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ecobee Comments Regarding the California Energy Commission Flexible Demand Appliance Standards

ecobee thanks the California Energy Commission (CEC) Commissioners and Staff for this opportunity to provide input regarding the Flexible Demand Appliance Standards, Docket No. 20-FDAS-01. ecobee— a leading developer of smart thermostats and other smart home products and services that facilitate cost-effective load management – submits these consolidated comments on two topics: (1) the pre-rulemaking draft of the proposed standards language (docketed on September 30, 2021); and (2) the questions posed in the CEC’s Request for Information for Flexible Demand Appliance Standards (docketed on September 1, 2021). Overall, as stated in its previously submitted comments in this docket¹ and in the Load Management Rulemaking, Docket No. 19-OIR-01,² ecobee strongly supports the CEC’s efforts to implement the flexible load management technologies needed to achieve California’s emissions reduction goals in a cost-effective manner. We believe these comments will assist the CEC in determining how best to facilitate customer adoption and utilization of such technologies in accordance with applicable statutory directives.

I. Comments Regarding the Pre-Rulemaking Draft of the Proposed Flexible Demand Appliance Standards

ecobee proposes the following revisions to section 1690(e)(2) of the September 30, 2021 pre-rulemaking draft language for the Flexible Demand Appliance Standards (new language underlined):

¹ ecobee Comments on Flexible Demand Appliance Standards (Feb. 3, 2021).

² ecobee Supplemental Comment Letter on Load Management Standards (May 24, 2021); ecobee Comments on Draft Staff Report (Apr. 23, 2021); ecobee Comments on Draft Load Management Standards (Mar. 16, 2020); ecobee Load Management Scoping Comments (Jan. 24, 2020).

Section 1690: Appliance Specific Standards and Requirements.

* * *

(2) Flexible demand appliance standards. All thermostats manufactured on or after January 1, 2024 shall meet the following standards.

A. Thermostats shall be a “connected device” as defined in section 1687 of this Article. Thermostats shall be capable of receiving time-varying or time-of-use price signals from the utility or other load management entity.

B. Responsive Setback Capabilities. All thermostats shall have a clock mechanism that allows the building occupant to program the temperature setpoints for at least four periods within 24 hours. Thermostats shall be capable of responsive setback capabilities that automatically optimize HVAC runtime performance in relation to occupant-programmed setpoint(s) in response to time-varying or time-of-use price signals from the utility or other load-management entity.

C. User Display and Interface. The thermostat shall be capable of displaying the following:

1. communications system connection status;
2. demand response period or pricing event status;
3. the currently sensed temperature; and
4. the current set point.

D. In-App Capabilities. All thermostats shall have simple in-app capabilities allowing customers to utilize Responsive Setback Capabilities described in Section (B) with respect to time-varying or time of use pricing.

The purpose of these proposed revisions is to ensure that the CEC’s standards require all smart thermostats under these standards to provide customers with the ability to respond automatically to time-varying utility rates as part of their “smart” functionality.

It is vital that this capability be built into smart thermostat devices, as opposed to relying on direct utility control through a mechanism like OpenADR. Deploying time-of-use rate response capability as an inherent feature of smart thermostat technology, thus providing a consumer product that optimizes flexible load resources *alongside* customer comfort, can

deliver unique and significant value to individual consumers and the grid. Device manufacturers have the ability to provide a tailored experience suited to the needs and environment of the customer, balancing savings and the customer experience by incorporating available information about unique variables such as customer comfort preferences, real-time occupancy patterns, a home's specific thermodynamic properties and HVAC system performance, and indoor humidity conditions. Without this tailored experience, customer fatigue and opt-outs may erode the benefits that the CEC seeks to achieve through its flexible demand appliance standards. As discussed further below, a vendor-mediated process can also promote ease of participation through streamlined in-app enrollment which helps customers make a choice to participate, but allows the product vendor to handle details that customers are unlikely to have memorized such as their account number or the specific name of the tariff or rate they're on. The CEC's standards will be most impactful if they set the stage for a product and experience that customers want and can easily opt in to, which smart thermostat manufacturers are well-positioned to provide.

ecobee's feedback on this issue is based on a third-party evaluation conducted by Demand Side Analytics of eco+ – a new thermostat software platform introduced in 2019 to facilitate cost-effective customer load management in response to time-varying or time-of-use (TOU) price signals.³ Fundamentally, this evaluation shows that the ability of smart thermostats to respond automatically to time-varying rates provides substantial, incremental value compared to "smart" thermostats that lack such functionality, and can successfully do so with minimal risk of customer opt-outs and attrition.

The eco+ platform is a software upgrade for consumers that has been pushed out to ecobee smart thermostats to improve the energy performance of residential HVAC systems.⁴ The platform consists of algorithms for personalized time-of-use, demand response, and energy efficiency optimization:

Time-of-Use Optimization (TOU) – For ecobee owners whose retail electricity rate varies by hour of the day, the TOU algorithm shifts energy use from high

³ <https://www.ecobee.com/en-us/eco-plus>

⁴ All ecobee 3 or newer models are eligible for the eco+ upgrade. Over 90% of ecobee customers have an ecobee3 or newer.

price hours to lower price hours while maintaining the desired comfort levels through customized pre-cooling and temporary temperature setbacks.

Demand Response (DR) – Presented to users as Community Energy Savings (CES), this feature shifts cooling loads away from peak hours when the electrical grid is most constrained through customized pre-cooling of the home and temporary temperature setbacks during system peak hours.

Energy Efficiency (EE) – Features like Enhanced Smart Away, Schedule Assistant, and Feels Like are designed to help ecobee owners further lower their overall heating and cooling energy consumption beyond the standard smart thermostat savings, for example by adjusting for vacancy faster, recommending updates to users' thermostat schedules, and accounting for indoor humidity fluctuations to ensure user comfort.

The Demand Side Analytics evaluation analyzed the impacts of eco+ against a baseline of smart thermostats that are not automating a response to price signals, using a randomized encouragement design (RED) that included approximately 240,000 ecobee thermostats with results stratified by US Building America Climate Zone.⁵ The California-specific results depicted in Figure 1 below, which span both the marine and the dry climate zones by covering the Pacific Gas & Electric and Sacramento Municipal Utility District service territories, show the incremental savings that a tool like eco+ can offer through TOU rate optimization, including:

- Incremental bill savings of 7-19% on customer cooling expenditures
- Incremental demand savings ranging from .10-.25 kW per device
- Incremental on-peak savings ranging from 20-28%
- Incremental overall energy savings ranging from 3-9%

⁵ <https://www.ecobee.com/en-us/ecoplusemv/>

Figure 1 - eco+ TOU optimization results for summer 2019 & 2020

Rate	Year	Climate Region	Peak Duration (hours)	Price Ratio (Peak: Off-Peak)	Average kW Savings During Peak Period	On-Peak Percent Savings	Overall Percent Energy Savings	Percent Savings On Cooling Costs
Hydro One Residential TOU	2019	Canada	6	2	0.18	36%	3%	8%
FPL RTR-1	2019	Hot Humid	9	5.8	0.22	13%	5%	10%
SMUD Residential TOD	2019	Hot Dry	3	2.4	0.25	23%	4%	8%
PG&E EV-A	2019	Mixed Dry	6	3.7	0.18	28%	9%	19%
PG&E EV-A	2019	Marine	6	3.7	0.1	20%	4%	11%
Duke Energy RT	2020	Mixed Humid	6	1.2	0.25	20%	8%	9%
PacifiCorp Residential Service EV-TOU	2020	Cold	5	3.3	0.43	33%	15%	23%
SMUD Residential TOD	2020	Dry	3	2.4	0.28	21%	3%	7%
Tucson Electric Power Residential Demand TOU	2020	Dry	4	1.7	0.46	25%	6%	9%

Demand Side Analytics

Notably, such savings were achieved with minimal impacts to customer comfort. When surveyed about their experience, 76% of respondents in the study who observed an impact related to comfort indicated that their comfort remained the same or improved. This is an essential aspect of a flexible demand technology that, more than any other being addressed in this proceeding, is customer-facing and has a significant impact on a customer’s living environment. The Demand Side Analytics evaluation shows that customers respond well to a personalized response that balances savings, comfort, and greenhouse gas impact. Establishing a flexible framework that facilitates this type of curated experience is key to fostering customer adoption and utilization of flexible demand appliances.

Customer control and comfort are central to avoiding customer fatigue and opt-outs. Standards that rest on outside control of smart thermostats through direct utility control or OpenADR are inconsistent with this customer-centric approach because smart thermostat vendors have unique access to data points regarding a home’s thermodynamic properties. They can design algorithms that account for how long an individual home takes to heat up or cool down (how leaky it is), in order to personalize optimizations in a way that maximizes comfort and grid impacts. They also have historical and real-time occupancy data as well as comfort/savings preferences for each home to additionally maximize grid impacts without impacting comfort. Utility or device-level OpenADR would treat each home in the same way with

a uniform setback and precool that does not account for the inherent differences between homes and between the home's inhabitants.

Smart thermostat manufacturers can also serve as an important channel for successful customer enrollment in TOU rate optimization. Both the data from the Demand Side Analytics evaluation of eco+ and publicly available data regarding California's roll-out of default time-of-use rates show that significant proportions of customers are unable to identify their applicable time-of-use rate.⁶ Such customers can be well-served by a device vendor that is able to access that information on their behalf and manage their load accordingly.

As discussed further below, the CEC should focus on the benefits of internal smart thermostat rate optimization functionality in finalizing these standards, as the most suitable way to deliver the benefits of automated management of flexible loads without driving away consumers from advanced technologies by making them uncomfortable in their homes.

II. Comments Regarding the Request for Information for Flexible Demand Appliance Standards

ecobee also offers the following responses to the Request for Information (RFI) for Flexible Demand Appliance Standards issued on September 1, 2021:

Question 3: What is the market share of each identified appliance with the flexible demand approaches identified above?

Up to 25% of households in the United States own some type of "connected" thermostat.⁷

⁶ Southern California Edison (SCE) presented an analysis to the California Public Utilities Commission Time of Use Market Education & Optimization Workgroup indicating that close to half of residential customers are not sure what rate they're on. Additionally, the Demand Side Analytics eco+ evaluation report shows that, in regions with default TOU like SMUD, only 41% of customers identified and selected their rate. Of the 59% that did not identify their rate, 73% clicked, "I don't have a TOU rate." This demonstrates a general lack of customer awareness around rates even in jurisdictions with widespread deployment of and customer education on TOU rates. This lack of knowledge and/or lack of specificity is a significant obstacle to maximizing the benefits of automation technology, given that a utility like SCE has three separate TOU rate plans alone (<https://www.sce.com/residential/rates/Time-Of-Use-Residential-Rate-Plans>).

⁷ Statista, Which smart home devices does your household own?, <https://www.statista.com/statistics/1124290/smart-home-device-ownership-us>.

Question 4: What other flexible demand approaches are available for staff to consider? Please include references to publicly available sources.

ecobee previously provided the following Response to Staff's Request for Proposals regarding potential Flexible Appliance Demand Response Modes:

- *What demand response mode signals are accepted by flexible appliances? And why should this standard be considered as a priority?*
 - DR Signals: API or OpenADR. This is maximal load shed that the customer is willing to provide for emergencies or economic scarcity events.
 - Pricing Signals: Day-ahead pricing or seasonal/annual pricing. Since these signals are delivered daily to customers, the comfort impacts must be minimal or non-existent to avoid customer fatigue and opt-outs.
 - In general, there are different models that would suffice, including receiving signals through a vendor's cloud via OpenADR or standard REST API, as long as the vendor maintains the control of its product to allow for an effective, customer-oriented interface.
- *What responses are provided by the flexible appliance?*
 - With respect to the possibility of having appliances shift load to lower cost/lower GHG emission times: ecobee via eco+ is currently capable of this functionality and over 120,000 ecobee customers are experiencing this feature today throughout North America. The eco+ platform accomplishes this by intelligently pre-cooling a home ahead of a high priced intervals and customizing a savings protocol during the pricing peak.
 - Customers want a personalized response that balances savings, comfort and GHG impact, rather than a "one-size-fits-all" approach where the customer experience is defined in a standard. ecobee's eco+ platform is able to provide a tailored approach incorporating information about the "thermal model" of the home through the thermostat, for example by creating personalized optimizations using data about real-time occupancy patterns, a home's specific thermodynamic properties and HVAC system performance, and indoor humidity conditions, in order to maximize thermostat setbacks with minimal impacts to customer comfort. Establishing a flexible framework that allows for this type of curated experience is key to fostering customer adoption and utilization of flexible demand appliances.

- *Identify communication and load control requirements to enable flexible demand in appliances.*
 - ecobee supports a central database of utility/load-serving entity (LSE) rates as contemplated in the Load Management Standards. We also recommend that the Commission establish a mechanism for load management vendors to match posted rates with customers via API or other commonly accepted secure HTTP protocol, per the discussion above on customer confusion regarding rate and tariff identification.
 - Posting rates is significantly cheaper and does not require complex integrations between LSEs and manufacturers, and leverages cloud infrastructures generally in place for connected devices without necessitating that the utility have any direct access to devices. This approach also leaves room for the device manufacturer to innovate with respect to its customer interface.
 - Currently, ecobee maintains its own database of time-varying rates, but would be able to connect our database to a publicly available source such as the database being creating through the Load Management Standards.
 - The Commission should not rely on or require the customer to have individual knowledge of applicable rates/tariffs, since many don't know this currently. Instead, device manufacturers should be provided:
 - the flexibility to connect to a hosted rate database that is maintained and updated; and
 - a mechanism to match customers to their applicable tariff to perform personalized, optimal energy optimization.
 - Wi-Fi
 - WiFi is commonly used by customers for connected devices in the home, and customers need internet/wifi for many basic household functions (communications, entertainment, etc) and have an incentive to maintain wi-fi connections. In contrast, there may be little or no incentive for customer to reconnect devices that are only connected to the utility via non-consumer centric protocols (CTA2045).
 - With WiFi, devices are generally controlled via app.
 - Note that manufacturers do not need consistent connectivity to implement demand response; this can be pre-programmed and executed at the correct times and updated upon reconnection.
 - The bulk of U.S households have internet and a critical value proposition of Smart Thermostat (connected devices) is app-based control which uses WiFi. People who buy these devices generally have WiFi.

- *Describe the benefits and costs to the consumer, and to the manufacturer, of an internal vs. an external communications module that accepts signals for flexible demand modes.*
 - Benefits to consumer of an internal module (utilizing WiFi communication):
 - An internal module can integrate with overall device operations to provide savings while maintaining comfort as demonstrated in the eco+ measurement and verification study. As consumers utilize wi-fi for many in-home uses, it's reasonable to believe they will have an incentive to maintain internet and wi-fi connectivity vs. other standards such as CTA2045.
 - In ecobee's experience, this integration of demand response as part of the eco+ software platform has resulted in significantly higher participation levels, lower opt-outs and greater overall impacts versus traditional utility demand response program strategies and enrollment tactics. Since launching eco+ into utility Bring Your Own Thermostat DR programs in December 2019, ecobee has seen a 150% increase in enrolled thermostats compared to cumulative enrollments from the previous five and a half years. ecobee believes similar results can be achieved in getting customers on rate optimization if the Commission establishes a mechanism for load management technology vendors to match customers with their applicable rates. That is a vital step that the CEC should not overlook in ensuring that any time-varying utility rate results in automated and optimized load management for customers at scale to maximize benefits to the electric grid.
 - Using an internal module facilitates machine learning and AI to provide customized optimization protocols that balance savings and comfort – and thus promote continued customer participation through a positive user experience.
 - Currently, eco+ optimizes around price and the price signals and optimization protocols are delivered through the cloud and in-home wi-fi connection, requiring no additional communications module between ecobee and the customer and also avoiding added cost for a separate communications framework.

We add to these prior comments that there are different models that would suffice, such as receiving signals through a vendor's cloud via OpenADR or standard PUSH API, as long as the vendor maintains the control of its product to allow for an effective, customer-oriented interface. If a future iteration of the standard includes any language regarding OpenADR for

thermostats, we recommend clarifying that OpenADR-based communication should take place as a "cloud-to-cloud" integration between a DRMS/DERMS provider as the "Virtual Top Node" and a DER manufacturer as the "Virtual End Node."

Question 6. With consideration to high and low projected stocks for Table 1 Phase 1 appliances, what other sources of information are available to estimate current and projected appliance stocks in CA?

Smart thermostats have a projected compound annual growth rate of ~15%.

Question 8. Are there alternative assumptions for product lifetime for the identified appliances that staff should consider and why? Please provide sources of information for those alternative assumptions.

Most technical reference manuals estimate smart thermostat useful life at 10-11 years, consistent with the 10 year estimate in Table 5.

Question 9. What other methods are there to estimate the flexible demand capability of appliances that better account for the range of benefits enabled?

Daily load shift optimizations can be measured using a control group, as in the eco+ evaluation discussed above and available at <https://www.ecobee.com/en-us/ecoplusemv>.

Question 13. What other appliance load shape data sources are currently available?

See the eco+ evaluation results available at <https://www.ecobee.com/en-us/ecoplusemv>.

Question 22. What minimum standards are needed for cybersecurity of flexible demand appliances?

Generally manufacturer cloud to device communications will be secure, since device manufacturers have significant incentives to maintain security in order to protect brands, customer experience, customer privacy and data. This approach eliminates the vulnerability created from having a central point of attack for intrusions and malice. This approach also eliminates the need for utilities or the CEC to operate a distributed system with millions of end nodes, providing cost savings to consumers. Therefore, ecobee recommends that the Commission leverage that existing secure relationship for these standards.

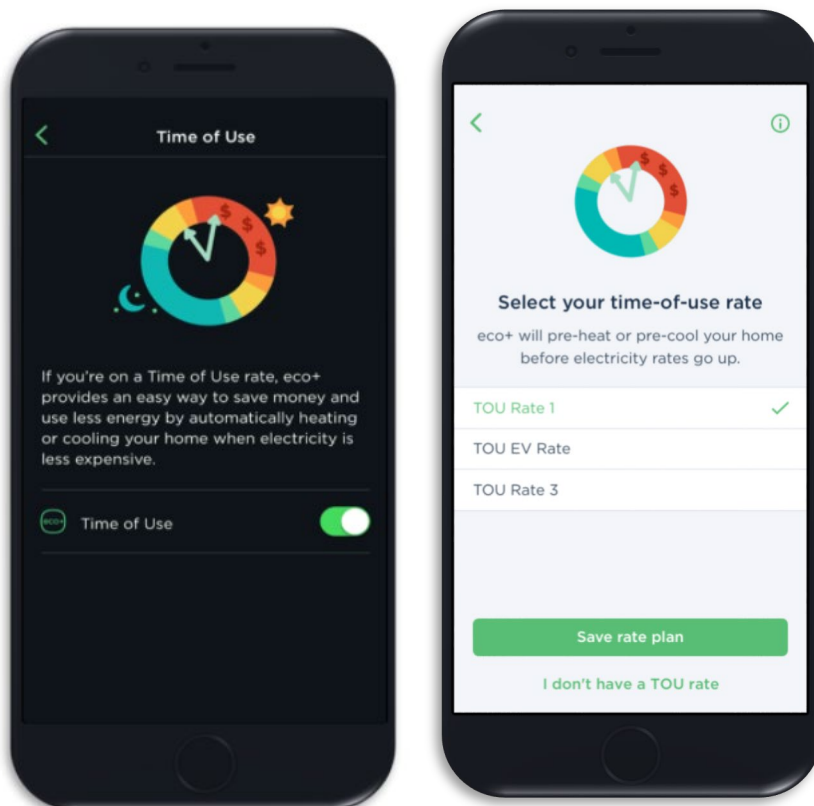
Device manufacturers can update device security and patch vulnerabilities via cloud firmware updates, whereas third parties are unable to do this because the firmware is designed and maintained by the device manufacturer. The device manufacturer can also provide Cloud-to-Device encryption to limit communications to the device from manufacturer clouds. Where applicable, Two-Factor Authentication for device access and control can be utilized in order for the user to validate their identity before their device configurations can be altered. In general, ecobee supports the National Institute of Standards and Technology Cybersecurity Framework Version 1.1. Further, manufacturers who sell products in California must already comply with California SB-327 Ch. 886 Information privacy: connected devices.

The CEC should not require a direct connection from utilities through OpenADR or otherwise in order to decrease vulnerabilities that could occur from having a single point of failure or intrusion for malicious attacks. In addition to reducing attack points, this will allow reliance on the existing secure connection through the device manufacturer.

Questions 23-27: Customer Consent

ecobee strongly supports allowing in-app capabilities as through its eco+ platform. The eco+ software upgrade is presented to users through an in-app interstitial. The time-of-use optimization screen is depicted below in Figure 2. Customers are presented with the option of turning on the time-of-use feature by selecting their appropriate rate from a list of eligible TOU rates available to their home address. The customer's rate selection can then be made available to ecobee's utility partners via the ecobee Utility APIs.

Figure 2 - eco+ Time-of-Use Optimization enrollment screen



This simple process is key to achieving broad consumer uptake. Fundamentally, the less friction for the customer in providing necessary authorizations, the more likely the customer is to choose to participate in providing flexible load resources. Illustrating this point, a 2019 report by the California Public Utility Commission’s Energy Division described an analysis by demand response provider EnergyHub finding that requiring customer provision of utility account numbers significantly decreased demand response (DR) program enrollment as compared to a simpler enrollment process through Smart Meter Texas requiring only the customer name and address:

requiring customers to provide utility account numbers to enroll in DR programs – not required in programs in Texas – resulted in an 84% drop-off in customer enrollments. In addition, requiring customers to complete CISR [Customer Information Standardized Request] forms resulted in a 39% decrease in customer enrollment applications, according to EnergyHub. These obstacles led EnergyHub to enroll just

3% of eligible California customers it targeted for DRAM [the Demand Response Auction Mechanism], as compared with over 40% in Texas.⁸

There are other models across the country, such as Smart Meter Texas and the Massachusetts Clean Peak Standard, that have been developed to simplify the customer experience and maximize participation through simple enrollments, while retaining the ability to audit service providers. This is a superior approach to making the process so complex for customers that it reduces participation significantly.

Question 28. What considerations should inform staff analyses on the projected equity impacts of proposed standards, to ensure flexible demand appliance sold or leased in California benefit all Californians?

ecobee supports utility programs to discount hardware purchases and provide free installation in order to maximize equity and reduce barriers to participation. The California Public Utilities Commission is considering these types of issues in docket R.20-11-003.

Question 30. What percentage of thermostats have a scheduling function for automating thermostat operation?

Question 31. What percentage of thermostats sold or leased in California have an ability to connect to the internet?

As noted above, connected thermostats have an approximately 25% market penetration in the United States.⁹

Question 32. What percentage of thermostats sold or leased in California have an ability to receive and act upon simple OpenADR commands to alter the thermostat operating schedule?

⁸ Energy Division's Evaluation of Demand Response Auction Mechanism – Final Report [Public Version – Redacted] at (Jan. 4, 2019), *available at* <https://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442460092> (citing EnergyHub, "Optimizing the demand response enrollment process: Best practices for customer enrollment and a seamless customer experience," White Paper, 2016, *available at* <https://info.energyhub.com/optimizing-demand-response-enrollment>).

⁹ Statista, Which smart home devices does your household own?, <https://www.statista.com/statistics/1124290/smart-home-device-ownership-us>.



As discussed above, ecobee urges the CEC to pursue OpenADR only on a cloud-to-cloud rather than a device level. This is critical for security and to ensure that these standards are backwards compatible through cloud-to-cloud, since smart thermostats are already in 25% of U.S. homes. ecobee would oppose any standard that requires OpenADR at the device level as a hardware requirement.

Thank you for the opportunity to participate in this important proceeding. We look forward to continued engagement with the CEC regarding the Flexible Demand Appliance Standards.

Respectfully submitted,

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