DOCKETED	
Docket Number:	24-FDAS-03
Project Title:	Flexible Demand Appliance Standards for Low-Voltage Thermostats
TN #:	260346
Document Title:	Lawrence Berkeley National Laboratory Comments - Berkeley Lab Comments - CEC RFI Potential Flexible Demand Appliance Standards for Low-Voltage Thermostats (24-FDAS-03)
Description:	N/A
Filer:	System
Organization:	Lawrence Berkeley National Laboratory
Submitter Role:	Public Agency
Submission Date:	11/27/2024 1:15:43 PM
Docketed Date:	11/27/2024

Comment Received From: Lawrence Berkeley National Laboratory
Submitted On: 11/27/2024
Docket Number: 24-FDAS-03

Berkeley Lab Comments - CEC RFI Potential Flexible Demand Appliance Standards for Low-Voltage Thermostats (24-FDAS-03)

Please see comments attached.

Additional submitted attachment is included below.

November 27th, 2024
Michael Sokol
Director of the Efficiency Division
California Energy Commission
Docket Unit
Re: Docket 24-FDAS-03
715 P Street
Sacramento, CA 95814

Re: Lawrence Berkeley National Laboratory Response to CEC's Request for Information (RFI) Potential Flexible Demand Appliance Standards for Low-Voltage Thermostats

Director Michael Sokol,

Berkeley Lab is pleased to present our response to the CEC's Request for Information (RFI) on Potential Flexible Demand Appliance Standards for Low-Voltage Thermostats.

Question 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?

Cluster load shapes from the LBNL-Load model, developed for Phase 4 of the CPUC Demand Response (DR) Potential Study, are available online (https://buildings.lbl.gov/potential-studies). These cluster load shapes include heating, cooling, and ventilation (for the commercial sector) end use loads that are modeled based on a temperature regression model. While the parameters of the regression model were based on real site-level meter data, they are not based on submetering of HVAC loads and therefore do not represent some of the behavioral nuances that other load shape data sources may include.

Staff may also wish to consider data sources from building simulation and forecasting models such as ResStock (NREL), ComStock (NREL), and Scout (LBNL).

Question 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.

Question 8.b. How much energy load in kW is each low-voltage thermostat shifting?
In California Load Flexibility Research and Deployment Hub (CalFlexHub) field testing at dozens of homes with two different thermostat vendors, Berkeley Lab researchers have measured ~0.8-1.5 kW of load shed per home as an exemplary performance over 2-3 hours peak price times. These are the load shed for high performing price response events. Often the response is lower. In some cases the load shed is coupled with one hour of precooling immediately before the shed, or high price time. The above performance was observed from deploying a 3F cooling setpoint reset and is dependent on a number of factors such as weather, size of home or cooling load, and whether

precooling is used. Please note that the average performance from the field test is significantly lower due to manual override, connectivity issues and other factors.

Question 8.c. What is the time shift duration?
In the CalFlexHub field testing described above, we refer to the results as "load shed". We were hesitant to call it "load shift" because although 1-hour precooling was used in the majority of the test days, compared to 2-3 hours of setback, it's not enough to actually shift the curtailed energy consumption; we looked at the short period precooling as an improvement of comfort. True load shift will likely require longer precooling.

Question 8.d. What are the participation rates with an opt-in and opt-out framework?
Berkeley Lab Researchers used the opt-in method for CalFlexHub field testing and the participation rate with ~$30 incentive level was still quite low.

Question 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 aggregations of (customer-consented) HVAC loads.

For communication protocols in general, most focus either on device ‘functional control’ (turning something off or on, changing a setpoint, changing an operating level, etc.) or carry ‘grid signals’ e.g. prices, or event-based DR commands. A few protocols cover both.

The "Matter" communications protocol enables devices in buildings to communicate with each other for a variety of purposes, mostly functional control, but the upcoming revision is expected to include carrying prices. It also supports useful functionality such as devices reporting their own energy use.

In 2019, Apple, Google, Amazon, and many other companies joined forces to finally create Matter, which is likely to become the *de facto* application layer standard for connecting ordinary building devices. The communication landscape is otherwise highly scattered among proprietary protocols and open standards implemented by small fractions of the market. Having one standard would dramatically increase interoperability and facilitate energy savings not otherwise possible without custom integrations or awkward gateways between protocols. How much and how fast Matter catches on is something only time will tell, but it is quite plausible that it quickly grabs. The Matter protocol can facilitate a variety of features useful for energy analysis, energy efficiency, and demand flexibility.

For grid signals, the relevant technology standards are OpenADR and IEEE 2030.5. 2030.5 can carry demand response signals (including prices) but to date is almost entirely used for managing inverters (plus capacity management in Australia). OpenADR 2.0b is almost entirely used today for cloud-cloud communication as implementing it is complex. By contrast, OpenADR 3.0 is so simple it could be put into a Wi-Fi light bulb. OpenADR 3.0 can carry all of the useful signals of 2.0b - and more. It can be a vehicle to send either prices or functional controls to thermostats (e.g. changing their setpoint), as well as tracking consumption.

Several of the smart thermostat companies have incorporated OpenADR at the vendor cloud level that allow them to receive signals from utilities or third parties and participate in DR events. The OpenADR Alliance web page provides a list of all OpenADR certified thermostats. See
https://products.openadr.org/?_sf_ppp=10&_sft_client-type=thermostat&sf_paged=4
This query shows 38 thermostat products that are certified for OpenADR. This query does not separate residential and commercial thermostat technologies but a quick scan of the list shows that about half or more of the 38 products are residential systems. The OpenADR compliant product web pages list which OpenADR profile the thermostat product is compliant with. See for example, the public information about ecobee, which lists that it is compliant with OpenADR Profile 2.0b.
https://products.openadr.org/product/ecobee-inc-ecobeedr/

Since OpenADR 3.0 is so new, it is likely few are compliant with OpenADR 3.0 but they are compliant with OpenADR 2.0. There are also thermostat vendors who offer OpenADR “compliant” communication for their thermostat systems. These companies are compliant with the protocol and can receive and respond to OpenADR signals, but they are not technically certified.

Question 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.

CalFlexHub research has shown that many smart thermostat technologies rely on using a 3rd party optimization platform rather than building the capability to respond to dynamic pricing in the thermostat companies cloud optimization. As far as business models, these thermostat manufacturers charge 3rd parties a device fee plus an API fee. Now that the IOUs’ Expanded Dynamic Rates pilots are approved and close to launch, it might start to change how the manufacturers think about the issue. The availability of dynamic prices may motivate thermostat manufacturing to build the capability to integrate with MIDAS.

Question 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 CEC CalFlexHub conducts research on price responsive end-use equipment. While CalFlexHub does not have information on what percentage of thermostats sold can respond to MIDAS data, it does have other potentially valuable information.

CalFlexHub has conducted research with two connected thermostats brands that have participated in dynamic pricing tests. Both demonstration projects are led by a partner who is a third party aggregator, DERMS and VPP provider. In both cases, the thermostat manufacturers chose to not invest in developing their own capabilities to receive and respond to pricing signals themselves but rather to provide an API integration option for a 3rd party. In the case of CalFlexHub, our third party aggregator partner can receive hourly the prices and convert the high and low price times to events that can be interpreted by a smart thermostat like a traditional DR event. This DR event information was communicated through the proprietary API to the thermostat. The thermostat manufacturers have informed us that they do not see their customers asking for price response capabilities, so they have not developed MIDAS integration yet.

CalFlexHub's fictitious price and GHG signals (presented in 24 hour pairs for each season https://calflexhub.lbl.gov/calflexhub-affiliate-program/) are hosted on both the CEC MIDAS and the CalFlexHub price server. There are several demo projects in CalFlexHub that have used MIDAS but not the CalFlexHub residential thermostat projects.

Separate from CalFlexHub activities, we are aware that at least one residential thermostat company's technology can respond to GHG signals as well as TOU signals but we are not aware of their current status integrating with the MIDAS API.

Berkeley Lab appreciates the opportunity to provide these comments in response to the CEC's RFI on Potential Flexible Demand Appliance Standards for Low-Voltage Thermostats.

The following individuals contributed comments: Jingjing Liu, Bruce Nordman, Mary Ann Piette, and Sarah Smith.

Sincerely,
Alecia Ward
Leader, Program and Business Development
Energy Technologies Area
award@lbl.gov