them. And even right now, the federal government is considering raising the minimum efficiencies.

Okay, so that's a take-home there. Oh, and one other thing.

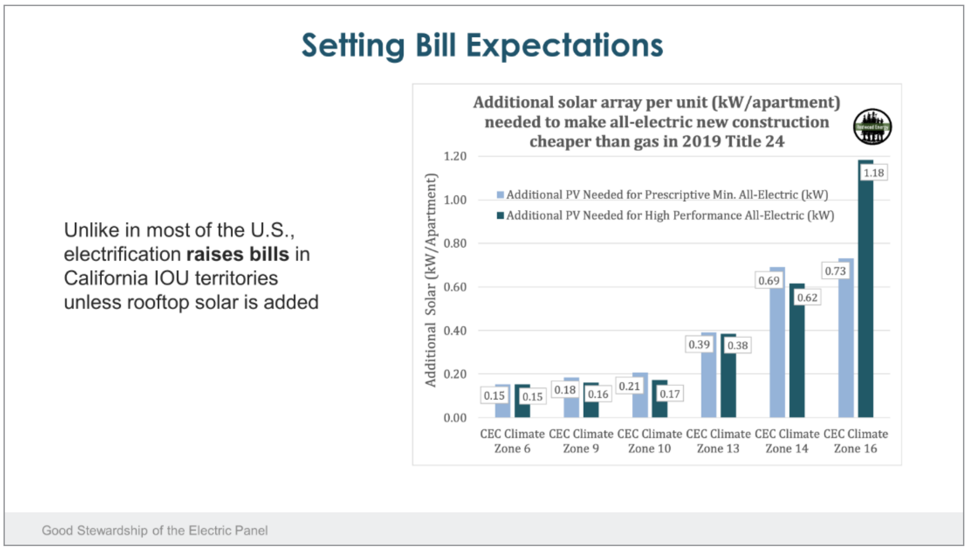
The most efficient heat pump, just kind of fun to know, the most efficient heat pump in our country is now a 42 sear, not 33, but it's only a 7,000 BTU heat pump. And it's a HSPF 15, not 14 here. But once again, it's only a 7,000 BTU ductless mini split, but that's the most efficient. And if you think that we're kind of like, oh, 8.2 HSPF, that's good enough. Like you can get almost double that. Or in other words, using half as much energy with the best heat pumps out there.

Great, okay. Well, I was worried that I wasn't going to go long enough. That's not, I shouldn't have worried that. Okay, next slide.



Okay, here's some tech data, and I want to point out that they're saying, this tech data is basically saying, you know, only 5% of the homes that we worked on doing HVAC retrofits needed a service upgrade. But if you look at this data more closely, it's kind of disturbing because the green dotted lines there, that represents the likelihood of them needing a panel upgrade if they kept gas. Because the green ones are gas ones, where people went and they put in a heat pump, but they kept the gas furnace around for the just-in-case kind of thing. I don't know, maybe that makes sense up in northern Canada, but it doesn't make any sense anywhere in California to have to leave the gas system behind. Heat pumps work great. I mean, they're working right now. I'm in Wisconsin making this presentation. It's snowing outside and there's people with heat pumps. We're at negative 15 Fahrenheit. They were doing just fine in Wisconsin. Negative 15 with just their heat pump. There's nothing in California that requires leaving gas around. So this graph says basically, you know, older homes and if you completely electrify, it increases your chance of needing a service upgrade, which makes sense. I'm showing you to say like, hey, there's a whole bunch of contractors out there installing gas, and they shouldn't be doing that.

And it also doesn't end up lowering their utility bill, because they still have gas space heating. So now they've added electric space heating without getting the utility baseline increase that lowers bills. It's kind of a worst-case scenario for the people who are going to be paying those bills going on into the future. And also, those hybrid systems are expensive, because they're so complex to get a gas system and a heat pump working with the same ductwork and the same controls.



This is my point here, is to set bill expectations. You can get people to have the same bill or lower if you add solar. And that is something that some of the earliest contractors in California, like A1 Guaranteed HVAC, that was doing it back in 2015 and 2016, electrifying people's homes on purpose, getting everything electrified. And then they discovered they added a little bit of solar to their contract, they can make a lot more money. So they did this great presentation, like we used to make 25, 30 grand a house. Now we're making 40 to 70 grand a house when we're adding solar. And people are thanking us for it because they're putting in the solar rate the same time as they're electrifying everything and they're getting net lower bills at the end. And so many customers in California care about climate change and they want to get rid the fossil fuels. So in their head, they're like, great, solar, that's clean energy on the roof, I've got clean energy in the house. But these bars, what they represent is the amount of a kilowatt necessary in addition, in addition to just electrifying. And these are for apartments, but the rules still hold. So basically you should put some amount of solar and basically you can't do less than one kilowatt and still hook it up. So if you can put a kilowatt or more of solar on the roof, and then you will have guaranteed lower bills.

That's it. Okay, now we get to do the Q &A. There's 13 Q &A, so I'm going to try to get that quick.

Jim Frank, Energy Solutions:

Real quick, I want to kick some of the questions to future sessions, so things that like load calc questions, we have a session for that. And I don't know, some of the equipment questions, since we have an equipment session, but if you want to roll through the ones that think are pertinent to this session and answer, that'd be great.

Sean Armstrong, Redwood Energy:

Yeah, okay, I will do that.

So Dan, you asked about the HEA study including a known amount of homes with heat pumps or EV chargers.

Those homes did not have EV chargers. That's what we know about them, but they could have been all-electric, they could have been gas hybrid. In PG &E territory, we're still looking at only maybe 8 % of the homes are all electric.

No more than 8 % of that data represents all electric homes, so it's almost all gas-using homes without EV chargers. Next one. Anonymous asks, what's the source for the California housing stock age and the knob and tube figures? I looked up knob and tube independently to figure out when did knob and tubes get phased out. It wasn't right away, but it did get phased out in the 1940s That's what I learned just reading up on it for a while and the California housing stock age I can't remember our data sources one of those big official ones, but I don't remember I apologize.

Anonymous further down says insurance companies often want knob and tube pulled out.

Absolutely. It is uh, I mean The knob and tube wires are coated with an old plastic and plastic eventually cracks so all wiring eventually has to get replaced. There isn't some wiring system out there that lasts forever. Naomi Horowitz asked, is it true if you replace any of the knob and tube you have to replace the whole system? Nope, that's not true.

Charles Opperman asked, sorry I didn't finish, smart panels can't be used to shave base loads. I'll let someone else do the SPAN and smart panels. Yep, thanks. James, you asked, does raising the temp to 140 degrees still make sense if you have a large heat pump water heater, like an 80 gallon tank I assume you mean by large? Wouldn't it be more efficient to run the unit at 120 degrees in heat pump mode if capacity isn't an issue?

Yes. Yeah, because the higher the temperature of the tank, the more heat loss, the lower the temperature stored in the tank, the less heat loss and less energy efficiency, assuming you don't have that electric resistance element kicking in.

So electric resistance element, if you can just get that turned off any way you can get it turned off, that's the big energy savings. But yes, if you have like an 80-gallon tank and you're not running out of hot water, you should lower the tank temperature as low as you can. Not below 120, though. At 117 Fahrenheit, you can have Legionnaire disease start to grow, and that's a very terrible illness. You don't want that. Feels like a bad flu.

Question: What's my experience of the reliability of current generation heat pump water heaters?

They're terrific.

I know Nate, he's done 10 houses. You know, I have all the data on the 10 houses that he's done, but that's his experience is 10 homes that he completely electrified as of a year and a half ago. He's probably done some more, but he's mostly likes to teach. I have thousands, like 25 ,000 heat pump water heaters installed in my portfolio of apartments and they're working great. I mean, my same clients come back year after year after year. I'm working on like 14 years of apartments with some of my clients that have been doing heat pump water heaters in and they're just fine. They last to their warranty 10 years like anything else. After 10 years, they start to fail. So, tanks generally last about 15 years, just like any old tank does.

Nate is not accurate to the field data. I probably have the most field data, and I'd say they're just like a normal water heater. I hear no complaints about them failing soon. The first models that GE put out in 2010 had a whole bunch of failures, but that was in 2010, and that was just one batch.

Next question, Jamie – let's stop criticizing electrical contractors for adhering to code requirements. If homeowners want to increase their electric load or invest in solar electricians, less than solar electricians require to meet. I apologize if you think I'm criticizing electrical contractors. I'm not. I'm just trying to give information to you all about what I consider best practices. So I don't want that to sound like a criticism, although I can understand if I'm saying do something different. That's kind of critical, but that's not my intent. Do my studies take into account future loads due to the take-up of EVs and EV chargers? What we've found is that EVs do not add significantly to loads in homes if they are managed. If you put a level 2 fast charger on at the same time as you're cooking dinner and everything else, that's a problem, but cars don't need to be charged while you're also making dinner. There's a whole night while you're sleeping. and most cars don't need more than a 120-volt plug-in in order to meet their next daily loads. Most people don't need even a level 2 charger. So yeah, they really don't increase significantly the peak loads if you do it right. If you do everything wrong, then it could be a problem. Jamie, you say, another issue not being addressed in the electrification conversation is the lifetime of electrical services.

It was about services just aging out and corroding in the Northwest. Oh, yeah. Fair enough. Yeah. Entropy happens. Everything fails. So things from the 70s generally need to get replaced by now because 50 years is a fair amount of life for almost anything. Yeah.

So, it's just new and not corroded, same size, and upsizing. And so a lot of what we want to try to avoid is all the upsizing, which takes a whole lot of utility involvement. Yeah. Yeah, upsizing is different from just maintenance replacement of stuff. Yeah, it's fine.

Robert, you just wanted to point out that you have your ream tank programmed.

And I know that you say, you know, you have yours programmed to ramp up before 3 p.m.

So, if you turn off your electric resistance element we found that was consistently the most energy efficient. However, if you have a very predictable water consumption pattern in the evening maybe you don't have electric resistance kicked in. It's just that we found that households were unpredictable, and so electric resistance would get turned on at times we didn't expect it to, and it would end up just ruining the entire day's energy profile of success. So, I hear what you're doing, Robert. Our experiment with the REAM RUDE tanks is that it would be better to not let electric resistance be on. And honestly, we just kept the tank on at the exact same temperature, 140 Fahrenheit in the winter and 130 in the summer in heat pump only mode. And that was the most successful strategy that we had for meeting everyone's hot water shower needs.

Melinda, you say, can I confirm the 120v Heat pump water heater has a built-in thermostatic valve? It does. Sean? Yes. We're at time for this session. Oh, let me go then. So yeah, thank you, Sean. Appreciate it. I know you have to, if you have to go, you have to go but we are gonna get to some of these questions in future sessions.

Session 2, Part 1:

Power Efficiency with Tom Kabat

Sandy Laube, Energy Solutions:

And welcome back to our panel symposium, we are back from intermission and ready to start the second half of our program today. Next slide please. All right, session two, part one. We're going to be going behind the meter in the next couple of sessions and kicking us off will be Jenny Low with Build It Green.

Jenny Low, Build It Green:

Good morning, everyone. It is my pleasure to introduce you to Tom Kabat. He was the moderating the last session. And he is a seasoned energy engineer who'll be sharing with you the strategies to manage the home's power so you can optimize the panel to its full capacity. Tom, the stage is yours, especially since I have a feeling a few of other questions are probably going to rainfall on you as you kick it off. All right.

Tom Kabat:

And then I've got a lot of slides to go through, so bear with me, and we'll get through this. All right, next.

All right, so what I want to focus on is helping contractors look at their role in being good stewards of the electric panel. And as prior speakers have mentioned, if we're focused on this, we'll be able to get more work fitting on the neighborhood grids without over-clogging those, because those look like those will probably be the first choke points in the electrification transition for California. It looks like there's a lot of generator capacity and more generators coming online and more efficiency and batteries and things like that happening at the bulk power level. But down at the neighborhood level, if things aren't sized right, things can clog up there. And then we'll go into the example of the particular house or the branch circuit within a house, that's where, you know, obviously things clog up if you try to put too big a device on too small a branch circuit. So the problem and the opportunity is that we're going to do a lot of rapid electrification and if and the opportunity is if we do it right, we'll be able to get it done smoothly without disappointing the customers and we'll be able to preserve our ability to do additional jobs by leaving space on the panel and in the neighborhood. Next slide.

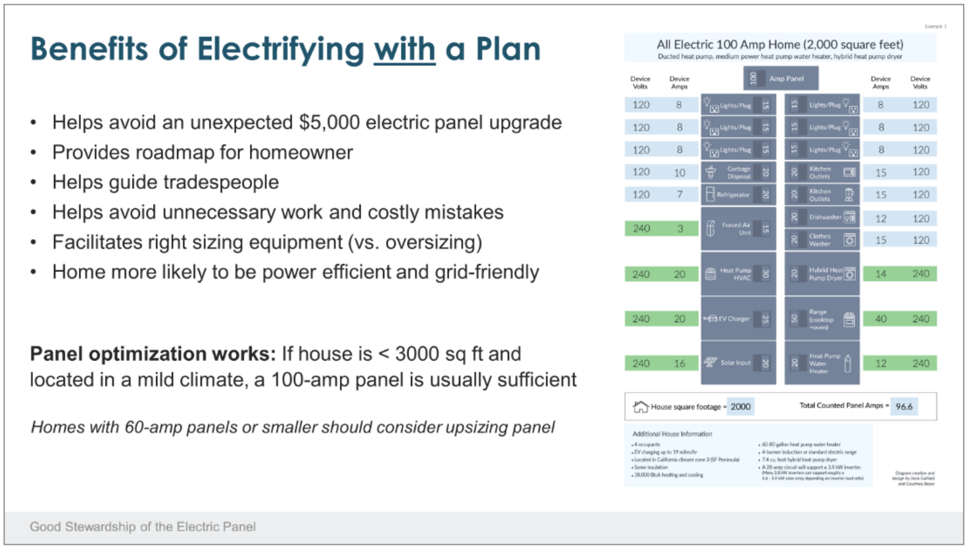
So that solution is being these kind of good stewards of the panel and avoiding resistor strips in the HVAC equipment and minimizing them in heat pump water heaters, as Sean was pointing out earlier. And then I want to point out something in the design process that you can consider using big stout wire and smaller nameplate machines at the end of the wire, and then you right-size the breaker to protect the machine. The wire's big enough, it's fine. And so, you know, you can give your customers all that future proofing they need by putting in, say, a 17-amp heat pump machine on a 40-amp capable wire, connected to a 20-amp breaker protecting that machine. And then in the future, if they want to go larger, or, you know, something happens and they want to do more utility control and get a big machine, they can just swap out and put a bigger breaker there in a bigger machine and run it on the wire. The wire had all that labor cost in it. The breaker size has no labor cost and the machine picking is easy too. So that's how we future-proof. So, contractors, I think if by pointing these kind of things out to your clients, you can get the jobs based on being good stewards of the panel. Next.

So, our choices are basically, you know, make a plan and go into that planning process, or do it right without a plan, and that means focusing on right-sized equipment and the power efficient, that high HSPF equipment Sean was pointing out, that large tank heat pump water heater with smaller

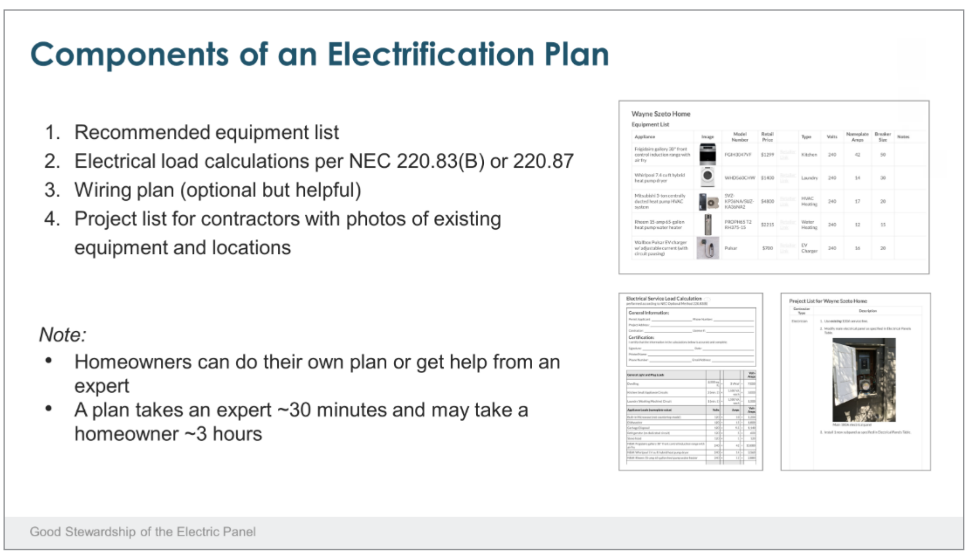
And the third choice is kind of do it wrong, which paints customers into a corner because they end up with, say, an overpowerful water heater and an overpowerful car charger and a poor efficiency heat pump, and they don't have room to do the cooking then or something else. So, you know, you can be like me and really focus on making plans or you guys are mostly contractors so you can do it right without a plan, but I'm going to mostly focus on the left two boxes. Next.

So the typical examples we see of not having thought ahead, and this paints the customer in the corner is in the bottom left of the graph. And that is folks ending up with 50 amp car chargers that they're using for six hours a week when they've got their cars home 100 hours a week, and then 50- amp HVAC systems that never even peak that high but get close, and 30-amp water heaters. Those are, for me, the evidence of when nobody's been careful yet. But by being careful, we can right-size those things and make a lot of progress. Next.

All right, next.



So the benefits of electrifying with the plan are saving that $5,000 to $2 ,000 if they've got underground wiring, avoiding that adventure, avoiding the adventures with the utility folks. They're nice folks, but if you can cut them a break by figuring out how to electrify within your panel size, you still can submit a load sheet to them to tell them about the loads you add, but it doesn't have to go through their upsizing engineering study for your And panel optimization works. If the house is less than 3,000 square feet and located in a mild climate where most Californians live, 100-amp panels are sufficient. It's just a matter of what steps you go through to pick the equipment to make it work. Next.

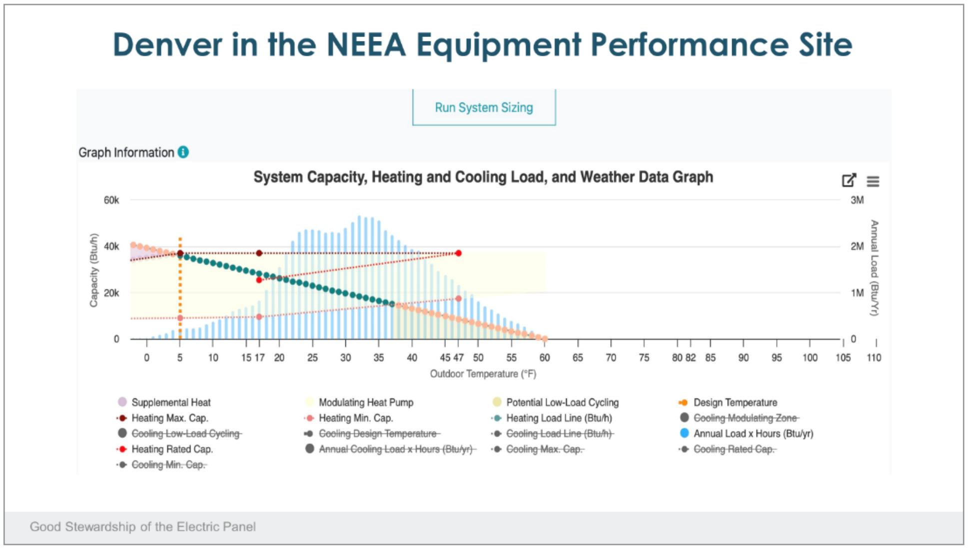


The components of a plan, you know, it's got an equipment list. It can have a wiring diagram. It can have a project list for contractors. That's the kind of stuff I focus on.

And so, they'll call you back for the next steps on it next. So, actions. That's what we definitely need all the contractors to do. So, regardless of whether you're making the plan or not, you can still do your project compatible with full home electrification by keeping your project in its lane. I like the cooking range that's got a cooktop on top and the oven under it, so it's on one circuit. So, these are the kinds of things that I call multifunction machines, and the heat pump is one. It heats and it cools and it dehumidifies, but then choose the HVAC systems that avoid resistor strips.

We've got some excellent heat pumps on the market, and so there's no need for the resistor strips. You can also make a thermal plan if you're building performance contractor. You can do the heat loss calculations for your customer. You don't have to execute all that improvement before electrifying and putting in a heat pump.

They can take a little time to put the heat pump in first and do the shell fixes after, but you need to work that out with the customer so that they know they're taking responsibility for getting after that efficiency improvement in the building shell. So, I don't want to make upgrading the shell a prerequisite until you can't sell the heat pump until you upgraded the shell. You can do it in either order and that's to be worked out. Thanks.



This is just a little picture, I was talking to folks in Colorado. So this is from Denver Climate Zone. This is a graph showing how a certain heat pump would work there. The building shell loss is that slope line up to the left. And so, what it's showing is as it gets colder and colder to the left, the building shell needs more and more heat. The heat pump capability is that yellow band across the top. You can see that machine was maintaining a full three tons, 36 ,000 BTUs per hour of output into the building. At all those temperatures, it went all the way to five degrees Fahrenheit and then just started slightly tailing off, but there's no load out there. Certainly, in California, there's hardly any load in the populated areas below 25 Fahrenheit. Anyway, this is a place to look. You'll see some links at the end of my slides for where to go for some of this data. Next. So, what I look at in these NEEA air source heat pump tables is I look at the performance of the unit at a couple of different temperatures. Up towards the top, I've circled three things. In the cooling mode, the design temperature out there is 95 Fahrenheit, and the thing was using two and a half kilowatts, circled in red, and delivering 33 ,000 BTUs of cooling.

NEEA Equipment Performance Table

Information Tables

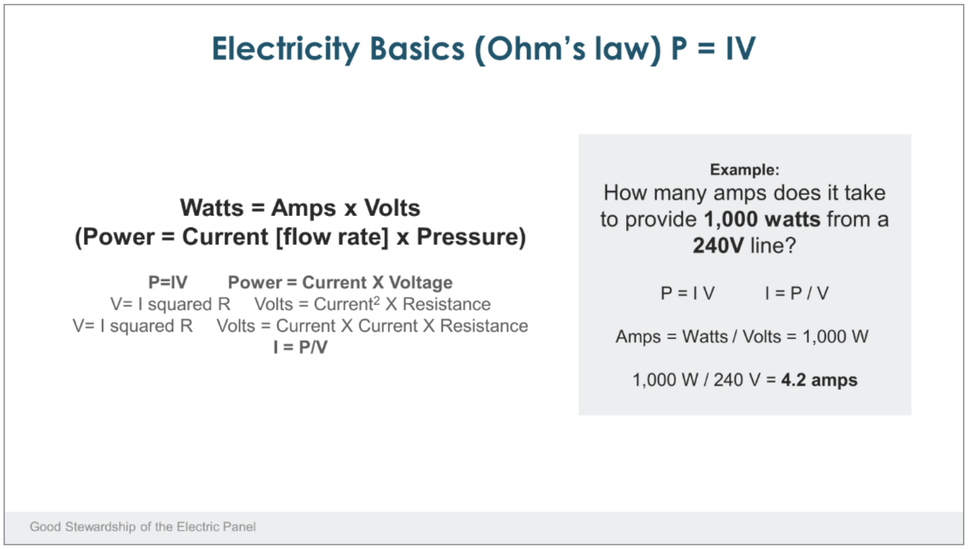
Brand	AMERICAN STANDARD / MITSUBISHI ELECTRIC
Series	Nv-Series
Ducting Configuration	Singlezone Ducted, Compact Ducted
AHRI Certificate #	206374558
Outdoor Unit Model #	NAXSKH30A112AA
Indoor Model #	TPEADA0301AA70A
Indoor Unit Type	Mini-Splits
Furnace Model #	
EER	12.5
SEER	15
HSPF (Region IV)	9
EER2	
SEER2	
HSPF2 (Region IV)	

Performance Specs

Heating / Cooling	Outdoor Dry Bulb	Indoor Dry Bulb	Unit	Min	Rated	Max
Cooling	95°F	80°F	Btu/h	15,600	33,000	33,000
			kW	1.12	2.49	2.49
			COP	4.08	3.88	3.88
Cooling	82°F	80°F	Btu/h	17,500	-	35,600
			kW	0.94	-	2.13
			COP	5.46	-	4.9
Heating	47°F	70°F	Btu/h	17,400	37,000	37,000
			kW	1.05	2.94	3.26
			COP	4.86	3.69	3.33
Heating	17°F	70°F	Btu/h	9,500	25,400	37,000
			kW	1.18	2.96	4.99
			COP	2.36	2.51	2.17
Heating	5°F	70°F	Btu/h	9,000	-	37,000
			kW	1.44	-	5.67
			COP	1.83	-	1.91
Heating	-13°F	70°F	Btu/h	8,500	-	29,600
			kW	1.34	-	5.79
			COP	1.86	-	1.5

Good Stewardship of the Electric Panel

So, this one uses a little more energy in the, or peak power in the winter than it does to meet its peak power needs in the summer. Kind of interesting. And so you can look at these tables and interpolate between them. It gives you a great feel for where is that unit going to peak. Next. So, I want to talk a little bit about the electric calculations too. So, electric basics, I'm just a mechanical engineer, but I do know Ohm's law, and its power equals current times voltage, current with a symbol I. So, P equals IV, and then you can rearrange that equation, we use it a bunch to figure out stuff like, well, how many amps are flowing through this line? And so,

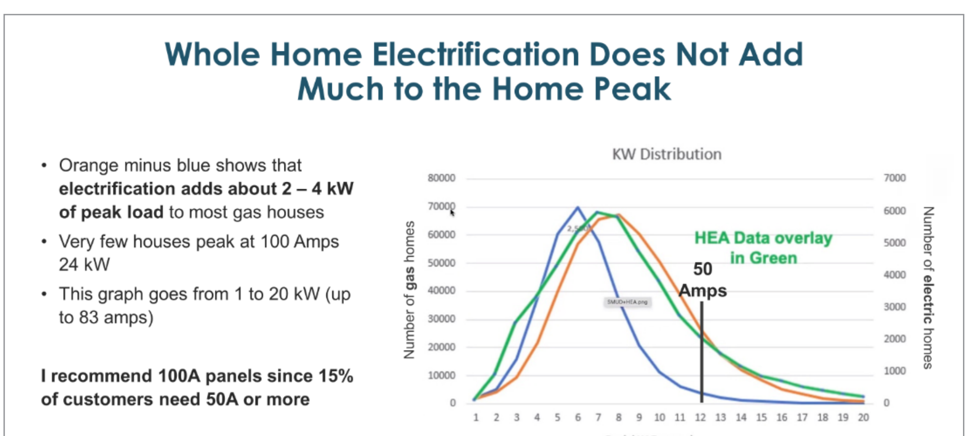


I'm mostly an energy guy, so I work with energy and power.

And so the basic current safety issue is that larger diameter wires have less resistance. They're able to conduct more through their bigger channel.

The more resistance they have as the current flows through there, the more heat they have to dissipate. That resistance shows up as heat. They have to dissipate it. The way they dissipate it is heating up to high temperatures and high temperatures cook the insulation. So, what we're trying to do in that section 220 is size things, size wires upward and loads downward so that we don't overheat equipment and overheat wires or overheat breakers and panel boxes so that the insulation in them cooks. Next. All right. You've already seen this graph. Thanks for Sean to get that out there in front of folks. It is showing in the measured data, and this is measured energy data.

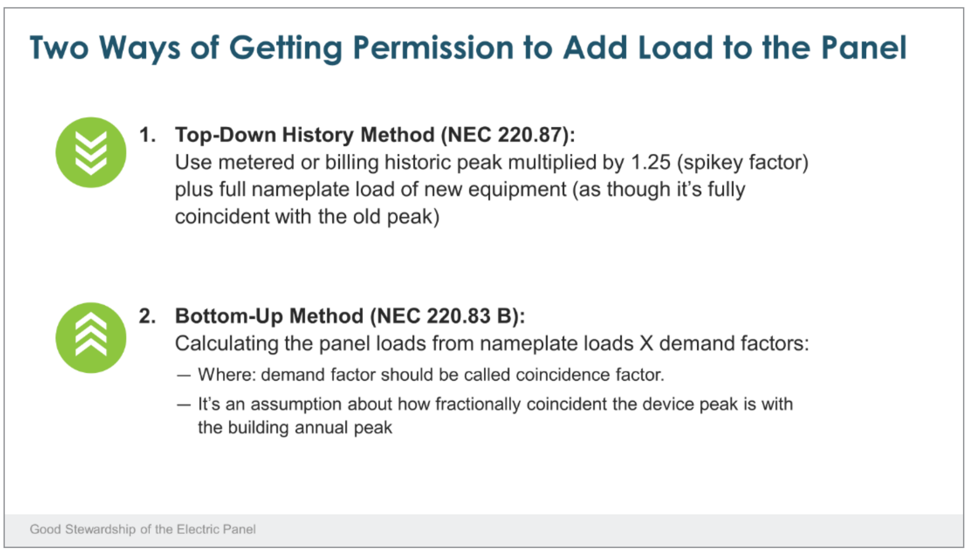
So, these are, I think, maybe 15-minute peaks or one-hour peaks. But PG&E has meter data coming in at both levels. And somebody was asking about, how do 15-minute peaks compare to one-hour peaks? And what I noticed from looking at a lot of people's data is 15-minute peak for the year is often about, say, one or two kilowatts higher than the average of the four 15-minute periods in that hour. And the reason I think it's happening that way is it tends to be in mealtimes, it's cooking is adding these extra couple of kilowatts occasionally in that highest 15 minutes of the year. And then, and that's in that hour and the cooking intensity varies and then things drop back down again. So, and a little explanation about where those loads are coming from, next.



So, this graph is a different way to look at those loads and that HEA data overlay is the green line there. That's kind of reinterpreting that data you saw and just looking at it in frequency. You know, number of houses is the up version on that graph and amount of power is the, across to the right on that graph.

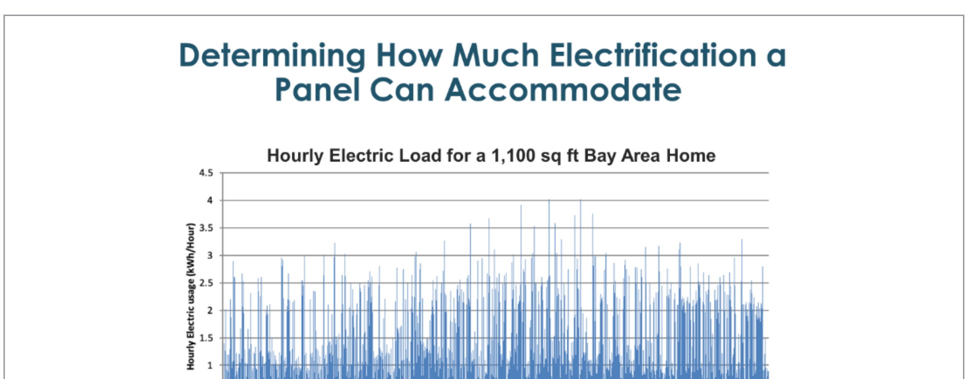
So, 12 kilowatts of power at 240 volts on the panel is taking 50 amps. So that's what a 50-amp panel could provide. And what you notice is thousands and thousands of houses to the left of 50 amps could be met by 50-amp panels. to live large on that You'd have to be really careful to live large And so I tend to recommend going over to a hundred amp panel if you're below 100 amps but I see rarely any needs to go above 100 if you start applying some of these techniques. Next.

All right, so two load calculation techniques. The top-down method is using that history, and so it's taking a look at the highest hour or highest 15 minutes. If it's the last 30 days of data you're using, you're putting a monitor on there, the code says use 15-minute data if you're only using 30 days of data. And so when it's silent about saying, or use a whole year of data, I'm assuming since they specified 15 minutes, if it's 30 days, that then the hourly data is gonna be fine for using the whole year. If you only use 30 days, you also have to do some kind of adjustment for what will the peak load be if you weren't, those 30 days weren't in the peak period for your building like the heat of summer or the cold peak of winter. Anyway, so that's the top down history method. And like I mentioned in the Q &A, if you've got solar or battery system or already a load management system on your house, all three of those things modify the metered load. And so those kind of disqualify you in the current code for using that top down method.

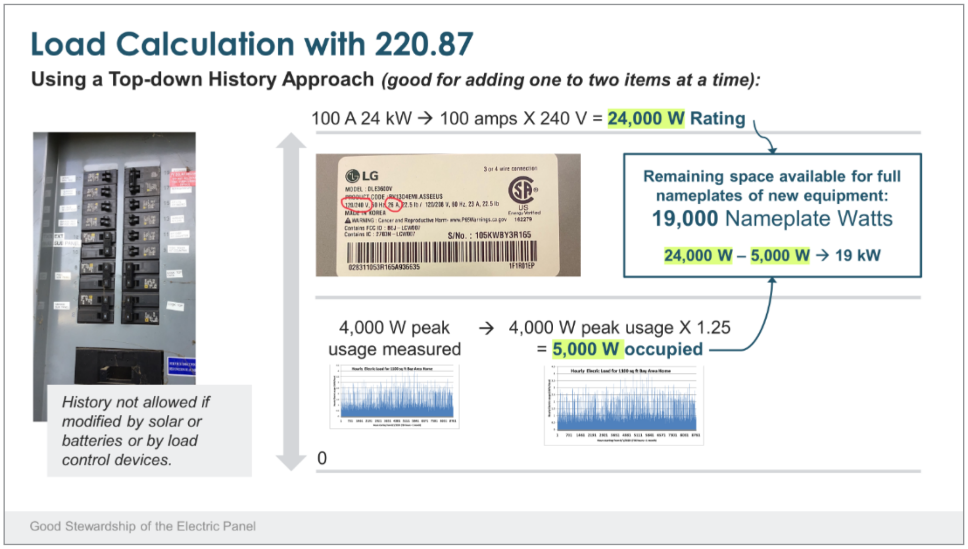


We use the B thing a lot. That's the one when you're adding space heating. So it uses a nameplate method to calculate, you know, the power that the home's going to need by all its attached end-use devices, the heating, the washer, the dryer, the water heater, the cooking. So we apply that. Next. Oh, actually, so I'll go into here, 22087, it starts with a panel rating, say 100 amps times 240 volts, gives us 24 kilowatts of panel capability without overheating the panel. And then we look at what was the peak for the last year and the peak hour usage or peak 15 minutes, whichever you want to use, but then you multiply that by 1.25 to get a safety factor in there, and all the remaining space between the panel capacity and

Next slide.

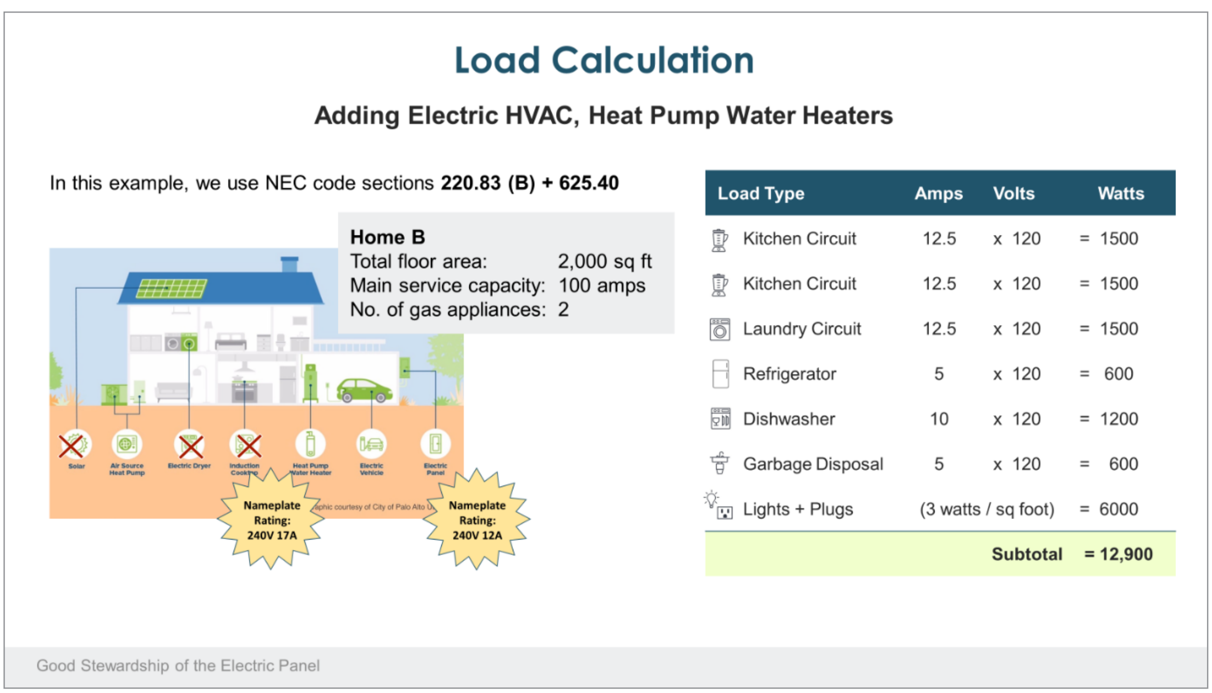


All right, so that's an example of what does hourly electric load look like on a house in California. Here in this data, that it's peaking at 4 kilowatts. That's a lot less than the 24 kilowatt capability of a 100-amp panel. So you can see that. And then next.



All right, and this is just representing a little bit cartoonishly that the height of the panel is that capacity of the panel, the 100 amps or 24 kilowatts. And then the occupied space at the bottom of the graph uses that history of 4,000 watts times 1.25, which makes 4,000 go to 5,000 of space needed for existing stuff. And then all that space above the line is space we can put new full load nameplates into. So, 19 kilowatts of space to add more nameplate loads. Next.

So that bottom-up method is good when you don't have history, Or you've got solar batteries, et cetera, and maybe load management. So that wouldn't allow you to use 22087. 22087 is good and easy, especially when you're doing just one or two devices. Next. But when you want to add a lot of devices, I switch over to 22083B, bottom up, because it starts applying diversity factors. Instead of using the whole nameplate rating and saying it all hits on the peak, the code has factors, and so we put those in. And so you'll see at the end of the slides, there's an appendix and a bunch of examples that'll look like this, next.



And so in this one, you can see where we sum up all the connected loads of different things in the house. We take the first 8 ,000 watts at 100 % coincidence. The code calls it a demand factor, but it's really how coincident is the load with the peak.

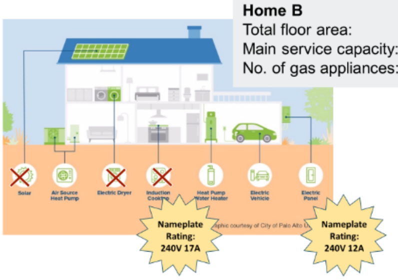
So, the first 8,000 at 100, the next, everything over that at 40%.

Load Calculation

Adding Electric HVAC, Heat Pump Water Heaters

In this example, we use NEC code sections **220.83 (B)**

Home B
Total floor area: 2,000 sq ft
Main service capacity: 100 amps
No. of gas appliances: 2



Load Type	Amps	Volts	Watts
Kitchen Circuit	12.5	x 120	= 1500
Kitchen Circuit	12.5	x 120	= 1500
Laundry Circuit	12.5	x 120	= 1500
Refrigerator	10	x 120	= 1200
Dishwasher	10	x 120	= 1200
Garbage Disposal	5	x 120	= 600
Lights + Plugs	(3 watts / sq foot)		= 6000
First 8,000 watts @ 1.0 coincidence factor			= 8,000
Remaining 5,500 watts @ 0.4 coinc. Factor			= 2,200
HVAC 4,080 watts @ 1.0 coincidence factor			= 4,080
HPWH 2,880 watts @ 0.4 coincidence factor			= 1,152
		Total	**= 15,432**

Amperage = 15,432 with 240V = 65 amps

Good Stewardship of the Electric Panel

And, but other things like water heating count at 40% and cooking. So, that's how we do it. Next.

Electrical Load Calculations

General Light and Plug Loads					Volt-Amps
Dwelling	2,350 sq. ft.	×	3 VA/sf	=	7,050
Kitchen Small Appliance Circuits	2 (min. 2)	×	1,500 VA each	=	3,000
Laundry (Washing Machine) Circuit	1 (min. 1)	×	1,500 VA each	=	1,500
Appliance Loads (nameplate value)	**Volts**		**Amps**		**Volt-Amps**
Built-in Microwave (not countertop model)	120	×	10	=	1,200
Dishwasher	120	×	15	=	1,800
Garbage Disposal	120	×	9.5	=	1,140
Refrigerator (on dedicated circuit)	120	×	5	=	600
Stove hood	120	×	1	=	120
NEW: Frigidaire gallery 30" front control induction range with air fry	240	×	42	=	10,080
NEW: Whirlpool 7.4 cu ft hybrid heat pump dryer	240	×	14	=	3,360
NEW: Rheem 15-amp 65-gallon heat pump water heater	240	×	12	=	2,880
General Loads Subtotal					32,730
First 8,000 VA @ 100%					8,000
Remaining VA @ 40%					9,892
General Loads Total					17,892
Other Loads (nameplate value)	**Volts**		**Amps**		**Volt-Amps**
NEW: Electric Vehicle Charging Load @ 125% (with circuit pausing)	240	×	0	=	0
Bathroom Heater #1 @ 100%	120	×	11	=	1,320
NEW: Mitsubishi 3-ton centrally ducted heat pump HVAC system @ 100%	240	×	17	=	4,080
Other Loads Total					5,400
Total Load (General + Other)					23,292 VA
Divide Load by 240 Volts					97 A
Rating of Existing Electrical Service					100 A
Panel Upgrade Required?					No

Good Stewardship of the Electric Panel

And we end up with tables that look like this to submit to the building department.

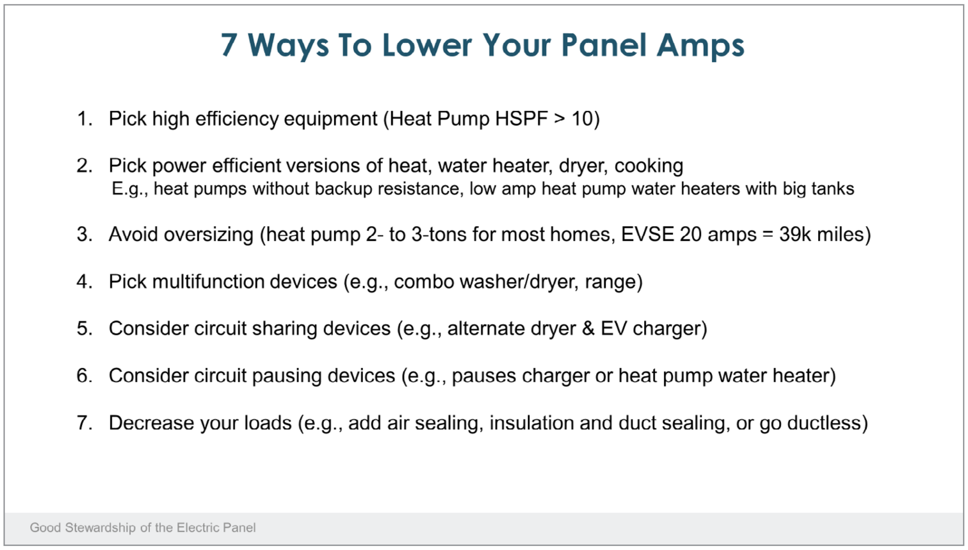
The basics here, I want to just show graphically. It's that in the 220.83B, we've got a couple of cases at the bottom, like EV charging and space heat, which count as 100% coincident. But then most other things we're adding in electrification, you know, we're really trying to add five things. We're trying to add cooking, water heating, drying, space heat, and EV charging.

So this is how they work into those tables. Next.

NEC Code Sections Relevant to Electrification

- 220.82 (B) New Homes 10 kW @ 1.0
- 220.82 (C) New Homes HVAC @ 1.0 with some diversity for strip heat and 4+ separate zones
- 220.83 (A) Existing Homes 8 kW @ 1.0
- 220.83 (B) Existing Homes adding HVAC @ 1.0 coincidence factor
  First 8 kW of other loads also counts at 1.0 coincidence factor

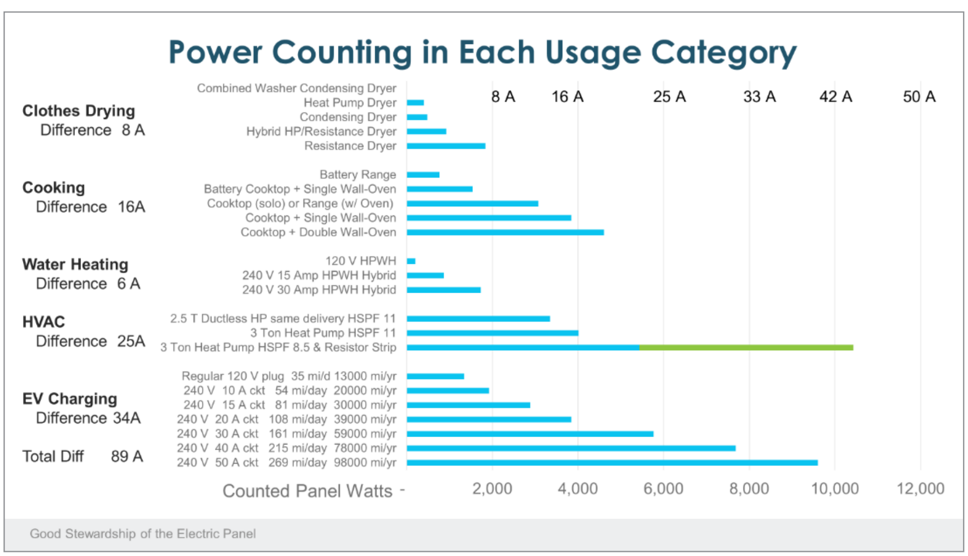
Here's just a slide of some of my favorite parts of the code that I use and what they do for us. Next.



All right. Fitting everything on. Next. We're going to fit it on both electrically and space-wise. So, there are seven ways to lower your panel lamps electrically to get everything to fit so these calculations work.

It's picked a high efficiency equipment and really look at those spec sheets to see the HSPFs. You want really high HSPFs, especially here in California with our high electric rates now. The clients are gonna need those high efficient equipment and then right sizing and then pick power efficient versions of the water heater, dryer, cooking, et cetera. I'll show you those in a second. Avoid over- sizing.

And what we need to do is work with the customer to understand right sizing and comfort. And that NIA plot I showed about modulating heat pumps, that'll help explain why we want a smaller heat pump in the house to give them more hours of comfort. And then avoid oversizing the EV charger. 20-amp circuit will give them 39,000 miles of charging at only eight hours a day. If they want to charge longer, they can get more than 39,000 miles. The average person's driving 13,000. So anyway, there's plenty of space. We don't need to oversize things. They don't need to play Indy 500 at home, trying fast pit stops. Okay, pick multifunction devices. And then Larry will be talking about a couple of power saving devices or power control devices, power sharing, power pausing, and then decrease your loads with air sealing projects, duct sealing, insulation, or going ductless is another way on the HVAC and just avoiding the whole duct heat loss thing, which adds to the peak power needs. Next.



This is my favorite plot. It's got the five different end use categories on the left. So you can see them in bold, clothes drying, cooking, water heating, HVAC, and EV charging. And then the scale to the right, if we look at the bottom, it's the code counted panel watts, how many watts are showing up in the panel from the end use device doing that service for the customer. So I've got zero to 12,000 watts, so zero to 12 kilowatts. Up above the scale, you can see, I put in the equivalent panel amps up there. So it's zero on the left to 50 amps on the far right. And then each of the blue bars represents how each one of those choices is would count against the load calculation. And so my favorite is in the top left part of the graph there, the combined washer-dryer machine. And it's one machine. I put dry, dirty clothes in. And two hours later, I get dry, clean clothes out of it. It's magic. I don't have to go there and manage wet clothes in between. It saves $10,000 of floor space. It only takes the washer circuit of 120 volts, and it does the drying too.

And then the other four options going down to the long one there is a resistance dryer, the standard electric resistance dryer that 60% of dryers already are. So, you can pick something along that curve and then same with cooking, that the two smallest power cooking things are kind of new evolving technologies, a battery, a range with a battery in it that plugs into the 120 volt circuit for the clock behind the range and a cooktop But the bottom three there in the cooking category are normal things we see all the time. I like that combined range right in the middle, the Goldilocks solution. It's 240 volts, can be on a 40 or 50 amp circuit, does all the cooking we need. And then water heating, we were talking about the 120 volt one, that's that tiny little blue dot there. And then the big old oversized 30 amp common heat pump hybrid water heater.

HVAC, you know, I'm putting in there two things showing. The two bottom bars are three-ton systems. Just different, I guess, oh, yeah, different HSPF. And then also the green bar there is a big old resistor strip that we don't need. So, get rid of the resistor strip and then get the better HSPF.

And then I show a two and a half ton ductless above that. So, it delivers the same amount of heat to the building as a three ton. It just doesn't, isn't losing a half ton through the ducts. So that's another way to save power on the panel. And now that bottom set is like six different versions of how powerful an EV charger can be and what it does to the panel if it's not controlled. I'm just showing here all the uncontrolled ones. Larry will get to the controls. But what you can see in the difference column in the far left is the difference between the high and the low amperage use. And so the total difference down the stack is 89 amps are savable between doing kind of common old wrong decisions that really kind of overpowered and the best cutting edge decisions and the new common practice. So, a way to save 89 amps. Next.

And there's actually a question that probably would be good to kind of slip in here before we move away too far from the load calculations. Someone is asking, can you recommend any worksheets or calculators for performing electrical load calculations? Yeah, so there is a watt diet calculator and I put a link in the slides to it. It's something Redwood Energy Partners and I have worked on together and a number of other folks.

And then also there's a link to an app that I built with a friend and it does those calcs too.

What's going on in our intentional load calculations is we're helping drive people towards the power efficient end and providing equipment choices and ways to get there, as opposed to just treating everything as though we're neutral to it and seeing how big a panel we have to switch up to, as if we've given up the game. If we've conceded, we have to upsize and we're just trying to figure out how high do I have to jump?

Super Watt Diet With 120V Cooking

Replace:	Old Wattage	With:	Voltage	Wattage	Amps nameplate	Amps Counted	Amps removed	Net Amps Added		
Gas Dryer	800	Combo W/D machine	120	1200	10	2	1.33	0.7		
Gas Cooktop	200	Battery Cooktop	120	1200	10	2	0.33	1.7		
Gas WH	0	120V HPWH	120	900	7	1.5	0	1.5		
Gas Furnace/AC	4500	3 Ton 240V Inverter HP	240	4500	18.75	18.75	18.75	-		
Gasoline Car	0	120 V EVSE	120	1200	10	0	0	-	12,000	miles/year
Pre Elec. Total	5,500	Electrification Total		9,000	56	24.3	20.4	**3.8**	**Amps Added**	
								920	**Watts Added**	

Watt Diet With 240V Cooking

Replace:	Old Wattage	With:	Voltage	Wattage	Amps nameplate	Amps Counted	Amps removed	Net Amps Added		
Gas Dryer	800	Combo W/D machine	120	1200	10	2	1.33	0.7		
Gas Cooktop	200	240V Range	240	9600	40	16	0.33	15.7		
Gas WH	0	120V HPWH	120	900	7	1.5	0	1.5		
Gas Furnace/AC	4500	3 Ton 240V Inverter HP	240	4500	18.75	18.75	18.75	-		
Gasoline Car	0	240V 40A Smart charger	240	7680	32	0	0	-	78,000	miles/year
Pre Elec. Total	5,500	Electrification Total		23,880	108	38.3	20.4	**17.8**	**Amps Added**	
								4,280	**Watts Added**	

Regular Jumbo Electrification

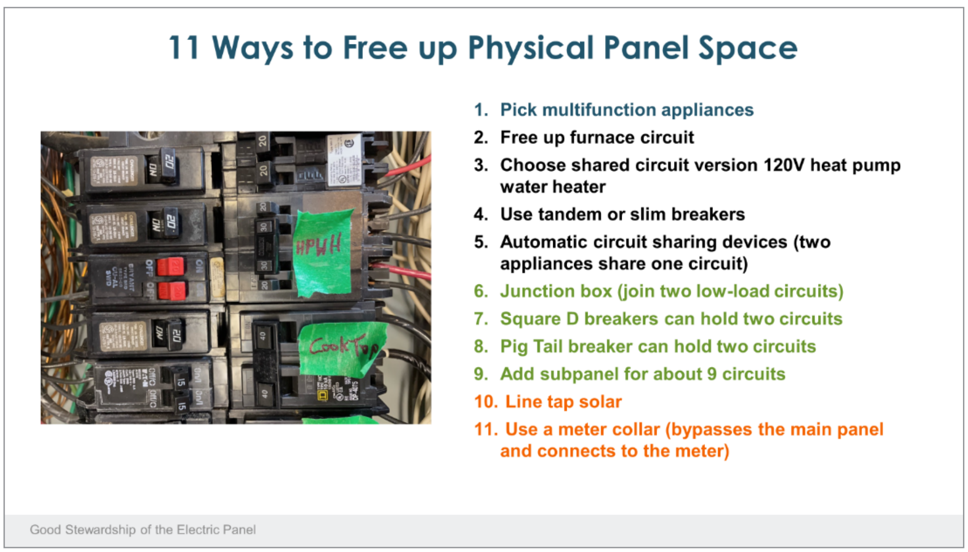
Replace:	Old Wattage	With:	Voltage	Wattage	Amps nameplate	Amps Counted	Amps removed	Net Amps Added		
Gas Dryer	800	30 Amp Dryer	240	4500	18.75	7.5	-	7.5		
Gas Cooktop	200	240V Range	240	9600	40	16	0.33	15.7		
Gas WH	0	30 Amp HPWH	240	4500	18.75	7.5	0	7.5		
Gas Furnace/AC	4500	3 ton 240V HP + 5 kW res	240	9500	39.58	39.583	18.75	20.8		
Gasoline Car	0	240V 40A dumb charger	240	7680	32	32	0	32.0	78,000	miles/year
Pre Elec. Total	5,500	Electrification Total		35,780	149	102.6	19.1	**83.5**	**Amps Added**	

We're going to we're going to play this thing to win and come in under the wire. This this slide is showing just three alternative plans, kind of caricatures. So, the bottom one I call regular jumbo

electrification. The top one, super watt diet with 120 volt cooking that new range that has a battery embedded in it. You know, factory built with a battery so it can do power cooking.

And then the middle one doesn't have that special cooking, that emerging cooking technology. It's just got all regular stuff that's pretty prominent in the market already. But the way I, you know, I'd look to the right of this graph and just see that the three cases on these things is in the super watt diet one, it only added four amps to the panel load calculation. In the jumbo one, it added about 84 amps. And so I want people to take a look through that and see where they want to be on this Goldilocks chart. Next.

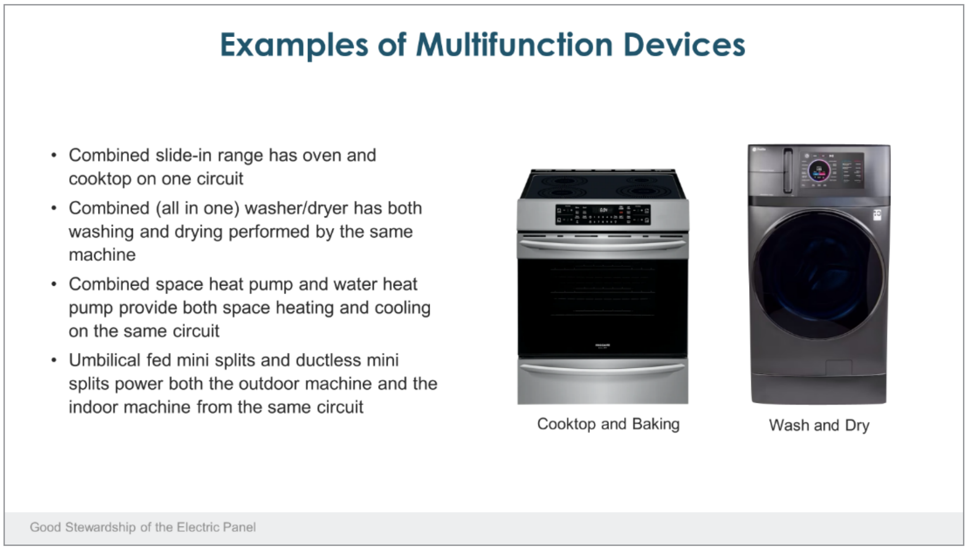
And so this is kind of the same data. Now it's but it's left and right. Old jumbo methods is on the right and very what died is on the left. The thing I've included in this one is a number of poles I had to add in the electric panel to do the new electrification and number of circuits I had to add. And so under old jumbo methods, including resistor strips for the heat pump and stuff like that, it ends up, you can kind of see it in the poles column, it added 12 poles and far right circuits, it added six circuits to do all that. In the super watt diet thing, it added one pole and one circuit, it, but that was trying to get by on a one-ton heat pump, which is like, that only works in passive house design, where you've got the super walls and stuff. Probably normally go, or in California, often go to a one and a half or two-ton heat pump for most efficient houses, maybe three tons if they're not efficient. Next.



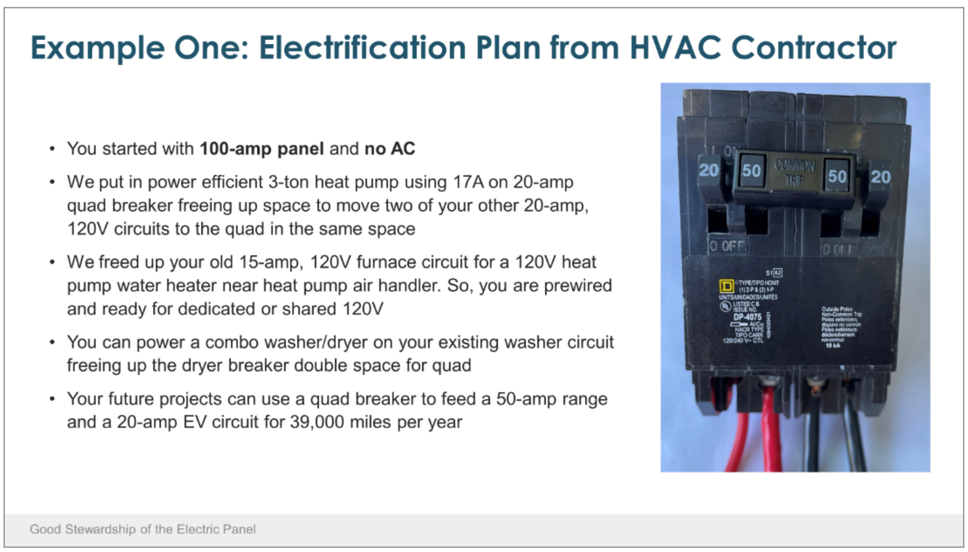
OK, so that was a lot about electrical issues, and now we're down to physical space on the panel.

And so I've gone over a few of them. Pick those multifunction devices that don't need separate circuits for two devices if it's being done by one device. Free up the furnace circuit. So by using an umbilical-fed heat pump where the outdoor unit feeds the indoor unit, it doesn't need a separate circuit to run the furnace. That frees up the furnace circuit to run the new 120 volt water heater. So, choose the shared circuit version of 120 volt heat pump water heaters instead of the dedicated one. And that means it can go on an existing circuit. Use those tandem or slim breakers. I show a few of them there. And then Larry will talk a bit about these automatic circuit sharing devices, which also can run two devices off the same initial branch and then a kind of a smart junction between them.

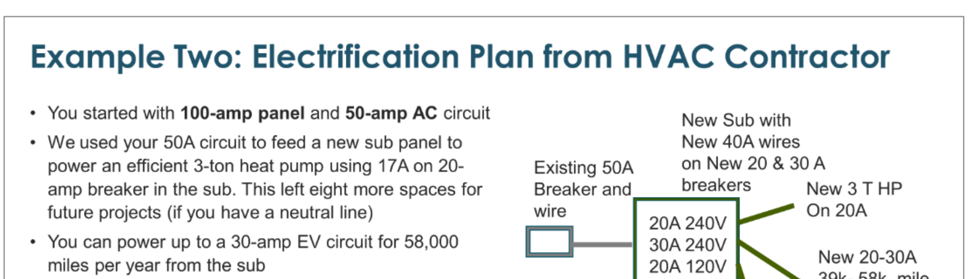
And so there's four ways there to combine two circuits on to become one circuit on one breaker. And then the two bottom red things are two different ways to connect solar without it taking circuit space. Next.



So, here's just a couple pictures of these multifunction devices, you know, they cook top on top with that range, and just a slide in range, a lot of people have them already, and then this combined machine that washes and dries my clothes, I haven't found one that folds yet, next.



And then now the contractors can be making kind of a physical electrification plan with customer if they don't like a lot of paperwork. And so they told me about a couple different things, you know, this slide will help you kind of look at that scenario where you can tell the customer you started with a 100 amp panel and no air conditioner. And then we put in the power efficient three-ton heat pump on a, you know, that needs 17 amps, we put it on a 20 amp circuit, but in a quad breaker. And so, then the that frees up two spots on the quad breaker to land old circuits onto. And then there's other things where we're freeing up different things by using say the using the 120 volt furnace circuit now that's freed up by the heat pump to run the water heater and a few other things. So, you can kind of walk them through how that happens showing the physical things of the two different quad breakers you might use in their job in their main panel. Next.



And if there’s not room to do that in the main panel, one of the other things you can do is a lot of you’ll run across a client who’s got a hundred amp panel and a 50 amp wire going to their outdoor disconnect for the AC their air So you can replace that disconnect with a new sub panel. And that sub panel will have a breaker that You can still do the disconnect to do the maintenance on the HVAC. So you can just click that breaker off. That’s what it takes to make the service person safe.

And then it’s got more breaker spaces.

And you can have a 20-amp circuit for outdoor circuiting and other things. Do the load calcs on this kind of stuff and see if you wanted any controls. But it’s a way to turn what they have now into what they need next and next.

So, this is just the diagram of what I mean by umbilical fed. On the blue line is power coming into the outdoor unit, and it’s got a line in its refrigerant line set going to the indoor unit, powering it. That frees up the old furnace circuit next.

And we already talked about these tandem or slim breakers, but they let us get more breakers into the same space just because they’re narrower. Next.

We’ve gone over that example, so next.

And these are just examples of these new products just on the market in the past year or two that really free up a lot of amps and panel spaces. The two different, on the right side, 120-volt versions of heat pump water heaters. More are coming out in the coming months. More models, more features.

Next.

6 Contractor Practices to be Good Stewards

- Avoid strip heat resistors
- Pick highest efficiency equipment at small power size for long run hours (get buy in)
- Pick Heat Pumps with umbilical-fed air handlers
- Pick 120V plug-in heat pump water heaters (convert old furnace circuit to receptacle)
- Pick combined devices that meet two needs e.g. heat and cool, space and water, oven and cooktop, washing and drying
- Use Quad Breakers for 240V devices you add. Whether you need them… or the next trade. Show the client: “In our bid, because we’re careful, you still have room for more”
    - Maybe you can install the circuit for the next trade. E.g. HPWH, for emergency ready
    - Maybe you put your quad breaker where solar is and move the solar onto it. Or put your quad where 20-amp (20%) solar will be (opposite from utility feed end)

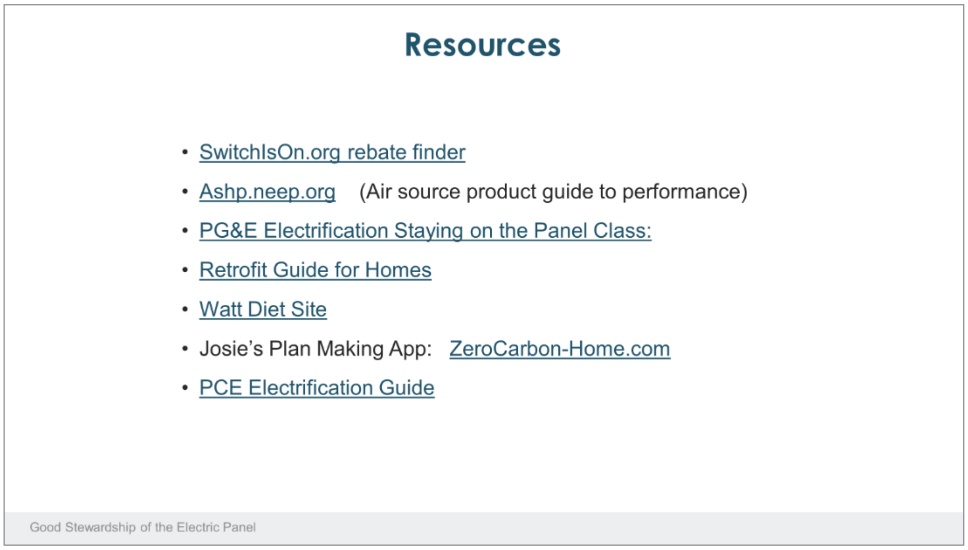
Good Stewardship of the Electric Panel

All right, we're in our final slide. The six practices to be good stewards.

You've been hearing that. Pick the highest efficiency equipment at small power size and kind of small sizing units. Be aggressive in downsizing the units. Count on long run hours and talk it over with a customer to get their buy-in on this is the way the thing works. You don't set it way back at night.

You keep it at a pretty steady temperature and it's fine.

And then pick heat pumps with umbilical fed air handlers, pick the 120 volt versions of the water heaters if you wanna get to really low power, and pick the combined devices. Use the quad breakers when you're doing your work, even if you don't need them to complete your work, but put yours on a quad breaker. You could even say land their solar on the outside of your quad breaker into the same spot.



So that concludes the slides.

Jenny Low, Build It Green:

Oh, perfect timing, Tom. So I just wanna announce to everyone that to submit your questions through the Q and A and that the recording will be sent out to all registrants and posted on the tech website. So with that official announcement, we're gonna dive into the questions and they're gonna start coming in. So, Tom, since you were just talking about breakers, Mitch was sharing that breakers don't protect the machine, they protect the wire from being overloaded and causing the circuit to have a catastrophic failure. Is it a good idea to retrofit an existing panel with some smart breakers for the higher consuming circuits?

Tom Kabat:

I don't know much about smart breakers, but I agree, well, the breaker protects both things. We size it down, we definitely have to size it to protect the wire. Okay, but there's a maximum size also related to the machine. So the machine usually will accept a bigger breaker than the wire in most design cases. So maybe Larry will talk a little more about power control and maybe he can cover something on smart breakers.

Jenny Low, Build It Green:

Perfect. And I'm going to go quickly through the questions because I think we have like seven or eight. So, if you want to give high level answers to that, and then you may be able to expand more in the written form.

So, Pete Marsh from the last one was saying that for sizing heat pumps for HVAC current best practice is to do manual J calcs and/or blower door but I've seen an approach that intrigues me - download hourly gas consumption data from the utility. Most gas utilities, at least in California, now have mirrors that report hourly. Then you can pick out the handful of highest consumption hours of the year and figure out the BTU output required from a proposed heat pump based on the BTU input to the existing gas furnace. I'm skipping some.

Tom Kabat:

Yeah, I'm very familiar with that method. I've written it up and put it into different tools. I think it works. What the beauty of that method is it really gives you that house with those occupants, the way they behave, the windows they leave open. Because the way they behave and the windows they leave open, the amount of insulation it really has and how good that insulation is, all that shows up in their gas use. And so when we've got gas use data down the daily level and we can pick the highest day of the year and provide a heat pump that can meet that highest day's energy delivery in just 12 or 14 hours. Why would we need a bigger heat pump than that? And so that's the method.

Jenny Low, Build It Green:

So, Dan asks, so the NEAP tool is excellent. It does require a load calculation, so that should always be part of your HVAC plan?

Tom Kabat:

Yep, it sounds like a statement And I agree, do a load calculation or calculate it the way we just talked about from gas usage, backwards, up and out. And I subtract out the summer baseline gas usage, figure out the rest is for winter space heating on that peak day during the cold weather. And you can even, you know, PG&E even provides that what was the temperature that day. So, we can calibrate. Okay.

Jenny Low, Build It Green:

When picking high efficiency equipment, main utilities with peak load challenges wants to use EER2 and the second version. What's your perspective on the right metrics to use when picking efficient equipment that doesn't impact peak loads as much?

Tom Kabat:

I haven't, you know, I'm not too familiar with that issue, you know, but basically the more efficient the equipment, the lower its peak use is going to be and the lower its energy use will be on that peak stress day. So that's gonna leave more space on the grid to get more people electrified. So it's climb to the top of the scales, whatever those scales are, climb towards the top.

Jenny Low, Build It Green:

Okay, so this is a more interesting question, Tom.

Are you finding that AHJs in NorCal are actually setting top-down and bottom-up low calcs? From what I'm hearing, there seems to be skepticism from electricians or HJs.

Tom Kabat:

You know, that's very normal for trades that are adding one device. That's the easy way to go about doing it. You know, you can quickly show there's generally a lot of space left in the calculation, and the device I'm adding is a little part of it. And then, you know, they publish on their sometimes AHJ websites, they'll publish the full-blown stack diagram of how you do the bottom-up calculation, the 83B. A lot of times, though, be careful, they'll use 83A for new homes because they're also dealing with new homes. Some of the differences are a new home counts 10 kilowatts of basic loads as always on at 100 % coincidence factor. And the retrofit code allows us to use 8 kilowatts, So we get a little extra space by using 83B. So do look at what they're asking you to use.

Jenny Low, Build It Green:

OK, two quick more questions, and then we'll close out the Q &A. Can you clarify if your slide of the 120-volt Rheem portrays a hybrid or if it's a heat pump only? My understanding is that Rheem is 240-volt hybrid, but the 120-volt is heat pump only with no resistance heating.

Tom Kabat:

That was the 120-volt version, shared circuit model shown. It had that black cowling where the mixing valve is. It had no resistor in there, but it had an onboard mixing valve. And so it lets you program the unit up, say, to 140 degrees and still dial in to deliver 120-degree safe, non-scalding water.

Jenny Low, Build It Green:

Okay. And then the last question is, in what scenarios would it make sense to choose a 240 volt heat pump water heater over 120 volts?

Tom Kabat:

Yes. When you have a requirement, say you've got a lot of bedrooms and bathrooms, you need a high first hour rating of lots of gallons of water delivered in that first hour, and you've got a little closet that's not very wide. So, you have to get a small volume water heater or small dimensions. And so you can slip a couple inch narrow or 240 volt unit into a tight space than if you were to go for the low power one. I always like a bigger tank, and sometimes a bigger tank has bigger diameter. So it's based on size constraints. It's the only time I really want to go over to 240 volt.

Jenny Low, Build It Green:

Okay, and I'm going to squeeze in one last question, and then we'll pass it over to Abhijeet and Larry. But are line side taps often allowed for residential solar?

Tom Kabat:

They're allowed if you've got the lines. Now, so sometimes you've got these combination meter boxes like the one here, where the meter socket is in the box, and I don't really have access to these two connector lines very well, but when you've got a separate meter from your panel box, there's lines and that's where you can get your line side tap in. And the meter collar I mentioned is a way that just plugs into the meter socket and can land solar there, or there's new smart meter collars, hopefully others will talk about them, that can take offtake power also from that meter collar.

Jenny Low, Build It Green:

Perfect, and thank you, Tom, for going through such a wave of questions, and we're going to Thanks for helping me through all that, Jenny, and it's great to talk with the folks.

Sandy Laube, Energy Solutions:

Next slide, please. Thank you, everyone. And now we're going to move to our next session, and we'll be introducing Abhijeet Pande from TRC, who will lead us into power control strategies.

Session 2, Part 2:

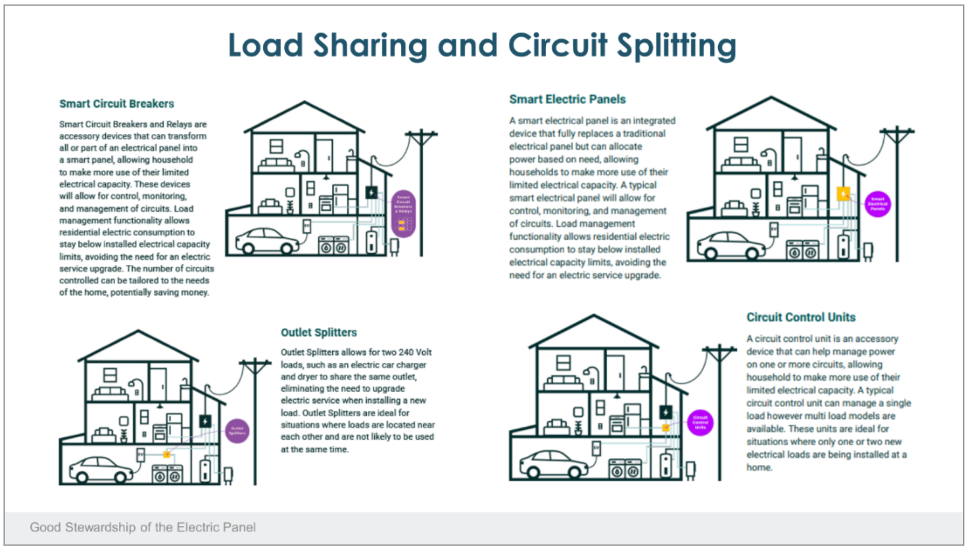
Power Control with Larry Waters, Electrify My Home

Abhijeet Pande, TRC:

Thanks, Sandy and Tom. That was a great presentation and feeds very nicely into our next presenter, Larry Waters, who's President at Electrify My Home, a full-service electrification service provider. Larry's presentation is going to focus on power control strategies. Some of the questions that came up in the previous session, we'll try to answer in this one as well. Larry, take it away.

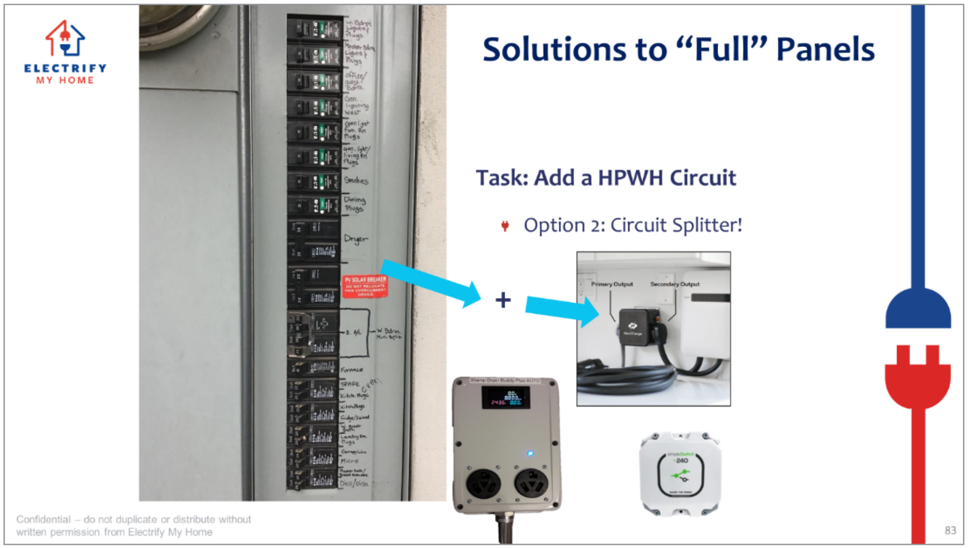
Larry Waters, Electrify My Home:

Hey, good morning, everybody. I'm assuming you-all can hear me, so we're just going to go with that. Thank you for joining us on the Power Symposium. This is a pretty awesome deal, TECH's putting out here. We're going to talk a little bit.



So, the question is, are these panels full? And so a little bit about what we do, we're a company that goes out to people's homes and helps them electrify everything in their house. We're an HVAC company as well as an electrical contractor, and we're providing full electrification for houses with the part of our mission statement is that practicing good stewardship of the electrical panel and so we use a lot of different methodologies to do this and different plans and so panel is full either its spaces are taken or it's at capacity and we can tell when a panel spaces are taken pretty easily just by visually you know looking at it but we don't know if it's at capacity until we do a load calc we can do the top-down

We do a lot of heat pump water heaters and low energy heat pump systems and multiple low energy heat pump systems on houses. And we very rarely, like last year, we only had seven panel upgrades.

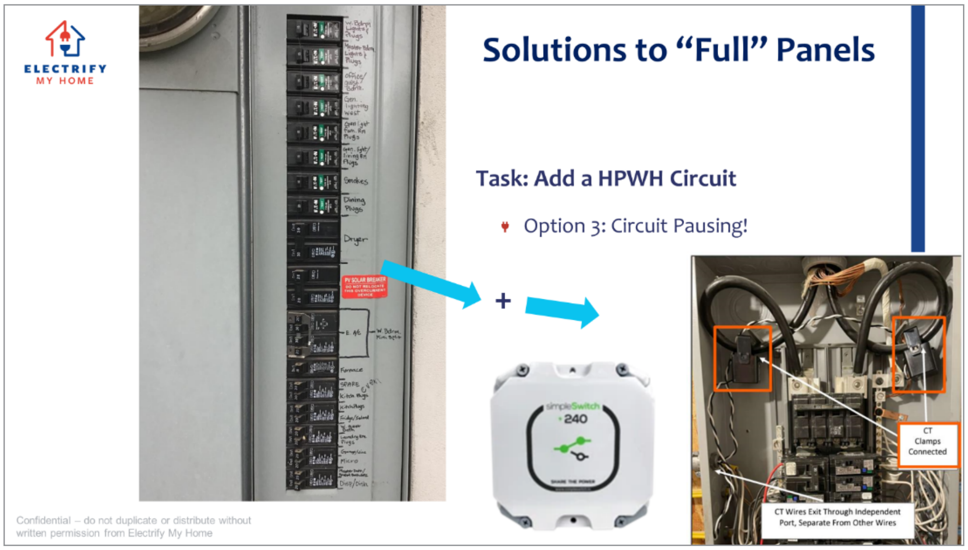


And those were more than likely panels that were kind of in bad shape. So to add a heat pump water heater circuit, click it again, please. What do we do? Circuit splitters, we use a lot of these circuit splitters. So here in the center, we see the NeoCharge circuit splitter. This is the one with the two plugs plugged into it. This is a pretty simple little device. It's saved our butts a lot of times. You plug it right into an existing 240-volt outlet. It comes with the different NEA plugs on it, so it'll go 50 amps or 30 amps.

And we use these quite often for splitting a dryer circuit and a heat pump water heater circuit or a dryer circuit and a single plug-in car charger circuit. These are really really helpful when we're in that 30 amp range. We like them a lot for that. They are kind of a they're a smart dumb product. They don't need any kind of an app or anything to operate. They have a primary and secondary side. You plug the primary load in which would be the dryer, and basically anytime you're not drying clothes, it will allow your secondary unit to operate. Now, this comes with some conversation from the customer.

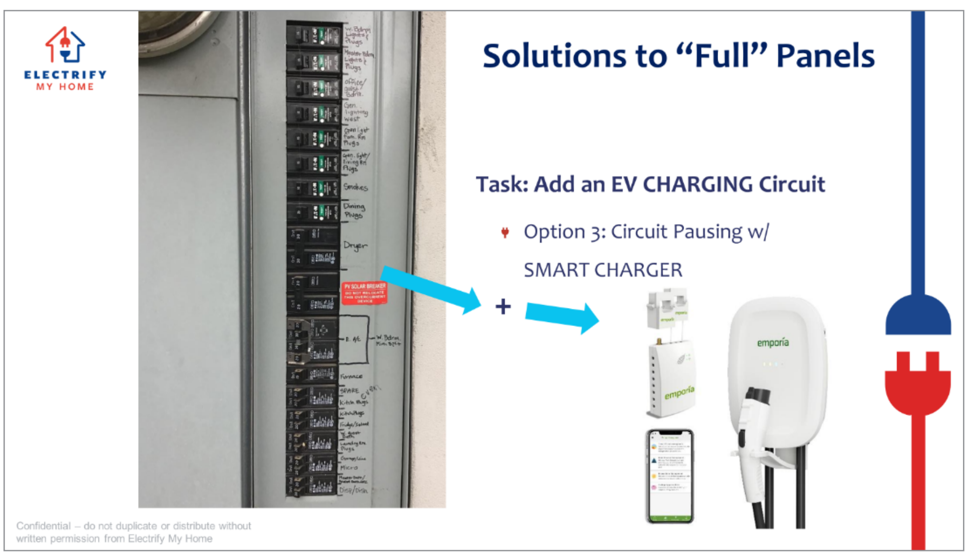
I won't do this in a house that is doing a lot of laundry, and they got a bigger family, and there's a potential for them to run the dryer long enough that the water heater can't recharge. But, so, this is all going to come out in the conversations we're going to have with the customers up front and as we're planning their full electrification project. What you see down here to the left on the bottom here is called the dryer buddy and it's a very similar unit. Plugs into the dryer outlet, gives you a couple of plugs on top, it's a little bit more manageable, has some visuals built into it, also a little bit more expensive. The beautiful thing about these Neo charges is these things are usually a couple hundred bucks maybe $300 when you can usually find them on sale and then the circuit splitter you see down at the bottom there is a simple switch now the simple switch is really handy because it

We can take one wire to run both. Obviously, if you're cooking, it's not going to charge the car. We always put the car charger on as the secondary, the load on that. And so, as long as you're not baking cookies, your car can charge up. Next slide, please.



We also use pausing devices. So, the simple switch can be used as a pausing device as well.

that's been collected over the last couple of years in PG&E territory with HEA found that you know 98 % of the panels out there never went over 80 amps. So we know that panels are not going over. My house is a kind of an anecdotal story. I'm fully electrified. I do have a 115-volt plug-in water heater. If you guys are scared of those, don't be. They work just fine. But I have a circuit pausing device, which is a SPAN panel. But this is something that can be attached directly to an existing panel, and it can just drop that secondary load when it gets up close to full load capacity. Next slide.



So there's also the Emporia car charging units. We install quite a few of these. These are similar to, if you don't know about the SPAN drive, we'll talk more about that in a minute or two. The SPAN drive or the Emporia system actually has a circuit pausing device in it as well.

So that helps us expand those, for those people that don't want the heat pump dryer or to do the ultimate watt diet, this kind of helps them protect the upside of the panel capacity. Next slide.

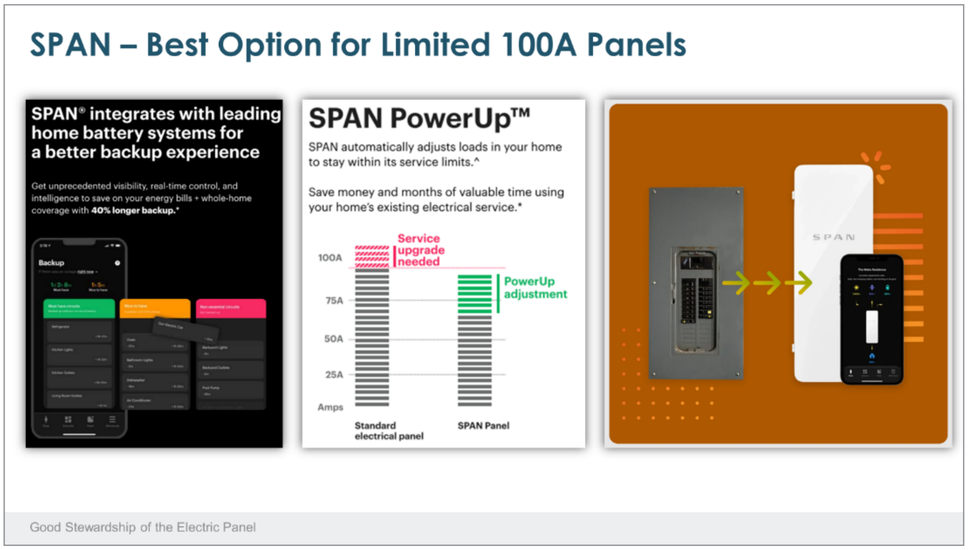
There you go.

So, somebody asked a question in the last slideshow about a smart panel. And these have, these are two different types of smart panels that are available out there now. I know that there’s more.

It’s just a regular load center with smart breakers. And these breakers can be used for individual loads. They’re all tracked with a power hub. And with an app on your phone, you can monitor what your energy use is and just make sure you’re going back and forth like you should be on that. The SPAN panel that you see on the right is kind of the crème de la crème of that. The SPAN panel, I have one in my house and we’ve installed about, I don’t know, less than half a dozen of them so far, but we have a few on contract. But the SPAN panels are amazing because they allow us to not only monitor all the circuits, but they do everything internally, and we set it up when we install the system to drop specific loads. So we had a project up in Davis a couple of months ago, and it was really a nail-biter because they had a wire coming in from the street that was capable of a 125 amp upgrade, and when we went to go get it cleared through PG&E, after we had presented it to the customer that it would be fairly easy to do PG&E declined it and said that we were going to have to dig a trench and run a new wire because that wire was direct burial.

So even though the wire was the correct size for 125 amps, they wouldn’t let us upload the breaker size to 125. So we installed the SPAN panel. The SPAN has their power up app that now allows that panel to be programmed to a maximum amperage. And so if it gets up to the maximum amperage, it will drop out a single circuit of which I think we designated the dryer. So on that project, we added a low energy heat pump system. They had a current 24,000 BTU air conditioner and a gas furnace. We put in a Mitsubishi heat pump system, like Tom was showing on the slides before. That was a 20- amp load, so we were really at 20 amps on that. We didn’t save any capacity there. We ran a wire for the stove that was not preexisting. That was a 50-amp upgrade to the panel. That pushed us to a bottom-up calculation of about 118 amps, although that house would never hit that. One of the other strategies we did was a 110-volt plug-in water heater that kept us at 118 amps, and then we did the SPAN panel. This one was kind of a weird one because the lady had an electric kiln at her house that we had to cover.

So, another SPAN that we did recently was I put one at my house. I have an Tesla battery, an old 100 amp Zinsko panel that I changed out, two heat pumps one in the garage one for the house, the electric water heater plug in 120V, the 220V plug in dryer, and all electric with induction range cooktop combo unit that one did a bottom-up load calc at about 114 amps and we put the span in with this with the with the span loaded in to offset the garage heat pump if we came up to the high thing but also with the span I can go in if I’m using the garage heat pump and hit load although I never will because I did a top load line test on my own home and I turned everything in the house on and I was at less than 10 kilowatt, I know I’m never going to get there but my load calculation was showing that I was up above 100 amps.

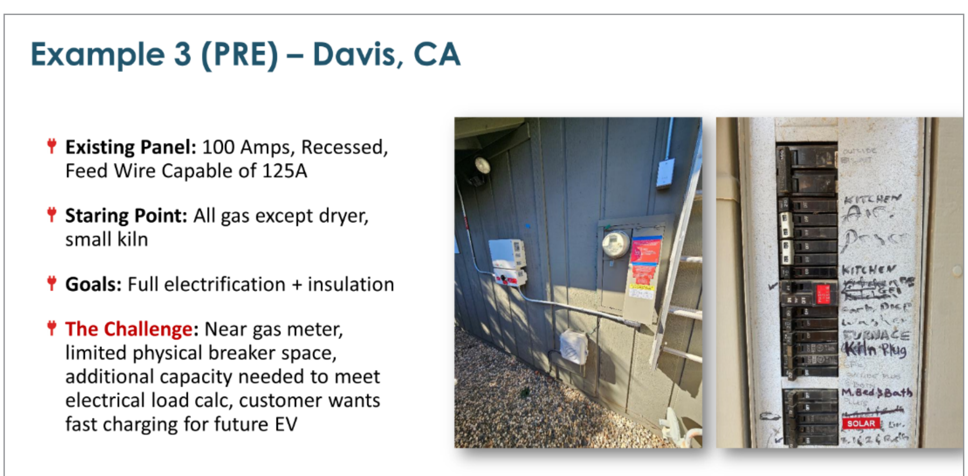


So, with my Tesla battery, it does show a full control panel view of where my power is coming from at all times, if it's coming from solar. I will say with the SPAN, I've had a little bit of a problem with it connecting up with my older inverters, my microinverters from many years ago. That's been a little bit of an issue. Does show the current coming in, but it doesn't show the data quite right yet so we're working on that little problem but overall the SPAN has been a complete success on that part. We are also doing a job in Oakland where the customer was getting a they were getting a 350 amp upgrade to their home and they had a hundred amp system in there before the electrician is putting in two SPAN panels and my question for them is why they needed

And I think Tom mentioned it before, when we take amperage away from the neighborhood and put it in our own house that we're never going to use, the utility has to allocate that amperage to your home, which could cause someone else in the neighborhood not to be able to

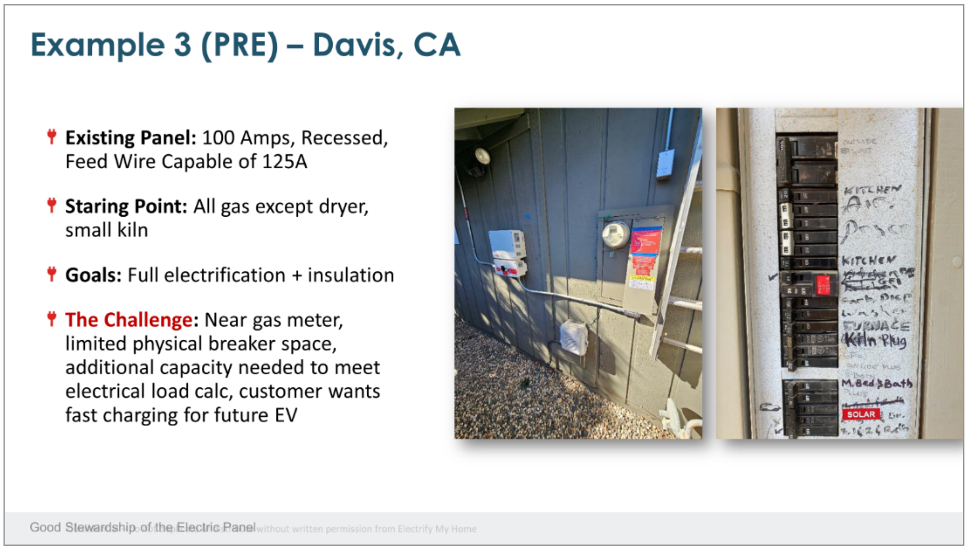
So we need to be really careful and not upgrade our homes more than we need. So SPAN is an excellent way of doing them. SPAN is also an excellent way of avoiding those trenching jobs with the wires coming in from the street. We don't have to worry about that anymore. SPAN is a secondary panel. We don't need to involve PG&E with the process if we're still using our same breaker size on our main breaker. It's just a local code inspection. So, it's a great option for those situations when we're just a little bit over on our load cops and more and more cities are asking for those load cops. Now, we're typically doing them on all the houses that we're doing. Any upgrades, especially including the stove, because that seems like the one that pushes everything over the edge.

But the SPAN power-up system has been remarkable in the way it operates, and it's a very new feature on these. If you've got any SPAN panels out there deployed, you can expand the capacity of those panels by just loading the power up app onto that SPAN panel, and it will be able to add additional loads to the system. So next slide, please.



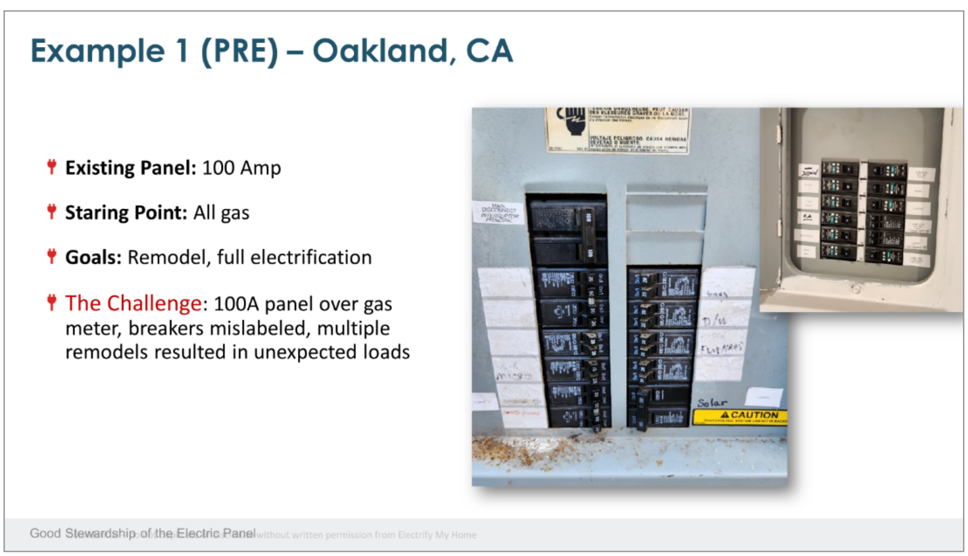
Here's that house in Davis. Sorry, I got ahead of the slides. So, we had 100 amps recessed. The feed wire was capable of 125. The starting point, they were all gas except for the dryer.

We did a full electrification plus insulation. The panel was near the gas meter. You can kind of see the gas meter down here in the corner. The panel had also already been moved around a lot. There was quite a few different types of breakers in there. We needed to get additional capacity to meet electrical load calc. Customer wanted fast charging for future EB, so we did set them up so they can put a SPAN drive in there later. Next slide please.



This is what that beautiful system looked like. I would tell you, you know, these don't take just a few minutes to install. They, this was a day and a half install for the SPAN. Make sure if you're going to sell these that you go through all the training and that you allocate enough time to do these correctly. We did have to do a splice box on the bottom here.

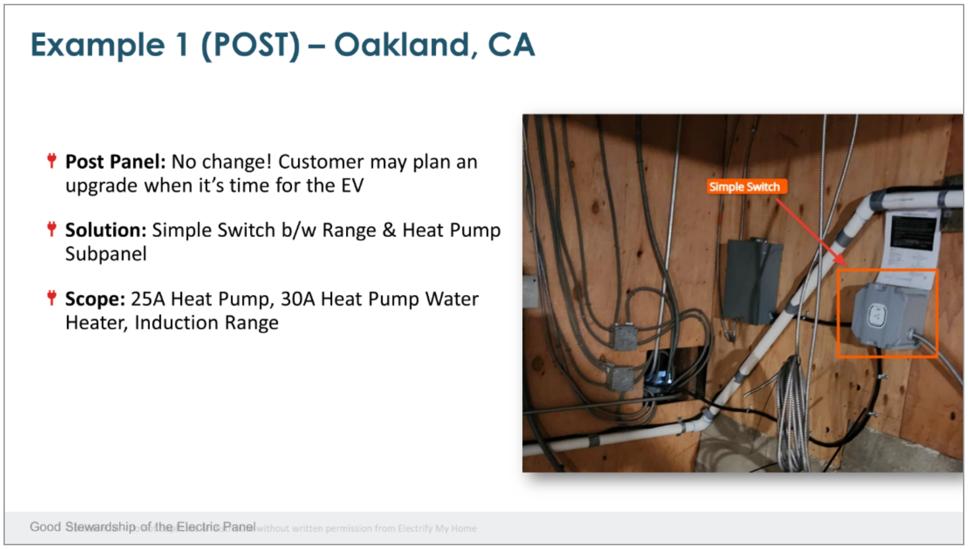
This is actually incorrect. We did the smart panel feeding from the main at 100 amps and 20 amp Mitsubishi heat pump, 120 volt RUUD water heater, and the new induction range. And they're going to do the fast charging. Next slide, please.



Some pre-wiring we did on a job in Oakland.

The house was all gas, 100 amp. We wanted to So, remodel for full electrification, the gas meter once again, or the electrical panel was once again over the gas meter. Bunch of the label or breakers were mislabeled. This was really problematic. We had a breaker that was labeled garage sub panel, and when we went out to do the job, we actually found that that was wired into a weird junction box, and there was a bunch of circuits coming off of it that weren't even breakered. So, there was a

whole bunch of really like voodoo stuff going on with this electrical panel and the sub panel. So, what we ended up doing, next slide please, is we ran the, this is kind of interesting, this is one of those things you got to figure out when you're on the job site, but we ran the 50 amp that was going to go to the stove circuit, or So what we ended up doing is robbing the stove circuit running it through a simple switch running one side into the simple switch for the stove as a primary So the stove would run as the primary appliance and then we ran our sub panel That controlled two heat pumps



So we're going to go now we're going to land the sub panel for the heat pumps into the main panel. Now they had an electrician kind of come out and figure all that stuff out. But what we were doing is is cycling the heat pumps any time they were cooking. So if they maintain the house and keep it warm or cool with the heat pumps like we've designed them to do. the small amount of time when they're cooking you know the heat pumps would turn off and then once the stove is off the heat pumps would be able to turn back on again. But what we found there was an unintended consequence and is that they would have to reprogram the time on the thermostat every time they did that. It didn't it since became more of an issue. So, We can get pretty creative with these circuit- switching devices. We've also got a lot of these where we've split that stove circuit and gone to the car charger, and we just eliminate the need for that extra space in the breaker box. So, it's really an amazing device there. So next slide, please.

So, we want to make sure that we think about things when we're talking to our customers. And being a good steward of the electrical panel is the most important thing that we can do. The other most important thing, or the other very important thing we can do, is design their heat pump systems properly. So, we use low-energy heat pump systems, and we don't install strip heaters.

And we've been really cautious about making sure our customers understand how their systems are going to operate, and understand how they're going to need to use them in the future.

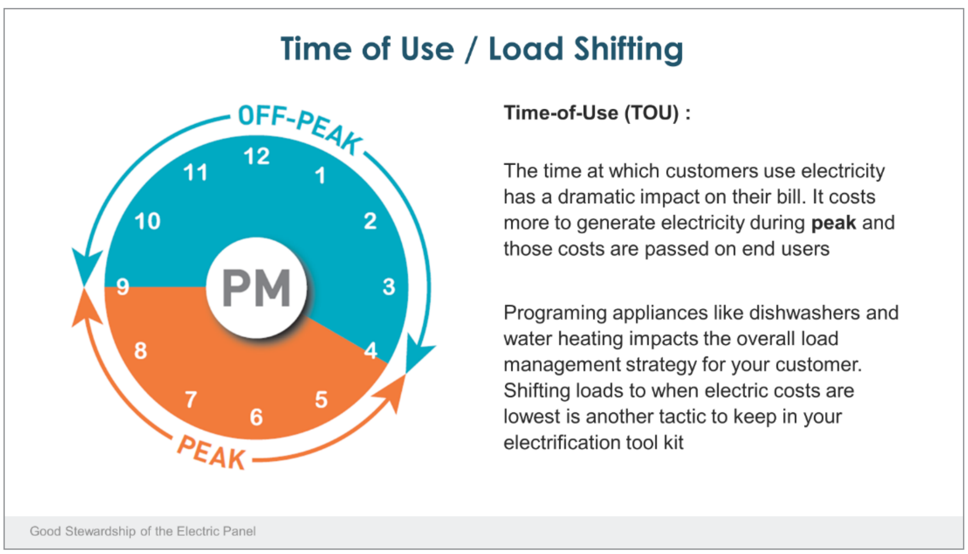
We've never installed a unitary piece of equipment. We only put in inverter equipment. So it's really important to plan your customer's pathway out, especially if you're just an HPAC contractor and you're really trying to get into the kind of the electrification business model is we need to get in there and smartly plan. Let that customer know what all these measures are that they're going to have to do and begin with the end in sight. Begin with helping them dial in each and every load. And if they don't have renewables on the house, I try to leave the panel upgrades for the

renewable guys if I can. We do have some homes out there that we're waiting to get the upgrades for the electrical panels done. So, we're temporarily using these circuit splitting devices until they can get the new panel upgrade.

Use the circuit sharing devices as a temporary measure. So, also consider the cost of these things, right? So, those NeoCharge units, those are a good long or short-term problem solver.

And you can unplug that thing and take it and use it somewhere else when you're done. Like, you can get somebody's heat pump water heater installed. We did a few of those back in the late part of last year.

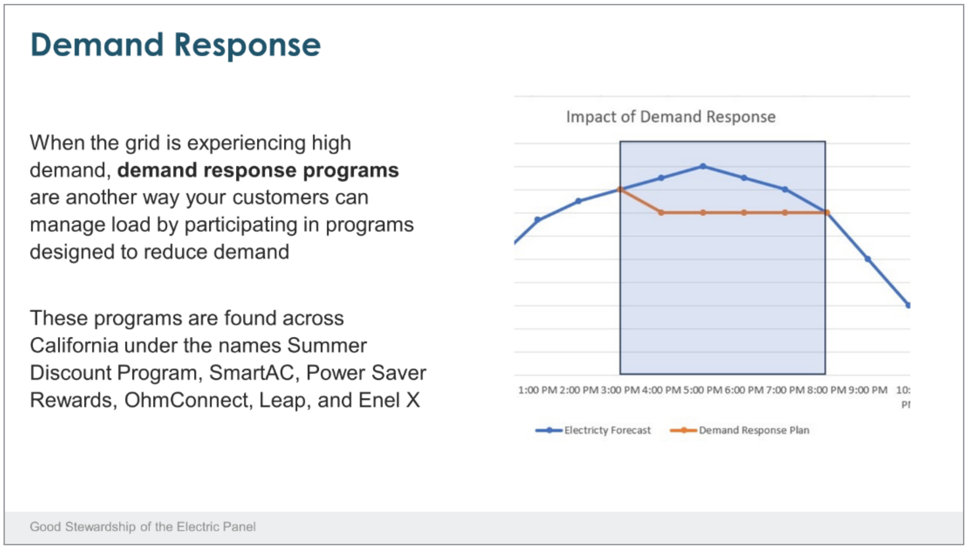
So we just put the water heaters in, plugged them into the dryer outlet, then got them up and running on their on their electrical tax credit for both years. So and then amperages and loads are going to dictate what type. But you can get creative with this. Put that put that small subpanel as long as those loads don't matter, like if it's running the two heat pumps outside and it's off that one subpanel, and they're sub-breakered. So those two heat pumps on that one that I showed you a minute ago, those were not equaling 50 amps, but they were sub-breakered in that breaker panel. So it worked fine. So that'll dictate what type you're going to use. We mostly just use the NeoCharge and the SimpleSwitch and lots and lots of subpans is what we use here. But just make sure you're tailoring this for the actual customer's need. Next slide, please.



Other load management strategies. Okay, next slide, please. So, on and off peak, time of use and load shifting. This is incredibly important to explain to your customers out there, especially when doing the water heater stuff. We want to put these water heaters in so the customers are not using them between four and 9 p.m. And we've talked about it in this symposium already and a lot of other trainings, But we need to size our customers' heat pump water heaters correctly so that they can have an off-cycle and it doesn't cause them grief. We want these electrification measures in our customers' homes to improve their lives and not cause them problems. We want them to have more comfort and less comfort. And we want them to tell their friends and family how well things have come out. So, we need to size things properly.

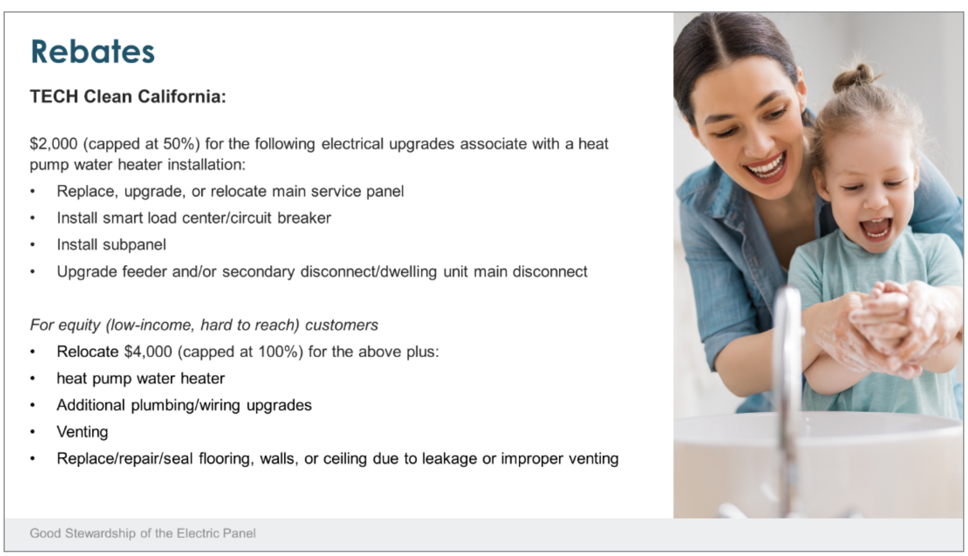
So potentially they could pre-cool or pre-heat the house before 4 p.m. and turn that thing off between 4 or 9 and coast through there and not have the house get radically warmer or cooler between cycles. So that's always part of our solutions is making sure we have the right system involved and the right amount of envelope measures to where we can make these houses coast for a

few hours and not impact the customer's climate or comfort. So power, really expensive between four and nine, much less expensive, but still expensive during off-peak hours. So, install really efficient for off-peak and install smart so they can peak shape. So next one.

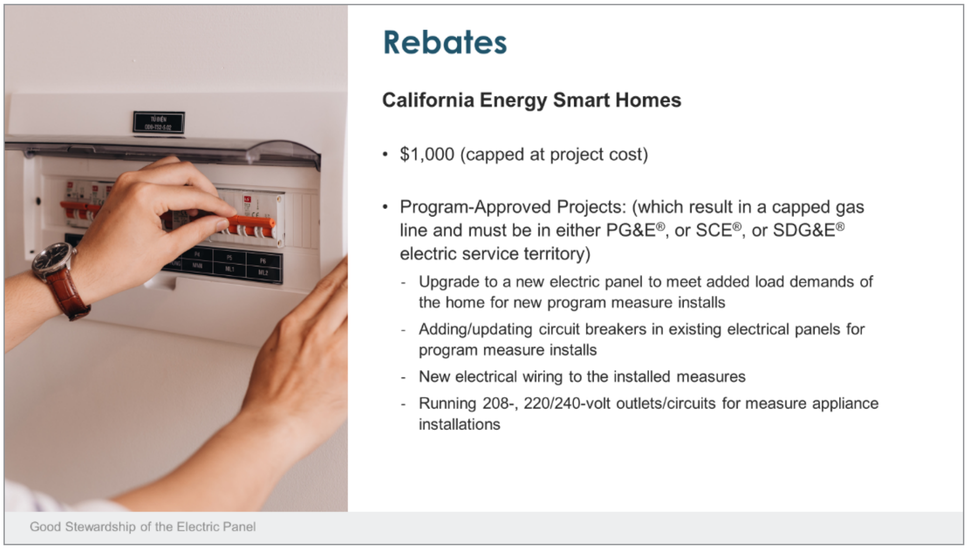


Let's get our customers signed up on demand response. If we're putting in these water heaters, let's let them know, talk them into this. Let them turn off their water heating systems between cycles or during that off peak time, put in a big enough tank, get that mixing valve dialed in, put a really, really large tank in the house. The larger, the better. And I know what the customer objections are. I have a 50 now, why would I want a bigger tank?

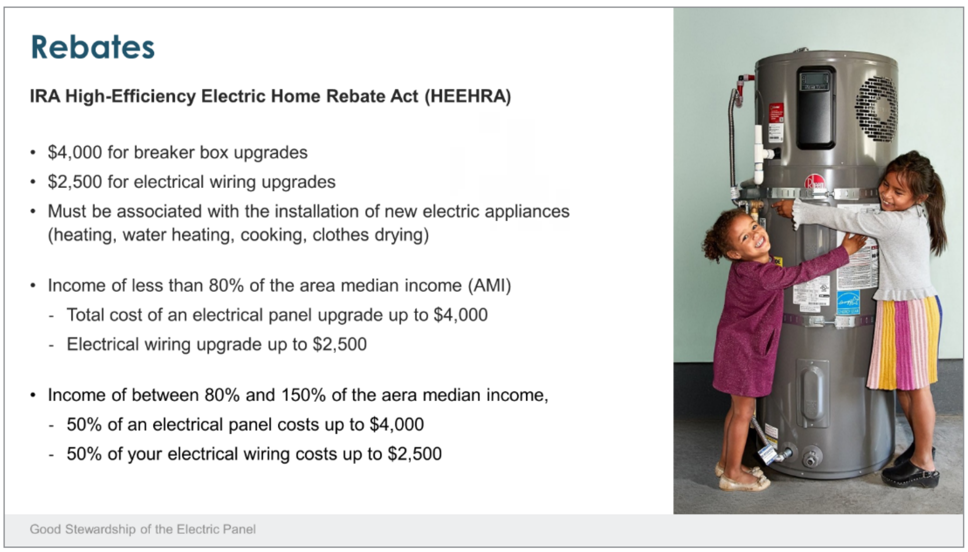
It's best to put 80s in wherever we can. If they'll fit, put an 80 in just for these situations when we're going to be doing load shifting or demand response. So, when the grid is experiencing high demand, these programs are really, really beneficial because they can drop those loads out there. And really, this is why the utility companies are providing such big rebates for these things is because they're really depending on these batteries being installed out there that they can switch on and off when they need to. So, next question or next slide please. I think that's it. Rebates and other incentives. Go ahead, Sandy. All right, so next slide. All right, I'm going to not spend a whole lot of time on these because since we are going to send these slides out in the decks, but since we obviously would like you to optimize before you upgrade, but there are an awful lot of incentives out there.



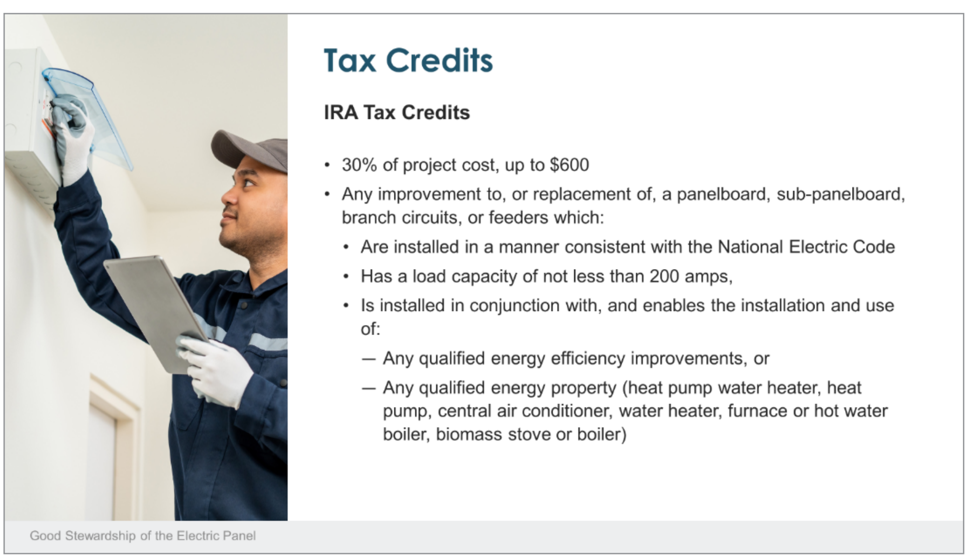
So the first obviously is TechClean California. Next slide, please.



We also have California Energy Smart Homes has incentives.



We have incentives coming up through the IRA.



Sandy Laube, Energy Solutions:

And now we are at Q &A. So, I am going to hand back to Abhijeet to take us through Q &A with Larry.

Abhijeet Pande, TRC:

Thanks, Sandy and Larry. There's a few questions that I think, Larry, you answered, but I'm gonna ask them so you can kind of expand on some of these answers. So first couple of questions are from an anonymous attendee. First one is more a statement that you can program smart breakers and they're saying they currently use the SPAN panel where you can program large loads.

And then a related comment that the ideal panel proposals will consider the customer's budget, and so the cost of the equipment. Some of the equipment, like the combination washer-dryers or the battery with the range, are more expensive, as well as the cost of combined circuits. So maybe you could address both of those together. How do you address the cost of the equation as well as deprogramming of large loads?

Larry Waters, Electrify My Home:

Well, I mean, we have these low energy ranges coming out, but they're not available to the masses yet. And the majority of the customers that we deal with, they have small families. They're going to keep their own electric dryers and all that. So, we want to make provision for those. So, the costs that we put into the SPAN panel It can be offset by not having to purchase these other expensive devices if we're doing the SPAN panel at the same time we're doing the heat pump water heater there's additional incentives for that.

So, there's a lot of good reasons to go for that and the SPAN panel is going to open them up to more opportunities later if they want to add additional load to the house. Like I don't want my customer to electrify their whole house and then go to the home show and see a hot tub and go, man, I wish I could buy one of those, right? So, it does give them the opportunity to expand their capacity beyond.

We often lock people into like a full electrical panel on load capacity when they're just doing the four major gas changes. And so that's really, it opens up an opportunity for all that kind of expansion because people out there that are electrifying their homes, they want to do the right thing for the environment they want to do the right thing for their house, they want to get off gas, but not everybody wants to go out and change their entire lifestyle, right? So, we got to be cognizant of that, put in the right size water heaters. So, like 110 volt sometimes is a good solution if it's a big enough tank to where we can offset some power. But I think that answered that question.

Abhijeet Pande, TRC:

I think it did. And talking to that last point about 110 or 120 volt, Diane Bailey had a couple of questions. I'm going to try to summarize those instead of reading the question, but the first – both of them related to building code requirements, specifically the CPC Table 501.12 for first-hour rating for water heaters, which is a calculation based on number of bedrooms, number of bathrooms, and making a comment that for a four bedroom, three bath house the minimum first hour rating is 74 gallons and a related question was how has that been addressed through energy code, so we can maybe keep that particular part of the question aside. So maybe you can answer the first hour rating question first and then talk about the first hour rating versus the higher temperature, which Tom also kind of touched upon earlier.

Larry Waters, Electrify My Home:

Yeah, I mean, from our experience of actually working with building departments and things like that, we want to get something that's going to be clearly visible to a building inspector as like you can show them like a chart like this, right? You can show them the chart that says, if I use this particular water heater on this particular 74-gallon first-hour rating need, that means I can only use two models through State or A.O. Smith that have the little backup heater.

We could probably argue the point that if we keep the water hotter, and then we get to our, but you're never gonna be able to have that conversation with a building inspector. Building inspectors are really looking at things very black and white. And sometimes you have to explain like, that we were out on a job with a guy, and I had to explain to him that the outdoor unit was powering the indoor unit because the indoor unit we were using was one that could work with multiple systems and it had and he was like fighting me, where's your disconnect switch on this? Where am I wired? So we want to keep it simple for them. So using the right product on that. And so you're really kind of stuck with the, or not stuck with them. It's a fantastic product, but you know, there is a product available with that state 65 or the 66 or 80 gallon 115 volt plugin with the, excuse me, 120-volt plug- in with the auxiliary heater.

Abhijeet Pande, TRC:

Thanks, Larry. And sort of a slightly couple of different flavors of questions around the circuit splitter idea, both from anonymous attendee again. First one says, does the circuit splitter not kill the power to the heat pump water heater if it's used? And a comment that we found that you have to reset the heat pump water heater if the circuit splitter So it will kill the power to the heat pump water heater.

Larry Waters, Electrify My Home:

Well, the heat pump water heater comes back on and the power goes off. I mean, that's just what it does, right? So, some of those circuit splitters also have a little bit of power that goes to each one, but it has a draw. So as soon as it draws a load, it switches over. And so it keeps the control panels up and running on them. So, it's not going to really matter that much.

Abhijeet Pande, TRC:

Thanks. And then, a related question, when we are doing that circuit splitting with the EVSE, the EV charging, if you only use the 30-amp dryer circuit, do you not need to degrade that EVSE charging itself.

Larry Waters, Electrify My Home:

You do. You do. The other thing you could do is you could put up, you could put a little sub panel post the car charger. If you're running it off a 50 amp wire and you're running it down to a 30 amp dryer and you want to run a 50 amp to your car, you could do a little sub breaker after the, after the splitter and breaker it down to 30 and that would That's kind of what we did on those heat pumps. So that would work as well. But you could just get a 30-amp car charger. If you need to set your car charger up for 30 amps, it's not going to change the mileage that much. And maybe you want to share a range circuit if you need that higher output.

Abhijeet Pande, TRC:

Sounds good. And then a final question from the questions provided here. Actually, it was a

question that you answered already in your presentation, but I'm going to ask again just to clarify for everyone. And I think one of your slides already covered it, but maybe you can clarify that. The original question was can you put smart breakers on existing dumb panels.

Larry Waters, Electrify My Home:

You can if it's the particular panel that that breaker is from. I only know of the smart breakers that are from that one brand, and the name is escaping me right now. But if that panel is in the house, you can add the smart breaker to it. But they don't generally go on like a square D panel or something like that. I haven't seen those breakers.

Abhijeet Pande, TRC:

Thanks, Larry. I think that's all the questions we have here. There's still a couple outstanding questions or comments around the first star rating and how the first star rating disqualifies many homes for 120 volt heat pumps.

Larry Waters, Electrify My Home:

Well, I mean, there's a on the first hour rating of specific systems. So, like I have a chart right here. Right. So, the first hour rating of an HPVX66DHPT Premier 120 plug in is 76. So that means and the highest first hour rating requirement on the plumbing code is 74. So, it would have to be a state or an A.O. Smith with 120-volt plug-in with the electric heat, and that is a hybrid water heater. It just has a very small electric element in it, and it's still a circuit-sharing device. And so there are options if we just look at the chart, there are options for every size house. And then, I don't know, I mean, in a house that's questionable, let's share a circuit and find a space for the 30-amp model. I mean, these are the tradeoffs that we have to deal with when we're designing these houses up, right?

So it's not our first go-to on those. I had to use one at my house because I was over-amperage, and I put my water heater in before I put my SPAN panel in, so I needed a 110-volter. Now that I have my SPAN, I could upgrade it to a 220, but I'm not going to. So, it's all in how you're going to manage the plan.

Abhijeet Pande, TRC:

Thanks, Larry. That plan is a great kind of point to kind of bring it all together. One last question. Are those rebates that were mentioned, are those stackable? Is it a kind of a use one or the other or can you combine them?

Larry Waters, Electrify My Home:

Well, some of the rebates are stackable and some of them are not. So, there's the big rebates from TECH, the $3,100, the $3,800 and the kicker for the panel are achievable with the tax credit. So those two can work together. I believe that there's a rebate from California Energy Smart Homes that's not stackable with like BayREN and some of the others. No idea where the audience is coming from. But some of the BayREN rebates are not stackable with other rebates. It just depends on where the money, what coffer the money is coming out of. A great place to check where the rebates are is the website that we all use, which is? The Switch is On. There you go, SwitchesOn.org.

Abhijeet Pande, TRC:

Thanks, Larry. And that takes us to right at the end of our presentation. I appreciate your presentation here, and I'm going to turn it over to Owen Howlett to take over to the next session. Thanks a lot, everybody.

Session 2, Part 3:

Policy Impacts and Status with Laura Feinstien, SPUR; Brennan Less, Lawrence Berkeley National Labs; and Travis Holtby, California Public Utilities Commission

Owen Howlett, California Energy Commission

Thanks, Larry, and thanks, Abhijeet.

So, welcome to our fifth and final session today, which covers policy considerations. As Jim Frank mentioned at the beginning of today's webinar, the total cost to Californians for upsizing their panels could be $25 to $40 billion, unless we're able to find ways for homes to handle those new loads without making expensive modifications to panels or circuitry.

Those costs, those upgrade costs, also incur delays because homeowners may be reluctant to pay those costs to decarbonize. So, the state has an interest in minimizing both those costs and the delays so we can meet our statewide climate goals. In this session, we'll be reviewing some ways in which policy changes could smooth that path. We'll cover potential changes to the National Electrical Code, which is law in California through our state building code. We'll also be covering changes to state policy and future ways of reducing panel-related costs. I'm Owen Howlett with the California Energy Commission's Efficiency Division. Our panelists for this session are Laura Feinstein with SPUR, which is a Bay Area nonprofit that deals with public policy and planning, also Brennan Less with Lawrence Berkeley National Lab, and Travis Holtby with CPUC's Energy Division.

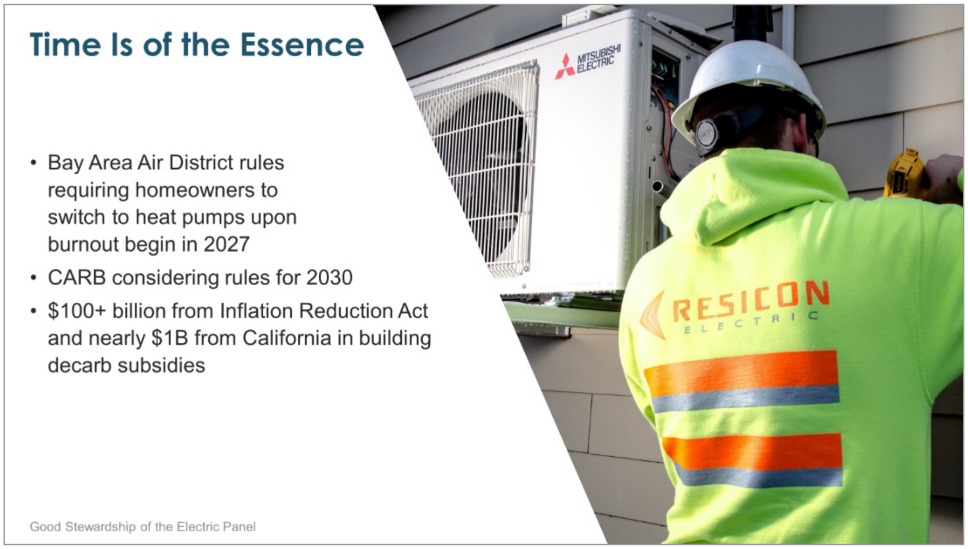
For information on our speakers' bios, they're all shown on the event page. If you'd like more information about them and their work during the presentation, please write any questions you have in the Q &A box and not in the chat box. A recording of the session will be sent to every registrant at the end and will be published on TECH's website. So, Laura, please take it away.

Laura Feinstein, SPUR:

Great, thank you, Owen. So I'm going to be speaking today more from the perspective of how government institutions and utilities can make it easier for people to optimize the panel so that they don't need to undergo that panel and service upgrade process. And when they do need to do that, how to make that electric service upgrade process faster, smoother, and less expensive. And as Owen just so eloquently said, we really need to make this process, both the optimization and the upgrades, work better if if we're going to meet all of our clean air and climate goals. Next slide.

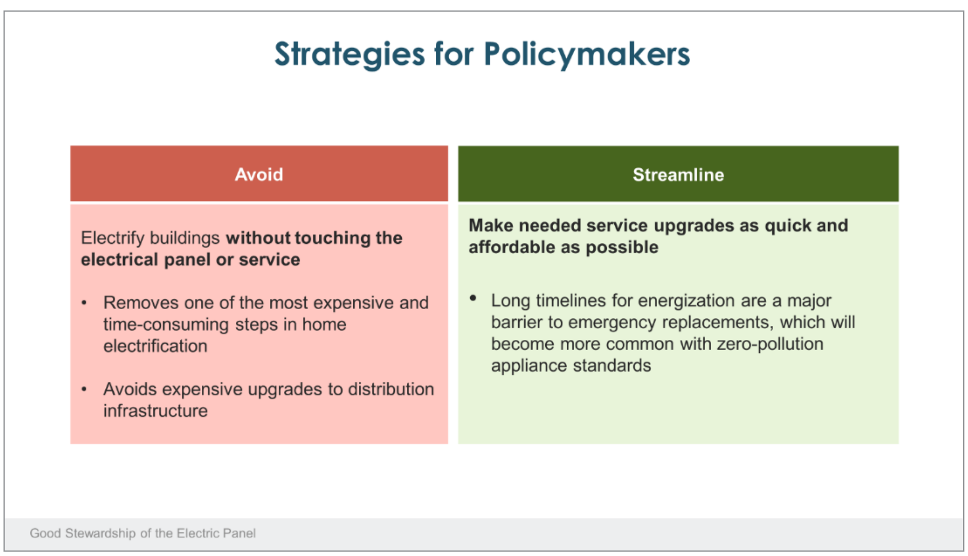
So you've just heard some really interesting and thoughtful presentations, like Tom's, about how it is that contractors and homeowners can do what I would almost characterize as a limbo dance to stay on their existing panel.

It's all doable. But one of my big takeaways, whenever I have this conversation about panel optimization is that it shouldn't be as hard to do as it is right now. And that is because we really need to update a lot of codes and incentive programs and permitting processes from where they are right now where they kind of encourage people to move along that path of panel upsizing and instead come at them from a new perspective where we've built in simpler pathways, more obvious pathways for contractors and homeowners to follow that optimization route instead.



And part of why it's so important to be talking about how to make panel optimization easier to engage in and how to make the upgrade process faster and less expensive when people do need it, is because the whole framework around installations of heat pumps is about to change quickly California. Here in the Bay Area where I'm sitting, the Bay Area Air District passed rules that in 2027, just three years away, whenever smaller residential type gas water heaters break, they will have to be replaced with a zero pollution version, most likely a heat pump, and then 2029 for furnaces and so on.And the Air Resources Board is right now debating passing similar rules that would require a time of replacement switches to heat pumps in 2030. So, for those contractors here, most likely when you've been doing heat pump installation jobs, it's been a planned replacement.

And so, there's a certain amount of time to spend considering, planning, filling out the utility paperwork, et cetera. And that whole scenario is likely to change, and the majority of heat pump installations in a few years will most likely be emergency replacements. So, all of this starts to need to work a lot faster and easier than it has been. Otherwise, we risk A, people kind of sitting there without heat or hot water, or simply underspending all these great incentive programs that we have right now that will cover the cost of heat pumps, but they won't cover the cost of a service upgrade, right? Next slide.



So, I like to think of the strategies that policymakers, you know, the people who are at government agencies, our local building inspectors, our utilities, I like to think of the types of things that they can be doing to make the panel and service optimization and upgrade process work better, they have kind of two big buckets of strategies. The first is to pursue a lot of what we've been talking about today, which is to make it easier to avoid doing a panel or service upgrade in the first place. And that doesn't mean going in and telling the customer, no, you cannot have a 200 amp panel, but rather being able to lay out those trade-offs and be able to ideally give the customer what they need what they want within the existing panel in order to help save money

And then the other big bucket of strategies is streamlining. So, some customers are going to want the types of equipment that need larger capacity panels.

We need to make, and some of them are just simply going to need it regardless, right? So, we need to make that process work better for people, make it quicker and more affordable.

So, you know, I'm going to run through some strategies and most of these have been gleaned from conversations with a lot of people who are on this panel, but also a lot of people like those who are in the audience today who have done electrification projects and seen firsthand

And I want to encourage all of you here today, if you have ideas of things that should be added to these, these concepts, please drop them in the Q &A. Not everything needs to be a question. I'm also would love to hear people's ideas about how to improve the process. But to run through some of my ideas. First up, we really need to remove what is a baked-in bias towards overestimating load in the National Electrical Code. So, Tom talked about how you can use the NEC as it is today and kind of the smartest way possible to end up with a lower but still code-compliant estimate of the required panel size. But also, as Brennan's going to be talking about after me, there's a number of ways in which the current electrical code is written that actually tends to generate overestimates of necessary load and could use an update.

For example, you know, as Tom was pointing out, you only get to use those coincidence factors and you only get to assume that certain appliances are only on at the same time, you are not all on at the same time if you use one section of the electrical code But why shouldn't you be able to apply that for either section? There's just some illogical things built into how the NEC is written right now that deserve an update.

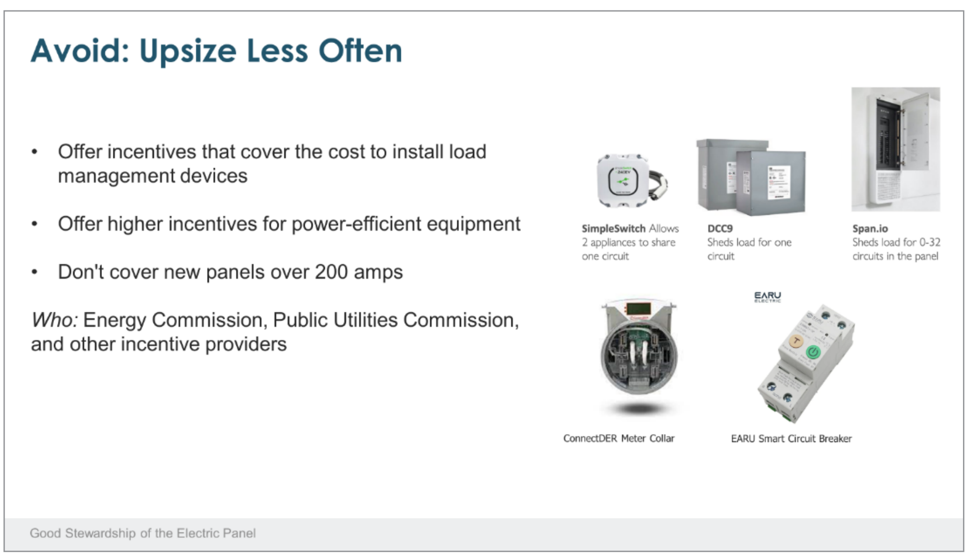
And even before the NEC is updated or regardless, there's also a lot of inconsistency in how authorities having jurisdiction and interpret the current electrical code. I think it's Y-Tan, I may mispronounce her name, had a great comment in there that there's some inconsistency on building inspection departments. Some of them accept the bottom-up calculations. Some of them like the top-down calculations. Some of them have spreadsheets about how to do those calculations that differ from one another. We really need the Building Standards Commission to offer some guidance to authorities having jurisdiction on a consistent interpretation of the load calculation sections in the National Electrical Code. So, everyone's asking for the same thing. Oh, next slide.

Then, as Tom mentioned, one way of estimating load in the NEC is a top-down estimate that requires knowing what a customer's peak demand is for the past 12 months, or if they haven't been in the home for a full year, as long as they have held the account.

Now, a lot of contractors estimate that peak demand with 15-minute interval data from AMI data that they download from the utility. But there's actually a fair amount of ambiguity and how code is written on whether it's acceptable in all cases to estimate peak demand from AMI data, from meter data, plus it's extra work. It really would be preferable if all energy utilities simply provided to customers, perhaps on their bill, just a number of what their peak demand in the previous 12

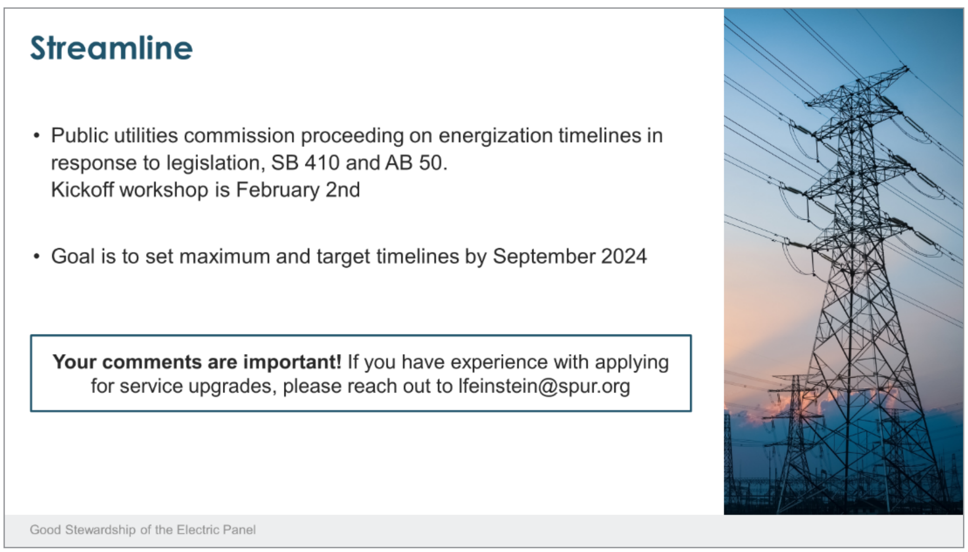
months was. And then a contractor can simply take that and they're off and running with their top- down load calculations.

There's also been actually some issues where some customers, even though the utilities actually collect 15-minute interval data from their smart meters, they don't actually allow customers to access that. They've only allowed them to access our interval data. So, if we can't get the utilities on board with the idea of providing a pre-calculated peak demand number, at least all customers need access to their 15-minute interval data. And that would be up to the California Public Utilities Commission and utilities to update those practices. Next slide.



Now, we've also been talking a lot about incentive programs, and we are in a historic moment in terms of the sheer number and size of incentive programs for heat pumps. We have the Inflation Reduction Act from the federal government, the Equitable Building Decarb Program from the state, TECH, BayREN. There's a huge number of programs that will help cover the cost of installing new heat pumps. And many of them will cover the cost of a new panel. But none of them so far will cover the cost of all these devices we've heard about today that can help a customer avoid needing that new panel. So, you know, for example, you could get $2 ,000 to install a new 200 amp panel, but you can't get a few hundred bucks to cover the cost of a circuit splitter that would help you avoid the need for that new panel. So that's just something we need to fix.

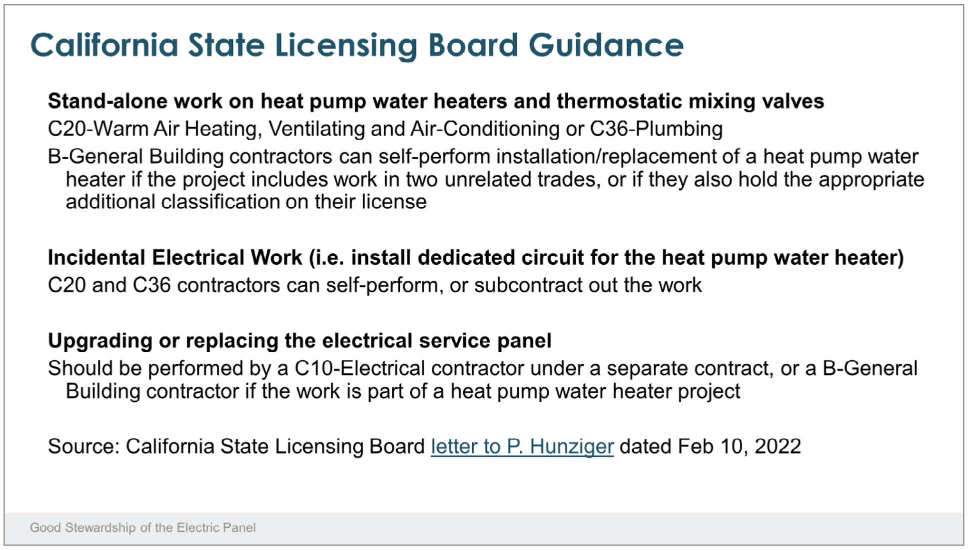
Also, it would help if there were extra kickers available for power efficient equipment. I think some people have pointed out that in some cases, the more power efficient options are quite cost competitive. But in other cases, you know, things like the combined washer dryers, the ranges with batteries built in, sometimes there's that more power efficient equipment is some of the more expensive options. And there should be some smartly designed kickers available for power efficient equipment if it helps avoid that panel and service upgrade. And last but not least, you know, I think it would be smart to have a max on panel capacity that would be covered by an incentive program. So yes, give people rebates when they need an upsized panel, but don't provide a rebate for a panel over 200 amps. And conversely, what people need is simply to swap out an existing panel for a new one because it's old, it's rusty, but they don't actually need to increase its capacity. They just need to replace it for safety reasons or to add breaker space. That should also be covered. We don't wanna only allow people to replace their panels if they upsize, if all they need really is just kind of a maintenance replacement. So incentive providers should be thinking about updating their programs along these lines. Next slide.



And there's also a process underway at the California Public Utilities Commission that is going to be looking at those long timelines we've heard about for getting electrical service upgrades done. We

heard early on from PG&E, it can take a few weeks, but it can also take nine months and upward to get an electrical service upgrade done by your utility. I think as most of us understand, And if a contractor talks to a customer about, so great, you get $6,000 in incentives to put in a heat pump, but, oh, you're going to have to work for nine months and fill out a ton of paperwork to get your There's a lot of people who are going to walk away from doing that.

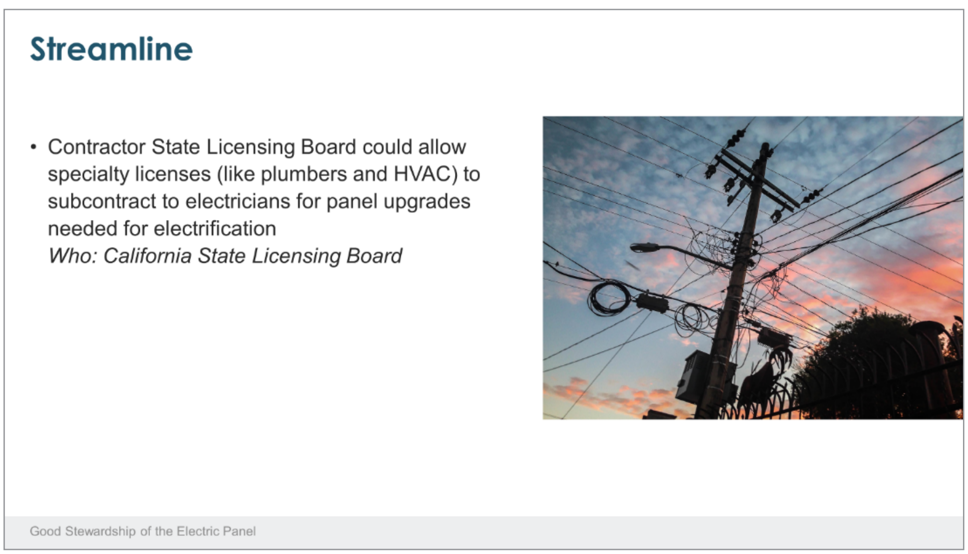
So there were two pieces of legislation passed last year that directed the California Public Utilities Commission to set maximum and target timelines for what we've been calling electrical service upgrades, but which really fit into this broader bucket of work that's called energization for the utilities. And this is a public process, and I think it's really important that the commissioners hear from people who have gone through the electric service upgrade process, and as well is applying for panel upgrades, and what their experiences have been, and some of the challenges they've experienced. Because there's often a huge discord between what the policymakers think is a problem and what people's on-the-ground experiences are. So, if you have interest in giving some input into your experiences with service upgrades and dealing with your utility, please reach out to me. I'd love to hear from you.



And last, a quick mention of some of the complexities around licensing and which contractors can do which type of type of work. So, there's the California State Licensing Board has some specific guidelines about which licenses are allowed to do which types of work.

General building contractors can do them as well in some cases. And the licenses that can work on heat pump water heaters can do incidental electrical work, such as installing a dedicated circuit, but they cannot upgrade or replace the electrical service panel themselves. So that work needs to be done by an electrical contractor. And specifically, one of the challenges is that these specialty contractors that work on, that do most of the heat pump water heater installations, cannot directly subcontract to an electrician.

Next slide.



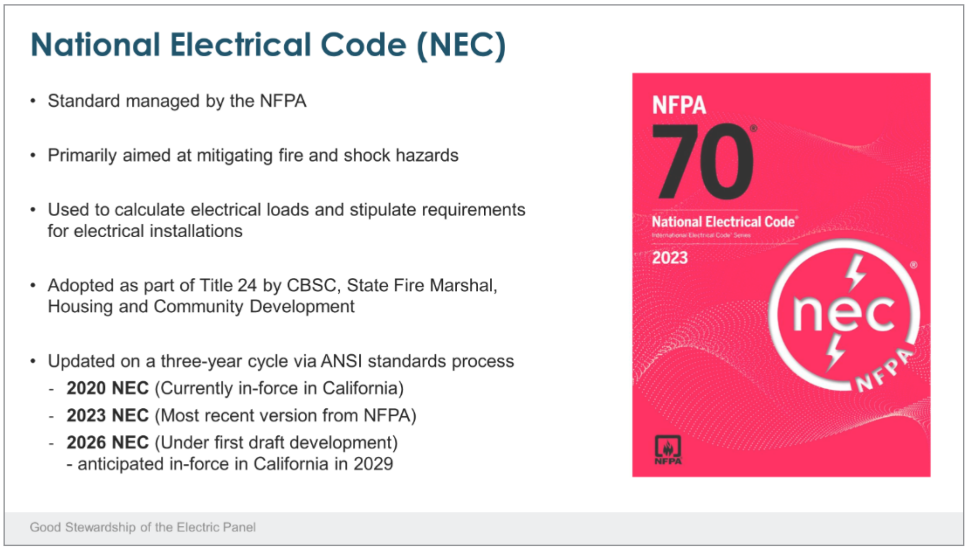
So, a solution to that would be for the California State Licensing Board to potentially allow specialty licenses like plumbers and HVAC to directly subcontract to electricians to do panel upgrades when they're needed for an electrification project. It would just kind of help smooth out that work plan and help the contractors work more cleanly together. Next slide. And that's it. I'm going to be passing it on now to Brennan Less from Lawrence Berkeley National Lab to talk about the National Electric Code.

Brennan Less, Lawrence Berkeley National Lab:

Thank you so much, Laura, and to all the presenters and conveners of this webinar, really fantastic stuff.

So, yeah, my name is Brennan Less, I come from the Residential Building Systems Group at Lawrence Berkeley

National Lab, and we're connected to a lot of this work, but today I'm going to talk about some of the efforts we've been leading related to the National electrical code.



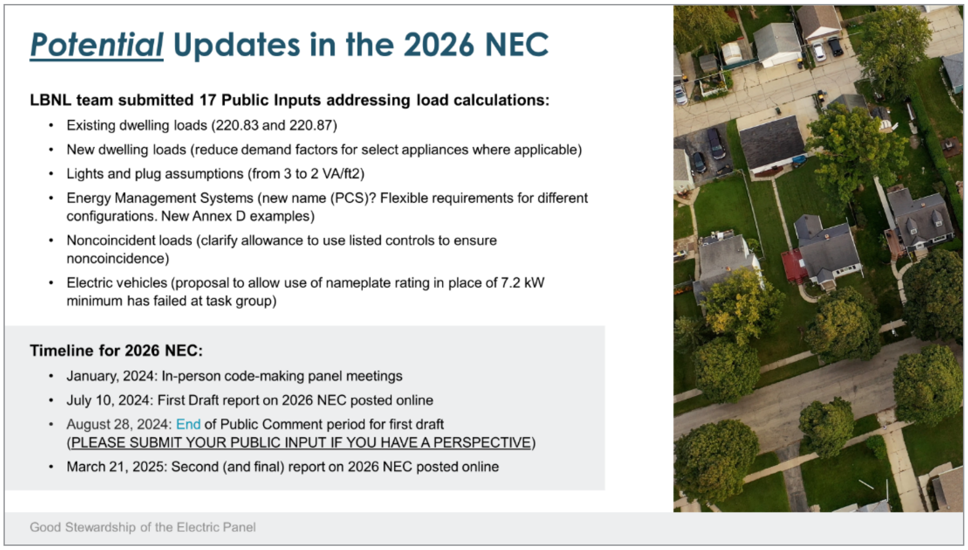
We've heard about the code from Tom in terms of what some of the calculation options are for existing dwellings. And then Laura just gave, I think, a fairly compelling description of how or why some of it might warrant changing in the sense that it can lead to very conservative estimates that are, in some cases, proving to be a real roadblock to the work we're trying to do in And so just starting off with like really basic background here, you know, what is the National Electrical Code? It's a national, it's a consensus standard managed by the NFPA, which I think as others have said is the National Fire Protection Association.

And it's basically, you know, it's a safety code, right? It's primarily aimed at, you know, worrying about overheating wires and avoiding shock hazards.

But I think that overall those are the main goals, right? The goal of the NEC is not to decarbonize housing. It's not to facilitate electrification, right? That's not the goal. It is aimed at mitigating fire and shock hazards largely. And so, you know, the way we connect with it here is that it's used to calculate electrical loads and figure out our requirements are do wire sizing, sizing of our our breakers, our overcurrent protection devices, and whatnot. So, there's this national standard. Again, it's NFPA 70. It's the National Electrical Code. But it gets adopted at state level, sort of state by state, under different timelines.

In California, it's adopted into, I think, Part 3 of Title 24 by the Building Standards Commission. And there are, I think, some pretty hefty involvement from other agencies like the State Fire Marshal and HCD, the Housing and Community Development Organizations. The NEC itself is updated on a three- year cycle. So, the most recent version of this code that has been published by NFPA is for the 2023 code. But California is on a one-time step delay there. So, the state, what is currently in force is the 2023 version of the code. In a handful of years, the state will adopt the 2023 version, and so on and so forth.

And so the 2026 code, you know, that'll be the future code near the end of this decade in California, is under first draft development right now. And again, we expect to see that coming into law, you know, near the end of this decade. Let's jump to our next slide.



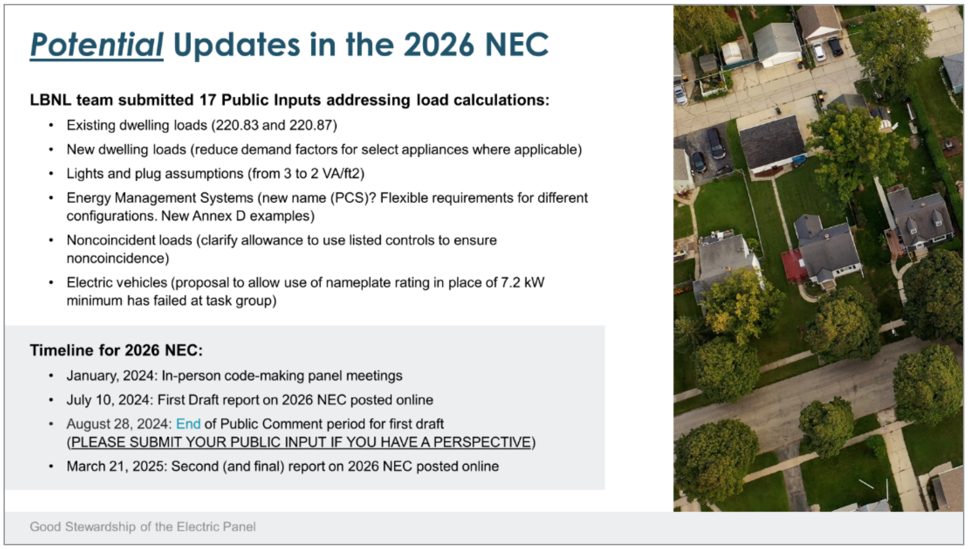
And so what our group at Lawrence Berkeley Lab has done with a lot of support and help from others who are on this call and at other organizations, we've done a bunch of load analysis, so actually like gathering power data from existing homes and analyzing how different loads contribute And then also just evaluating the code and trying to figure out what the roadblocks are and seeing if there's anything we can do about it.

There's this sort of process where the code is updated and that process functions based on public inputs. The public or electricians or other organizations put in their ideas for what the code should be. And then the sort of panel members at the NFPA code making panels decide if they should update the code or not. And so we put in a bunch of PIs this year addressing the existing dwelling calculations to 2083 to 2087. We put in sort of related PIs around new dwelling loads. I think Tom had maybe mentioned that. We want to kind of tackle the lights and plug assumptions that are in the code. Right now it's really high. It doesn't really acknowledge the fact that LEDs and CFLs are a thing and are now prohibited from sale according to the U.S. Department of Energy.

We also got these issues of all these load controls that people have been talking about today, right, whether it's the sort of like smart panels or the circuit splitters. We wanted to get some language in the code that made it more clear that those were acceptable and allowable and appropriate for use and to specify how they could be used. And then similarly provisions around electric vehicles and how they're treated in these calculations. Now, a lot of this is sort of with clarifying intent, right? There are, you know, some ways that you can interpret the current code that allows the use of smart panels or circuit splitters right now, but it's, you know, a bit less explicit than we would like it to be. And so a lot of the goals behind these PIs were to clarify the code, add language that makes it so that it's easier and more consistent for the authorities and for practitioners and for, you know homeowners even to understand you know what the actual requirements and rules are um the we actually i just got back um this past Friday from the in-person code making panel meeting for um this section of the code where i was a guest uh not a participant um so that was very illuminating but basically the code making panel has made its decisions.

I encourage absolutely everybody on this call to read that, to look at what changes have been proposed and what changes have been rejected, and to see that there's another public comment period coming out. This is everyone's opportunity to go to NFPA.org, NFPA 70, and issue public comments on what the code making panel is doing here, right? So if you like the changes they're making, you can support that. But more importantly is if there are changes we don't like, you want to put in what you would like the change to be and some substantiation around that. So this is a real opportunity to sort of have some impact on what this code ultimately does in relation to these challenges that we've got here. So again, that's like the summer. That public period will be closing August 28 and probably starting maybe a month or two before that.

The final sort of second draft of the 2026 code should come out in March 2025. So that's when we'll be seeing sort of final version. So keep posted NFPA.org. You can follow the standard and get sort of updates automatically. Jump to the next slide.

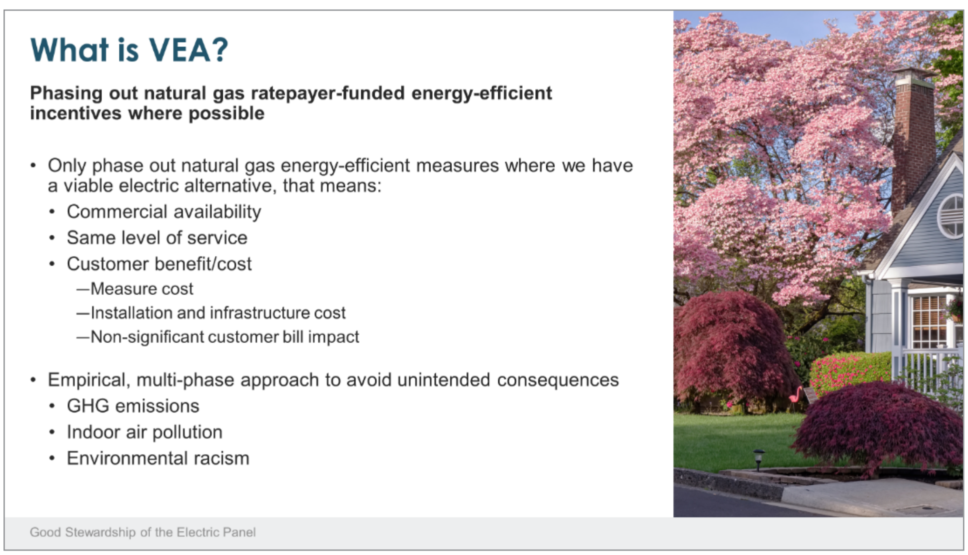


You know, I feel that Laura already sort of addressed the lion's share of these points in that I don't want to eat up the time that Travis is allotted. Needless to say, we think there are some pathways where even if we don't successfully change the code, that the state can choose to interpret the code and issue formal interpretations that advance this market rather than hinder it and ensure that we're all able to electrify homes and do it safely and do it without undue cost and time burdens.

So with that, I'll pass it off to our colleague, Travis, and thanks everybody for your time and attention.

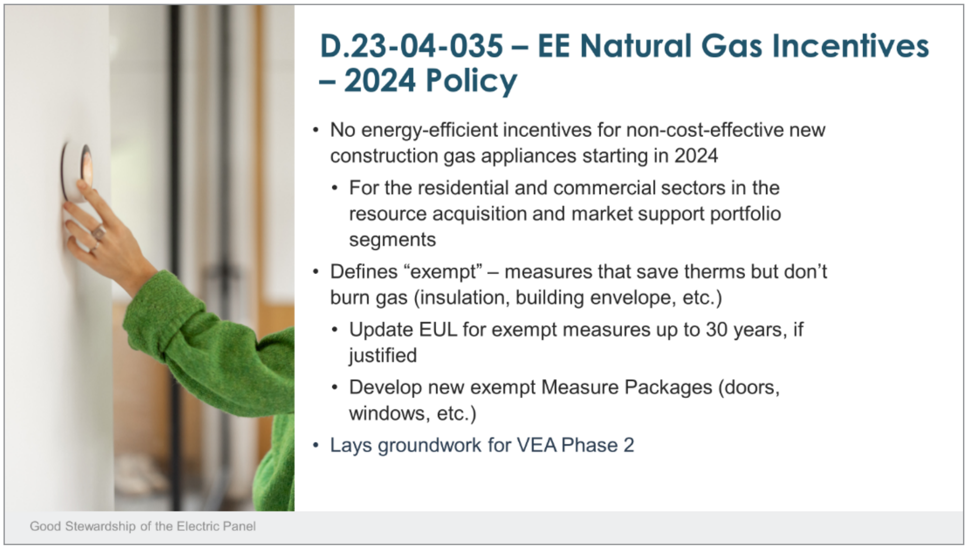
Travis Holtby, California Public Utilities Commission:

All right, thanks, Brennan. So I work at the California Public Utilities Commission in the EE branch. I'm the lead for a number of different aspects of that work, but I'll be talking today about the viable electric alternative policy that we're developing. And this is kind of synonymous with the phase out of natural gas.

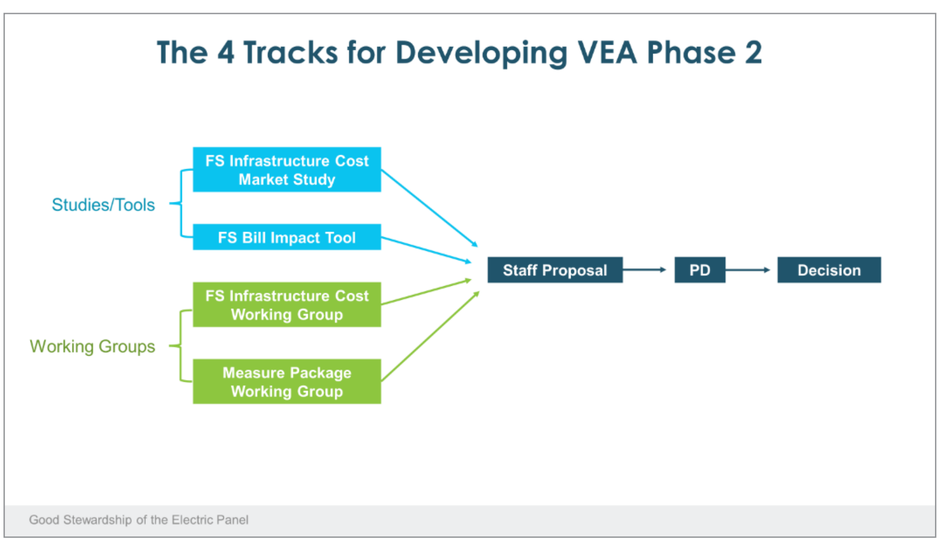


So, I'll talk a little bit more about that now. And we've really tried with this policy, which is going to be kind of an iterative phased in approach to only do this with natural gas measures where we have that viable electric alternative. So, what does that mean? That means, is it commercially available? So, can customers actually go down to Home Depot and buy it? Is it something they can install in their homes now? We wanna make sure it also has the equivalent level of service And that there's also a benefit or at least an inequality with the gas measure that is replacing from the perspective of a customer. So that means looking at what's the cost of the measure, what's the cost of the installation and the infrastructure, which is how this kind of ties into the call today. Things like panel upgrades and optimization. And we also want to look at the customer's bill impacts and what is the impact on those of electrification. So, the reason that we're trying to do this phased in and kind of incremental approach that's going to be hopefully over three different decisions that will culminate in the phase three decision in 2025, is because if we're not doing this, then we're risking exacerbating the very problems that we're So things like GHG emissions, indoor air pollution, and perpetuating environmental racism. Now, how would that happen, you might be asking?

So, if we take away that incentive, then it might be that customers will switch to that gas baseline. So that will mean a dirtier appliance, a less efficient appliance, which results in air pollution and all things we're trying to avoid. Next slide.

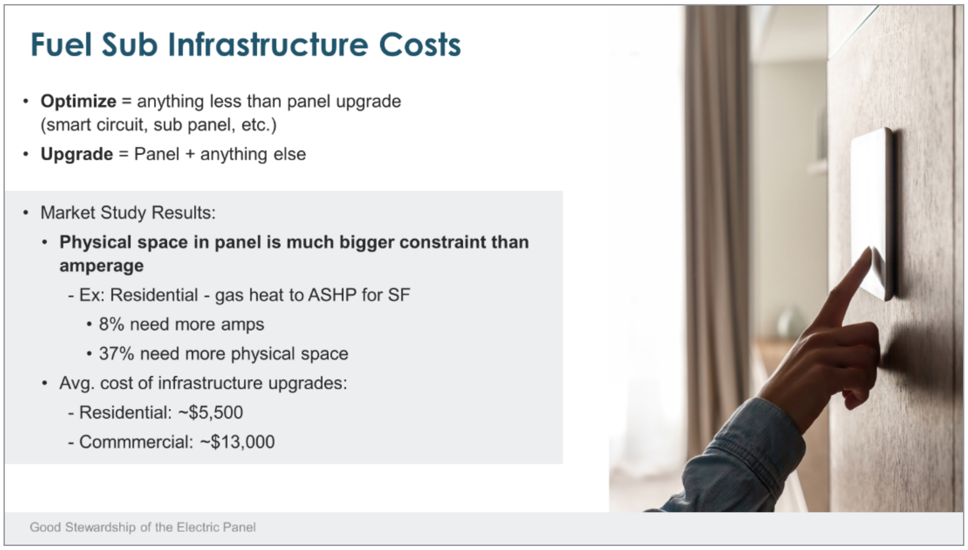


OK, so what we've done so far is the first decision which came out in April of last year, and so that essentially did three different things, the first of which was getting rid of energy efficiency incentives for gas measures or gas appliances that weren't cost effective in new construction. So that's a couple of caveats to it. So, this isn't a huge part of IOU's EE portfolios. It's a pretty small amount, but like I said, we really want to kind of build momentum, signal the market and take it one step at a time as responsibly as we can. This was also only for the residential and commercial sectors and we left out the equity segment of the portfolios. So that was part one. Part two of the decision was defining what measures were exempt from this policy, and that was pretty straightforward. We defined exempt as measures that will save therms, but that don't burn gas. So, think about things like insulation, building envelope measures, low flow shower heads, things like that. We also mandated the update of EULs, of the EUL for these measures to 30 years, where it was justified by evidence, it had previously been 20. And we also directed IOUs to develop new exempt measure packages. And the third thing was really to lay the groundwork for phase two, which we are in right now. Next slide.



Okay, so there's four tracks of phase two, and I'll go through this relatively quickly. The first two were studies, the second are working groups. The first study that I'll talk about is the fuel substitution infrastructure cost market study, and this is very much tied to that first working group on the same subject. So, the working group is going to be looking at how do we interpret this data? How do we turn that into policy? And the reason we decided to do this market study is because while there's a lot of good research out there on these costs, there's nothing that we could find that was a real statewide data source that looked at the entire state of California and could give us robust data on the different markets in the different part of the state. So, we initiated that study. We finished that up now. We'll be doing the webinar for that soon. And I'll go into a few details on what we found in the next slide.

But the second tool that we're working on is the fuel substitution bill impact tool. So what this is going to do is essentially two things.



it's going to show for any kind of given home in California, this isn't gonna be AMI data. So this will be kind of aggregated generalized data. So we could say for a single family home pre-1975 in LA, that's 1500 square feet. What would be the impact to the total utility bills of that building if we were to switch out the water heater from gas to a heat pump water heater, for example. So that's part one.

But the second one, which is pretty cool, is that it's going to also have a very user-friendly web-based interface that anybody in the state can go on to see that information. So, for contractors on this call, you could direct your customers to this and say, hey, check out this website. You can see what the impact would be of switching from your classic gas measure to an electric measure.

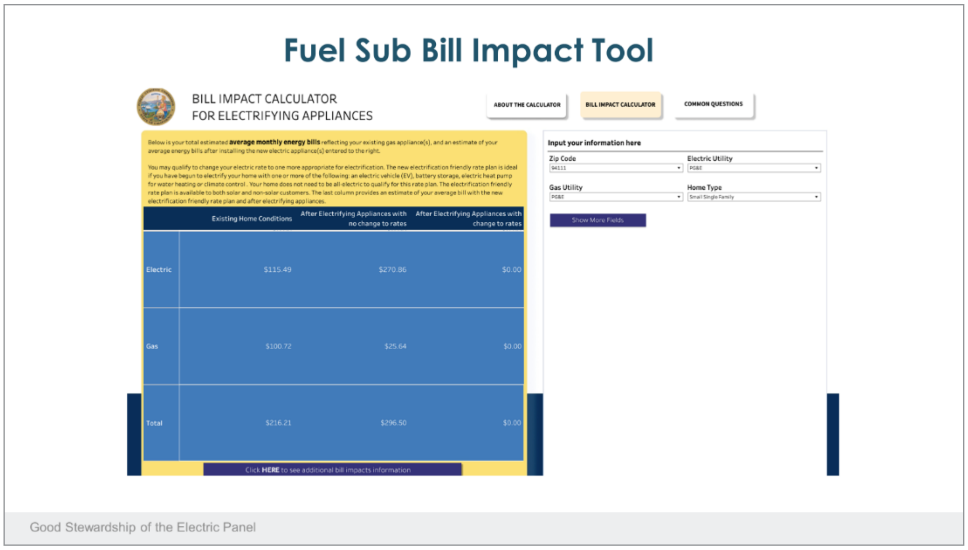
And the final working group is just how do we actually technically work all this into the existing systems and the existing policy mechanisms we have. Okay, next slide.

Okay, so that market study I was talking about, I wanted to share just a couple of details on that. Kind of what's your appetite for the public webinar we'll be doing soon. First is just some definitions. So we're, and I think this really fits in with what previous speakers have talked about.

So, one was, you don't really need anything there's enough space in the panel there's enough amperage. So, just the wiring costs and that's already built into the existing system we have so I haven't elaborated on that here. The other two are optimizing and upgrading, and the kind of deciding factor between those two categories is is the panel upgraded.

If it is, it's considered an upgrade. So, what we found, and this is a big market study with a lot of different findings that we have, but I've just included a few here. First one, the big takeaway, which really reaffirms what we've been hearing from other speakers is that physical space in a panel is a far bigger constraint than amperage. So, to give you an example of that, in residential single-family homes, one of the scenarios as we looked at, was going from gas heat to air source heat pump. And only 8 % of the homes in this market study needed more amperage, but 37 % needed more physical space in their panel. So again, that's going to be the real barrier to overcome with a lot of customers. It's not necessarily needing more service as far as amps. It's really just needing that physical space.

And there's different things that can be used for that, as previous speakers have talked about. What we found in this market study, too, is that the average cost for those infrastructure upgrades for residential, it was $5,500. And this is the kind of the highest-level aggregation. So, this is looking at water heating, air source heat pumps, all that together. We have that data broken out, but this is just to give you a general idea. And then for commercial, it was $13 ,000. So significant, and like we heard earlier, there can be a huge range depending on where you live, but overall those were the costs they are not insignificant. Okay, next slide.

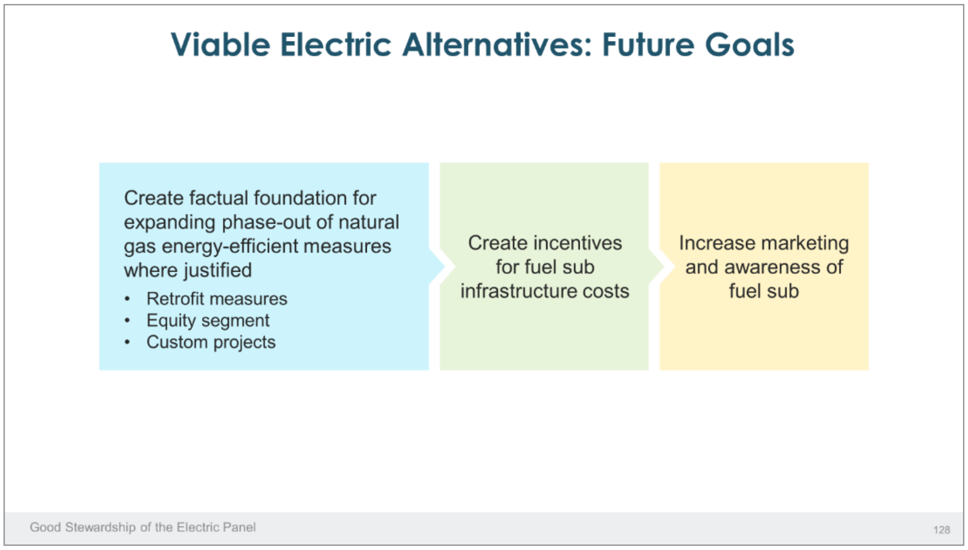


And I guess I should say too, we can stay on this slide, but just to address that subject matter, the kind of conceptual reason that we're looking at this, that we want to be really aware of these infrastructure costs is so that we can kind of expand the scope

So right now we're really just looking at what's the cost of the measure. So if you go down to Home Depot and buy it, how much does that cost? And we base the incentive on that. But we want to really pivot from that and look at it from a much more customer centric approach of how much is actually being spent by the customer. So that's why we're looking at all these different things.

So right here is a draft screenshot of our fuel substitution bill impact tool. This will change a little bit. This is just an early draft that we're still finalizing. But just to give you an idea of what it looks like, you have the electric gas and then the combined total there on the left side. There would be values, there will be when we have it finished and kind of debugged in that far right column. And you can see on the right side of the page, we have the different variables customers can put in there. And if I were to click that purple button, there's a lot more variables that go in there. So the only thing that a customer would need to use this tool is their zip code. Everything else is auto-populated with default values.

The thinking with this is that most customers, they just want to know kind of a binary answer. Is this good for me financially or is it bad? I don't want to spend a ton of time on the phone with my utility looking at my bills to be able to answer that question. So we tried to use that as our north star here. But if the customers have that information or inclination to go a little bit deeper, they can change any of those default values to get a more robust look at what those bill impacts will be. All right, next slide.



Okay, so what we're working towards with all of this viable electric alternative policy is that we really want to create that broader factual foundation to help push along the phase out of natural gas EE incentives. So I'm kind of at pains to stress this every time I talk about this, we're not banning anything. We're not banning any gas appliances. What we're doing is we're no longer going to be subsidizing those with ratepayer-funded incentives. So we're making a shift away from those gas efficiency measures to electrification measures. And we want to expand that phase out to retrofit measures because, again, currently it's just new construction. We also want to have the equity segment in there as well as bigger custom projects. So things like factories, refineries, things like that. We also want to create those incentives for fuel substitution infrastructure costs, again, kind of widening the scope and looking from a customer-centric perspective. And we want to increase that awareness and marketing of fuel substitution to push decarbonization and building electrification further. Okay, next slide.

All right, and that is all I have. Happy to take any questions, but I'll pass it back over to our moderator.

Owen Howlett, California Energy Commission:

Yeah, thank you, Travis. So a couple of questions that come in that are kind of clarifications on what Travis presented. First one is from an anonymous attendee, what's the timeline for the fuel substitution bill impact tool being available to the public?

Travis Holtby, California Public Utilities Commission:

Yeah, that's a good question. When we when we get frequently, our hope is that in the next couple months, we'll be able to have it out and available to the public. Like I said, we're doing kind of a QCQA process now, and we don't have a date picked out when we're going to release that, but we will definitely be sending out emails to the EE proceeding. So if you want to be the first to know about that, just sign up for updates from that proceeding and you'll know when. But again, our hope is in the next couple of months.

Owen Howlett, California Energy Commission:

Thanks. And there was also a question from David Cole about saying that NREL has a website for doing load calculations. So it's kind of a public-facing website where people can put in load calcs and it will spit out an answer for them. Is that something that CPU-C is thinking about including alongside the Build Impact Estimator?

Travis Holtby, California Public Utilities Commission:

Yeah, so there's a couple different ones out there. There's the NREL-1 SCE has an electrification calculator. PG&E has one as well. And so I think there's value to each of those. And TECH is also working on a little bit of this as well. they're all slightly different approaches. We haven't really decided as far as the presentation of the calculator on the CPUC website, are we gonna have links to those, but we're certainly going to be getting feedback from stakeholders, including the IOUs and PG&E and SCE who have these calculators to make sure that we're not having these wildly divergent assumptions. But the idea is that rather than, you know, let's say you live in SDG &E territory, or you live, you know, really, you live somewhere that doesn't have, you know, a bill impact estimator already, that anybody can just come to this one website and have a really good estimate of what that impact is. So, and we don't think it's going to be, we're not trying to get rid of any other calculators, but we want to make sure that we have a good universal one for all the rate payers that we serve.

Owen Howlett, California Energy Commission:

Great. And another kind of clarification question from Alice Sung about about rates. I'm assuming that users of that online bill impact calculator can choose kind of what rate or what rate they might be on in the future to see the impact on their electric and their gas bill. Is that the case?

Travis Holtby, California Public Utilities Commission:

I should have touched on that. So, what we have right now is we have not all but almost all of the approved current rates in the tool itself. I say not all because I think we have rates representing 90 – 95% of all customers. So, there's a lot of little rates that only apply to a couple of customers. So, we're not being completely universal with it, but we're covering almost everybody.

And so you will, the default will be whatever the most common rate is for that building type in that zip code area. But yes, the customer will be able to go in and change it. But one of the cool parts with the tool is we're actually going to have as that output table, the just simplified output table I showed a screenshot of, it'll show what the bill impact will be with the existing customer's rate and it will also show which rate would save the customer the most money and what those values would be. So, the idea is to empower customers to be able to know a little bit more to get in touch with their utility and if they want to electrify to change to the best rate for that. And it could be the pro- electrification rate but maybe it's a different time of use rate or something else. So we want to make sure that information is out there and available to customers.

Owen Howlett, California Energy Commission:

OK, thanks. And I just wanted to also clarify a bit more on David Cole's question about, will the CPC's bill impact estimator include something about the NEC load calcs, the panel load calcs? Will you include that directly or maybe a link to those calcs somewhere else? Or can you not make policy during a Q &A session?

Travis Holtby, California Public Utilities Commission:

Yeah, so we don't have anything in that right now. That's a good point, though. Yeah, we have a whole kind of read me section of the page and that may be something to include there. So yeah, not in there now, but a good thing for us to think about.

Owen Howlett, California Energy Commission:

Thank you. And then I'll take any input from the moderators or from the organizers about whether we need to wrap up, but I think we can fit one or two more questions in here. We can keep going. Okay, so Alice Song had a question about the environmental racism issue. Doesn't that exacerbate the environmental racism and leave them with gas appliances in the homes that strand their assets and put them at the mercy of rising costs of gas?

Travis Holtby, California Public Utilities Commission:

Yeah, great question. And we had a lot of debate about this and a lot of comments. But where we settled was that we just we don't really have enough information to be able to say that if we cut these incentives for gas, what level should we put them at for the heat pump, for electrification alternatives, to make sure that we're not having people just reverting to baseline. And so it was wanting to make sure, and I take her point, that we are essentially continuing the status quo, which is somewhat unjust. But the idea was that there's the possibility that if we implement this policy too quickly, we're gonna make that status quo even worse for those communities that we're most interested in helping. So, it's a primary focus of the staff proposal I'm working on now on next decisions. But we really didn't want to move so quickly that we're making the very problem we're trying to solve worse.

Owen Howlett, California Energy Commission:

So it's kind of like that thing that doctors do where they say first do no harm.

Travis Holtby, California Public Utilities Commission:

That's a good way of putting it. We don't take the Hippocratic oath to work at the CPUC but that that the idea.

Owen Howlett, California Energy Commission:

There's also a question here about, is there anything that CPUC could do to get the IOUs to hire more staff to shorten the duration of the load application process? Travis, I assume that's something that you may not be able to answer unless there's already an existing policy on that.

Travis Holtby, California Public Utilities Commission:

Yeah. But we definitely are aware that that is an issue. And some of those workforce delays and delays on the utility side are causing people to stick with gas and we want them to be electrifying. Right. So, Laura, you have a hand up. Do you want to is there a question you wanted to pose or answer?

Laura Feinstein, SPUR:

I just wanted to chime in that. I think this question of hiring more staff will probably be something that comes up in that proceeding that I mentioned. And so it'll be a deep dive into how the process works at various investor-owned utilities and how to accelerate it. I'm sure the question of hiring more staff will be on the table. So, keep an eye out for that. They haven't actually publicly released the information on the proceeding, but it should be coming soon.

Owen Howlett, California Energy Commission:

Okay, I said one clarification before I hand back over to Jim Frank. Travis, one of your results said that only 8% of the projects you looked at needed more amps in their panel. Just to clarify, though, for that study, were you only looking at changing out gas heating to air source heat pump? Was that the only upgrade you were looking at in that study? Or were you looking at whole house electrification?

Travis Holtby, California Public Utilities Commission:

Yeah, no, that was so that was just one example that I pulled to illustrate that point. The study was looking at a number of different scenarios. So, we looked at just swapping out furnaces for air source heat pumps. We looked at just doing water heating. We looked at just doing cooking and then we looked at combinations of those three. So, we have that data and we will definitely be presenting that in the webinar that's coming up and releasing that to the public. So, everyone will be able to look through all of those results. I just picked that out as an example to illustrate the broader point.

Owen Howlett, California Energy Commission:

So, people shouldn't run too hard with that 8% number?

Travis Holtby, California Public Utilities Commission:

No, no. I mean, you could for that specific end use. But again, that's generalized across the whole state, too. And we'll have an Excel-based tool where everybody can very easily slice and dice the data. And you can see for this climate region, because we've aggregated the climate zones to make it a little bit more discernible for the results. But yeah, you'll be able to slice and dice in a lot of different ways. But yeah, don't take just that 8% as kind of the gospel across all end uses, all parts of the state, is just an example.

Owen Howlett, California Energy Commission:

Well, thank you. Thank you, Travis and Laura and Brennan. I just wanted to say here also, we've been able to tackle some of these issues here today, but by no means all of them. So please, everybody, continue to take part in offline discussions in working groups and in proceedings about these issues. It's all critical to the state's progress. I'm going to hand it back to Jim Frank with Energy Solutions, and he's going to give us a summary of today's conclusions and action items.

Jim Frank, Energy Solutions:

Yeah, thank you, Owen. And thanks, everyone, for attending. We have six minutes before the end of the ultimate call here. And I was thinking about giving a summary, but I think we'll take it offline. We'll take some time to put some thought into our responses and then provide that out along with this deck and the recording, we'll make that all available. So look for that to come. But I did want to, just because we've had to move through things, I wanted to open it up to all the panelists and moderators if there are questions that we had to move past quickly. We've got a couple minutes. I'd like to give you the chance to respond to any of that. So we'll take a couple more minutes for that and then Sandy has a message for us and then we'll close. Anything that we had to move very quickly through. Tom, you have your hand up.

Tom Kabat:

Yeah, I just had a quick thought on that interesting statistic of the 8 percent were found to need panel upsizing and 37 percent need space upsizing. I've been working on these seven ways to reduce the need for the panel upsizing. Had they applied some of those, some or all of those seven? And same thing with the 11 ways to find the panel space. So there's a lot of ways to get customers' needs met. And so we need to keep people aware of all those ways.

Jim Frank, Energy Solutions:

All right. Any other comments from any panelists or moderators before we end with Sandy's message? Laura, go ahead.

Laura Feinstein, SPUR:

Well, there was 1 question that I wanted to answer about whether there's any plans to standardize permitting for heat pump installations similar to solar. And I wanted to give a little background on that and some thoughts. So, yes. There was a study done by National Renewable Energy Laboratory a number of years ago that showed that permitting and inspection costs accounted for 8% of the costs of installing rooftop solar. And that kicked off an effort in California to reduce those costs that was quite effective. The first big step was that the governor's Office of Planning and Research published a solar permitting guidebook, and legislation required local jurisdictions to use those best practices to streamline their permitting.

And then the most recent step is that then since then legislation has been adopted to require that local jurisdictions start to use online systems for approving permits for solar panels. And I do know that solar app is which is the kind of the leading application that was made by National Renewable Energy Laboratory for doing online permitting is kind of trying to figure out how to make it all work for heat pumps. So I would say it's still on the horizon, but let's hopefully it will be coming.

Jim Frank, Energy Solutions:

Cool. Thank you, Laura. All right. Sandy, do you want to give us a closing message and we'll wrap?

Sandy Laube, Energy Solutions:

All right. I will make our final boarding call. On behalf of TECH Clean California, myself and Jim Energy Solutions, and the phenomenal group of experts who led us today through this really amazing topic, I want to thank everyone who came today and everyone who who will watch this in the future. We will make this recording available on TECH Clean California, and everyone who registered will get a link to it. So, the slides will be available and will the recording. And any questions that we did not answer live, we will answer and those will also be emailed out to everyone who would register for the link. Thank you again and have a wonderful rest of your week.

We appreciate your interest in the "Good Stewardship of the Panel" Webinar. If you have any questions, please reach out to us at TECH.info@energy-solution.com.