



Upgradeable Setback Thermostats

California Statewide Utility Codes and Standards Program

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California Energy Commission
Staff Pre-Rulemaking Workshop
2013 Title 24 Part 6

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Overview

- Existing requirement for setback thermostats modified to require Upgradeable Setback Thermostats (USTs)
- Upgradeable refers to ability to add communication to thermostat without tools
- Communication will enable end-user to shed A/C load if voluntarily participating in demand response programs

Type of Change

- Change language in Section 112(c) and Section 150, which does not allow tradeoff against other building features
- Default 4°F setback by UST in response to demand response signal
 - Set back can be user-defined
 - User can override setback at any time

Background

- Why Demand Response?
 - Enhance grid reliability and prevent rolling blackouts
 - DR is more cost effective than building additional power plants to meet peak demand (only a few hours annually)
 - California utilities are moving towards Peak Day pricing
 - Pass high cost of delivering power during critical periods on to customers, rather than average into summer rates
 - Creates an opportunity for consumers to manage their bills
 - Studies show that enabling technology provides ~2x the load impact as DR using pricing or incentives alone¹
 - Customer participation in DR programs and events are **VOLUNTARY**

1. Faruqi and Sergici, "Household Response to Dynamic Pricing of Electricity: A Survey of the Experimental Evidence," February 15, 2010

Background

- Why Demand Responsive Thermostats?
 - Residential and commercial A/C represent at least 30% of summer peak electricity loads²
 - Other loads are also becoming more easily shed as part of demand response
 - Lighting
 - Refrigerators
 - Washing machines
 - Plug loads / power strips

2. <http://www.cpuc.ca.gov/cfaqs/howhighiscaliforniaselectricitydemandandwheredoesthepowercomefrom.htm>
June 8, 2010

Existing Language – 112(c)

- **112(c) Thermostats.** All unitary heating and/or cooling systems including heat pumps that are not controlled by a central energy management control system (EMCS) shall have a setback thermostat.
 - **1. Setback Capabilities.** All thermostats shall have a clock mechanism that allows the building occupant to program the temperature set points for at least four periods within 24 hours. Thermostats for heat pumps shall meet the requirements of Section 112(b).
 - **EXCEPTION 1 to Section 112(c):** Gravity gas wall heaters, gravity floor heaters, gravity room heaters, non-central electric heaters, fireplaces or decorative gas appliances, wood stoves, room air conditioners, and room air-conditioner heat pumps need not comply with this requirement. Additionally, room air-conditioner heat pumps need not comply with Section 112(b). Under performance method of compliance, the resulting increase in energy use due to elimination of the setback thermostat shall be factored into the compliance analysis in accordance with a method prescribed by the Executive Director.

Background – 2008 PCT Proposal

- Programmable Communicating Thermostat (PCT) proposal for 2008 code:
 - Built-in one-way communication (RDS)
 - Add expansion slot to allow utility or service provider to utilize different communication method
 - Mandatory response to emergency events
 - Met with political resistance
- This is different

2013 UST Proposal

- Realize there were legitimate consumer concerns with previous proposal
 - No more mandatory participation in emergency events
 - Allow for manual override
 - Added requirement to allow for physically disabling the communication component of the thermostat
 - Default demand response is 4°F setback, but can be defined by the user
- Participation in DR program/event is voluntary

Technology

- USTs would be allowed in 2 configurations:
 - Plug-in interface for a (removable) communication device, for example USNAP
 - Built-in communicating device that can be completely turned off by a switch on the thermostat case (existing buildings)
- Communicating thermostats are currently available at a variety of price points



Preliminary Cost Analysis

- Surveyed HomeDepot.com
 - 7-day touch screen programmable thermostat
 - \$59.98 without communication
 - \$99.88 with 2 USNAP ports (including Wi-Fi module)
 - Communication module adder
 - \$96.82 – adds communication to an existing tstat
 - Average of these two price points: \$68.36
 - Effective Useful life: 15 years (1999 ASHRAE)
 - Assume incremental cost of \$0 after 15 years
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Savings – Assumptions (Res & NR)

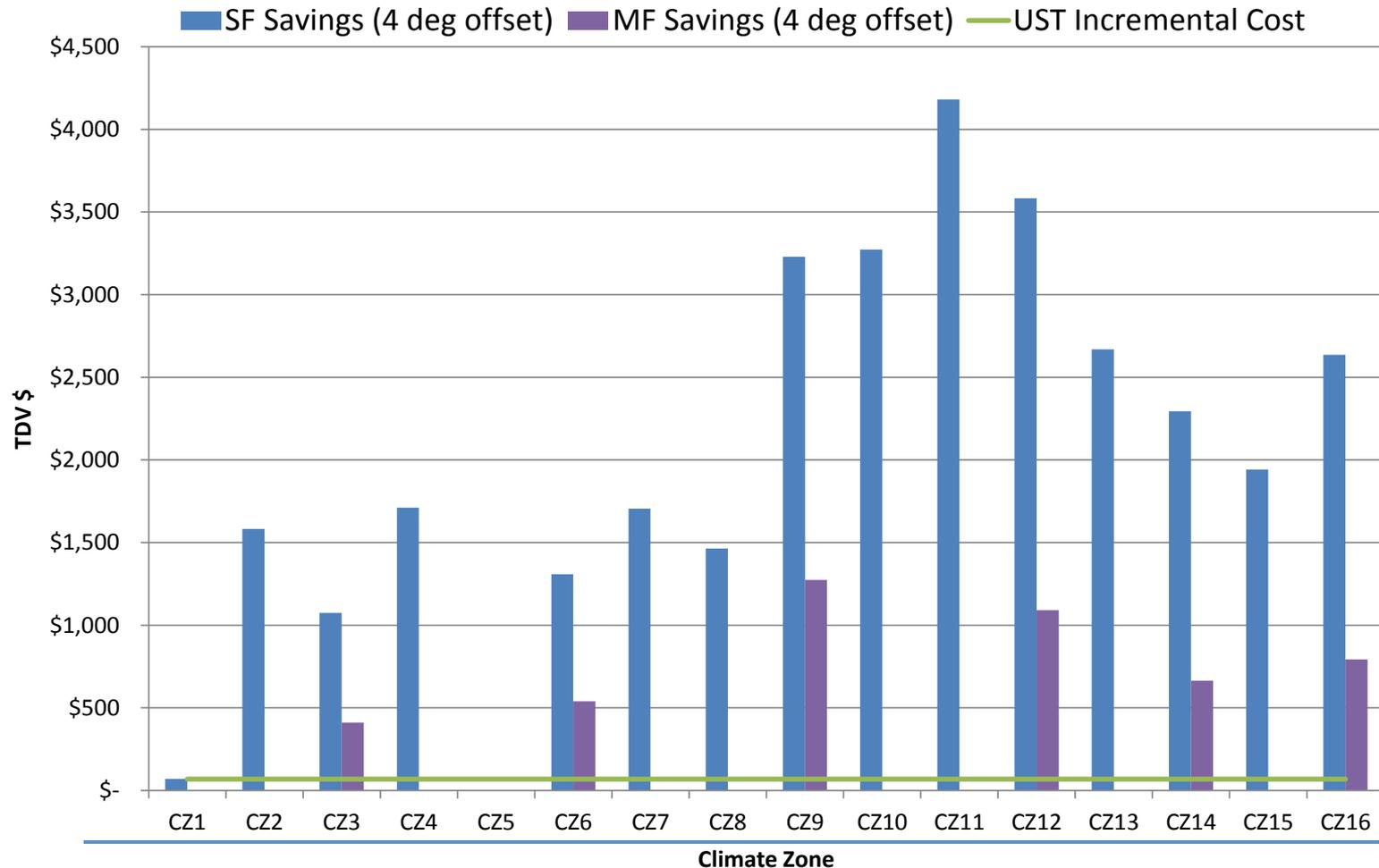
- Customers on time of use rate with peak day pricing (critical peak pricing) by default
 - Identified top 1% of TDV hours (88 hours) as demand response events
- Modeled energy impact of 4 degree setback during each peak hour
- Customer Participation Rate – 70%
 - Assume 30% of customers opt out of CPP rate
- Event Override – 10%

Savings – Residential (30-year TDV)

Single Family Dwelling savings per UST				Multi-Family Dwelling savings per unit (UST)			
Climate Zone	Electricity Savings (kWh)	Demand Savings (kW)	Residential TDV \$ Value	Climate Zone	Electricity Savings (kWh)	Demand Savings (kW)	Residential TDV \$ Value
CZ1	3	0.00	\$71	CZ1	-	-	-
CZ2	26	0.00	\$1,582	CZ2	-	-	-
CZ3	15	0.00	\$1,075	CZ3	5	0.00	\$410
CZ4	28	0.00	\$1,712	CZ4	-	-	-
CZ5	0	0.00	\$0	CZ5	-	-	-
CZ6	18	0.00	\$1,308	CZ6	7	0.00	\$540
CZ7	25	0.51	\$1,706	CZ7	-	-	-
CZ8	32	0.18	\$1,464	CZ8	-	-	-
CZ9	58	0.49	\$3,229	CZ9	17	0.28	\$1,274
CZ10	66	0.70	\$3,273	CZ10	-	-	-
CZ11	89	-0.01	\$4,180	CZ11	-	-	-
CZ12	80	-0.01	\$3,582	CZ12	21	0.00	\$1,091
CZ13	84	0.79	\$2,669	CZ13	-	-	-
CZ14	78	0.47	\$2,295	CZ14	21	0.14	\$664
CZ15	96	0.01	\$1,941	CZ15	-	-	-
CZ16	52	1.24	\$2,637	CZ16	14	0.40	\$793

Savings – Residential (30-yr TDV)

Residential Savings per UST



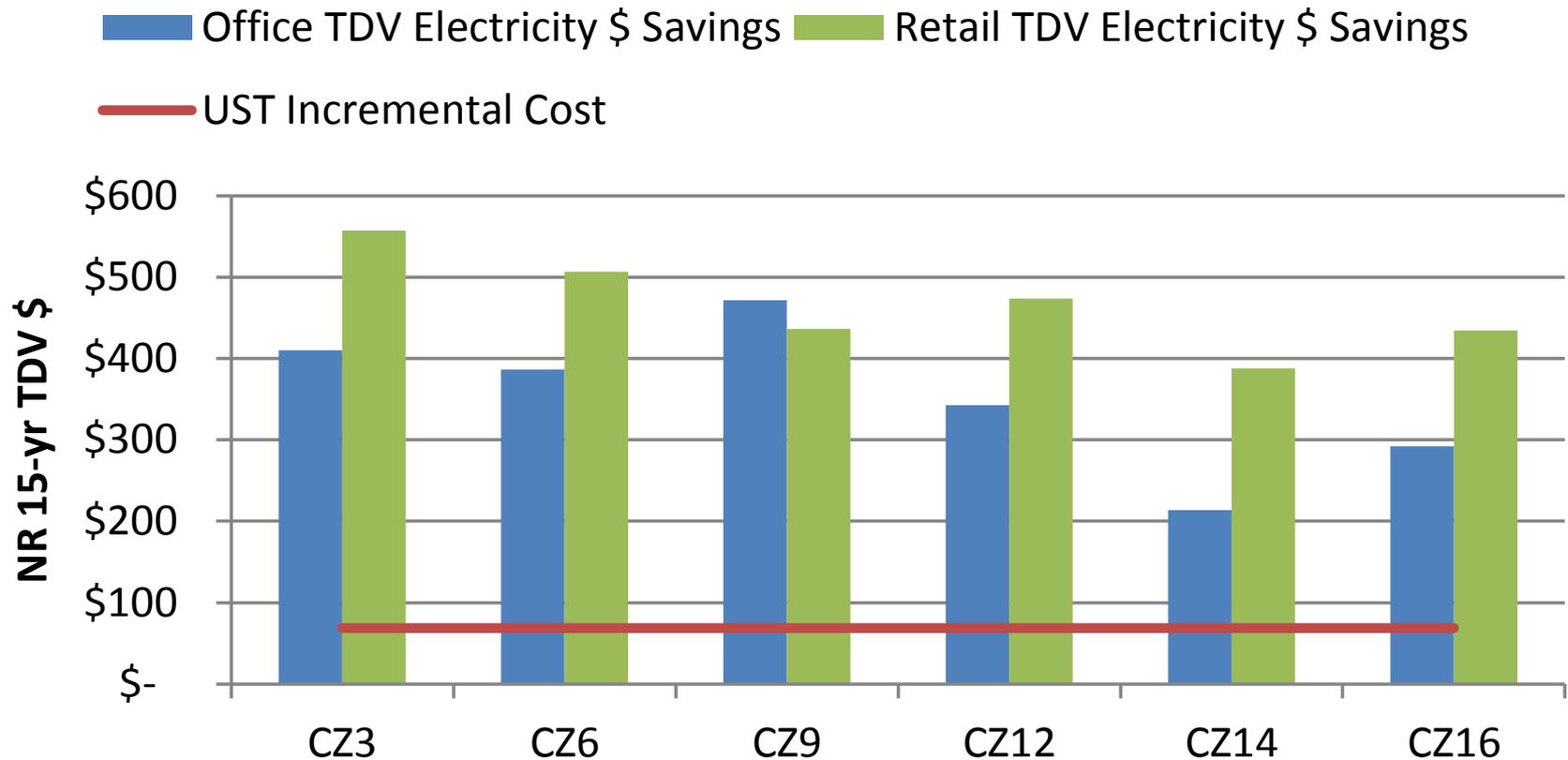
Savings – Nonresidential

Climate Zone	Office savings per unit (UST)		
	Electricity Savings (kWh)	Demand Savings (kW)	Office TDV Electricity \$ Savings
CZ3	27	0.09	\$ 410
CZ6	23	0.09	\$ 387
CZ9	26	0.12	\$ 471
CZ12	22	0.11	\$ 343
CZ14	17	0.08	\$ 214
CZ16	18	0.08	\$ 292

Climate Zone	Retail savings per unit (UST)		
	Electricity Savings (kWh)	Demand Savings (kW)	Retail TDV Electricity \$ Savings
CZ3	37	0.12	\$ 557
CZ6	31	0.12	\$ 506
CZ9	25	0.12	\$ 437
CZ12	30	0.15	\$ 473
CZ14	31	0.15	\$ 388
CZ16	28	0.13	\$ 435

Savings – Nonresidential (15-yr TDV)

Nonresidential Savings per UST



Proposed Language – 112(c)2

- **112(c) Thermostats.** All unitary heating and/or cooling systems including heat pumps that are not controlled by a central energy management control system (EMCS) shall have an Upgradeable Setback Thermostat (UST) that is certified by the manufacturer to the Energy Commission to meet the requirements of Subsections 112(c)(1), 112(c)(2), and 112(c)3 below:
 - **2. Upgradeable Capabilities.** USTs shall not include onboard communication devices and shall have at least one industry standard expansion/communication port which will allow for the installation of a removable communication module. If the communication module is not present, the UST shall function as a programmable setback thermostat. When the communication module is installed by the occupant, the UST shall be capable of both receiving and responding to demand response (DR) signals including price and emergency signals sent by the utility. USTs, with the communication module installed, shall be capable of receiving and responding to the DR signals as follows:

Proposed Language – 112(c)2

- **A. Price Events.** Upon receiving a price event signal, the UST shall adjust the thermostat setpoint by the number of degrees indicated by the user for the duration specified in the event signal. The UST, upon installation of the communication module by the occupant, shall default to price event offsets of +4°F for cooling and -4°F for heating when a DR signal is present; however, occupants shall be able to change the offsets and thermostat settings at any time. The UST shall have the capability to allow occupants to define setpoints for heating and cooling in response to price signals as an alternative to temperature-offsetting response, as described in Reference Joint Appendix JA5.
- **B. Emergency Events.** Upon receiving an emergency event signal, the UST shall respond to a specific offset contained in the emergency signal for heating and cooling modes, as described in Reference Joint Appendix JA5.
- **C. Override Function.** For all DR events, including price and emergency events, the UST shall include a physical override function, which when activated by the occupant, restores the UST to the conditions just prior to the current DR event.

Proposed Language – 112(c)3

- **3. Other Required Capabilities.** USTs shall also have the following capabilities onboard, as described in Reference Joint Appendix JA5:
 - **A.** The expansion/communication port shall be readily accessible to the occupant for installing and removing the communication module. The occupant shall be able to insert or remove the communications module without the need to use tools or hardware.
 - **B.** Provide user information regarding communications system connection status, type of event DR event, such as price or emergency, and other maintenance-related information. This information shall be on the standard UST display, using a Liquid Crystal Display, standalone indicator using Light Emitting Diodes, or other means.
 - **C.** At a minimum, standardized terminal mapping of terminal numbers 1-9. This approach must include 24 volt power supply, both analog and digital USTs, and must support heat pumps with resistance heat strips and reversing valve in both residential and small commercial packaged units.
 - **D.** Include the capability to randomize, over a 30-minute period after the end of an event, the time at which the thermostat returns to the programmed setpoint.
 - **E.** Include the capability to allow the occupant to restore the default temperature offsets and setpoints to levels specified in 112(c)2A and Reference Joint Appendix

Proposed Language – 112(c)

Exceptions

- **EXCEPTION 1 to Section 112(c):** Gravity gas wall heaters, gravity floor heaters, gravity room heaters, non-central electric heaters, fireplaces or decorative gas appliances, wood stoves, room air conditioners, and room air-conditioner heat pumps need not comply with this requirement. Additionally, room air-conditioner heat pumps need not comply with Section 112(b).
- **EXCEPTION 2 to Section 112(c):** Other devices within the heating and cooling system capable of providing equivalent demand response functionality described in Section 112(c) that is approved by the Executive Director.
- **EXCEPTION 3 to Section 112(c):** Thermostats installed in existing buildings including new additions to existing buildings, may be equipped with onboard communication devices provided that the thermostats are equipped with a physical on/off switch that cuts off power to the onboard communication device without affecting normal functioning of the setback thermostat.

Any Questions?

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