Meeting Notes

2022 California Energy Code (Title 24, Part 6)

Agenda for the Utility-Sponsored Stakeholder Meeting for:

Water Heating and Multifamily All Electric Package

Posted April 13, 2020

Meeting Information

Meeting Date: March 17, 2020

Meeting Time: 8:30am – 12:30pm PST

Location: Adobe Connect webinar (sign-up at title24stakeholders.com/events)

Meeting Host: California Statewide Utility Codes and Standards Team

Meeting Agenda

Start Time	Topic	Presenter
10 minutes prior to call	*Live Attendee Poll*	
8:30 am	Meeting Guidelines	Statewide CASE Team
8:35 am	Opening Remarks from the California Energy Commission	Energy Commission Staff
8:40 am	Overview and Welcome	Statewide Utility Codes and Standards Representative
8:45 am	**CASE Presentation I:** Multifamily Domestic Hot Water • Hot Water Distribution • Drain Water Heat Recovery • Solar Thermal Water Heating • Central Heat Pump Water Heating	Gwelen Paliaga, Jingjuan (Dove) Feng, and John Arent (Statewide CASE Team)
11:15 am	**CASE Presentation II:** Multifamily All Electric Package	Abhijeet Pande, Jingjuan (Dove) Feng (Statewide CASE Team)
12:15 pm	Wrap Up and Closing	Statewide CASE Team

Meeting Attendees

Statewide Utility Codes and Standards Team – Utility Staff:

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Jeremiah	Valera	jeremiah.valera@ladwp.com	Los Angeles Department of Water and Power
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Codes and Standards Enhancement (CASE) Team Members:

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Stakeholder Attendees:

First Name	Last Name	Affiliation
John	Bade	2050 Partners
Peter	Mustacich	2050 Partners
Laura	Petrillo-Groh	AHRI
Shannon	Corcoran	Air-Conditioning, Heating, and Refrigeration Institute (AHRI)
Tim	Rooney	AO Smith
Nick	Young	Association for Energy Affordability
Peter	Grant	Beyond Efficiency
Dan	Johnson	Beyond Efficiency Inc
Dan	Moffroid	Bosch Thermotechnology
Eric	Truskoski	Bradford White Corporation
Nick	Brown	Build Smart Group
David	Choo	CalCERTS, Inc.
Russ	King	CalCERTS, Inc.
Scott	Cheek	Carrier
Luis	Salcedo	Carrier Corporation
Jeanne	Fricot	Center for Sustainable Energy
James	Domanski	CLEAResult
Tom	Paine	ConSol
Meg	Waltner	Energy 350
Neil	Placer	EnerNex
Gabriel	Ayala	Enovative Group, Inc.
George	Nesbitt	Environmental Design / Build
Barbara	Collins	ERH Weest
Robert	Fortunato	ForStrategy Consulting Inc.

Gina	Rodda	Gabel Energy
Tom	Kabat	GoodGridizen.org
Robert	Glass	Goodman Mfg. Company
Gilad	Nahari	IDiaz Design, Inc.
Jeff	Boldt	IMEG Corp.
Inna	Dolottseva	Interface Engineering
Mark	Lessans	Johnson Controls
David	Ware	Knauf Insulation
David	Winningham	Lennox International
Mark	Wiese	Mark Wiese
Marshall	Hunt	MBH Associates
Amelie	Besson	MidPen Housing
Monique	Davis	Midpen Housing
Bruce	Severance	Mitsubishi Electric
Margo	Thompson	Newport Ventures
Arielle	Usher	--None--
Rahul	Athalye	NORESCO
Erica	DiLello	Noresco
Silas	Taylor	NORESCO
Randy	Oshiro	Noritz America
Pierre	Delforge	NRDC
Noah	Horowitz	NRDC
Sid	Dinwiddie	PABCO
Gregory	Switzer	Partner Energy
Patrick	Villaume	Patterson-Kelley
Abram	Conant	Proctor Engineering Group, Ltd.
Sami	Taylor	Raimi + Associates
Sean	Armstrong	Redwood Energy
Rod	Buchalter	RenewABILITY Energy Inc.
Vrushali	Mendon	Resource Refocus LLC
Joe	Boros	Rheem Manufacturing Company
James	York	Rinnai America Corporation
Nathan	Denni	Rushing
Barry	Hooper	SF Dept of Environment
Steve	Komenda	Signature Sales
Nehemiah	Stone	Stone Energy Associates
Adam	Chrisman	SunEarth, Inc.
Ruchi	Shah	TNDC
Brendan	McGovern	Trane
Wayne	Alldredge	VCA Green
Luca	Costa	VCA Green
Andre	Cayer	Watercycles Energy Recovery inc.
Yanda	Zhang	ZYD ENERGY INC

Meeting Resources

1. Agenda
2. Presentation
3. Submeasure Summaries
    a. Multifamily Hot Water Distribution
    b. Multifamily Drainwater Heat Recovery
    c. Multifamily Solar Thermal Water Heating
    d. Multifamily Central Heat Pump Water Heating
    e. Multifamily All Electric Package

Meeting Notes

1.1 CASE Presentation I: Multifamily Domestic Hot Water

1.1.1 Hot Water Distribution (Gwelen Paliaga, Statewide CASE Team)

1.1.1.1 Pipe Insulation Verification: Add a prescriptive requirement for field verification of pipe insulation quality.

1. Jeff Boldt (IMEG Corp.): Climate Zone 5 can be as low as 33°F for inlet water from rivers/lakes, but as high as ~75°F in summer. How cool does inlet water get in California?
    a. Julianna Wei (Statewide CASE Team): Cold water inlet temperature range is 50-75°F in California; in the compliance software, this is calculated from the ground temperature and average of previous days cold water temperature.
    b. Yanda Zhang (ZYD ENERGY INC): Jeff, cold water supply temperature was based on Title 24, Part 6 Alternative Calculation Method (ACM) Reference Manual. For Climate Zone 5, the minimum is 52°F and maximum is 60°F.
    c. John Bade (2050 Partners): Jeff is referring to ASHRAE Climate Zone 5, not California Climate Zone 5.
2. George Nesbitt (Environmental Design / Build): I'm not sure I've seen anyone insulate valves (other than me).
3. Allen Wong (Energy Commission): Why assume no replacement cost?
    a. Gwelen Paliaga (Statewide CASE Team): Are you aware that insulation is replaced at some point and time? Our understanding is that insulation is not replaced, it is often buried in walls and has a long lifespan.
    b. George Nesbitt (Environmental Design / Build): It will never be replaced because it's buried, exposed insulation might be when it's damaged, but also not highly likely.
4. Arielle Usher: Costs seem too low.
    a. Gwelen Paliaga (Statewide CASE Team): If we are missing something in the cost please send us more detail on what you think we are missing.

5. Jeff Boldt (IMEG Corp.): Has Title 24, Part 6 considered limiting lavatory water heating? ASHRAE 90.1 is considering that for lavatories that do not share piping with showers, e.g. airports.

6. George Nesbitt (Environmental Design / Build): What R-value was use in the hot water Loop calculations?

    a. (Not addressed during the meeting, response presented here.) Gwelen Paliaga, TRC: Insulation R-value matched current code from table 120.3-A.

1.1.1.2 Increase stringency of existing mandatory pipe insulation thickness for pipes larger than two inches.

1. George Nesbitt (Environmental Design / Build): The HERS costs are possibly high, assuming you are already on the job, so it's not much extra work to look at another measure. 100 percent verification is possible (you often inspect each floor). Failures will cost more.

    a. (Not addressed during the meeting, response presented here.) Gwelen Paliaga, TRC: The inspection cost assumptions are on the conservative (high) side, and will be lower in some circumstances, particularly if other inspections are coordinated at the same time. The measure is highly cost effective, even with these conservative cost assumptions.

2. George Nesbitt (Environmental Design / Build): As boiler rooms get used, and people walk over the insulation, and changes get made, the amount of insulation diminishes.

1.1.1.3 Add a compliance option for pipe sizing according to California Plumbing Code (CPC) Appendix M.

1. Dan Johnson (Beyond Efficiency Inc): Why not mandate Appendix M?

    a. Gwelen Paliaga (Statewide CASE Team): We looked into that in detail. The issue is that it is an unadopted appendix of the plumbing code, thus requires jurisdictional approval/adoption. It is worth considering in the future to align the energy and plumbing code.

2. John Bade (2050 Partners): Have you looked at the interaction of the measures? That is, does using smaller pipe and therefore thinner insulation leads to higher losses? I'm not saying it does necessarily lead to higher losses - just asking whether this has been modelled with all submeasures applied together.

    a. Gwelen Paliaga (Statewide CASE Team): We have not done that.

    b. Julianna Wei (Statewide CASE Team): Referring to "interactive effects"; Gwelen was referring to interactive effects between pipe heat loss causing an increase in internal heat gain and increase HVAC energy use. The calculation model we used account for different insulation thickness impact on different diameter pipes.

    c. John Bade (2050 Partners): Understood, but one submeasure drives smaller pipes, and therefore possibly thinner insulation in some cases. So, we bump up requirements for insulation on thicker pipes, and then drive the use of thinner pipes.

d. Gwelen Paliaga (Statewide CASE Team): Thinner pipes already have fairly thick insulation. Also, thinner pipes (risers mostly) are more likely to not fit in the stud space if insulation thickness is increased.

e. John Bade (2050 Partners): Gwelen - again, I am not claiming that there is negative interaction - just asking if it has been modeled or considered.

f. Gwelen Paliaga (Statewide CASE Team): Thanks for clarifying. The answer is we did not model the interactive effects - you are right the combination of increased insulation and Appendix M will degrade the appendix M savings a bit (when pipes decrease from 2 inches down to 1.5 inches).

3. George Nesbitt (Environmental Design / Build): What you don't inspect may not conform.

4. Allen Wong (Energy Commission): Real quick- Could you repeat what you said about which pipes aren't included in the sampling options? No piping within the dwelling units, and what else?

    a. (Not addressed during the meeting, response presented here.) Gwelen Paliaga, TRC: Required inspections only apply to recirculation pipes, that is pipes that have recirculation flow, not branch pipes or run outs. The sampling option allows for a sampling approach of the risers pipes.

5. Meg Waltner (Energy 350): In the cost-effectiveness calculations for the enforcement approach, did you assume that the energy savings were the same under each approach?

    a. Gwelen Paliaga (Statewide CASE Team): Yes, we did assume the same energy savings. We assume that the inspection results in all of the issues being resolved. That is why we are proposing 100 percent inspection in the water heater room and the first level. If we make sure to inspect 100 percent of the first portion of the system that will ensure that quality is established and can be confirmed through sampling for the rest of the building.

6. Jeff Boldt (IMEG Corp.): For small pipes, should ASHRAE 90.1 and Title 24, Part 6 consider making more stringent requirements about insulation U-values because they are more critical on small pipes?

    a. (Not addressed during the meeting, response presented here.) Gwelen Paliaga, TRC: Small pipes currently have relatively thick insulation requirements compared to large pipes. Also, small pipes with current insulation thickness max out the available space in stud walls. For these two reasons, we chose not to pursue increased thickness on small pipes for this CASE topic.

7. George Nesbitt (Environmental Design / Build): Change the plumbing code to catch up with smaller flow fixtures.

1. Danny Tam (Energy Commission): That's up to HCD (California Department of Housing and Community Development) to update Title 24, Part 5. It's outside our scope, as much as I would like to.

8. Bruce Severance (Mitsubishi Electric): Is the CASE Team considering Gary Klein's work on 3/8 inch pipe distribution within the units?

a. (Not addressed during the meeting, response presented here.) Gwelen Paliaga, TRC: Yes, the CASE team considered 3/8 inch pipes in the units. Currently the California Plumbing Code (and the UPC that it is based on) limit pipe size to 1/2 inch. Per CPC, 3/8 inch pipes need jurisdictional approval. The plumbing code needs to be changed before a requirement can be added to the energy code.

9. John Bade (2050 Partners): I've not seen evidence that 100 percent inspection leads to very different outcomes than a good quality sample inspection.

    a. Ruchi Shah (TNDC): John Bade (2050 Partners), do you think requiring 100 percent insulation, might push contractors to do a better job with insulation in the first place?

10. George Nesbitt (Environmental Design / Build): Having worked as a HERS Rater, in multifamily when you are inspecting a site, a lot of multifamily buildings get sheet rocked floor by floor. The amount of time that a unit or a floor is in rough construction is large before you get to wall insulation. There is a lot of time to get in and look. If you are already on site for a project, it is very easy to walk a whole floor and look at every riser. It takes no time.

    a. Gwelen Paliaga (Statewide CASE Team): We have heard from other HERS Raters and contractors that timing can be an issue as to when insulation installation for the piping occurs.

    b. George Nesbitt (Environmental Design / Build): The people that insulate the pipes are not the same as those that insulate the building. The pipes cannot be insulated until it has been inspected. Maybe there is a slight timing issue, but I do not think that the timing is that narrow.

    c. Gwelen Paliaga (Statewide CASE Team): I also saw a response that said 50 percent rather than 1/7 inch.

    d. George Nesbitt (Environmental Design / Build): What will happen when you do 1/7 inch for a new measure is that you will have failures at the start.

    e. Gwelen Paliaga (Statewide CASE Team): That is why we have 100 percent on the entire first floor.

    f. Dan Johnson (Beyond Efficiency Inc): I agree with George on 100 percent for new measures. Also, a building might have 6 risers, or 8. How many do you sample?

    g. George Nesbitt (Environmental Design / Build): Sampling is usually calculated on the 1st, and then 1 of 7.

    h. (Not addressed during the meeting, response presented here.) Gwelen Paliaga, TRC: Based on stakeholder feedback, the CASE team is considering changing the sampling rate to 50 percent.

1.1.1.4 Drainwater Heat Recovery (Dove Feng (Statewide CASE Team))

1. Pierre Delforge (NRDC): Is the "Unequal to heater" design compatible with central HPWH (heat pump water heaters)? If not, this design is not "central HPWH ready".

a. Danny Tam (Energy Commission): Pierre, I think there is a way to pipe it to make it work. Maybe the report can include recommendation on how to plumb DWHR for central HPWH.

b. Pierre Delforge (NRDC): Thanks Danny, these recommendations would be helpful to include, as well as any impact on the efficiency of the HPWH design. DWHR savings should be considered at a system level including HPWH efficiency.

2. Gina Rodda (Gabel Energy): I would also like to see how this affects "pod" design in terms of savings.

    a. Dove Feng (Statewide CASE Team): We have at the beginning of the CASE study considered the “pod” design where one water heater serves several dwelling units. There are a lot of design considerations and we figured the savings would be in between the central and individual water heater case and if neither is cost effective this would not be either.

3. Meg Waltner (Energy 350): Did you consider a DWHR unit per individual housing unit option?

    a. Dove Feng (Statewide CASE Team): Yes, we did consider it but it was not cost effective, so we did not look into it further.

4. Sean Armstrong (Redwood Energy): Could you please provide more data on the non-cost effectiveness? That is important given how challenging it is to waive the efficiency-based requirement for metering.

    a. Dove Feng (Statewide CASE Team): We have been conservative when we estimate the cost, for example for access panels and other equipment.

5. Meg Waltner (Energy 350): Did you consider cost savings from peak capacity reduction at the water heater?

    a. Dove Feng (Statewide CASE Team): We have not looked at that. That is a good point. The heater size would be reduced such that we should see some savings on the water heater design. For the next code cycle, we should definitely account for these savings. We do not think the measure can be made cost effective this cycle because of the high submetering costs.

    b. Meg Waltner (Energy 350): Thanks Dove. I would recommend looking at a DWHR device per dwelling unit to avoid submeter cost combined with accounting for the capacity reduction at the central water heater. I'd recommend looking at this scenario for this code cycle.

6. Danny Tam (Energy Commission): There is an exception for the individual metering for low income housing.

    a. Gwelen Paliaga (Statewide CASE Team): Regarding the water meters, California Building Coede requires them and there are exceptions for a few building types, including deed restricted affordable housing.

7. Tom Kabat (GoodGridizen.org): I think you mentioned using an EF (energy factor) lower than the product data and that you used "conservative" cost estimates (people often mean they used

larger numbers for costs when they say "conservative") Did you do something similar to the forecast of gas price?

1.1.2 Solar Thermal Water Heating (Jon Arent (Statewide CASE Team))

1. Ruchi Shah (TNDC): I have been hearing if we used PV (photovoltaic) instead of solar thermal to offset DHW (domestic hot water) use, the model penalizes, is this being addressed?
    a. Danny Tam (Energy Commission): PV cannot be used to offset efficiency EDR (energy design rating), can you elaborate on your question?
    b. Ruchi Shah (TNDC): If I install electric HPWH and pair it with PV? Can that be modeled for an all-electric building?
    c. Wayne Alldredge (VCA Green): We are very interested in this as well. The energy and life cycle costs look better than solar thermal. Extra PV coupled with HPWH should be modeled.
    d. Danny Tam (Energy Commission): The way the 2019 Standards work, there is a efficiency EDR and PV/Battery/DR EDR. You can add more PV but that would not impact the efficiency EDR. We are considering for central HPWH to offset the solar thermal requirement with PV.
    e. Wayne Alldredge (VCA Green): Dedicating a specific amount of PV for hot water would be a great option.
    f. Danny Tam (Energy Commission): What we don't want is someone to use an ER HPWH and offsetting with PV.
    g. Bruce Severance (Mitsubishi Electric): It has been my understanding for several years that solar thermal initial cost and maintenance is significantly higher than HP (heat pump) systems + PV, and that has been the case for several years now. It seems that the cost-effective analysis should be weighed against competing HP systems on a range of project sizes and system capacities. Consideration should also be given to system complexity and failure modes, for example, potential overheating of glycol resulting in both reduced heat transfer efficiency and heat transfer fluid replacement. Also, solar thermal is dependent upon hot weather, rather than sunny weather. PV system output increases during sunny cold weather, which makes it output more consistent across climate zones. Solar thermal also cannot put excess output back into the grid.
    h. Wayne Alldredge (VCA Green): No, couple with HP water heating.
2. Jon Arent (Statewide CASE Team): The idea is to have PV with a HP water heater as an option. The commission will have to weigh in on PV being paired with that type of system as a requirement so that CHPWH are not discouraged or overly incentivized.
3. Dove Feng (Statewide CASE Team): We are exempting HPWH systems from requiring solar thermal.
4. Meg Waltner (Energy 350): Are the software updates presented here also eliminated?
    a. Danny Tam (Energy Commission): We are considering it, it might be only for the performance method.

b. Jon: No, they are not being eliminated. We use the latest software updates to CBECC (California Building Energy Code Compliance) to provide a more robust and better model for solar thermal systems. Before it only looked at monthly contributions and now it looks at hourly contributions. The existing prescriptive requirement is unchanged. It enables you to have a more accurate model of the solar thermal system savings for both benefits, exceeding requirements, and tradeoffs.

5. Gina Rodda (Gabel Energy): There is an option already to use PV with heat pump water heaters, look for the docketed reports on this (Joint Appendix 13) that have been provided by the Energy Commission in the last few months for 2019

    a. Kelly Cunningham: JA13 is a proposal, but it is not part of the Standard at this time.

    b. Danny Tam (Energy Commission): Gina that is only for that specific Sanden option, once we have other systems available it would be extremely difficult to write prescriptive language for any CHPWH. Also, JA13 says nothing about PV.

    c. Gina Rodda (Gabel Energy): Thanks Danny, I was hoping it would be extended beyond the Sanden option.

    d. Danny Tam (Energy Commission): Under performance we are considering it.

6. Bruce Severance (Mitsubishi Electric): Have the solar thermal incentives been extended to HPHW+PV yet?

7. Ruchi Shah (TNDC): Can we model in solar thermal both black plate collectors and solar tubes?

    a. Jon Arent (Statewide CASE Team): I do not recall if their performance is characterized in the same way. The plate ones have an intercept with the nominal efficiency and a slope of performance degradation with temperature. I will need to double check for tubes. In speaking with contractors, we have heard that evacuated tubes are not used for these purposes because they produce a higher temperature and are typically more expensive. Most of our analysis is for flat plates. We have heard that the tubes are not used for multifamily hot water.

    b. Danny Tam (Energy Commission): For solar thermal systems, as long as they have the slope and intercept it can be added to the list. I believe evacuated tubes have those performance ratings. We could not model unglazed flat plates.

1.1.3 Central Heat Pump Water Heating

1. Bruce Severance (Mitsubishi Electric): It is critical to emphasize that introducing warm water into the HP tank reduces heat transfer efficiency and return water if it goes back to central system can only go to a looping tank. On single family, this measure should never introduce warm water to the HP tank as it can damage the compressor.

    a. Danny Tam (Energy Commission): Yes, we are highly aware of this issue.

2. Adam Chrisman (SunEarth Inc.): Does the modeling allow for variations in COP (coefficient of performance) for HPWH as ambient temperatures change?

3. Peter Mustacich (2050 Partners): What gas and electric cost escalators does this assume?

a. Julianna Wei (Statewide CASE Team): We are using 2022 TDV values and the underlying assumptions for electric and gas rates. You can refer to the Energy Commission for more details on TDV and point out that there is a metrics workshop still planned for the 26th by the Energy Commission where they can get more details.

4. Seam Armstrong: I looked the installed costs and I do not believe the gas versus water heater costs. The gas costs are much more significant and the HPWH costs should not be 10 times more and should have a longer lifetime than 15 years. Then solar thermal lifetimes should be reduced to 10 years, there is no way that they would last 10 years. I am not sure where the design discrepancy is, it might be a sizing questions where the HPWH size is too high. This may be a nonrealistic design. I would like to review your costs.

    a. Dove Feng (Statewide CASE Team): We are assuming that that building already has gas hookups which brings down these costs. Ecotope supported the design and approved it.

    b. Sean: Ecotope may have approved this but may not have designed it in this way.

    c. Dove Feng (Statewide CASE Team): We sent the floor plan and basic assumptions to Ecotope to carry out the design.

    d. Ruchi Shah (TNDC): I agree with Sean and can share our (TNDC's - affordable housing multifamily) replacement costs too.

    e. Julianna Wei (Statewide CASE Team): Solar thermal does incorporate replacement costs at year 15.

    f. Jon Arent (Statewide CASE Team): The warranty is not going to be the same as expected life. The data that I collected assumes regular maintenance, and with that maintenance 30 years is reasonable.

    g. Sean Armstrong (Redwood Energy): Having been in the industry for 30 years, I have not seen a thermal solar system that lasts 30 years. Solar thermal is matched with gas and what I am seeing is that there are several advantageous for the gas system which is making it difficult to show the cost effectiveness of HPWHs.

    h. Dove Feng (Statewide CASE Team: I understand your concerns and we will connect further; I do want to point out that this does not need to be shown to be cost effective.

    i. Barry Hooper (SF Dept of Environment): There is significant value in there being a cost-effective compliance option being offered in the code, so it is not irrelevant that there is a cost-effective option to comply.

    j. Adam Chrisman (SunEarth Inc.): Sean, please contact me and I will show your Solar Thermal System in service over 30 years.

    k. Wayne Alldredge (VCA Green): Totally agree with Sean.

    l. John Arent: I can get some data on solar thermal longevity.

    m. Gilad Nahari: Sean, I disagree, there are many SWH system over 15 and 20 years

    n. Nick Young (Association for Energy Affordability): did you ask for any design input other than from Ecotope?

o. Wayne Alldredge (VCA Green): 30 years on solar thermal are outliers, not average

p. (Update 4/9/2020: The Statewide CASE Team has followed up with stakeholders with a separate call to clarify design and cost assumptions. Stakeholders on the call agreed with the design inputs used for the CASE analysis, and the pricing represent a design using current industry best practice).

5. Amelie Besson (MidPen Housing): Can you tell us what exactly is included in those costs?

    a. Julianna Wei (Statewide CASE Team): Amelie, details cost components and numbers will be included in the CASE report; please reach out for these figures in the interim.

6. Josh Rasin: If this is new construction, why are we assuming there is already gas infrastructure?

    a. Ruchi Shah (TNDC): Josh that's right, I do not get that too.

    b. Julianna Wei (Statewide CASE Team): Josh R: Gas infrastructure cost is included because the central HPWH system is compared to the gas water heater baseline

7. John Bade (2050 Partners): The language requiring testing to Appendix E of Subpart G of Part 3431 forces the use of a >120-gallon commercial HPWH. Smaller buildings might be better off using product tested under the consumer side.

    a. Dove Feng (Statewide CASE Team): I agree, there might be concerns about using different standards. We need to review them in more detail to understand the testing configurations and ratings to come up with a proper testing process. We do want to have a similar comparison across different products, that will be the goal. We want people to be able to use the performance approach. We want to gather testing data so that we can model those products effectively.

8. John Bade (2050 Partners): There are no requirements for if and how these units are ducted, which makes a big difference in performance. The only mention is in the ACM language, which refers to a "split ducted heat pump."

    a. Wayne Alldredge (VCA Green): Never saw a need for ducts on these.

    b. John Bade (2050 Partners): Wayne - as long as you have a space with plenty of air entering and that air is not heated by your space heating system.

9. Nick Young (Association for Energy Affordability): Why was a multi-pass configuration as commonly installed for Colmac and Nyle systems not modeled? Multi-pass HPWH reduce the number of components and eliminate electric resistance recirculation. Peak COP will be lower, but the overall COP could be as good as or better than the single-pass system, depending on the percent of heat loss due to recirculation.

    a. (Not addressed during the meeting, response presented here.) Dove Feng (Statewide CASE Team): The compliance software currently does not have the capability to model a multi-pass system. The newly proposed JA will provide a prescriptive pathway for multi-pass design. In the future, when manufacturers follow JA requirement to provide testing data, the compliance software will be able to model multi-pass system and allow compliance using performance approach as well.

10. Peter Grant: If Ecotope created the design for this CASE report, and Sean is saying that it's sized far larger than what he sees in construction, this implies that code designs assume higher hot water loads than engineers use when practicing. That's the main reason code-based systems would be larger, right? Does this imply that the Title 24 hot water draw profiles are overestimating load compared to what engineers are using in their design assumptions?
    a. Danny Tam (Energy Commission): I would say the prescriptive Sanden option is conservative because we are coming up with a formula that works for all climate zone and building sizes. Ecotope/Ben Larson also assisted us in coming up with the prescriptive option.
    b. Peter Grant: Danny - is the implication there that people could earn compliance credit by specifying a less conservative, smaller system in the right cases (e.g. more favorable climate zones)?
    c. Danny Tam (Energy Commission): In CBECC 1.2 you can specify different compressor numbers, main tank and loop tank sizes than the prescriptive option. So, yes there might be more credit available. Also loop pipe insulation has a big impact.
11. George Nesbitt (Environmental Design / Build): Solar Hot Water pairs with electric as well as gas.
    a. Adam Chrisman (SunEarth Inc.): Solar thermal as a preheat pairs with all backup heating systems. Same as HPWH if you wanted to size them smaller to pair with gas.
12. Nick Young (Association for Energy Affordability): would an alternative prescriptive pathway preclude a project form getting CREDIT for CHPWH?
    a. Julianna Wei (Statewide CASE Team): Nick, having a central HPWH prescriptive req does not preclude a project from getting credit
13. Meg Waltner (Energy 350): What COP did you use in your final model?
14. John Bade (2050 Partners): Should say only HPWH with tank >= 120 gallons.
15. Wayne Alldredge (VCA Green): To clarify my previous comments, it's the costs of installation and life expectancy that seams way off. I'm not commenting on the energy analysis.
16. Tom Kabat (GoodGridizen.org): As an analyst I try to use centered cost estimates instead of "conservative" (allowed to be biased) ones. Otherwise I'm giving biased results. I owe people unbiased, centered results.
17. Dove Feng (Statewide CASE Team): Regarding the modeling for the COP, in the current model we can only model the Sanden units which reported a higher COP. We don’t know at what conditions this COP is rated. That is why we are concerned about reporting the COP directly in the CASE report. Currently, most manufacturers test their product in house. It is difficult to compare it between manufacturers, they are not reporting the COP as the efficiency metric, which is why we are pushing for a more standardized testing approach.
    a. John Bade (2050 Partners): There is a standard test - the test procedure in Part 431. I am pretty sure you are preempted from using another test procedure.

b. Eric Truskoski (Bradford White Corporation): That's correct. Manufacturers can only test to U.S. DOE test procedures.

c. Julianna Wei (Statewide CASE Team): John, we are proposing the CFR test for units larger than the residential sized units will align with test standards that the Energy Commission decides upon for the certification.

18. Adam Chrisman (SunEarth Inc.): Was the assumed COP allowed to vary with ambient temperature conditions for this analysis? Air source HPWH in particular have performance slopes not constants.

19. Gilad Nahari: Can anyone suggest manufacturers that comply with the testing requirements?

    a. Julianna Wei (Statewide CASE Team): Our research indicates manufacturers do not typically test against the CFR test procedure at the moment.

    b. Gilad Nahari: Thanks for replying. I am struggling finding any central HP manufacturer and found only Colmac. even in the ASHRAE show in Orlando I could not find any.

    c. Julianna Wei (Statewide CASE Team): Manufacturers with central HPWH products include Colmac, Nyle, Mitsubishi, Sanden and Rheem.

    d. George Nesbitt (Environmental Design / Build): AO Smith has a 120 gallon commercial HPWH with a COP of 4.2.

    e. Sean Armstrong (Redwood Energy): AO Smith also has a central HPWH. Rheem and other individual 50-80 gallon tanks can be used for central, but are not designed for that.

    f. Julianna Wei (Statewide CASE Team): Sean, yes, AO Smith and perhaps a couple other models may be used for central HPWH applications also

    g. Gilad Nahari: AO Smoth has small individule HP only 50-80 gall. also Rheem. I could not find their central HP system.

    h. Sean Armstrong (Redwood Energy): AO Smith has a 6 ton, 40F or greater system.

    i. John Bade (2050 Partners): Gilad - https://www.hotwater.com/Water-Heaters/Commercial/Water-Heaters/Heat-Pump/CHP-120-Fully-Integrated-Heat-Pump/.

20. Sean Armstrong (Redwood Energy): John Bade (2050 Partners) and folks, using indoor, already conditioned air as the source for HPWH can be a great efficiency move, if the HPWH would have gone into resistance mode at 40F. Keeping the air warm with a COP 3-4 heat pump, and then using that heat with a COP 3-4 water heater, preserves the overall COP at 3-4. That's much better than electric resistance.

    a. John Bade (2050 Partners): Sean - - that is not correct. Two processes in series each with a COP of 4 yields an overall COP of 2.5.

    b. Sean Armstrong (Redwood Energy): John, thanks! That wasn't what I'd understood on combined COPs, but it's still the case that COP 2.5 is better than 0.95.

    c. John Bade (2050 Partners): Sean - look at it this way - If you are using gas for space heating then you have a hybrid gas/electric system with an efficiency lower than your gas furnace.

    d. Sean Armstrong (Redwood Energy): John, understood. But not using gas is my baseline assumption.

21. Abhijeet Pande (Statewide CASE Team): Sean - eliminating gas lines themselves will save money but for this code change we are not assuming that everyone is eliminating gas to the building all together. They may have gas for cooking for example. We do account for gas piping to the water heater for the building.

    a. Sean Armstrong (Redwood Energy): Abhijeet, very few buildings are using gas these days for cooking--the ventilations requirements are expensive and challenging.

    b. George Nesbitt (Environmental Design / Build): You need kitchen range ventilation whether you use gas or electric, there's moisture and pollutants from what and how you cook with electricity too.

    c. John Bade (2050 Partners): Sean, Wayne - I agree with George. I am not aware of any difference in Title 24, Part 6 ventilation requirements based on cooking fuel.

    d. Sean Armstrong (Redwood Energy): Ventilation of gas has 10x more NOx (nitrous oxide), Sox (sulfur oxide) than electric cooking--those are almost exclusively gas combustion fumes.

22. Sean Armstrong (Redwood Energy): Leaving out the additional cost of solar thermal and gas delivery, just boiler to central HPWH, a gas system is ~1/3rd the cost. Adding in gas brings them even, and adding solar thermal to get compliance for a gas boiler makes it $100-200k more expensive.

23. Gabriel Ayala: Is the recirculation loop tank used in lieu of recirculation pump controls?

24. Adam Chrisman (SunEarth Inc.): HPWH are renewable energy devices as such need to be evaluated for a range of operating conditions. Even the residential test for UEF only assume a single operating point. Analysis of benefit cannot be made without accurate data of COP over the range of operation points for all 16 CA climate zones. Additional standardizing testing and reporting of HPWH is critical.

    a. John Bade (2050 Partners): Adam - You are not wrong, but there are federal preemption issues to consider.

    b. Peter Grant: I'd like to second Adam Chrisman (SunEarth Inc.)'s comments, and add that we can/should add those performance curves into the CBECC algorithms.

25. Nick Young (Association for Energy Affordability): Specifying the operating conditions, outside of which it would need to use auxiliary heating. Are there not enough systems that can operate in heat pump mode all the time?

    a. Dove Feng (Statewide CASE Team): There are many products that can do that. What we wanted to prevent is when people do not pick the product that is able to do that. So, we want to make sure that the design can meet the project threshold in the prescriptive minimum and have language that addresses this issue.

26. Nick Young (Association for Energy Affordability): If the main system is multi pass, why do we need an additional one? This seems like an over complication. A single tank with a single set of HPWHs that can modulate

a. Dove Feng (Statewide CASE Team): If you want to not use multiple tanks in the performance path you can do that. The benefit of the loop tank is that you are able to use a swing tank to handle the temperature maintenance load without engaging the primary water heater, including the mult-pass heater. The swing tank can also make sure the primary storage tank and HPWH can meet morning peak demand after heat loss in recirculation system overnight. You can maximize stratification to increase the efficiency of the multi pass.

b. Nick Young (Association for Energy Affordability): The marginal benefit to efficient of the swing tank and heat pump, does that offset the marginal cost of adding those components?

c. Dove Feng (Statewide CASE Team): That is a very good question. This is our first pass; we would like to have more stringent requirements. In the proposed design, if you want to only use a single tank, that will be captured by the software.

27. Abhijeet Pande (Statewide CASE Team): Sean - we will setup a follow-up call with you to discuss specifics. We did include costs from your projects and others when designing this cost-effectiveness analysis. As Dove mentioned, we are aware of cases where gas systems to HPWH is not such a large delta. The analysis here is dealing with larger systems.

28. Danny Tam (Energy Commission): Just to be clear, when Dove mentioned certification to the Energy Commission, we will be asking for performance data for a range of condition so we can build the performance curve. It is what we are doing right now with the Colmec and Nyle.

    a. John Bade (2050 Partners): Danny - understood, but federal preemption only allows requiring data that is part of the federal test procedure. If manufacturers want to voluntarily provide data, that's great.

    b. Danny Tam (Energy Commission): Most central HPWH are not currently federally regulated.

    c. John Bade (2050 Partners): All HPWH <6kW input are regulated. All HPWH >12kW input have a federal test procedure.

    d. Sean Armstrong (Redwood Energy): Danny's point is interesting--bigger HPWH are not federally regulated, which makes the Energy Commission the leader in setting performance standards. No pre-emption in efficiency standards, correct Danny?

    e. John Bade (2050 Partners): Agree that there is no preemption on the efficiency, but I am 98 percent sure the test procedure is preempted.

    f. Sean Armstrong (Redwood Energy): So, if efficiency, standards but not testing standards, are up to the Energy Commission then we can require Sandens outright, with COPs of 3.5-6 depending on the season. Right?

    g. Danny Tam (Energy Commission): As I understand it central HPWH like Colmec and Nyle don't have tanks and are outside the DOE definition. On the other hand Sandens are UEF rated so we are preempted from using that as a Standard design, without another option at the minimum level.

h. Sean Armstrong (Redwood Energy): So, if the Energy Commission made a Mayekawa, a CO2 product with COPs 4+, could that get around Federal Preemption, allowing us to set a COP goal that matches the Air Resource Board's refrigerant phase out timeline (2023)?

i. John Bade (2050 Partners): Danny - I just looked through 10 CFR 431 subpart G and see nothing that limits the test procedure only to units with integral tanks. None of the HPWH definitions in that subpart mention tanks, and the test procedure appears to be usable for non-tank units.

j. Nehemiah Stone (Stone Energy Associates): John, to test a HP w/o a tank, the manufacturer would have to add someone's tank for the test. It can be done, but it does not really give you a rating for the HP itself.

k. Danny Tam (Energy Commission): I should say there is no federal minimum standard for these systems. The Standard in §431.110, it says electric storage water heater.

l. Jingjuan Dove Feng (Statewide CASE Team): John, we have talked to most HPWH manufacturers, only Sanden is tested using the consumer standard. Colmac and Nyle are not, they use inhouse testing.

m. Jingjuan Dove Feng (Statewide CASE Team): Danny, because Colmac and Nyle do not have integrated tanks, I asked them specifically: do they think they fall into electric storage heater classification, they are not aware of it.

n. John Bade (2050 Partners): Dove - from Appendix E to Subpart G -"Note: On and after November 6, 2017, manufacturers must make any representations with respect to energy use or efficiency of commercial heat pump water heaters in accordance with the results of testing pursuant to this appendix."

o. Jingjuan Dove Feng (Statewide CASE Team): John, thanks. The CFR testing standard is also not sufficient as it only requires testing under one condition. That is why we are considering expanding the testing conditions but adopt the testing approach of the standard.

29. Sean Armstrong (Redwood Energy): The request is that the energy commission and its consultants do an analysis for gas just for the boiler system. You have to do this; it is the most common scenario in multifamily high-rise buildings. If you are not counting it in that way you are not assessing what is happening in the real world. You have to compare a gas service boiler to an all-electric building.

    a. Abhijeet Pande (Statewide CASE Team): We can discuss this during the all-electric package part.

30. George Nesbitt (Environmental Design / Build): Colmec is now shipping units with tanks, pre-plumbed and on skids to eliminate job site stupidity.

31. Jingjuan Dove Feng (Statewide CASE Team): Sean, the large Colmac system is about 60,000 a piece, I just checked cost from the PG&E test lab and from AEA cost collection effort.

    a. Sean Armstrong (Redwood Energy): Dove, what is the Btu output of the large Colmac that you priced? The point about right-sizing a Colmac is that a smaller one with a larger

tank may be the better choice for efficiency. The Btu and Storage ratios adopted were essentially 2x gas to 1x heat pump. 3x gas to 1x heat pump is the right sizing.

b. Jingjuan Dove Feng (Statewide CASE Team): Sean, please refer to our sizing table for Btu and storage.

c. Sean Armstrong (Redwood Energy): Danny, could we use a Mayekawa central HPWH, COP 4+, as the Standard due to lack of federal standards for that product type?

d. Jingjuan Dove Feng (Statewide CASE Team): Ecotope has provided the designs for gas and HPWH.

e. Jingjuan Dove Feng (Statewide CASE Team): Sean, as far as we know, Mayekawa's central HPWH is currently not available in California.

f. Danny Tam (Energy Commission): Well we can consider them, but first of all we need to test them, and they need to be cost effective, and COP 4+ at what condition?

g. Sean Armstrong (Redwood Energy): I don't know the answer there--Ecotope presented smaller sizing than Danny did. This is an unresolved question.

h. Sean Armstrong (Redwood Energy): Mayekawa is installed in two North Bay locations.

i. Jingjuan Dove Feng (Statewide CASE Team): I agree with Danny, testing is critical.

j. Jingjuan Dove Feng (Statewide CASE Team): Sean, we can connect offline, our research shows their larger size HPWH is not available.

k. Danny Tam (Energy Commission): Sean, like I said the prescriptive option is conservative because it needs to work for all sizes and climate zones. Ben Larson helped us developed the option, who used to be in Ecotope.

l. Sean Armstrong (Redwood Energy): OK, that makes sense---if this is a conservative design, for all climate types, then it would be oversized. But that's a problem, not a solution. We need climate specific sizing, since performance curves are climate specific.

m. George Nesbitt (Environmental Design / Build): Who says that a prescriptive requirement has to be the same for all climate zones?

n. Danny Tam (Energy Commission): Sean - then use performance, if a smaller "right" size would work then go for it.

o. George Nesbitt (Environmental Design / Build): Not all prescriptive requirements are the same (insulation, SHGC, radiant barriers, cool roofs, etc.) vary.

p. Sean Armstrong (Redwood Energy): Danny, I promise to only use Performance. That said, Barry Hooper (SF Dept of Environment)'s point is that cities use the Prescriptive Minimum. We need this to be as accurate to the real-world costs as possible to allow policies like gas bans to reflect the real world.

q. (Not addressed during the meeting, response presented here.) Dove Feng (Statewide CASE Team): The equipment sizing may appear to be oversized, but it has considered the HPWH actual heating capacity decrease significantly when outdoor air temperature decrease. The listed heating input is at a rated condition at 70F ambient air temperature.

1.2 CASE Presentation II: Multifamily All Electric Package

1. Wayne Alldredge (VCA Green): No gas infrastructure is a huge cost savings that tends to pay the offsets of going all electric. Many buildings are going all electric if they can legally not put in gas infrastructure.
    a. (Not directly addressed during the meeting though was addressed in response to another question, response presented here.) Abhijeet Pande (Statewide CASE Team): In terms of site cost infrastructure, for all electric buildings, we are not including cost savings for eliminating gas service to the building. The CASE Team is addressing regulated end uses since those are covered by Title 24 requirements, but developers may have gas to the building for other end uses like gas dryers, gas cooktops or decorative fireplaces. If you assume that there is no gas to the site that will only make the cost effectiveness better for the all-electric pathway.
    b. Wayne Alldredge (VCA Green): It doesn't need to be anything but an option. Climate zone doesn't matter. I believe the intent is to make this an alternative to gas, not a mandate against gas.
    c. Sean Armstrong (Redwood Energy): We just need the alternative to have cost-effectiveness that reflect real-world development choices, where gas infrastructure is paid by the developer/owner. Our Code has to capture that large, expensive, owner-paid construction cost.
    d. Wayne Alldredge (VCA Green): If it works in your project's energy estimate, then you have an option. If it doesn't model to show savings, then you need to stick to something more traditional.
2. Sean Armstrong (Redwood Energy): Does your study include the gas services cost, even if it is not used for cost effectiveness?
    a. Abhijeet Pande (Statewide CASE Team): Yes, we do have those costs. We did include the cost of running the gas line to individual space heaters and central water heaters.
3. Tom Kabat (GoodGridizen.org): Why not use an all-electric base for all buildings?
    a. (Not directly addressed during the meeting though was addressed in response to another question, response presented here.) Abhijeet Pande (Statewide CASE Team): The broader goal for the CASE Team is to support building decarbonization. The first step is to allow an equitable pathway for all-electric buildings to comply with Title 24 Part 6. We originally looked at two scenarios – a. all-electric as a baseline for all buildings OR b. all-electric baseline for buildings that have electric space and water heating systems in their proposed designs. After review of current market data and the current status of compliance software regarding central heat pump water heating, we have decided to go with option 2 for this CASE Report. This will still achieve the purpose of promoting all-electric designs.
4. Sean Armstrong (Redwood Energy): Gas water dryers, water heaters and furnaces all require 10' radius of no openable windows or doors. Having gas venting has made many high-rise design strategies impossible without vertical venting, which is hugely expensive. Gas stoves vs. electric stoves--teach me please the venting differences. Venting heat pumps requires only 3' radius, as it's just air, not air pollution.

a. John Bade (2050 Partners): Agreed on the appliances. Stoves do not have those issues.

b. George Nesbitt (Environmental Design / Build): It's been decades since you could vent an oven, gas or electric.

5. Rahul Athalye (NORESCO): There is no gas furnace plus DX (direct expansion) cooling? My question was about slide 158, not related to the other discussion here. Thanks!

    a. (Not directly addressed during the meeting, response presented here.) Abhijeet Pande (Statewide CASE Team): The data presented on slide 158 is for buildings that are all-electric and have electric space conditioning systems. So DX with Furnace will not show up here.

6. George Nesbitt (Environmental Design / Build): Heat pumps are not the same as renewable energy, heat pumps consume energy, while PV, hydro, wind, geothermal (not heat pumps) generate energy.

    a. (Not directly addressed during the meeting, response presented here.) Abhijeet Pande (Statewide CASE Team): That is correct.

7. Amelie Besson (MidPen Housing): These savings are without any solar PV, correct?

    a. Abhijeet Pande (Statewide CASE Team): That is correct.

8. Sean Armstrong (Redwood Energy): Is there any impact to Abhijeet's low estimate of all-electric buildings in 2023 (~17-19 percent)? That's a very low number, as he noted given the move to ban/discourage gas is up to 60 cities in CA at the end of 2020. So, does that low estimate matter?

    a. Abhijeet Pande (Statewide CASE Team): You are right, that the number is not as large as some would predict. The CASE Team reviewed available project starts and compared with overall construction volume on an annual basis. We when added to the current percentage by looking at cities working on all-electric reach efforts to develop a higher percentage. We made a conservative estimate of how much more the current local efforts will add to all-electric new construction based on number of cities that are currently engaged in reach codes. Certainly, having more buildings will help from market penetration perspective but that is beside the point here because the per building or per unit impact will not change.

9. Tom Paine (ConSol): That conclusion on first cost savings is problematic, developer saves on construction, resident pays a higher utility bill, and doesn't get savings because rent is market based. That makes housing less affordable

    a. Abhijeet Pande (Statewide CASE Team): That is a concern and we are engaging with developers on that topic. The analysis is using the TDV (time-dependent valuation) savings, not the utility savings. CCAs are also using different energy rates which can shift these costs. We are looking at how this effects cost effectiveness through the reach code efforts.

    b. Sean Armstrong (Redwood Energy): Tom, good point--we need all-electric to be paired with some PV. Not much, just enough to make operating costs even.

10. Sean Armstrong (Redwood Energy): Doesn't a furnace/DX require the same 15-30A circuit as a heat pump? That $150 cost difference for circuits doesn't seem accurate.
    a. Abhijeet Pande (Statewide CASE Team): In many cases this is not required and in some cases it is not needed. We are including the $150 cost adder to be conservative in our estimate.
11. Sean: Your electrification costs, for the rate, the CPUC is now including opt in time of use rates, which were not included in this analysis.
    a. Abhijeet Pande (Statewide CASE Team): This is only looking at TDV costs, not time of use costs.
12. Brendan McGovern (Trane): What about equipment lifecycle? Should that be in your cost analysis?
    a. Brendan McGovern (Trane): The two systems are going to have different lifecycles and repairability. This should be taken into account for an accurate analysis.
    b. Tom Kabat (GoodGridizen.org): With only a 15-year life estimate do you include the cost to retrofit gas systems to the required (to meet state goals) electric systems in year 16?
    c. Abhijeet Pande (Statewide CASE Team): For all HVAC systems we are doing a 15-year lifecycle. While there will be replacement on the gas and electric side, none are assumed to be replaced within the 15-year analysis period.
13. George Nesbitt (Environmental Design / Build): Were the greenhouse gas emissions calculated with an average emissions rate or an hourly rate, and for the current grid and not a 2030, 2050
    a. Abhijeet Pande (Statewide CASE Team): We are using the emissions calculations in the proposed 2022 TDV metric.
14. John Bade (2050 Partners): Did the costing take into account that for high-rise you need to find someplace to mount the outdoor unit outside that you can access for maintenance
    a. Dove Feng (Statewide CASE Team): We assumed all outdoor units are either on roof or on ground. We reviewed design drawings of many high-rise projects, and this is the dominant approach.
15. John Arent: What's the min outside temp the mini splits can operate without supplemental heat?
    a. (Not directly addressed during the meeting though was addressed in response to another question, response presented here.) Abhijeet Pande (Statewide CASE Team): The issue of supplemental heat is not just based on minimum outdoor temperature but more broadly on whether the compressor can meet load. Certainly, a cold start when outside temperatures are very low will likely trigger supplemental heat. The energy savings analysis accounts for supplemental heating.
16. Nick Brown: Did the benefit calcs include the new credit for Variable Capacity Heat Pumps (VCHP)? Modeling software underestimates savings for heat pumps even with VCHP credit most likely
    a. Abhijeet Pande (Statewide CASE Team): We are proposing a baseline/standard design with minimum efficiency systems for space heating and space cooling. In our results

here you will not see any credits for improved systems. However, in the performance approach if you use an improved design you will see a credit.

17. Sean Armstrong (Redwood Energy): Abhijeet, how does the CPUC's electrification rate directive affect your estimate?
    a. (Not directly addressed during the meeting though was addressed in response to another question, response presented here.) Abhijeet Pande (Statewide CASE Team): The CASE analysis is based on TDV using the proposed 2022 TDV metrics. That is separate from the customer utility bill analysis that you are alluding to.
18. Tom Paine (ConSol): We have tools to evaluate actual utility costs, that may be something ConSol could help with.
    a. (Not directly addressed during the meeting though was addressed in response to another question, response presented here.) Abhijeet Pande (Statewide CASE Team): Thanks for that response and we welcome your assistance. Please reach out to me directly and we can setup a follow-up call.
19. Sean Armstrong (Redwood Energy): I hear you saying that we use the federal minimum for the study. Having a study that shows better savings would be helpful. Is it against the rules to study high efficiency variable capacity heat pumps?
    a. Sean Armstrong (Redwood Energy): COPs of 3-4 would look great--is it against the rules to study it, even if the code does not get set on it?
    b. Abhijeet Pande (Statewide CASE Team): The point of this study was to establish a floor for the all-electric pathway. We want to make sure that the floor is set appropriately based on several factors. To your point, if you use a variable capacity heat pump you would see a compliance credit. You are still being compared to gas and you may not see your system comply by itself.
    c. Kelly Cunningham: We try to study these technologies in different programs. For this project, we might not be able to in depth study of a high-performance system using the CASE resources. It does not mean that we are not studying them in other programs that we run. We are doing a central heat pump study out of ATS and CVRH. I appreciate your comment, we can study it but not necessarily with this project. ATS is our San Ramon laboratory where we are testing Central HPWH. CVRH (Central Valley Research Homes) is our portfolio of single-family homes in Stockton that we have been testing space heating/cooling technologies within for several years. We have several reports posted here: https://title24stakeholders.com/measures/building-types/single-family/future/
20. Barry Hooper (SF Dept of Environment): For the all-electric prescriptively compliant definition, I understand the objective is to set a "floor". However, including any non-essential system components for purposes other than avoiding federal preemption contributes to a less-likely cost-effective prescriptive case. And for communities where all-electric becomes the only option, you get into an interesting question of whether it's the local ordinance or Title 24, Part 6 prescriptive baseline that may not be providing a cost-effective compliance option. Therefore, the all-electric prescriptive compliance option should be as cost-effective as possible

a. Abhijeet Pande (Statewide CASE Team): If you combine the first cost savings for heat pump space heating with the energy cost savings of CHPWH we are seeing the package to be cost effective over time using 2022 TDV. We are not requiring more efficient systems than the federal minimum in order to avoid preemption.

b. Tom Kabat (GoodGridizen.org): Clearly applicants can use fed min equip in performance approach. But I don't see a need to include fed min equipment in prescriptive approaches.

c. Abhijeet Pande (Statewide CASE Team): We are trying to avoid a scenario where the state or local jurisdiction comes under fire for appliance preemption. You do get a performance credit for a more efficient system. In the prescriptive path you are likely to use a system that is at least meeting the federal minimum, if not something that is more efficient.

d. John Bade (2050 Partners): Tom - preemption requires allowing fed min products in prescriptive approaches

e. Tom Kabat (GoodGridizen.org): John, my understanding is that pre-emption requires a jurisdiction to allow at least one path whereby a fed min device can be compliant. the performance path meets the one path allowed criteria. So, I would argue the prescriptive paths do not have to be compromised.

21. Bruce Severance (Mitsubishi Electric): Is there any reason why your conclusions could not show before and after gas hookups are accounted for? You are saying that the base case has a comparison between gas and electric, even in a retrofit situation. In order to show a benchmark for retrofit as well as new construction it would make sense to include the avoided cost of bringing the gas infrastructure into a large multifamily building. My concern is more about how the cost tradeoffs may affect policy.

    a. Abhijeet Pande (Statewide CASE Team): In the CASE report we are only addressing new construction. Having said that, we will be providing those numbers (with and without gas hookup) for new construction. My point is that even without using the cost savings from avoided gas hookup, the all-electric package is still cost effective.

22. Kelly Cunningham: The gas infrastructure cost questions is something that PG&E has been actively working on. There is not a large pool of public data on those costs. We are doing what we can to answer the Commission’s questions on this. We are working on this.

    a. Tom Paine (ConSol): We've been looking at gas infrastructure costs in detail for single family new construction. Existing estimates exaggerate the costs by 2 or 3 times.

    b. Tom Paine (ConSol): I've also heard from infrastructure consultants that in MF development, builders can get net revenue from the utilities for connecting gas, as in no savings at all

23. Sean: There are two different units being used, kWh and Therms. Could you use a standard unit to compare? Electric stoves use far less energy than gas stoves, but people continue to say that gas is more efficient. There is confusion around the energy consumption of appliances.

    a. John Bade (2050 Partners): When people say gas is "more efficient" they mean in terms of dollars, not energy.

b. Tom Kabat (GoodGridizen.org): Perhaps make the graphs in site kBtu (not Therms and kWh).

c. George Nesbitt (Environmental Design / Build): Different metrics, different results; site, source, carbon, TDV, $ costs.

d. Sean Armstrong (Redwood Energy): John, I'm not really sure what people mean by efficient--gas bills are higher than heat pump bills in more than half the country, today. Efficiency and GHG benefits are both greater with heat pumps.

e. Wayne Alldredge (VCA Green): Maybe use dollars instead of kBtu? how about $0.12/ kWh and $1.40 a Therm and then graph it out?

f. Abhijeet Pande (Statewide CASE Team): We are hoping that the Energy Commission's work on metrics will be wrapped up soon and then we can take this back to the source energy in Btu to have a direct comparison.

24. George Nesbitt (Environmental Design / Build): Berkeley's gas ban will not eliminate any gas infrastructure expansion, because the city is built out with gas available already everywhere

    a. Sean Armstrong (Redwood Energy): Gas laterals in Berkeley will be abandoned, rather than replaced. Gas infrastructure in the street can be abandoned over time, rather than maintained.

    b. Barry Hooper (SF Dept of Environment): That's not correct George. The situation is complex, but existing distribution infrastructure that is aged must receive various types of maintenance, which in some areas will include replacement, and in some areas will include sleeving or similar activities with lower cost than replacement but t a long way from zero.

    c. George Nesbitt (Environmental Design / Build): Even if you eliminated all the laterals on a street (i.e. build all new MF housing), you won't likely be removing the main in the street.

25. Bruce Severance (Mitsubishi Electric): you made the comment about including all life cycle costs and we agree with that. That would include emissions and leaks at gas wells and the global picture factored into avoided CO2 emissions and the near- and long-term impacts. If you are looking at carbon reductions, you are looking at all of those factors.

    a. Abhijeet Pande (Statewide CASE Team): We are working with the Energy Commission on this to address the emissions.

    b. Bruce Severance (Mitsubishi Electric): The projected term is also important. In 2023 we have CARBs new low GWP standard coming into effectiveness. There is no equivalent standard for super emitting gas sites.

26. Sean Armstrong (Redwood Energy): I used what PG&E charges for lateral which is $16,000 for single family homes for those connections.

    a. John Bade (2050 Partners): Sean - I would like to see that data on costs. I get pushback when I say they are even similar in other venues. Do you have a link?

b. Kelly Cunningham: We did consider those costs as part of the reach codes and they were blended into the consideration. We have since done more research and added to those costs. The costs are not published anywhere, I am coordinating with the teams inside PG&E and we have sent it to cities prior. We are looking into publishing that in the Reach Codes appendix.

Poll Results

Figure 1: Result of Poll 1, Multiple Choice. Explanation for No: I think a higher percentage of valves, pumps & other accessories as well as framing penetrations.

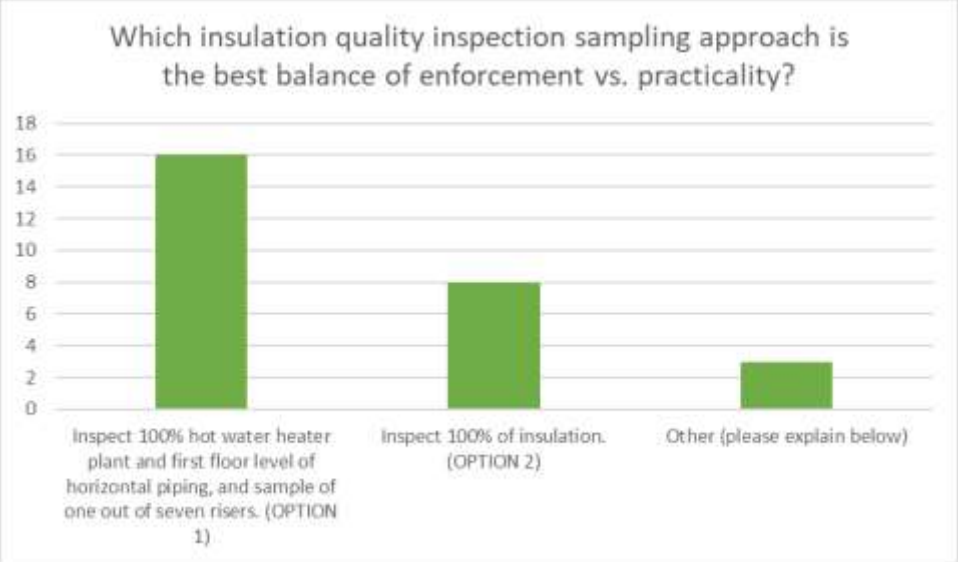

Figure 2: Result of Poll 2, Multiple Choice.

Explanations for Other:

- *Sampling makes sense as long as it's subject to HERS protocol, whereby a failed test negates sampling and triggers 100% inspection.*
- *Perhaps increase the percentage of risers inspected. 50%?*

- *Work with HERS providers to develop inspection process that works with other inspections that are being asked for and how they may affect construction schedule and communication with various subcontractors.*