

Meeting Notes



2022 California Energy Code (Title 24, Part 6)

Agenda for the Utility-Sponsored Stakeholder Meeting for:

Single Family Grid Integration

Posted April 10, 2020

Meeting Information

Meeting Date: March 19, 2020

Meeting Time: 8:30am – 11:30pm 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 | <i>Live Attendee Poll</i> | |
| 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: Single Family Grid Integration <ul style="list-style-type: none">• Home Energy Management Systems and Smart Thermostats• Battery Storage Systems• HPHW Load-shifting• HVAC Load-shifting | David Zhang (Energy Solutions) Bob Hendron, Kristin Heinemeier, Marc Hoeschele (Frontier Energy) Ben Larson (Larson Energy Engineering) |
| 11:15 pm | Wrap Up and Closing | Statewide CASE Team |

Meeting Attendees

Statewide Utility Codes and Standards Team – Utility Staff:

| First Name | Last Name | Email | Affiliation |
|------------|------------|--|---|
| Sang | Han | sang.han@ladwp.com | Los Angeles Department of Power and Water (LADWP) |
| Jim | Kemper | James.Kemper@ladwp.com | Los Angeles Department of Power and Water (LADWP) |
| Armen | Saiyan | Armen.saiyan@ladwp.com | Los Angeles Department of Power and Water (LADWP) |
| Mark | Alatorre | mark.alatorre@pge.com | Pacific Gas and Electric (PG&E) |
| Kelly | Cunningham | KACV@pge.com | Pacific Gas and Electric (PG&E) |
| Charles | Kim | charles.kim@sce.com | Southern California Edison Company (SCE) |
| Ruby Rose | Yepez | ruby.r.yepez@sce.com | Southern California Edison Company (SCE) |
| Joshua | Rasin | joshua.rasin@smud.org | Sacramento Municipal Utility District (SMUD) |
| Jun | Wen | jun.wen@sce.com | Southern California Edison Company (SCE) |
| Chris | Kuch | christopher.kuch@sce.com | Southern California Edison Company (SCE) |

Codes and Standards Enhancement (CASE) Team Members:

| First Name | Last Name | Email | Affiliation |
|------------|------------|--|------------------------|
| Kiri | Coakley | kcoakley@energy-solution.com | Energy Solutions |
| Garrett | Hedberg | ghedberg@energy-solution.com | Energy Solutions |
| Marisa | Lee | mlee@energy-solution.com | Energy Solutions |
| Eric | Martin | emartin@energy-solution.com | Energy Solutions |
| Heidi | Werner | hwerner@energy-solution.com | Energy Solutions |
| David | Zhang | dzhang@energy-solution.com | Energy Solutions |
| Bill | Dakin | bdakin@frontierenergy.com | Frontier Energy |
| Bob | Hendron | bhendron@frontierenergy.com | Frontier Energy |
| Marc | Hoeschele | mhoeschele@frontierenergy.com | Frontier Energy |
| Kristin | Heinemeier | kheinemeier@frontierenergy.com | Frontier Energy |
| Ben | Larson | ben@larsonenergyresearch.com | Larson Energy Research |
| Marshall | Hunt | - | MBH Associates |
| Jon | McHugh | Jon@mchughenergy.com | McHugh Energy |
| Rahul | Athalye | rathalye@noresco.com | NORESCO |
| Erica | DiLello | edilello@noresco.com | NORESCO |

California Energy Commission:

| First Name | Last Name | Email |
|------------|-------------|--|
| Payam | Bozorgchami | Payam.Bozorgchami@energy.ca.gov |
| Thao | Chau | thao.chau@energy.ca.gov |
| Danuta | Drozdownicz | danuta.drozdownicz@energy.ca.gov |
| Larry | Froess | larry.froess@energy.ca.gov |
| Matthew | Haro | matthew.haro@energy.ca.gov |
| Karen | Herter | karen.herter@energy.ca.gov |
| Simon | Lee | Simon.Lee@energy.ca.gov |
| Adrian | Ownby | adrian.ownby@energy.ca.gov |
| Armando | Ramirez | Armando.Ramirez@energy.ca.gov |
| Haile | Bucaneg | haile.bucaneg@energy.ca.gov |
| Cheng | Moua | cheng.moua@energy.ca.gov |
| Mazi | Shirakh | Maziar.Shirakh@energy.ca.gov |
| Danny | Tam | Danny.Tam@energy.ca.gov |

Stakeholder Attendees:

| First Name | Last Name | Affiliation |
|------------|---------------|----------------------------------|
| Shannon | Corcoran | AHRI |
| Laura | Petrillo-Groh | AHRI |
| Tim | Rooney | AO Smith |
| Tasha | Harvey | Arup |
| Peter | Grant | Beyond Efficiency |
| Eric | Truskoski | Bradford White Corporation |
| Nick | Brown | Build Smart Group |
| Jeremy | Wikstrom | CalCERTS |
| Jeanne | Fricot | Center for Sustainable Energy |
| James | Domanski | CLEAResult |
| Tom | Paine | ConSol |
| Henry | Ernst | Daikin |
| Brandon | De Young | De Young Properties |
| Farhang | Beik | DNV GL Energy Services USA, Inc. |

| | | |
|-----------|------------|---------------------------------------|
| Cassandra | Trester | Ei Companies |
| Chase | Maxwell | Ellison Schneider and Harris |
| Meg | Waltner | Energy 350 |
| Sean | Morash | EnerNex LLC |
| George | Nesbitt | Environmental Design / Build |
| Chuck | Thomas | EPRI |
| Torsten | Glidden | Franklin Energy |
| Gina | Rodda | Gabel Energy |
| Robert | Glass | Goodman Mfg. Company |
| John | Hughes | Ingersoll Rand |
| Mark | Lessans | Johnson Controls |
| David | Stephens | Johnson Controls |
| Christoph | Gehbauer | Lawrence Berkeley National Laboratory |
| Eleanor | Lee | Lawrence Berkeley National Laboratory |
| David | Winningham | Lennox International |
| Michael | Jouaneh | Lutron Electronics Co., Inc. |
| Bruce | Severance | Mitshubishi Electric |
| Arielle | Usher | |
| Ellen | Franconi | Pacific Northwest National Laboratory |
| Abram | Conant | Proctor Engineering Group, Ltd. |
| Peter | Schwartz | PSA |
| Vrushali | Mendon | Resource Refocus LLC |
| Diane | Jakobs | Rheem |
| Joe | Boros | Rheem Manufacturing Company |
| Jon | Gribble | Small Seeds |
| Courtney | Bonas | Stok |
| Nehemiah | Stone | Stone Energy Associates |
| Suzanne | Leta | SunPower |
| zheng | o'neill | Texas A&M University |
| Brendan | McGovern | Trane |
| Cathy | Chappell | TRC |
| Wayne | Alldredge | VCA Green |

Meeting Resources

1. [Agenda](#)
2. [Presentation Slides](#)
3. Submeasure Summaries
 - a. [Single Family Home Energy Management Systems and Smart Thermostats](#)
 - b. [Single Family Battery Storage Systems](#)
 - c. [Single Family HPHW Load-shifting](#)
 - d. [Single Family HVAC Load-shifting](#)

Meeting Notes

1.1 CASE Presentation I: Single Family Grid Integration

1.1.1 Home Energy Management Systems and Smart Thermostats (Bob Hendron and Kristin Heinemeier, Frontier Energy)

1. David Stephens (Johnson Controls): Are the cost models used to generate the analysis results available for review?
 - a. Marc Hoeschele (Frontier Energy): As compliance options, there is no requirement for cost effectiveness, but the various submeasures will have some discussion of costs in the draft CASE reports coming soon.
2. David Winningham (Lennox International): As this is targeted for 2022, the current ENERGY STAR® Smart Home Energy Management System specification (SHEMS) requires an ENERGY STAR Communicating Thermostat which is focused on Single Capacity HVAC products. While there is ongoing discussion with EPA to incorporate Thermostats that are focused on Staged and Variable Capacity products. These products tend to be more efficient and also allow enhanced demand response (DR) capabilities.
 - a. Bob Hendron (Frontier Energy): Thank you for that insight. We will look into the thermostat component of SHEMS (smart home energy management systems) in our stakeholder discussion.
3. John Hughes (Ingersoll Rand): What is the certification for AEET (Advanced Energy Efficiency Thermostats)?
 - a. Bob Hendron (Frontier Energy): I believe it is ENERGY STAR.
4. George Nesbitt (Environmental Design/Build): The market will eclipse the code long before the energy code is in effect in 2023. Did anyone invite: SkyCentrics, OhmConnect, WattSaver, EcoBee, etc. to this meeting?
 - a. Bob Hendron (Frontier Energy): Our hope is to at least begin setting some minimum criteria and acknowledge the emergence of HEMS in this cycle.
5. David Winningham (Lennox International): Run time may be a good measure for single stage products but not for Variable Capacity products. Variable capacity products adjust to more efficient operation with extended run times to improve overall efficiency and consumer comfort.
 - a. Kristin Heinemeier (Frontier Energy): This is a great point. This is why we did not want to just give a large amount of points for ENERGY STAR at this point. As variable

- capacity becomes a larger part of the market this will be important to address. We want to keep a tie to ENERGY STAR since there is a lot that goes into those efforts.
- b. George Nesbitt (Environmental Design/Build): The problem is you will shut down many possibilities.
6. Chase Maxwell (Ellison Schneider and Harris): Can you explain more about the climate zone application in California?
 - a. Kristin Heinemeier (Frontier Energy): The HEMS Submeasure Summary document describes mapping from ENERGY STAR climate zones to California climate zones. Let me know if you have additional questions!
 7. Ellen Franconi (Pacific Northwest National Laboratory): Also, what the percent run time reduction for heating and cooling is based on... is it a standard test based on a grid signal?
 - a. Bruce Severance (Mitsubishi Electric): How will the percentage of run time reduction treat VCHPs that operate at fractions of total capacity?
 - b. Kristin Heinemeier (Frontier Energy): The percent run time is the result of a field test where the thermostat is capturing performance data. Runtime is a function of many different things, like occupancy sensing, learning algorithms, setbacks, etc. It encapsulates a range of different impacts and leads directly to energy savings. Manufacturers have this data on run time and can compare that to standard vs smart thermostats. I think this is a good direction to continue to evaluate.
 8. Michael Jouaneh (Lutron Electronics Co., Inc.): If we change Joint Appendix 5 (JA5), would that impact Section 110.12 too? JA5 thermostats are used on nonresidential too so just want to understand if this would impact nonresidential too.
 - a. Kristin Heinemeier (Frontier Energy): Yes, we do intend that this change in nomenclature would apply to nonresidential. (No nonresidential requirements would be changed based on this measure).
 9. George Nesbitt (Environmental Design/Build): We know that communicating thermostats can be used to shift use. The most important function would be to turn the fan off when turning off a heater or air conditioner (AC).
 10. Bob Hendron (Frontier Energy): When a credit is provided, in the future we might want to provide a sliding scale for home energy systems. More complex systems with greater capabilities would be given greater credits.
 11. David Winningham (Lennox International): There is a meeting next week with the U.S. Environmental Protection Agency (EPA) to discuss the ENERGY STAR thermostat criteria going forward particularly for Variable Capacity products. Meeting may be moved out due to current situation but there is an effort to review and potentially expand the criteria. And agree AHRI Standard 1380 should be a key element for Variable Capacity Communicating Products.
 12. George Nesbitt (Environmental Design/Build): For some things the code is better at standardizing on standards that are set.

1.1.2 Battery Storage Systems (David Zhang, Energy Solutions)

1. Wayne Alldredge (VCA Green): What technologies/chemistries will be eliminated by moving to 85 percent?
 - a. Garrett Hedberg (Energy Solutions): David is currently outlining lithium ion (Li-Ion) but we are exploring options of how to classify other storage technologies.

- b. David Zhang (Energy Solutions): We do acknowledge that certain technologies might be limited. We have looked at a market survey of current technologies, and all meet that 85 percent requirement. We are continuing stakeholder outreach and discussing new battery chemistries that could penetrate the market with researchers within the timeframe of this code. We appreciate any material you could provide on potential new technologies. We are looking at 85 percent because the 2020 self-generating incentive program recently put in that requirement for residential applications. Based on their analysis, 85 percent results in reduced GHG emissions.
 - c. Wayne Alldredge (VCA Green): If all chemistries are still in play, then it is a moot point. Go with 85 percent.
 - d. Wayne Alldredge (VCA Green): It is important to keep Lead Acid based chemistries in play because not all buildings will be able to install Li-Ion based chemistries due to insurance or fire suppression requirements. That is really my point.
 - i. Wayne Alldredge (VCA Green): Li-On will require fire suppression according to National Fire Protection Association (NFPA) proposals. That cost needs to be included into the calculation.
 - e. David Zhang (Energy Solutions): We will dig into this. There are requirements in Joint Appendix 12 (JA12) around battery safety, which are referenced for storage systems. We would like to follow up with you on safety and a few other comments that you have had. We are not proposing any new safety requirements within JA12, there are many national and international requirements that we plan to reference within Title 24, Part 6 as applicable.
2. George Nesbitt (Environmental Design/Build): How accessible is the data for meeting this requirement? Real world battery efficiency is dependent on charge / discharge rates from my understanding.
 - a. Garrett Hedberg (Energy Solutions): George are you asking about data for the Round-Trip-Efficiency (RTE) requirement?
 - b. David Zhang (Energy Solutions): We are working with the Energy Commission on standard round-trip efficiency requirements.
 - c. Garrett Hedberg (Energy Solutions): There are also details of verification in the upcoming Draft CASE Report.
 3. Bruce Severance (Mitsubishi Electric): Is there any research translating energy and time dependent valuation (TDV) savings into return-on-investment for the homeowner over 15- to 20-year term?
 4. Robert Glass: If all current suppliers currently meet the new 85 percent requirements - how are there any savings due to adding these regulations?
 - a. Garrett Hedberg (Energy Solutions): The savings analysis was conducted based on the current 80 percent requirement vs the proposed 85 percent.
 5. Tom Paine (ConSol): Prices are not declining because the products are not widely available. How well do we understand the long-term availability of SGIP (self-generation incentive program)?
 6. George Nesbitt (Environmental Design/Build): The "public safety power shut offs" have been great advertising for battery systems.
 7. Bruce Severance (Mitsubishi Electric): Do the carbon reduction projections include the high carbon footprint of manufacturing and shipping battery components and recycling? It is my

understanding there is no method to recapture the most valuable elements of Li-Ion batteries, and they are very hard to disassemble.

8. **Poll: Should Title 24 include standalone batteries that are grid charged as a compliance option?**
 - a. Wayne Alldredge (VCA Green): Grid harmonization should be a requirement to approve any battery only installations.
 - b. Suzanne Leta (Sunpower): My answer would be no.
 - c. Mazi Shirakh (California Energy Commission): My answer would be yes, trying to figure out how to update.
 - d. George Nesbitt (Environmental Design/Build): SMUD's "community solar" does not include storage option, so the code should allow it.
9. Tom Paine (ConSol): Prices are not declining because the products are not widely available
10. George Nesbitt (Environmental Design/Build): The "public safety power shut offs" have been great advertising for battery systems
11. Tom Paine (ConSol): How well do we understand the long-term availability of SGIP?
12. Bruce Severance (Mitsubishi Electric): Do the carbon reduction projections include the high carbon footprint of manufacturing and shipping battery components and recycling? It is my understanding there is no method to recapture the most valuable elements of Lion batteries, and they are very hard to disassemble.
13. Garrett Hedberg (Energy Solutions): @Bruce going back to the TDV and ROI (return-on-investment) question. Our current analysis looked at TDV savings over a year, but we are planning on translating that to a customer's ROI. Projecting out to 15-20 years will also be included. The study is the 2017 SGIP Advanced Energy Storage Impact Evaluation.
14. Cassandra Trester (Ei Companies): Why only a 5kW battery? These are not readily available more popular is the 9.8kW.
 - a. Garrett Hedberg (Energy Solutions): That is the current minimum requirement for compliance in JA12.
15. **Poll: Would battery storage readiness requirements be beneficial for builders and contractors?**
16. Tom Paine (ConSol): Storage readiness adds too much up front cost. People that will be able to afford batteries in the future will be able to afford the electrical work.
17. George Nesbitt (Environmental Design/Build): Title 24, Part 6 currently requires a 7.5kW battery system as min, is the 5kW reducing the min?
 - a. Gina Rodda: George: You need 7.5 to reduce PV (photovoltaic) kW requirements, 5 kWh allows for building efficiency tradeoffs.
 - b. David Zhang (Energy Solutions): This is correct, but not the same as trading off for the solar requirement. We have not proposed any changes to the 5 kWh trade off.
18. Wayne Alldredge (VCA Green): "Space" near the panel will need to be 3 feet in every direction, plus the size of the battery.
19. George Nesbitt (Environmental Design/Build): The most important "readiness" req is having breaker space available in the main or appropriate sub panel.
20. Tom Paine (ConSol): We have no sense of what future storage adoption rates will be, and storage is not necessary for decarbonization, adding cost to new construction for an unknown potential is premature at best

21. Garrett Hedberg (Energy Solutions): There may be confusion between kW and kWh in the above. As Gina said, the number used was 5 kWh which is the usable capacity outlined in JA12.2.2.
22. Bruce Severance (Mitsubishi Electric): The benefits of battery storage are questionable and adding cost for builders seems unreasonable at this time. As far as HVAC is concerned, it would be better to reduce building leakage to 2ACH50 (\$500 cost) and requiring slab insulation in all climate zones (\$3/sf)
 - a. Wayne Alldredge (VCA Green): Cannot disagree with Bruce. Insulation is our friend
23. Mazi Shirakh (California Energy Commission): We do not think battery readiness adds much to the cost of the home.
24. Bruce Severance (Mitsubishi Electric): Thermal mass modulates temperature variations and would be a reliable means to load shift with HVAC. There are no long-term lifecycle costs to such measures as there are with battery replacement. I have been looking at cost effectiveness relative to EDR (energy design rating) in CBECC (California Building Energy Code Compliance Software) and improved shells with R60 attic insulation is cost effective in all climate zones except 7,8, and 15, and allows elimination of battery storage as a more cost-effective solution except Climate Zone 7,8 and 15.
 - a. Danny Tam (California Energy Commission): Bruce I think you might be confusing with the demand flexibility credit and the actual battery benefit.
 - b. Bruce Severance (Mitsubishi Electric): Is there any consideration for lower carbon batteries such as nickel zinc?
 - c. Mazi Shirakh (California Energy Commission): Many people are arguing the RTE should be dropped to 70 percent.
 - d. Danny Tam (California Energy Commission): There are really not much gain left in envelope, most of the kWh in the building comes from plug load now, which only battery storage can make an impact
 - e. Garrett Hedberg (Energy Solutions): Bruce this covers what David mentioned previously but yes, we would like to consider other chemistries and it would be helpful to check in after this meeting about the RTE requirement and market of other battery technologies.
 - f. Mazi Shirakh (California Energy Commission): Battery storage has the most EDR impact of any measures because it impacts all loads including plug loads.
25. Bruce Severance (Mitsubishi Electric): There is no air leakage standard, and CBECC does not allow full slab insulation to be modeled, so passive standards cannot even be evaluated in CBECC. No studies have been conducted on heat loss to ground, but anecdotal evidence for passive design is extensive.
26. George Nesbitt (Environmental Design/Build): Battery Storage ideally can have the use case / schedules updated remotely to support the grid as needed and when needed, as the needs will change with time.
27. Danny Tam (California Energy Commission): Even if you take the space heating, cooling and water heating load to zero, you are nowhere close to zero EDR because of plug loads.
28. Karen Herter (California Energy Commission): Can the utility change the default discharge time remotely? Or once the battery is installed only the customer can change it?
 - a. Mazi Shirakh (California Energy Commission): Karen, the utility can change the settings remotely.

- b. David Zhang (Energy Solutions): The utility cannot change the default discharge time remotely. Certain battery manufacturers allow a customer to change the discharge / charge times.
 - c. Mazi Shirakh (California Energy Commission): JA12 requires batteries to have the remote capability for changing setpoints. Need to discuss this.
29. Bruce Severance (Mitsubishi Electric): I built a zero-energy home in 2015 that has high thermal mass and is fully monitored, with less than 1/10 of the average HVAC loads. Even moderate thermal mass can replace the function of batteries if HVAC drives peak demand at the head of the duck.
- a. David Zhang (Energy Solutions): Thanks for the comment, the grid integration team is also looking into HVAC load shifting with respect to grid integration.
30. Wayne Alldredge (VCA Green): Just want to reiterate, it will be important to keep multiple battery chemistries available because applications vary.
- a. David Zhang (Energy Solutions): This is something we are looking at. We have come across a variety of reports that show batteries that might be safer, more recyclable, have longer lifetimes. They have not penetrated the residential storage market in the past few years, but we are keeping a look out as this might change.
31. Mazi Shirakh (California Energy Commission): There is discussion on what the roundtrip efficiency is. In reality, this does not matter too much as this is a compliance option. That means that if a battery performs better than 85 percent, it would get a slight credit. If a battery does not perform as well it would get a slight penalty. The relative credit does not change, only based on the benchmark. What we set as the roundtrip efficiency does not really change the credit that the battery will get.
- a. Wayne Alldredge (VCA Green): It might not matter at the credit, but it does matter whether it can get installed at a location. Anything with lithium is classified as a lithium ion – even nonflammable batteries are classified as flammable batteries. There are limitations there when it comes to insurance policies. It may not matter overall credit-wise, but getting more batteries installed that harmonize with the grid could be limited.
 - b. David Zhang (Energy Solutions): We will follow up after this call to get clarity on the different standards out there and the impact that 85 percent efficiency would have.
 - c. Joshua Rasin (SMUD): Mazi, Fed and T20 appliance standards can address plug loads, in addition to Energy Star, consumer messaging/education, and price signals from utility rates and programs.
32. Joshua Rasin (SMUD): Do GIWH receive compliance credit for storage? They are more efficient.
33. Simon Lee (California Energy Commission): About the space/location for battery system, electrical code has some requirements for the ventilation and working clearance around it (Article 706).

1.1.3 HPHW Load-Shifting (Marc Hoeschele, Ben Larson)

1. George Nesbitt (Environmental Design/Build): I think the most important feature we can have is flexibility, the ability to change all operating conditions, remotely, either through the utility or through the device manufacture, through a 3rd party
2. George Nesbitt (Environmental Design/Build): Of course, if devices do not have communication capabilities built in or easily added, then none of this matters.

3. David Winningham (Lennox International): Is CTA-2045 the only acceptable communication protocol?
 - a. Ben Larson (Larson Energy Research): No. Other protocols are also acceptable. CTA-2045 support is a minimum.
 - b. David Winningham (Lennox International): OpenADR?
 - c. Ben Larson (Larson Energy Research): CTA-2045 also enables other communications protocols like OpenADR.
 - d. Ben Larson (Larson Energy Research): The CTA-2045 requirement is at the water heater enabling communication pathways to the water heater and translating commands to a standardized language for the water heater to understand. You could then send the request to the water heater, from the utility, via OpenADR.
 - e. George Nesbitt (Environmental Design/Build): OpenADR is one path, but too expensive for residential, maybe ok on large MF projects with central systems.
 - f. David Winningham (Lennox International): While I recognize CTA-2045 is being used for Water Heaters other protocols such as OpenADR may have advantages of not requiring a port and can be directly integrated. Do not know that OpenADR is more expensive.
4. George Nesbitt (Environmental Design/Build): As the grid changes, and since issues are also local, we need to not lock in every schedule, every use case, in the Title 24, Part 6 code. All water heaters, electric or HPWH (heat pump water heater) need to have communication capabilities.
 - a. Nehemiah Stone (Stone Energy Associates): George, that would take a change to federal appliance standards.
 - b. Ben Larson (Larson Energy Research): CTA-2045 also has its own communications path (utility-water heater) that can be used.
 - c. Joshua Rasin (SMUD): To George's point, a default ability to read/respond to a price schedule would be more valuable locally than a default TOU (time of use) schedule for the entire state. Granted that requires communication, which would still require a failsafe operation mode in case of lack of communication.
 - d. Marc Hoeschele (Frontier Energy): OpenADR would be compatible with the CTA-2045 communications interface
 - e. Joshua Rasin (SMUD): Nehemiah, requiring communication in water heaters to receive a compliance credit is not out of the question.
 - f. George Nesbitt (Environmental Design/Build): I believe that OpenADR requires a server at the site.
 - g. Joshua Rasin (SMUD): OpenADR is accessible by most Utilities in California today. CTA-2045 would require additional investments. OpenADR does not require server onsite, for the Virtual End Node (VEN).
 - h. George Nesbitt (Environmental Design/Build): Title 24 and Title 20 need to require all equipment (water heater, furnace, AC, PV, Batter, EV at a minimum) to be able to communicate and change its use.
 - i. Marc Hoeschele (Frontier Energy): The costs for the communications interface are low and the WA state legislation is driving the process for implementation in 2021. The per unit costs are on the order of \$5/unit, or less in volume.

- j. George Nesbitt (Environmental Design/Build): A CTA-2045 port is a \$1.00 add. The CTA Communication device is \$50 or more. The cost to add control to a piece of equipment after the fact? who knows, and probably will not allow as much control.
 - k. Karen Herter (California Energy Commission): So, then Utility -> OpenADR -> \$50 module -> CTA-2045 -> water heater.
 - l. Joshua Rasin (SMUD): <https://store.skycentrics.com/dc-usnap-cta-2045-wi-fi-module-used-to-be-cea-2045/> - \$80 for a DC CTA-2045 module. However, I hear AC (air conditioning) is more commonly required for power requirements, and those are \$180 on Skycentrics website.
 - m. George Nesbitt (Environmental Design/Build): SkyCentrics requires a \$150 and up central communication device, and then the individual equipment devices (they also have indoor air quality monitoring)
 - n. David Winningham (Lennox International): Comments are more related to HVAC, but OpenADR can be readily implemented without additional hardware and eliminate the need for the CTA port. There are also other issues related to physical ports. and authentication.
 - o. George Nesbitt (Environmental Design/Build): OpenADR is site to site communication, how the site communicates out to the equipment can vary (my understanding). It is important that the manufactures do not prevent customers from using other control systems. A "universal port" allows more flexibility in how to get the signals. the equipment needs to have the ability to be fully controlled. Some Mitsubishi mini splits have the CTA-2045 ports already. Market volume will also bring prices down.
 - p. Chuck Thomas (EPRI): OpenADR to CTA-2045 can run on a Raspberry PI Zero W that can fit in the AC form Factor enclosure dimensions. Source code for OpenADR 2.0 VEN and CTA-2045 UCM can be found on Github. Cost of modules in the marketplace are based on volume.
5. Nehemiah Stone (Stone Energy Associates): In regard to slide 3, in current EPIC research we have found that it is easier to make a HPWH act as a thermal battery if it is 80 gallons, instead of 50 gallons. did you also look at increasing tank size to 80 gallons?
- a. Peter Grant (Beyond Efficiency): Did I hear correctly that this work focused on 50 gal HPWHs? Are there plans to study the impact with larger storage tanks? More volume = more stored energy, less load needed during the peak
 - b. Jon McHugh (MEC): An add on device like DR control is not federally preempted even as a prescriptive requirement, e.g. the water heater blanket of times past. Cheaper for the manufacturer to add it but not a requirement of manufacture.
 - c. Marc Hoeschele (Frontier Energy): We have not looked at 80 gallon yet. Will have to see how the algorithms are implemented. Presumably a larger water heater would get a larger credit.
6. Nehemiah Stone (Stone Energy Associates): Mark, what kind of coordination are you having with the multifamily domestic hot water team, in terms of the potential for implementing the control strategies into CBECC-Com?
- a. Marc Hoeschele (Frontier Energy): We have been coordinating with Kitty Wang of Energy Solutions who is leading the Non-res Grid Integration effort.
7. **Poll: Do you have any concerns in proposing a modification to JA13 for 2022 that would require the CTA-2045 communications interface?**

- a. Suzanne Leta (Sunpower): Is the expectation that there will be a credit provided with the installation of these systems?
 - b. Ben Larson (Larson Energy Research): Yes, and the form that this credit takes is still in the works pending completion of work in CBECC Res and the adoption of the proposed draft JA13.
8. Jon McHugh (MEC): Josh I like the idea of default TOU schedule. What would be default control? One example might be: Hybrid mode to standard setpoint all hours and during off-peak elevate setpoint but lock-out resistance heating to achieve elevated setpoint but allow hybrid control if tank temperature drops below standard setpoint?
- a. Karen Herter (California Energy Commission): Default TOU schedule should be an hourly schedule that can be changed by the utility remotely. TOU is no longer granular enough. Eventually, hourly will not be granular enough.
 - b. Ben Larson (Larson Energy Research): The idea is that the schedule would be utility-specific, depending where the water heater is installed. Preloading that gives a basic load-shifting schedule that you can fall back on to in case grid connectivity is lost. More can be done if you are always connected to the grid.
 - c. Joshua Rasin (SMUD): Karen and Jon, I agree hourly scheduling is a better description for what I meant by TOU.
 - d. Joshua Rasin (SMUD): Jon sure, that is a reasonable scenario.
9. Karen Herter (California Energy Commission): Default response to hourly prices can be determined by the manufacturer and modified by the customer as appropriate.
- a. George Nesbitt (Environmental Design/Build): The default schedule should be for the local utility.
 - b. Danny Tam (California Energy Commission): Karen that sounds more like the Advanced load up option. The default TOU is meant for customer who does not want to sign up for a utility program
 - c. Jon McHugh (MEC): Karen, I was referring to a default back-up TOU schedule that is strictly time based in the eventuality that communication is lost or never set up.
- 10. Poll: Should HERS verifications be required for verifying HPWH is in Advanced Load Up mode as well as that the proper TOU rate is active?**
- a. George Nesbitt (Environmental Design/Build): HERS Verification should be required.
 - b. Gina Rodda: Would the utility rate even be available at the time of HERS verification? My concern is causing issues with construction schedule
 - c. George Nesbitt (Environmental Design/Build): The credit should only be available if you connect the device, not just having the capability.
11. George Nesbitt (Environmental Design/Build): I want to say that the longer we install equipment that cannot be controlled, the more opportunity we have missed out on. Once equipment is installed, it will not be replaced for 10 to even 50 years.
12. George Nesbitt (Environmental Design/Build): If the water heater is connected to a utility it should be programmed by the utility (indirectly). If it is not connected to a utility it needs to have a default schedule, set by the manufacture? Or set by the installer, harder to make it right (for the customer or society).
- a. Marc Hoeschele (Frontier Energy): George- a lot of this is evolving.
 - b. Ben Larson (Larson Energy Research): George and Gina - There is a working group around JA13, figuring out how to get TOU schedules on the water heater at time of

install. It is definitely tricky, as you imagine. Again, the TOU control is designed as a backstop. It is the very minimum. Ideally, we get full grid connectivity to respond to changing conditions over days, weeks, and years.

1.1.4 HVAC Load-Shifting (Kristin Heinemeier)

1. David Winningham (Lennox International): Does the study based on single stage products only? Or did it include Variable Capacity products?
 - a. Marc Hoeschele (Frontier Energy): Yes, it would apply for both
2. Eleanor Lee: General question for load shifting strategies: For optimization studies and cost analysis, climate zone is considered but what occupant profile (e.g., working family vs retired) is being used in the analysis? How will the customer determine which strategy is best for their typical load profile?
 - a. Bob Hendron (Frontier Energy): I think just the standard Alternative Calculation Method (ACM) Reference Manual/ California Building Energy Code Compliance for Nonresidential Buildings Software occupant profiles. You are correct that work is needed to provide guidance to homeowners if they want to establish their own schedules.
 - b. Marc Hoeschele (Frontier Energy): Eleanor- the compliance software has assumed water heating load profiles and HVAC thermostat assumptions. Domestic hot water assumptions have a fair amount of diversity embedded. In reality, occupant specific profile variations are significant, and occupants must learn how to best fit their profiles with the TOU rates they are under.
3. George Nesbitt (Environmental Design/Build): With the rush to electrification and heat pumps (heating and cooling) space conditioning, we need to look at the heating schedules and "preheating." Did you look at different schedule possibilities?
 - a. Bob Hendron (Frontier Energy): We considered pre-heating early on but did not perform analysis.
4. George Nesbitt (Environmental Design/Build): Why did Climate Zone 12 not perform? though it was a "cooling" climate.
 - a. Marc Hoeschele (Frontier Energy): Presumably because there was excessive pre-cooling on days when it might not have been needed.
 - b. Bill Dakin (Frontier Energy): Climate Zone 12 has a large benefit with ventilation cooling that is assumed in the standard design. Pre-cooling benefit does not look as good as a result. Without ventilation cooling the benefit would look better.
5. David Winningham (Lennox International): For Variable Capacity products a step down of 5 degrees may force the equipment to operate less efficiently. Various products may react differently, but you may force it to its highest capacity and operate less efficiently and increase demand. A stepped/ramp down approach may offer more benefit.
 - a. Bob Hendron (Frontier Energy): Some of the HVAC efficiency effects should be reflected in the analysis. We can raise the ramp down possibility with Kristin in QA. Not sure we looked at variable speed though.
6. Joshua Rasin (SMUD): Many thermostats have the ability to add time periods to a schedule, for example ecobee and Emerson Sensi.
 - a. George Nesbitt (Environmental Design/Build): Your schedule and setpoint choices may have something to do with it, did you, or can you look at other schedules?

- i. Bob Hendron (Frontier Energy): We looked at a range of schedules and used E3 analysis done for a recent EPIC project. Other schedules could be analyzed but there are so many possibilities it is difficult to evaluate them all.
 - b. Mazi Shirakh (California Energy Commission): But it only impacts cooling loads, not the entire load of the house.
 - i. Joshua Rasin (SMUD): @Mazi - cooling loads are still the driver of the grid peak.
 - c. George Nesbitt (Environmental Design/Build): Smart Thermostats could do the scheduling with utility rates. The problem EcoBee has, is the customers do not know what utility rate they are on.
 - i. Joshua Rasin (SMUD): Climate Zone12 should be the SMUD rate, not PG&E, for cooling.
 - ii. George Nesbitt (Environmental Design/Build): I think you are precooling too late.
 - iii. George Nesbitt (Environmental Design/Build): Climate Zone 12 is not just SMUD, it is PG&E and other publicly-owned utilities too
 - iv. Kelly Cunningham: We can look into whether to use a percent split by service area in Climate Zone12, and possibly too large a delta T in set point, the HPWH study had to be very gentle to keep electric resistance from kicking in.
 - v. Karen Herter (California Energy Commission): I agree with George that the precooling schedule could be too late. Why "as late as possible"? The HVAC unit works more efficiently in the morning when the temp outside is cooler. As long as the home is well insulated, there are benefits to a long shallow precool rather than a short deep one.
- 7. Kristin Heinemeier (Frontier Energy): Speeds may need to be different for variable speed equipment. We will look to see if you might want something other than the allowed values.
- 8. Bob Hendron (Frontier Energy): How will homeowners know what their optimal schedule is?
 - a. Kristin Heinemeier (Frontier Energy): This is something that needs to be developed. The manufacturer, installer would then lead this conversation with the client. Within those climate zones there was not a whole lot of difference within the allowable ranges. There is a lot of latitude to generate savings, so long as they keep within the range. Homeowners would not be expected to do this analysis.
- 9. Wayne Alldredge (VCA Green): The key is communication standards. From bi-directional communication, artificial intelligence could be used in the future to determine optimal settings.
- 10. Karen Herter (California Energy Commission): @Josh - can you share SMUD's residential precooling study with the team?
 - a. Joshua Rasin (SMUD): Absolutely.
- 11. George Nesbitt (Environmental Design/Build): TOU and TDV do not fully capture the low(er) emissions of mid-day. TDV is used for the EDR calculations.
 - a. Marc Hoeschele (Frontier Energy): George- draft JA13 states "It will avoid use of electric resistance elements unless user needs cannot be met."
 - b. Ben Larson (Larson Energy Research): George - future HPWH controls, designed specifically for load shifting should avoid the problem of large jumps in set point.

12. Kristin Heinemeier (Frontier Energy): E3 used different TDV values to look at effectiveness. Based on the temperatures and hours that we selected, these values seemed to be beneficial.
13. Suzanne Leta (SunPower): Is there going to be a compliance option? For HVAC load shifting the compliance value is still to-be-determined?
 - a. Bill Dakin (Frontier Energy): The credit for HVAC load shifting is also based on TDV within the compliance software, as well as for HPWH. We are proposing that this stays at 70 percent, but that is still up for discussion with stakeholders.
 - b. Suzanne Leta (SunPower): So, the compliance credit is 30 percent of the full credit, same as under current code.
14. Suzanne Leta (SunPower): What about electric heating?
 - a. Bill Dakin (Frontier Energy): We did have some discussions about this. We have not fully addressed the topic. We decided not to evaluate since there is an issue with how heat pumps are installed, so incorrect installations can result in reduced benefit and improvements. We are not planning to address that in this code cycle.
15. Suzanne Leta (SunPower): With respect to time of use assumption, does that take into account not just peak demand but also ability to pair with operating system?
 - a. Bill Dakin (Frontier Energy): We are looking at impact of PV installation on roof, and impact on net kW with respect to both PV installed system per code and pre-cooling. We did not look at pairing an HVAC system to the PV output and controls.
 - b. Suzanne Leta (SunPower): I think it would be useful to take a look at that. I do not know that you can necessarily control the PV system to pair with the cooling setpoint, but the technology helps understand PV production during different seasons, at different times, with different designs.
 - c. Bill Dakin (Frontier Energy): We should have a discussion offline to follow up on this.
16. Bruce Severance (Mitsubishi Electric): There could be an allowance for product that eliminated strip heat as a standard feature.
 - a. Danny Tam (California Energy Commission): Bruce, such product (Sanden water heater) already gets credit when they are modeled. Using ER to absorb excess renewable is a terrible idea. It is like saying we should drive SUVs to absorb excess oil production.
 - b. George Nesbitt (Environmental Design/Build): I am not suggesting wasting energy, I am suggesting the Heat Pumps have the capacity to "absorb" more excess renewables when needed and use less when needed too.
 - c. Danny Tam (California Energy Commission): There are better mechanism to capture that excess than using elements in HPWH.
17. George Nesbitt (Environmental Design/Build): Electric Resistance (WH or space heating) can absorb a lot more excess renewable energy, 2025 is a long way away.
18. Bruce Severance (Mitsubishi Electric): Are you evaluating the impact of air leakage? Homes would likely not produce favorable pre-cooling results. Do you know what the baseline is? I have talked to well-respected researchers who think that lowering HVAC in CBECC does not really align with the real-world. They think the CBECC modeling is off in that category, which should be considered in cost-effectiveness evaluation across the broader spectrum of climate zones. The CASE Team should think about those possibilities.

- a. Kristin Heinemeier (Frontier Energy): No, we did not look at interactions with these. Different designs could have better pre-cooling results.
 - b. Bill Dakin (Frontier Energy): We appreciate your comments on that
- 19. Wayne Alldredge (VCA Green): Long term, we do not want water heater or HVAC to absorb excess renewable energy. That would be the job of green hydrogen plants and grid storage. Efficiency is king.
 - a. George Nesbitt (Environmental Design/Build): That is why we need flexibility and control, so the best use can be had
- 20. Karen Herter (California Energy Commission): SMUD looked at it - <https://www.smud.org/-/media/Documents/Corporate/About-Us/Energy-Research-and-Development/research-smart-thermostat-2015-usability-study.ashx?la=en&hash=0FCAD7E1BE58F0748A1E3996351A2722DB59431F>
 - a. Joshua Rasin (SMUD): I am working on getting it posted (2012 Precooling study).
- 21. Bruce Severance (Mitsubishi Electric): It seems there is a huge opportunity, interfacing with electric vehicles (EV) and having charging ramp up and down given solar output based on grid harmonization. We are focused on buildings here, but overall benefit here could be so much greater given recycling issues, carbon footprint, insurance. All of these life cycle costs are necessary in the EV arena but not the home battery arena. I agree with the comments that we should be looking at alternative battery technologies for home usage, other than lithium ion. We should encourage alternative batteries that might not work for transportation but have better benefits to homeowners. This is an important discussion that I encourage. The Energy Commission could play a pivotal role in facilitating these conversations with battery developers.
 - a. David Zhang (Energy Solutions): I appreciate the content. We have received stakeholder comments about nonstationary batteries being accounted for within Title 24, and I will follow up with the Energy Commission. This market is expected to grow faster than stationary storage over the next decade, so we will keep that in mind.
- 22. George Nesbitt (Environmental Design/Build): if we are throwing away carbon free renewable energy, that is when we need to use it. Electric Resistance allows use to absorb more (faster) if needed, or heat pump when less (slower) is needed. It also allows day to day variation (more today, less tomorrow) and as time passes, allows us to adjust to adjusting needs.
- 23. Bruce Severance (Mitsubishi Electric): I think you said that you evaluated test cases with and without insulated thermal mass. Is this evaluation in modeling only, or with actual data gathered through test case homes? I do not think CBECC models slab insulation, so I do not know how you would reach that conclusion.
 - a. Kristin Heinemeier (Frontier Energy): We did not model anything to do with wall mass, or thermal mass issues. We looked at how exposed the wall slab was and whether or not there was carpeting. That is basically the extent of what can readily be modelled in CBECC. We did not do field work on this. As far as we could tell from the modeling, it did not look like this made a big impact.
 - b. Bruce Severance (Mitsubishi Electric): Some cursory evaluation in software other than CBECC could better evaluate thermal mass impacts. From some experience, having built a zero-energy house myself that uses very high thermal mass rates that are highly insulated, this is capable of load shifting and eliminating 70-90 percent of the

HVAC load. Many Passive House builders express similar results. You are really modulating both heating and cooling quite a bit.

- c. Kristin Heinemeier (Frontier Energy): This makes sense to me.
- d. Bruce Severance (Mitsubishi Electric): I think it would be good to discuss this with experts in the field. There is a group of architects, etc. in the Bay Area that have a lot of expertise that I recommend speaking with.

1.2 Poll Data

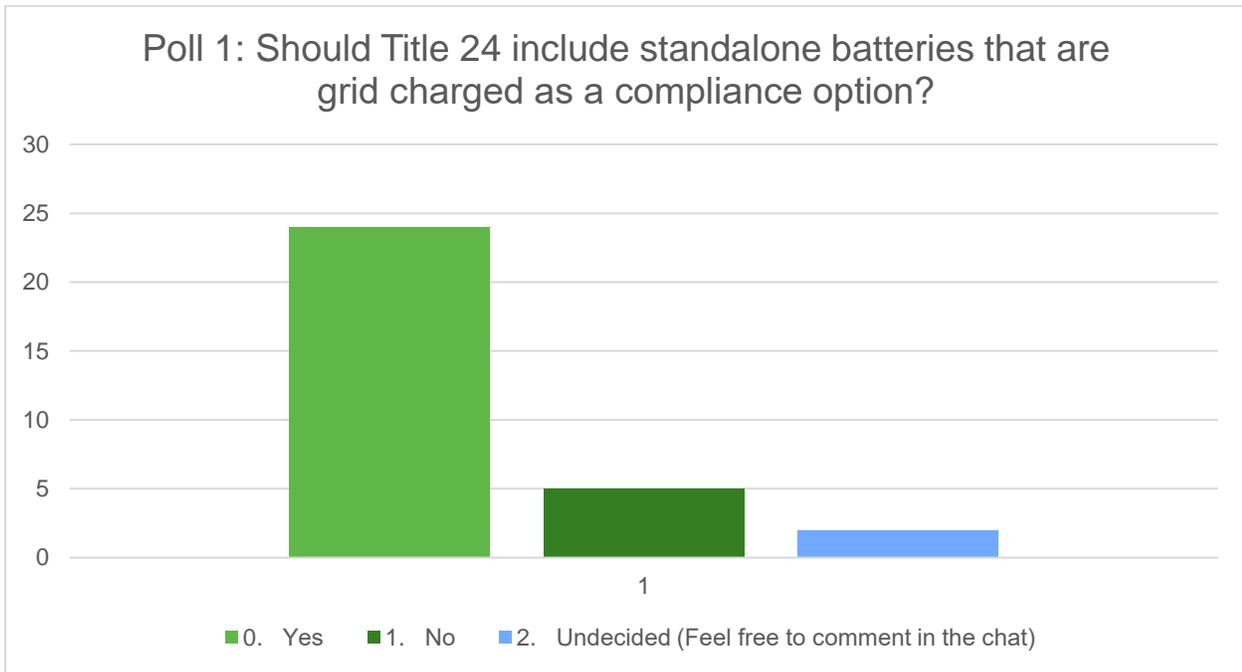


Figure 1: Results of Poll 1, Single Answer

Undecided responses:

- a. David Stephens (Johnson Controls): If the objective / application is to load level consumption, yes.
- b. Chase Maxwell (Ellison Schneider and Harris): If the goal is to flatten the duck curve, it should not matter if it is grid or locally charged.
- c. Diane Jakobs: Not clear that the energy savings are realistic. Not very widespread.
- d. Bruce Severance (Mitsubishi Electric): The lifecycle impacts and ROI to the consumer are highly questionable. Insulated thermal mass would be cheaper and have no maintenance or lifecycle costs.
- e. Joshua Rasin (SMUD): Grid charged would need to have a utility dispatch option to have value to the grid.
- f. Wayne Alldredge (VCA Green): Providing they are "Grid Harmonization" qualified.

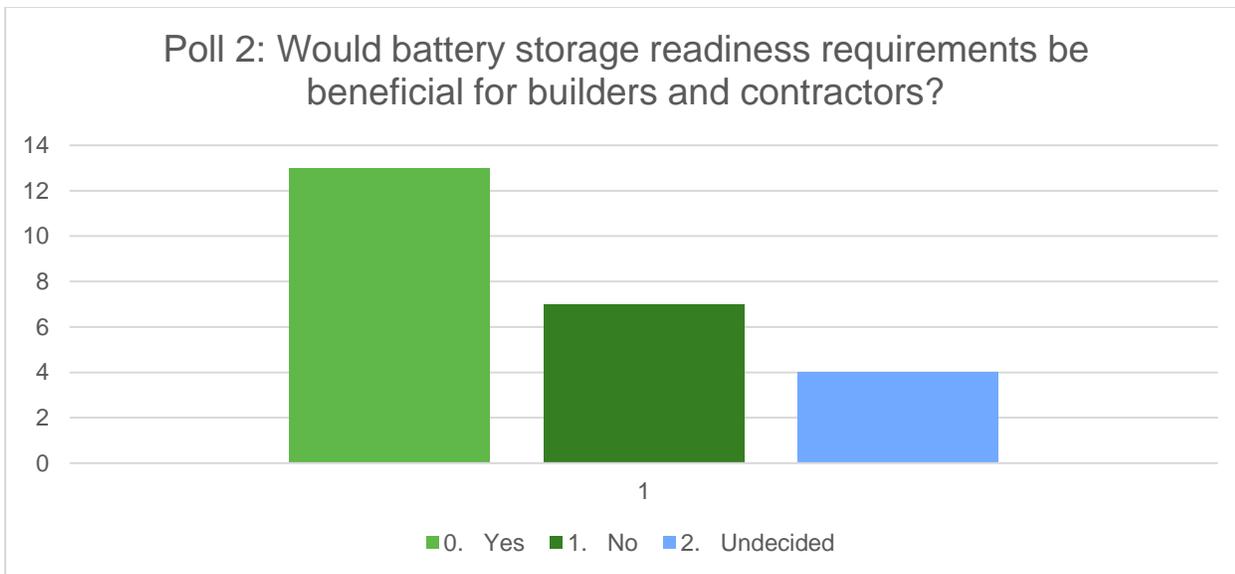


Figure 2: Results of Poll 2, Single Answer

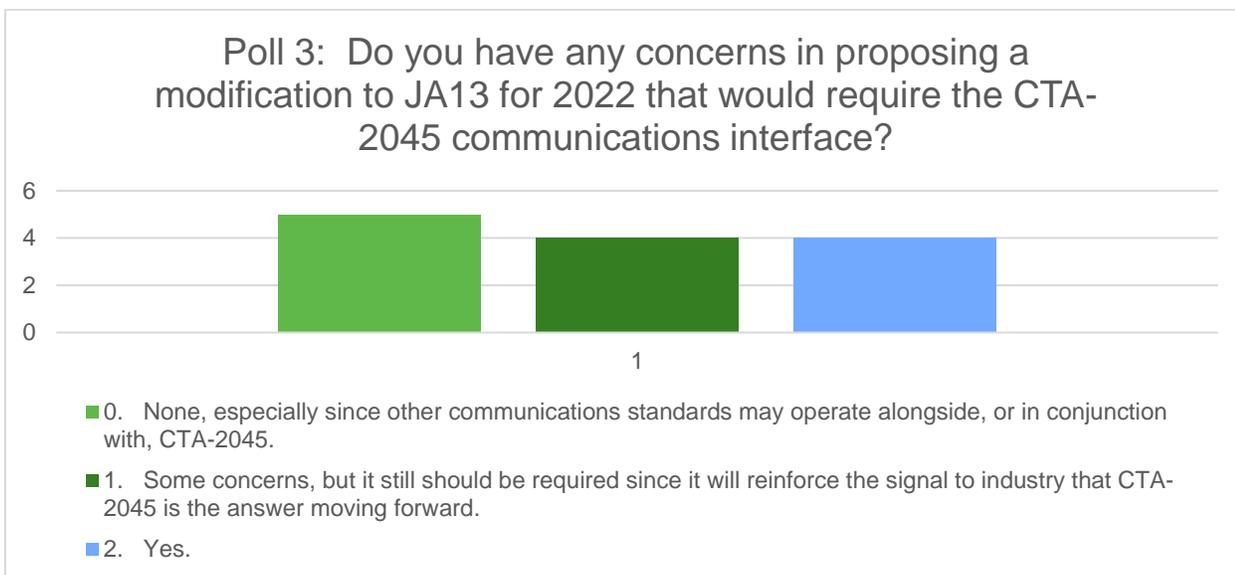


Figure 3: Results of Poll 3, Single Answer

Please share any concerns here:

- g. Joshua Rasin (SMUD): Full cost of CTA-2045, not just at device level, but also up to the utility to unlock dispatch abilities, which become a societal cost. Still a strong market signal to gain adoption.
- h. Cassandra Trester (Ei Companies): After chasing communication interfaces, most are tied to specifically to certain brands etc. Still have not seen readily available options.
- i. Nehemiah Stone (Stone Energy Associates): You need to understand the control logic inside of HP WHs even better than most manufacturers' reps do. We have found that Eco mode, and HP-only mode, are not triggered as the manufacturers' published logis says.

Poll 4: Should HERS verifications be required for verifying HPWH is in Advanced Load Up mode as well as that the proper TOU rate is active?

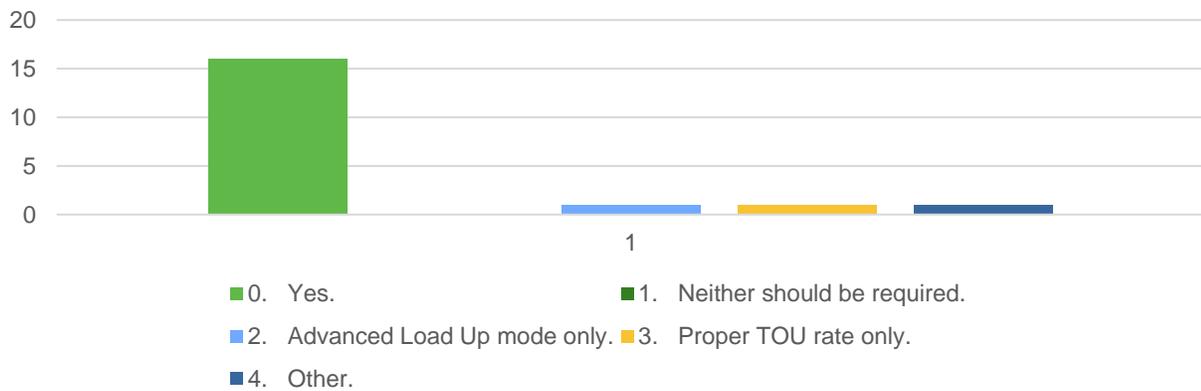


Figure 4: Results of Poll 4, Single Answer