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CA IOU Comments for CEC Low Voltage Thermostats RFI

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November 27, 2024

Efficiency Division, Load Flexibility Branch
California Energy Commission
715 P Street
Sacramento, CA 95814

Topic: Request for Information (RFI) on Potential Flexible Demand Appliance Standards for Low-Voltage Thermostats

Docket Number: 24-FDAS-03
TN Number: 259329

Dear Commission Staff,

This letter comprises the comments of the Pacific Gas and Electric Company (PG&E), San Diego Gas & Electric (SDG&E), and Southern California Edison (SCE), collectively referred to herein as the California Investor-Owned Utilities (CA IOUs), in response to the California Energy Commission Request for Information on Potential Flexible Demand Appliance Standards (FDAS) for Low-Voltage Thermostats.

The CA IOUs comprise some of the largest utility companies in the nation, serving over 32 million customers in the Western U.S. We are committed to helping customers reduce energy costs and consumption while striving to meet their evolving needs and expectations. Therefore, we advocate for standards that accurately reflect the climate and conditions of our respective service areas.

We respectfully submit the following comments to the California Energy Commission (CEC).

The CA IOUs offer general comments regarding flexible demand appliance standards for thermostats.

In 2023, the CEC set a goal of achieving 7,000 megawatts (MW) of flexible demand by 2030 through the smarter use of existing clean energy resources.[1] The CEC's "flexible demand" concept goes beyond traditional demand response programs that typically focus on reducing peak demand and avoiding outages when electric generation capacity is scarce, i.e. load "shed". For example, utilities may call for load shed on very hot summer days when the California Independent System Operator (CAISO) issues a "Flex Alert" or in response to other triggers, like high temperatures, economic factors, or emergency conditions.

The concept of "flexible demand" defined by Senate Bill 49 (2019) and used by the CEC for FDAS is not limited to load "shed" but includes load "shift":

[1] California Energy Commission. "California Adopts Goal to Make More Electricity Available Through Smarter Use." https://www.energy.ca.gov/news/2023-05/california-adopts-goal-make-more-electricity-available-through-smarter-use

> "Flexible demand" means the capability to schedule, **shift**, or curtail the electrical demand of a load-serving entity's customer through direct action by the customer or through action by a third party, the load-serving entity, or a grid balancing authority, with the customer's consent.[2]

The CA IOUs are conducting pilots to test the "shift" concept, which is more complex than typical load "shed" or curtailment. It is particularly complex to quantify the benefits to participating customers for increasing grid reliability. For example, some publicly owned utilities do not currently offer time varying rates; therefore, there is no customer bill-saving benefit for "shifting" their electricity consumption behaviors. For these customers, load shift would have to be incentivized via a different mechanism. Additionally, on some distribution circuits, peak hours may not coincide with CAISO's peak hours. Statewide or regional price or greenhouse gas signals may not capture these local capacity constraints, so responding to only these signals without considering distribution circuit specific capacity conditions may inadvertently challenge distribution circuit reliability.

Demand flexibility will be critical to achieving California's carbon neutrality goal by 2045. Heating, ventilation and air conditioning (HVAC) systems can be a significant source of flexible demand resources to California throughout the year, not just on a few hot summer days. Therefore, when considering FDAS for thermostats, the CEC should carefully consider various aspects of the flexible demand goal – enhancing grid reliability (including on distribution circuits), making electricity bills more affordable, reducing the curtailment of renewable energy and greenhouse gas (GHG) emissions, enabling widespread electrification, and empowering customer participation.[3]

1. **Staff is considering the appliances in Table 1 as a baseline for the low-voltage thermostat rulemaking scope. Are there additional examples that might be considered in-scope or out-of-scope?**

Table 1: Examples of In and Out-of-Scope Low-voltage Thermostats

In-Scope Devices	Out-of-Scope Devices
▪ Low-voltage thermostats ▪ Low-voltage thermostats that are part of other systems including security systems	▪ Line voltage thermostats ▪ Millivolt thermostats ▪ Building management system temperature controls ▪ Standalone temperature sensors ▪ User interfaces without low voltage interface to equipment

Source: California Energy Commission

Figure 1. RFI Table 1: In- and Out-of-Scope Thermostats

The CA IOUs recommend that the CEC consider including line voltage thermostats as in-scope devices, including manufacturer proprietary thermostats that come paired with HVAC equipment. We have previously suggested that the United States (U.S.) Environmental Protection Agency (EPA) include line voltage thermostats in the ENERGY STAR® Smart Thermostat Products Draft 1 Version 2.0 Specification scope.[4] Prior CA IOU team analysis suggests that between 9.7% and 12.3% of California's multifamily

[2] Senate Bill 49 (2019) and 20 CCR § 1691 (a).
[3] California Public Utilities Commission. "CPUC Sets Stage to Enable Widespread Demand Flexibility." https://www.cpuc.ca.gov/news-and-updates/all-news/cpuc-sets-stage-to-enable-widespread-demand-flexibility
[4] CA IOUs, *Comments on ENERGY STAR® Smart Thermostat Products Draft 1 Version 2.0 Specification.* (2022), p. 3-4. https://www.energystar.gov/sites/default/files/asset/document/CA%20IOUs%20Joint%20Comments.pdf.

residents use electric resistance heating as their primary heating source; these products are typically controlled by line voltage thermostats.

The CA IOUs also recommend that the CEC provide straightforward definitions for devices listed in Table 1 of the RFI to distinguish between in-scope and out-of-scope devices. For example, the low-voltage thermostat definition should specify a quantitative voltage range, and the definition should differentiate line voltage thermostats from low-voltage thermostats, as both types of devices could operate at low voltages. We present the following definitions for the CEC's consideration, which were either drafted by the CA IOU team or derived from documents issued by other regulatory or standards development bodies.

1. Draft definitions developed by the CA IOU team:
    a. **Low voltage thermostat:** A device used to control room temperature by sending analog signals of not more than 30 volts to heating, ventilation and air conditioning (HVAC) equipment. It must be capable of controlling at least one stage of heating and cooling. It can include the capability to control multiple stages of heating or cooling, a fan, emergency heating, and to change between heating and cooling modes. The device is intended for use with any HVAC equipment that accepts analog signals.
    b. Proprietary thermostatic controller: A device used to control room temperature by sending digital signals to heating, ventilation and air conditioning (HVAC) equipment. It uses a communication protocol designed to work exclusively with HVAC equipment specified by the manufacturer. Devices using open protocols, such as BACnet, LON, and Modbus, do not meet this definition, as they can be used with any equipment that accepts the protocol.
2. Definitions proposed in EPA's ENERGY STAR Draft 1 Version 2.0 Specification on Smart Thermostat Products:[5]
    a. **Low voltage thermostat:** Thermostat that switches load and operates at a nominal voltage <30 V AC.
    b. **Line voltage thermostat:** Thermostat that directly switches a load and has a nominal voltage between 120 and 240 V.
    c. **Wall-mounted line voltage thermostat:** A one-piece line voltage thermostat that is designed to be installed on a wall away from the heating unit and directly controls load-switching and has a nominal voltage between 120 and 240 V.
    d. **Smart thermostat (ST) device:** A device that controls HVAC equipment to regulate the temperature of the room or space in which it is installed and has the ability to communicate with sources external to the HVAC system. For connection, the ST device may rely on a Wi-Fi home area network and an internet connection that is independent of and not part of the ST Device. Where the ST device relies upon other devices that are not reasonably expected to be in the home, e.g., Zigbee gateway, these devices are part of the ST device.

[5] ENERGY STAR Product Specification for Smart Thermostat Products - Draft 1 Version 2.0. https://www.energystar.gov/sites/default/files/asset/document/ENERGY STAR Version 2.0 Smart Thermostat Draft 1 Program Requirements.pdf

e. **Smart thermostat product:** For the purposes of this specification, the ST product includes the ST device in the home with associated firmware, which is assumed to be updated during the time the ST device is used in the home, as well as a ST service supported by hardware and software outside of the home. The ST service would typically provide web and smartphone-based thermostat control.[6]

3. California's 2025 Building Energy Efficiency Standards in Title 24, Part 6[7] defines a "Thermostat" in the following manner that closely aligns with ASHRAE's terminology, except that ASHRAE's definition excludes the phrase "or system."[8]
    a. **Thermostat:** An automatic control device or system used to maintain temperature at a fixed or adjustable setpoint.
4. Natural Resources Canada has proposed the following definition for line voltage thermostats:[9]
    a. **Line-voltage thermostat:** A line voltage thermostat means a thermostat that is an electronic or mechanical regulating device that is intended for line-voltage (120 to 240 V) switching of a controlled resistive heating load. It includes a wall-mounted thermostat used with baseboards, panel convectors, or radiant floors; a built-in thermostat (from 1,000 to 1,500 W) used in baseboards or panel convectors; and two-component thermostats. It does not include thermostats used exclusively for or built into: fan-forced heaters; kick spaces; fireplaces; thermal storage heaters; electric baseboards; convectors incorporating both convection and radiant heating elements; portable heaters; and central heating units under the control of a single thermostat.

The CA IOUs are aware of at least one study on variable-capacity heat pumps (VCHPs) that found that using thermostats not recommended by equipment manufacturers led to more system on-and-off cycling and prevented the full realization of modulation benefits.[10] The CA IOUs recognize that some heating and cooling systems may come with control devices (i.e., thermostats or remote controllers) or be compatible with only certain thermostats. Since using third-party thermostats with variable-capacity systems that generally use communicating control devices may adversely impact space-conditioning performance, any thermostat provisions developed by the CEC should consider the thermostat's performance in conjunction with the system. For instance, the controls verification procedures in Normative Appendix I of AHRI Standards 210/240-2024 and 1600-2024 address the variable-capacity system's performance with its native controls or the manufacturer's approved control device.[11,12] At this stage, the CA IOUs support the consideration of VCHP controllers in this rulemaking.

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[6] See ENERGY STAR Product Specification for Smart Thermostat Products - Draft 1 Version 2.0, Figure 1 for a pictorial representation. Functions in the left-most group must be physically located in the home. Functions in the middle group commonly operate using a combination of hardware that is physically located within the home and services that rely fully or partially on communication with the cloud. The functions on the right typically reside in the cloud.

[7] 2025 Building Energy Efficiency Standards - Section 100.1 - Definitions and Rules of Construction. https://www.energy.ca.gov/filebrowser/download/6636?fid=6636#block-symsoft-page-title

[8] ASHRAE Terminology for "Thermostat." https://terminology.ashrae.org/?term=thermostat

[9] Natural Resources Canada Energy Efficiency Regulations - Line Voltage Thermostats. https://natural-resources.canada.ca/energy-efficiency/energy-efficiency-regulations/line-voltage-thermostats/24427

[10] Bruce Harley Energy Consulting, LLC. *Cycling of variable-speed heat pumps with third-party non-communicating thermostats in heating mode.* https://downloads.regulations.gov/EERE-2022-BT-TP-0028-0009/attachment_2.pdf

[11] AHRI Standard 210/240-2024. *Performance Rating of Unitary Air-conditioning and Air-source Heat Pump Equipment*. https://www.ahrinet.org/system/files/2024-09/AHRI%20Standard%20210%20240-2024%20%28I-P%29%20ICS.pdf

[12] AHRI Standard 1600-2024. *Performance Rating of Unitary Air-conditioning and Air-source Heat Pump Equipment. https://www.ahrinet.org/system/files/2024-05/AHRI%20Standard%201600-2024%20I-P_0.pdf*

2. **Staff is considering the low-voltage thermostat market share from *2019 California Residential Appliance Saturation Study (RASS)* in Table 2 as a baseline for the low-voltage thermostat scope. Are there additional data sources that might be considered?**

Table 2: 2019 RASS Survey Result for Low-voltage Thermostat

2019 RASS Survey Type of Thermostat	2019 RASS Survey Number of thermostats	2019 RASS Survey Percentage of Each
Smart	1,430,449	21%
Programable	3,983,601	57%
Non-programable	1,523,552	22%
OpenADR	0	0%
Total	6,937,602	100%

Source: RASS. 2019 Survey.

Figure 2. RFI Table 2: Thermostat Market Share

Regarding thermostat market share, the CA IOUs note that because the CEC has not proposed or finalized a definition of a flexible demand standard-compliant low-voltage thermostat, it is not possible to determine the stock or market share of FDAS-compliant thermostats in California. The existence of "smart" features, OpenADR compatibility, and/or Wi-Fi communication capability in a thermostat do not mean that the thermostat would be compliant with an eventual thermostat FDAS. Therefore, the information presented here is meant to inform the CEC's research on thermostats with features that may be of interest for a future FDAS, but it does not speak to the existence or market share of thermostats that are fully "demand flexible" under the CEC's FDAS definition.

The CA IOUs appreciate the CEC's estimates in Table 2 of the RFI on low-voltage thermostats and recommend reevaluating these estimates using the information offered in this section. In particular, the CA IOUs estimate that the installed stock of residential smart thermostats in California is between 1.5 and 4 million based on information in the data sources listed below. We did not identify good data sources for non-residential sector market share of smart thermostats; the sources provided below focus on the residential sector:

- Direct estimate from SCE based on responses from thermostat vendors that approximately 1 million residential smart thermostats are installed in its service territory.
- Meier, A., Daken, A., and Rainer, L. *Long-term trends in connected thermostat performance*. (2022).[13]
    - This study states that internet-connected thermostats control 30% of U.S. homes and comprise half of U.S. thermostat sales.
    - Based on 2023 Census Data showing that California has 14,763,237 housing units, and assuming California's connected thermostats are directly proportional to the U.S. share, this would give an estimate of about 4.4 million connected thermostats in California.
- Data on smart thermostats participating in CA IOU residential demand response programs are detailed in the response to question 8. Applying a scaling factor of 10 (based on the ratio of

[13] Meier, A., Daken, A., and Rainer, L. August. *Long-term trends in connected thermostat performance.* (2022). https://buildings.lbl.gov/publications/long-term-trends-connected-thermostat

demand response program enrollment to total installed smart thermostats in SCE's territory) yields an estimate of about 2.5 million smart thermostats in California.

- DNV. *Forward-Looking Smart Thermostat Study.* (2024).[14]
    - This study mentions over 400,000 smart thermostats installed through residential rebate and direct install energy efficiency programs between 2018 and 2021.
    - Deriving an estimate of 100,000 annual sales in California from 2018 to 2021 from programs, this would suggest an estimate of 700,000 smart thermostats by 2024. This is likely to be on the low end of total smart thermostats in California as it does not include non-participants.
    - This report also provides an overview of hourly load and savings shapes from homes that installed smart thermostats and other measures offered through direct install programs, and it is a potential HVAC load shape data source for the CEC to consider for RFI question 3.
- The CA IOUs' review of the 2020 Residential Energy Consumption Survey (RECS) issued by the U.S. Energy Information Administration (EIA) suggests that approximately 1.4 million smart thermostats, 5.9 million programmable thermostats, and 5 million non-programmable thermostats are installed in single-family and multifamily buildings in California.[15] Furthermore, EIA's 2018 Commercial Building Energy Consumption Survey (CBECS) indicates that 26% of commercial buildings use programmable thermostats whereas 5% of such buildings use smart thermostats.[16]

Table 2 of the RFI also claims zero low-voltage thermostats with OpenADR capability. However, the 2019 RASS did not inquire about OpenADR, so it does not provide information on the number of thermostats with this feature. For example, the questions from the 2019 RASS for heating systems, with similar questions for cooling systems, include:[17]

B5 What type of thermostat does your main heating system(s) use? (HTCTLTYP)

1 Smart thermostat *(Can be used with home automation systems and may sense when you are home, e.g., Nest, Lyric, Sensi or Ecobee)*
1 Programmable thermostat *(Can set heater to different temperatures for different times)*
2 Non-programmable thermostat *(Can turn heater on/off and set temperature by hand)*
3 No thermostat *(Simple on/off control or steam valve) (Go to B7.)*

B6 If your main heating system is controlled by a thermostat, what is the average thermostat temperature usually set for each time period during the heating season? *(Choose one answer for each time period. Provide the average setting if it varies.)*

	Off	Below 55°F	55 – 60°F	61 – 65°F	66 – 70°F	71 – 75°F	Over 75°F
Morning *(6am-9am)* (HMRNSET)		1		1	1	1	1
Day *(9am-5pm)* (HDAYSET)	1	1	1	1	1	1	1
Evening *(5pm-9pm)* (HEVNSET)	1	1	1	1	1	1	1
Night *(9pm-6am)* (HNITESET)	1	1	1	1	1	1	1

Figure 3. 2019 RASS Survey Questions Regarding Thermostats

Since the 2019 RASS did not ask about the OpenADR capability, the number of OpenADR compatible products is not zero but merely unspecified. OpenADR has been referenced since the 2013 edition of

[14] DNV. *CALMAC ID: CPU0367.01: CPUC Group A Impact Evaluation - Final Report Forward-Looking Smart Thermostat Study.* (2024). https://www.calmac.org/%5C%5C//publications/CPUC_GroupA_Fwdlooking_Tstat_FinalReport.pdf.

[15] Per a review of RECS 2020 Tables HC7.1 and state-based air-conditioning data. Data is accessible at: https://www.eia.gov/consumption/residential/data/2020/

[16] Per a review of Table B1 of CBECS 2018. Data is accessible at: https://www.eia.gov/consumption/commercial/data/2018/

[17] California Energy Commission. *2019 California Residential Appliance Saturation Survey.* (2021), Appendix A, p. A-8 and A-9. https://www.energy.ca.gov/publications/2021/2019-california-residential-appliance-saturation-study-rass

California's Title 24, Part 6, specifically in Reference Joint Appendix 5 (JA5) on technical specifications for Occupant Controlled Smart Thermostats (OCSTs).[18] Therefore, the RASS dataset should have accounted for the promulgation of such thermostats in California before 2019. The CA IOUs recommend that the CEC consider the impact of provisions previously incorporated into Title 24, Part 6. The effect of such provisions does not seem to be reflected in the 2019 RASS estimates. In 2016, approximately 83% of certified OCSTs reported to the CEC by manufacturers affirmed OpenADR messaging capability.[19] The 2019 edition of Title 24, Part 6 incorporated mandatory requirements for demand-responsive controls, specifically mentioning OpenADR in Section 110.12. Therefore, OpenADR capability is likely present in some percentage of smart thermostats.

3. Staff is considering using hourly HVAC energy use estimates from the Hourly Electric Load Model (HELM). What other HVAC load-shape data sources are currently available?

The CA IOUs recommend that the CEC consider the National Renewable Energy Laboratory's ResStock and ComStock databases as potential data sources for HVAC load shapes. ResStock and ComStock provide web-based dashboards of end-use load shapes by state and downloadable datasets.[20,21]

California's Electronic Technical Reference Manual (eTRM) is another potential source of HVAC load shape data for the CEC to consider.[22] While HELM's end-use energy intensities and schedules are based on the Database for Energy Efficient Resources (DEER) as a resource, the load shapes for eTRM deemed measures are developed using DEER simulation models and measure case consumption load profiles.

The HELM study referenced in the RFI assumes that furnace fans typically operate during heating or cooling modes. The CA IOUs suggest that the CEC also consider furnace fan load shapes in constant circulation mode. The federal test procedure for furnace fans assumes 400 hours as a nationally representative average for furnace fans embedded in single-stage and multi-stage or modulating products.[23]

Additionally, PG&E conducted a Smart Thermostat Control Pilot from 2022 to 2023 with a precursor study in 2021. This pilot focused on daily load shifting with smart thermostats enrolled in the DR program, and it provided an in-depth analysis of hourly load reduction values including load shape images.[24]

4. Staff assumes a 10-year lifetime for a low-voltage thermostat. Are there alternative assumptions for product lifetime that staff should consider? Please reference the sources of those alternative assumptions.

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[18] See Appendix JA5 - Technical Specifications for Occupant Controlled Smart Thermostats (2013). https://energycodeace.com/site/custom/public/reference-ace-2013/index.html#!Documents/ja53functionaldescriptions.htm

[19] See CEC's "2016 List of Occupant Controlled Smart Thermostats." https://www.energy.ca.gov/rules-and-regulations/building-energy-efficiency/manufacturer-certification-building-equipment/ocst

[20] NREL ResStock - Highly granular modeling of the U.S. housing stock. https://resstock.nrel.gov/

[21] NREL ComStock - Highly granular modeling of the U.S. commercial building stock. https://comstock.nrel.gov/

[22] California Electronic Technical Reference Manual (eTRM): https://www.caetrm.com/cpuc/table/electricloadshape/

[23] See Table 2 of Appendix AA to Subpart B of 10 CFR Part 430. https://www.ecfr.gov/current/title-10/chapter-II/subchapter-D/part-430/subpart-B/appendix-Appendix%20AA%20to%20Subpart%20B%20of%20Part%20430

[24] Demand Side Analytics. *CALMAC ID: PGE0498.01: 2022-2023 Load Impact Evaluation of Pacific Gas and Electric's Smart Thermostat Control Pilot.* (2024), p. 42-49. https://www.calmac.org/publications/PY2022-2023_Smart_Thermostat_Control_Pilot_Evaluation_Report_Final_(003).pdf

Based on California-specific sources, the CA IOUs estimate the lifetime for low-voltage thermostats to range between 9.1 and 11 years.[25,26] However, at least one other data source from the EPA suggests 15 years.[27]

5. **Staff has identified a range of typical flexible demand functions associated with low-voltage thermostats. Staff may consider using Joint Appendix JA5 *Technical Specifications for Occupant Controlled Smart Thermostats* as a baseline standard for functions in low-voltage thermostats. Provide a current market share and likely incremental cost of including the following capabilities:**
    a. **Bi-directional communications**
    b. **Hourly scheduling capability**
    c. **Device software optimization for GHG**
    d. **Device software optimization for hourly electricity pricing rates**
    e. **Cybersecurity**

Bi-directional communication and multi-hour scheduling capability are common in smart thermostats, particularly those certified as OCSTs in Joint Appendix 5 and those that comply with demand responsive controls requirements in Title 24, Part 6. While the CA IOUs do not have market share or incremental cost data specific to thermostats with these capabilities, our responses to questions 2 and 6 may assist the CEC with developing estimates.

The CA IOUs note that the flexible demand capabilities for thermostats defined in Senate Bill 49 (2019)—which include the ability to schedule, shift, or curtail the electrical demand of a load-serving entity's customer through direct action by the customer, a third-party, the load-serving entity, or a grid balancing authority, with the customer's consent—are currently implemented to some degree in California utility thermostat demand response programs. These capabilities are carried out via a manufacturer or third-party cloud, communicating with utility-based servers. Several eligible thermostats within these programs can implement schedules based on time-of-use rates; however, they are not responding to hourly pricing or GHG signals nor FlexAlerts from the MIDAS database due to a lack of a value proposition to do so. The CA IOUs expect thermostat manufacturers to develop products that can connect to MIDAS and respond to hourly prices and/or GHG signals as the MIDAS's value proposition grows in California.

The CA IOUs suggest that the CEC consider the relative costs versus benefits of embedding the capabilities listed in RFI question 5 into the thermostat device as opposed to in the manufacturer's cloud service or a third-party cloud service with the manufacturer's application programming interface (API). We support allowing for product intelligence to exist in the cloud rather than on devices and note that it would likely be costly to require intelligence to be located in product hardware or software.

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[25] California's eTRM provides an expected useful life estimate of 9.1 years. Estimate available here: https://www.caetrm.com/measure/SWHC039/08/value-table/377708/

[26] The New York State's Joint Utilities have previously estimated an effective useful life of 11 years for programmable setback, Wi-Fi (communicating), and learning thermostats. The source for this estimate is listed as "DEER 2014 EUL ID: HVAC-ProgTStats." See the following for more information: https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Programs/Home-Energy-Savings/TRM-effective-useful-life-table.pdf

[27] The EPA's calculator estimates 15 years under the "assumptions" tab: https://www.energystar.gov/ia/partners/promotions/cool_change/downloads/CalculatorProgrammableThermostat.xls

The CA IOUs also support the CEC's differentiation between the ability of thermostats to receive (pricing and GHG) signals and software optimization of the thermostat responses to those signals. We note that signals could be transmitted to end-use devices by a variety of entities including, for example, utility distributed energy resource management systems (DERMS), third-party aggregators, MIDAS, or the CAISO and stress that signal responses should be dictated on a local level and not a statewide level, as customer and grid needs vary by region. We suggest the CEC consider flexible options for delivering the desired flexible demand capabilities, whether built into in-scope thermostats, provided through a cloud-based service, or a combination of these options. A flexible regulation of this type would promote market innovation and competition and allow consumers to determine their preferred mode to respond to the signals that best meet local needs. Finally, we urge the CEC to coordinate this effort with the relevant CPUC proceedings that have ordered the CA IOUs to implement IEEE 2030.5 standard-based telemetry for projects sized 1 MW or greater.[28,29] In addition to IEEE 2030.5, the CA IOUs are exploring the capabilities of advanced metering infrastructure (AMI) 2.0, which among other uses would facilitate grid connectivity for HVAC equipment and other distributed energy resources.

6. **Staff estimates the total incremental cost to consumers (the difference in purchase price between a flexible-demand low-voltage thermostat and a non-flexible-demand low-voltage thermostat) to be $25. Staff is seeking input on whether this estimate is reasonable.**

The CA IOUs note that without a specific proposed definition of an FDAS-compliant thermostat, it will not be possible to accurately forecast the incremental cost to consumers of a compliant product compared to a non-compliant product. This incremental cost will depend on product features and complexity. Additionally, if the only compliant products available are those with a premium feature set, there could be additional incremental costs attributable to features that add to user amenity but do not affect demand flexibility (for example, an improved display or user interface).

The CA IOU team reviewed a major retailer's prices for smart thermostats eligible for the SmartFlex Rewards demand response program for PG&E customers[30] (as a proxy for flexible-demand thermostats) and non-eligible thermostats. Table 1 shows the range of prices for selected non-eligible thermostats as of November 2024. These thermostats do not have the ability to communicate using Wi-Fi, which is a key requirement of the program. Prices for non-eligible thermostats range from approximately $30 to $80.

Table 1. Price Summary of Thermostats without Wi-Fi (November 2024)

Manufacturer	Non-Eligible Thermostat	Price†
Emerson	70 Series Classic, Non-Programmable, Single Stage (1H/1C) Thermostat	$28.66
Honeywell	Horizontal Non-Programmable Thermostat	$28.98
Honeywell	1-Week Programmable Thermostat with Digital Display	$29.98
Emerson	70 Series, Non-Programmable, Heat Pump (2H/1C) Thermostat	$43.58
Orbit	Clear Comfort Programmable Thermostat	$43.91
Emerson	80 Series, Non-Programmable, Single Stage (1H/1C) Thermostat	$50.27

[28] California Public Utilities Commission. *Resolution E-5038.* (2021). https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M401/K369/401369674.PDF

[29] IEEE 2030.5 Standard Progress. https://www.qualitylogic.com/knowledge-center/ieee-2030-5-standard-progress/

[30] See eligible devices on the SmartFlex Rewards webpage: https://smartflexrewards.com/eligible-devices

Emerson	70 Series Classic, 5 + 2 Programmable, Single Stage (1H/1C) Thermostat	$50.43
Honeywell	Horizontal Non-Programmable Thermostat with Digital Backlit Display	$54.98
Emerson	80 Series, Non-Programmable, Universal (4H/2C) Thermostat	$69.94
Emerson	70 Series Classic, 5 + 2 Programmable, Single Stage (1H/1C) Thermostat	$73.49

†Source: www.homedepot.com

The team also compared prices of eligible products to prices of other thermostats offered by the same manufacturers that are similar to the eligible devices but without Wi-Fi capabilities. Table 2 summarizes these data including the price differential between SmartFlex eligible and non-Wi-Fi thermostats. Where there was a directly comparable product, the price difference ranged from $16.10 to $46.11, with the lower end attributed to a sale on the smart device.

Table 2. Price Summary of SmartFlex Rewards-Eligible Devices versus Similar Non-Wi-Fi Devices (November 2024)

Manufacturer	SmartFlex Rewards Eligible Thermostat	Price†	Similar Non-Wi-Fi Device from Same Manufacturer	Price of Non-Wi-Fi Thermostat†	Price Difference
Honeywell (sale price)	Wi-Fi 7-day Programmable Thermostat	$69.98	7-day Programmable Thermostat with Digital Backlit Display	$53.88	$16.10
Honeywell (list price)	Wi-Fi 7-day Programmable Thermostat	$99.99	7-day Programmable Thermostat with Digital Backlit Display	$53.88	$46.11
Emerson / Sensi	Sensi 7-day Programmable Wi-Fi Smart Thermostat	$105.99	Premium 7-Day Programmable Digital Thermostat	$73.49	$32.50
Emerson / Sensi	Sensi Wi-Fi Smart Thermostat	$129.00	90 Series 7-day Programmable Universal Thermostat	$104.75	$24.25

†Source: www.homedepot.com

Prices for eligible products without a directly comparable non-Wi-Fi product are presented in Table *3.* The products in this table range from approximately $90 to $280. The most expensive products are about ten times as expensive as the cheapest non-eligible thermostats.

Table 3. Price Summary of SmartFlex Rewards-Eligible Devices (November 2024)

Manufacturer	SmartFlex Rewards Eligible Thermostat	Price†
Emerson / Sensi	Sensi Lite Smart Thermostat	$89.00
Google Nest	Nest Thermostat	$129.99
Emerson/ Sensi	Sensi Touch Wi-Fi Smart Thermostat	$146.99
Ecobee	3 Lite Programmable Smart Thermostat	$149.99
Honeywell	Wi-Fi Smart Color 7-Day Programmable Smart Thermostat	$165.60
Emerson / Sensi	Sensi Touch 2 Wi-Fi Smart Thermostat	$189.00
Ecobee	Smart Thermostat with Voice Control	$249.00
Google Nest	Nest Learning Thermostat 4th Gen	$279.99

†Source: www.homedepot.com

Based on a review of these data, it is possible to find a flexible-demand thermostat product that only costs a consumer $25 more than a similar non-flexible-demand thermostat, but this value underestimates the likely cost difference to consumers; therefore, we do not think this value is reasonable. On average, smart, demand flexible thermostats can be meaningfully more expensive than non-smart thermostats. The CA IOUs recommend that the CEC review comprehensive product pricing data and revise the incremental cost estimate to better reflect a broader range of product costs once the features that define a FDAS-compliant thermostat are established.

7. **Staff may consider using Title 20, California Code of Regulations, Section 1692(c) General Requirements as a baseline standard for cybersecurity in low-voltage thermostats. Are there any additional cybersecurity requirements to be considered?**

Regarding cybersecurity, the CA IOUs recommend that the CEC review pertinent language in current state-based laws, industry trade association policy positions, and provisions in Title 24, Part 6, such as those described further below.

The CA IOUs encourage the CEC to consider state-based laws, including California's Information Privacy Law on Connected Devices[31] and Oregon's Law on Security Measures for Devices that Connect to the Internet.[32] Both state laws apply to all products enabled with an internet protocol, Wi-Fi, or Bluetooth, and require reasonable security features.

In terms of industry trade association policy positions, the Air Conditioning, Heating, and Refrigeration Institute (AHRI), the U.S.-based trade association for HVAC manufacturers, supports defining "reasonable security feature" as compliance via any one of the following:

(1) Consensus standards, including ANSI/UL/CSA 2900 or ANSI/CTA 2088;
(2) A security rating from a certified body; and
(3) Design features based on recognized guidelines, or NIST standards or guidelines.[33]

The Heating, Refrigeration and Air Conditioning Institute of Canada, the trade association in Canada for HVAC manufacturers, wholesalers and contractors, has referenced the IEC 62443 series as a standard applicable to connected HVAC products.[34]

The Consumer Technology Association, which represents the U.S. consumer technology industry, has taken the following policy position on any regulatory approach on cybersecurity:[35]

(1) Fosters industry-driven best practices for consumer device cybersecurity, not mandates;
(2) Creatively partners with the private sector to improve consumer IoT security;
(3) Looks at legal safe harbors for companies that choose to use any certifications or labeling that the government might want to encourage; and
(4) Harmonizes standards and expectations, domestically and internationally.

The CA IOUs believe that the CEC's future FDAS for thermostats should complement the provisions thermostats are required to meet in California's 2025 Building Energy Efficiency Standards set forth in

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[31] Senate Bill 327 (2018). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB327
[32] Oregon Laws 2019, Chapter 193 (2019). https://www.oregonlegislature.gov/bills_laws/lawsstatutes/2019orlaw0193.pdf
[33] AHRI State Legislative Priorities – Cybersecurity and Data Privacy. https://www.ahrinet.org/advocacy/state-legislative
[34] HRAI. *Cybersecurity Considerations for HVAC*. https://www.hrai.ca/newsletter/cybersecurity-considerations-for-hvac
[35] CTA Advocacy – Cybersecurity. https://www.cta.tech/Advocacy/Issues/Cybersecurity

Title 24, Part 6.[36] The provisions include the incorporation of the OpenADR 3.0 specification in addition to maintenance of the prior versions of OpenADR.[37,38]

Regarding cybersecurity, Section 11 of OpenADR 3.0 follows a security approach based on authentication, authorization, and a common security model that adopts industry-standard methods for these processes. The following assumptions underlie the OpenADR 3.0 security model:

- Virtual Top Node (VTN) security must meet stringent requirements. Client requests must be authenticated, and access to API resources and operations must be authorized.
- VTN clients include utility Business Logic and Virtual End Nodes (VENs); therefore, a security solution must work for both scenarios.
- VENs may be implemented within on-site customer devices such as a water heater, external hardware controllers, or a central device. VENs may also be implemented on cloud servers.
- VEN-represented devices are owned by a utility customer who has an account with the utility.
- VENs must be manually provisioned with a VTN address provided by the utility retailer.
- Business Logic and VEN clients must be provisioned with client secrets or other credentials before accessing a VTN.
- A VTN may be configured to allow 'unregistered' VENs to access the API, which is particularly applicable for tariff programs.

Section 11 of the OpenADR 3.0 specification also prescribes provisions on the choice of security protocols based on client scenarios, Transport Layer Security (TLS) requirements for VTNs and updating of TLS ciphers when appropriate, mitigating denial of service attacks through rate limiting implementation, implementation of OAuth 2.0 client credential flow for certified VEN clients (for authentication and authorization in machine-to-machine applications), and specific provisions for bearer token or webhooks associated with VTNs.

8. **Provide information on any demand response programs currently used in California or other locations for HVAC loads that use the thermostat for load control, including the following.**
    a. **How many low-voltage thermostats are used in these demand response programs?**

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[36] See the 2025 Building Energy Efficiency Standards for more information. https://www.energy.ca.gov/filebrowser/download/6636?fid=6636#block-symsoft-page-title

[37] OpenADR 3.0 Specification. https://www.openadr.org/openadr-3-0

[38] Other thermostat specific provisions in the 2025 Building Energy Efficiency Standards include:

- §110.2 prescribes mandatory requirements for thermostats and controls for space-conditioning equipment. More specifically, §110.2(b) on controls for heat pumps with supplementary heaters requires controls to avoid supplementary heater operation when the load can be met by the heat pump alone, and where the heat pump's heating is higher than the cut-on temperature for supplementary heating and the cut-off temperature for heat pump heating is higher than the cut-off temperature for supplementary heating. §110.2(c) requires setback capabilities for a thermostat not controlled by a central energy management control system. §150.0(i), §150.2(b)(1)(F), §160.3(a), and §180.2(b)(2)(A)(iv) mandate heating and cooling systems to meet provisions in §110.2(c).
- §120.2 is applicable to nonresidential and hotel/motel buildings and specifies several requirements pertaining to thermostatic controls for each zone, criteria for zonal thermostatic controls, hotel/motel guest room thermostats, heat pump controls, shut-off and reset controls for space-conditioning systems, automatic demand shed controls, and direct digital controls.
- §150.0(i)2 requires thermostats controlling heat pumps with electric resistance supplementary heat or gas furnace supplementary heat to receive outdoor air temperature from an outdoor air temperature sensor or from an internet weather service and display the outdoor air temperature.
- For buildings that install or are required to install demand responsive controls, §110.12(a)(5) mandates that demand responsive control thermostats comply with Reference Joint Appendix 5.

b. **How much energy load in kW is each low-voltage thermostat shifting?**
c. **What is the time shift duration?**
d. **What are the participation rates with an opt-in and opt-out framework?**

The CA IOUs clarify that demand response (DR) programs using thermostats typically focus on curtailment (i.e., shed, rather than shift) of HVAC equipment load to support grid reliability and respond to price spikes on the wholesale market. One exception is PG&E's Smart Thermostat Control Study and Pilot which incorporated daily load shifting into the DR program. Thermostats automatically increase their setpoints to curtail or reduce the overall air conditioner electricity consumption during DR events throughout the year. Pre-cooling can achieve limited shifting; however, this action is typically tied to limited DR events. Daily load shifting with thermostats is more effectively achieved with time-of-use rates, hourly pricing tariffs, or GHG signals. However, total air conditioning energy shifted by thermostats will vary depending on daily weather conditions and occupant comfort preferences. The CA IOUs share the following data tables for event-based demand response programs (shed) and daily load shifting based on time-of-use tariffs (shift).

CA IOU demand response programs that use thermostats for event-based load control include SDG&E's AC Saver smart thermostats (ended in 2023), SCE's Smart Energy Program (active), PG&E's SmartAC Program (active), and PG&E's Smart Thermostat Control Study and Pilot (2021-2023). As noted, these event-based demand response programs focus on load *shed*, not load shifting as posed in question 8, with the exception of the PG&E pilot. Still, this information is shared to provide detail on the load reduction potential of thermostat demand response programs. Information about these programs is detailed below and in Table 4 (information about the PG&E pilot is included with the discussion of load shifting programs in the next section).

a. 245,000 low-voltage thermostats participate in these demand response programs
b. There is 0.20 to 0.70 kW of load shed per low-voltage thermostat[39,40,41]
c. A typical load shed duration is 2 to 4 hours per event

Table 4. Additional data by utility on event-based demand response thermostat programs

Description	SDG&E	SCE	PG&E
No. of thermostats	40,000	95,000	110,000
Demand reduction impact (shed) (kW)	0.20-0.25	0.70	0.30
Event (shed) duration	2-4 hours	2-4 hours	2-4 hours
Participation rates	N/A	97%[42]	N/A

Regarding load shifting, statewide results are available for the 2019 California Smart Thermostat Time-of-Use Pilot, which included customers from all three IOUs.[43] According to the evaluation report, the

[39] Christensen Associates Energy Consulting. *CALMAC ID: PGE0443: Load Impact Evaluation for Pacific Gas & Electric Company's SmartAC™ Program.* (2020). https://www.calmac.org/publications/4._PGE_2019_SmartAC_Report_PUBLIC.pdf

[40] Demand Side Analytics. *CALMAC ID: SCE0463: 2021 Smart Energy Program Load Impact Evaluation.* (2022). https://www.calmac.org/publications/SCE0463.01_PY2021_SCE_DR_Program_Report_SEP_Public.pdf

[41] Trinkley, L., SDG&E. Direct communication. October 18, 2024. See also: Resource Innovations. *2022 SDG&E AC Saver Day of Load Impact Evaluation - IOU 2023 Load Impact Protocol Workshop*. (2023). https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/demand-response/demand-response-workshops/2023-load-impact-protocol-workshops/2023-dr-load-impact-workshop---ac-saver-day-of-2023.pdf

[42] Southern California Edison. Direct communication. October 18, 2024. Value based on the number of enrolled thermostats available for each event minus offline devices or those where a signal was not successfully broadcasted (i.e., dispatch failure).

[43] Evergreen Economics*. CALMAC ID: CPU0202.01: Evaluation of the California Statewide Smart Thermostat Time of Use Pilot.* (2020). https://www.calmac.org/publications/PCT_TOU_Evaluation_Report_Final_033120.pdf

daily peak hour load shift ranged from -2.1 kWh (net increase in consumption) to 0.49 kWh. [44] Additional information from SCE's Smart Energy Program[45] and PG&E's Smart Thermostat Control Study and Pilot[46] is available in Table 5 below. Future pilots and programs are expected to provide more information about the load shift potential of connected thermostats in California.

Table 5. Additional data by utility on shift impact of thermostats on TOU rates

Description	**SDG&E**	**SCE**	**PG&E**
No. of thermostats	N/A	95,000	110,000
Energy shifted (kWh)	N/A	0.39*	0.32**
Event (shift) duration	N/A	2 hours	4 hours

*Average event-day shift impact
**Average daily shift impact July-September[47]

We also encourage the CEC to contact municipal utilities for data from municipal utility programs. The ENERGY STAR Summary of HVAC & Smart Thermostat Programs[48] mentions the following California municipal utilities with residential and/or commercial smart thermostat demand response programs: Glendale Water & Power, Los Angeles Department of Water & Power, Modesto Irrigation District, Pasadena Water and Power, Riverside Public Utilities, Sacramento Municipal Utility District, and Turlock Irrigation District.[49]

9. **Is there anything like a common communications protocol or platform with significant market share, and/or which could facilitate aggregation of HVAC systems via thermostatic controls? Please feel free to describe alternatives to ensuring effective and reliable communications with targeted aggregation of (customer-consented) HVAC loads.**

The CA IOUs support secure, bi-directional, reliable, and open standard-based communication protocols and platforms to facilitate HVAC load shifting via thermostat controls. Internet communication can be established through Wi-Fi or cellular, while demand management communication is possible via OpenADR. Internet protocol is widely available to over 90% of California households and customers. The CA IOUs use OpenADR 2.0 in all automated demand response programs, and OpenADR 3.0 was released in November 2023; these protocols allow for the aggregation of devices. Many smart thermostats and other home devices can also communicate using Bluetooth or Zigbee technology, which reliably enable

44 Ibid., Table 23.

45 Southern California Edison. Direct communication. November 8, 2024.

46 Demand Side Analytics. *CALMAC ID: PGE0498.01: 2022-2023 Load Impact Evaluation of Pacific Gas and Electric's Smart Thermostat Control Pilot.* (2024). https://www.calmac.org/publications/PY2022-2023_Smart_Thermostat_Control_Pilot_Evaluation_Report_Final_(003).pdf

47 Value derived from Table 14 of the *2022-2023 Load Impact Evaluation of Pacific Gas and Electric's Smart Thermostat Control Pilot* using the ALL System Daily TOU Automation Peak Period kW Impacts by Day Type as follows.

	4-5pm	**5-6pm**	**6-7pm**	**7-8pm**	**Total kWh Shifted**
AVERAGE DAY JULY	0.14	0.08	0.05	0.03	0.30
AVERAGE DAY AUGUST	0.14	0.11	0.08	0.06	0.39
AVERAGE DAY SEPTEMBER	0.09	0.08	0.05	0.06	0.28
				Average	0.32

48 ENERGY STAR Summary of HVAC & Smart Thermostat Programs. https://www.energystar.gov/productfinder/downloads/2023/2023%20ENERGY%20STAR%20Summary%20of%20HVAC%20&%20Smart%20Thermostats.pdf

49 In addition to these, Burbank Water and Power has also launched a smart thermostat demand management program, Cool Rewards.

two-way communication with packet error rates in low single digits. Utility AMI smart meters support Zigbee communication, which could potentially be used to broadcast demand flexibility signals to compatible devices. More research is needed on this pathway. We suggest that the CEC consider all relevant communications protocols in designing a thermostat FDAS, as communications protocols continue to evolve. Market adoption of new demand flexible appliances such as water heaters and electric vehicles could popularize new communication protocols that could supplant existing ones. Furthermore, the CEC should consider interoperability with existing efforts; the CA IOUs are currently implementing other communication protocols including IEEE 2030.5 standard-based telemetry for projects sized 1 MW or greater.

Although radio broadcast is a common form of communication, the CA IOUs currently do not support the use of radio broadcasting for demand flexibility signaling. We reiterate that the feasibility and cost effectiveness of radio broadcasting for widespread transmission of demand flexibility signals needs further study and exploration. In contrast, Wi-Fi or cellular-based internet communication, already in use for enabling demand flexibility in thermostats and appliances, offers a more established solution.[50] More cost analysis and technical evaluation are needed to demonstrate that radio-based communication is feasible for California, including the 10 to 15% of Californians who remain under-connected or unconnected.[51] Radio signals can be physically interrupted by buildings, hills, or mountains or signal interference from other electric devices, including televisions and variable-speed electric motors.[52] Therefore, additional transmission and receiver equipment must be constructed to minimize signal interference and attenuation. Basic radio communication is one-way, and to achieve the two-way communication under consideration for FDAS would require additional investments in infrastructure. No major manufacturers offer a communicating thermostat with radio receivers in addition to internet connectivity. As we stated in response to the CEC's rulemaking on FDAS for pool pump controls,[53] the technical feasibility of using radio broadcasting to transmit demand flexibility information in the future may be affected by the ongoing transition from analog radio to hybrid and digital radio signals with higher data rates that could be more suitable for ancillary uses like utility load management.[54] For more information on this topic, please refer to the CA IOU comment letter submitted to the CEC on July 3, 2024, in Docket 24-FDAS-02 with topic: *Request for Information and Feedback: Expanding Flexible Demand in California through Statewide MIDAS Data Delivery: A Comparison of Signaling Options*.[55]

We note that there are various reasons why even thermostats that do have communications capability may not effectively and reliably receive and respond to signals; therefore, a common communications protocol is not the only requirement for thermostat communication for demand flexibility. Any

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[50] PG&E's WatterSaver program uses internet or cellular connectivity to deliver load shifting signals to electric storage water heaters.

[51] California Emerging Technology Fund. *2021 Statewide Broadband Adoption Survey.* https://www.cetfund.org/action-and-results/statewide-surveys/2021-2/

[52] See Figure 31 – Severe Radio Interference from Variable-Speed Electric-Motor Drives https://www.arrl.org/files/file/Technology/RFI%20Main%20Page/Naval_RFI_Handbook.pdf

[53] See California Investor Owned Utilities - Joint Comments on FDAS Pool Pumps 15-day Language, submitted on July 10, 2023 to Docket Number: 23-FDAS-01: https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=23-FDAS-01

[54] See the U.S. Federal Communications Commission's consumer guide on digital radio for more information. https://www.fcc.gov/consumers/guides/digital-radio

[55] See California Investor Owned Utilities - Comments on Request for Information and Feedback: Expanding Flexible Demand in California through Statewide MIDAS Data Delivery: A Comparison of Signaling Options, submitted on July 5, 2024 to Docket Number: 24-FDAS-02: https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=24-FDAS-02

connectivity pathway (for example, Wi-Fi or cellular) could have connectivity interruptions due to site or user issues or transmission interference. In retrofit scenarios, existing site wiring may not allow for the thermostat to perform its full range of functions. For example, if the existing thermostat uses a 3-wire configuration, the user may need to run new wire (i.e., with 5 or more conductors) or install a wire extender kit to be able to wire a new connected or demand-flexible thermostat such that all functions are available. Without this additional wiring, even if the thermostat has communication features, they may not work as desired. Furthermore, for some products, connectivity and communication features are designed primarily to facilitate control of the system by the user, the manufacturer cloud, or a third-party via the manufacturer cloud. These products are not designed to be directly signaled by a third-party outside of the manufacturer framework. In addition to communications protocols and platforms, the CEC should consider these real-world complications and account for them in the standard's design and in estimates of the standard's impact. The CEC should design a standard that works within the framework in which products were designed to operate.

10. **Please discuss strategies for low-voltage thermostats to best utilize the CEC's Market Informed Demand Automation Server (MIDAS), which provides access to utilities' time-varying rates, GHG emission signals, and California Independent System Operator (California ISO) Flex Alerts.**

The CA IOUs support FDAS requirements for secure, bi-directional, reliable, and open standard-based communication, which allows devices to receive and respond to demand flexibility signals from the CEC's MIDAS, utilities, or authorized third parties. The CA IOUs support the capability of smart thermostats to access signals from MIDAS via internet protocol through Wi-Fi or cellular rather than via radio broadcast signals.

For thermostats, the primary operational response to pricing signals is the adjustment of setpoints. Initial findings from CA IOU pricing pilots (PG&E's Real Time Pricing Pilot and SCE's CalFUSE pilots) show that setpoint adjustment strategies vary widely due to price tolerance thresholds and comfort preferences. Household income and personal comfort preferences will influence a customer's willingness to change in response to pricing signals. Additionally, these pilots are finding that automation service providers (ASPs) are critical for helping customers optimize their response strategies to pricing signals regardless of technology. ASPs help customers understand the implications of setpoint adjustment strategies in response to pricing signals. The pricing pilots indicate that customers need more information, education, and support from ASPs to respond to pricing signals. We do not automatically assume that customers will optimize their behavior based solely on pricing signals from MIDAS or other entities. It is important to note that because not all energy service providers provide time-of-use rates, load shifting may have limited value to some customers unless there is some other incentive mechanism to support their participation.

11. **What percentage of low-voltage thermostats sold in California have an ability to respond to data originated from MIDAS to alter the HVAC operating schedule? Describe whether low-voltage thermostats can respond to MIDAS's price, GHG, or Flex Alert.**

The CA IOUs support the commercialization and widespread adoption of thermostats that respond to price, GHG, and Flex Alert signals. We are not aware of commercially available thermostat products that can specifically respond to price or GHG signals from MIDAS, but several low-voltage thermostat products, such as those from Nest, ecobee, Copeland, and Honeywell, can react to DR events sent from utility or DR aggregator servers via manufacturer clouds using the internet. Manufacturers such as ecobee and Copeland have integrated APIs with at least one DR aggregator's server for thermostats to respond to pricing signals in addition to DR events or daily load shifting. Responding to signals directly from MIDAS is technically achievable, but manufacturers would need a business case to implement this capability versus simply providing demand flexibility through utility servers, aggregators, or manufacturer clouds. In addition to the ability to respond to signals from MIDAS and other origination points (like local utilities and DR aggregators), we recommend that manufacturers be required to ensure these signals can result in thermostat actions that reduce or shift load, such as setpoint adjustments or air conditioning cycling.

The CA IOUs appreciate the opportunity to provide these comments regarding the Request for Information on Potential Flexible Demand Appliance Standards for Low-Voltage Thermostats. We thank the California Energy Commission for its consideration.

Sincerely,

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