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NRDC 45-Day Language Hearing Comments

Additional submitted attachment is included below.

NRDC Comments on the 2019 Building Energy Efficiency Standards 45-Day Language Lead Commissioner Hearing

2/21/18

The Natural Resources Defense Council (NRDC) appreciates the opportunity to comment on the California Energy Commission (CEC)'s 45-Day Language for the 2019 Building Energy Efficiency Standards ("the standards") following the February 5-6, 2018, Lead Commissioner Hearing. The standards are an important policy tool to help California implement its climate and energy goals. By requiring homes to be built as efficiently as is cost effective, and calling for their annual electricity use to be offset by on-site solar generation, the 2019 code is a major step toward zero net energy (ZNE). CEC's work to remove standards-related hurdles to electrified space and water heating is a major step towards buildings that have a minimal carbon footprint, not just minimal energy use.

NRDC is generally very supportive of CEC's proposal for the standards. They represent a significant and cost-effective step forward towards the deep decarbonization of CA's building sector – the second-largest source of greenhouse gas emissions in the state. The standards will provide major energy savings, $1.7 billion in net benefits to California, and significant health benefits from the reduction of indoor and outdoor air pollution from the burning of fossil fuels in buildings and at power plants.[1]

The standards prescribe energy and water savings measures that are cost effective – in other words, homeowners save more on utility bills than they spend on efficiency improvements. As occupants attest, a more energy-efficient home is also a more comfortable home.[2] For owners, homes with an energy efficient certification sell faster — and at a premium — than homes without one.[3] And for low-income residents, making housing more energy efficient will provide

[1]http://docketpublic.energy.ca.gov/PublicDocuments/17-BSTD-02/TN222219_20180118T161547_Draft_Explanatory_Memorandum_for_the_2019_Standards'_Economic_a.pdf
[2]https://energy.gov/articles/home-energy-audits-making-homes-more-energy-efficient-and-comfortable
[3]https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/Energy%20Efficiency%20for%20Real%20Estate%20Professionals%20non-editable_0.pdf

real relief from high energy bills and increase their disposable income. In California, low-income households spend twice as much on energy as a percentage of income than the statewide average.

Building Envelope

NRDC supports energy efficiency, particularly of the building envelope, as the primary means to achieve energy savings in buildings. Envelope energy efficiency measures last a long time and are much easier to include in a home during initial construction. They provide savings day and night, summer and winter, not simply when the sun is shining and the PV array is generating energy. California utilities are facing a growing challenge of net electricity demand ramping up quickly as home and grid-scale PV production drops in the evening, and CEC is working hard to develop grid harmonization approaches to minimize that effect. In line with California's carbon emissions reduction goals, homes that are designed to be as efficient as possible are critical to help mitigate this effect.

We support the improvements being made to prescriptive and mandatory envelope energy efficiency. For single family homes, the maximum prescriptive U-factor for high performance walls will be reduced to 0.048 from 0.051 in climate zones 1-5 and 8-16. While this change represents less of an improvement than was deliberated in the pre-rulemaking, we see it as sensible given the technical challenges raised. NRDC also supports the improved prescriptive insulation requirements for high performance attics in single family homes, for which the requirements have been simplified, and, in the cases of climate zones 4 and 8-16, which will be increased from R-13 to R-19. Similar adjustments will be made for multifamily. A modest increase in the prescriptive insulating properties of windows and a reduction in allowed solar heat gain coefficient are also part of the code change, as well as a narrowed allowance for glazing on doors. Quality insulation installation, a procedure for installing and verifying the efficacy of insulation, will be a prescriptive requirement in the code for the first time, something NRDC strongly supports.

Mandatory Solar Photovoltaic (PV)

NRDC supports the mandatory PV requirement in residential new construction, separate from the efficiency requirements, which has been a key aspect of this proposed code change. PV is an essential renewable energy source that will enable California to reach its long-term carbon reduction goals. PV will also save its homeowners money – while the upfront cost accounts for a sizeable fraction of the $10,537 compliance cost for single-family home purchasers, over the life of the home the panels are expected to more than pay back. Under net-energy metering 2.0, code-required PV is expected to provide between $5,000 and $15,000 per household in net present benefit across California climate zones, even factoring in a range of future PV costs. This provides a wide path forward for cost effective PV in all climate zones, which extends even to the case of aggressive net-energy metering reform or higher-than-expected PV cost.

In addition, innovative low- or no-cost financing options are becoming widely available to help offset PV purchase price. More solar in California will also increase solar industry jobs related to construction, installation, and maintenance of solar systems. The commission expects 200 MW of small-scale solar to result from this code in 2020, a modest boost to statewide small-scale installations that already measured 1.2 GW this past year.

NRDC asks that CEC finalizes several critical open items:

Performance Path Baseline for Electric Water Heating

We strongly support CEC's commitment, announced at the February 5th hearing, to provide an independent compliance option for electric water heating. The lack of such a baseline in the current code is a major barrier to unlocking the potential for high-efficiency electric water heating to reduce GHG emissions in new buildings. We support CEC's proposed approach that would set the baseline to an electric water heater that meets federal minimum energy efficiency standards, combined with two complementary efficiency measures, as discussed by CEC staff at the hearing: compact distribution and drain water heat recovery. We expect this addition to take the form of a standard design described in the Alternative Calculation Method (ACM) Reference Manual, to be discussed at a CEC workshop in May 2018.

Flexible Load Credit for Electric Water Heating

We support CEC's proposal to provide a limited compliance credit to battery energy storage systems, that will provide several energy design rating (EDR) points of credit towards the energy efficiency target score. Providing a credit for energy storage is important because it has a critical role to play in helping California achieve its clean energy and greenhouse gas (GHG) reduction goals in an affordable manner. Reaching these targets requires affordable solutions to mitigate the imbalance between energy supply and demand, known as the "duck curve". We believe that the proposed storage credits are appropriately balanced with energy efficiency requirements which remain critical to energy savings and GHG emissions reductions.

We urge CEC to make a similar credit available to thermal storage systems – including grid-connected flexible electric water heating and pre-cooling or pre-heating – when they are controlled similarly to the control schemes prescribed for battery storage. Credit for energy storage should be technology neutral and performance-based. We have included a proposed draft specification for electric water heating to qualify for this credit as an appendix.

We expect the credit from thermal storage measures to be smaller than the battery credit, reflecting smaller, but nonetheless important and very affordable, storage capacity. The total storage credit that can be counted toward efficiency requirements should not exceed the battery storage credit, in order not to provide excessive trade-off on the efficiency of the building envelope, which remains critical to energy savings and GHG emissions reductions.

Carbon Emissions Reporting in CBECC-Res

For the first time, the residential standards compliance software, CBECC-Res, will report home carbon emissions in addition to energy performance. NRDC appreciates and strongly supports this update. We further request that CEC initiate stakeholder discussions on the GHG emissions profile used to produce these results. We ask CEC to publish the existing hourly schedule and methodology prior to soliciting stakeholder input so we may improve the carbon valuation methodology to reflect accurately the emissions impacts of energy design choices made in the 2020-2022 period.

Compact Hot Water Distribution System Credit (RA4.4.6)

NRDC strongly supports the inclusion of a performance path credit for compact hot water distribution systems, laid out in Reference Appendix RA4.4.6. The criteria for determining eligibility can all be calculated at the project design phase, and require no special drawings or on-site measurements. These are significant benefits that should greatly improve the likelihood that water- and energy-saving compact designs for domestic hot water (DHW) distribution systems will be installed in new residential building projects. The basic credit will provide a 30% reduction in the energy lost by the DHW distribution system due to pipe heat loss and the purging of cooled-down hot water at the fixture, with larger credits available for projects with additional documentation.

NRDC urges the following clarifications and corrections:

1. Revise the language on Weighted Distance for clarity as follows: “MasterBath = The plan view, straight line distance from the water heater to the furthest fixture <u>served by that water heater</u> in the master bathroom (feet).” Make similar revisions for Kitchen and FurthestThird. In projects

with multiple water heaters, the distance between a hot water outlet and the water heater that is specifically serving that outlet is most relevant.

2. Table 4.4.6-2: Confirm the values shown in this table for 3-story homes. The value of coefficient "a" for Non-Recirculating distribution systems ("10") appears inconsistent with values in the table for 1- and 2-story homes, and may be a typographical error.

3. Footnote 7 has been edited incorrectly, and the word "either" should be "neither".

4. Revise Footnote 8 regarding the point of measurement as follows: "For example, a shower/tub combination would take the measurement from the ~~center~~ fixture supply outlet of the shower/tub, while a two sink lavatory in the master bath would take the measurement from the ~~center~~ fixture supply outlet of the furthest lavatory." Reference to the "center" of a fixture is unnecessarily imprecise. The water supply outlet is a preferable point of measurement, as it is a more specific point, just as visible in plan view, and the actual point of use by the end-user.

CALGreen

NRDC requests that CEC add to the CALGreen code a discussion of how CBECC-Res may be used to set emissions-based reach codes, as discussed at the hearings. NRDC also believes that CALGreen should include electrification-ready provisions to facilitate the installation of electrified appliances and vehicles. These provisions would call for new homes to include, for example, physical space and electric panel capacity to convert gas-based appliances to, for example, high efficiency electric water heaters and electric vehicles during the life of the home.

Appendix

Proposed Specification for Electric Water Heating with Load management for California Title 24 2019 Building Codes Standards

1. Purpose and Scope

This provides the requirements for an electric water heating system to qualify for a water heating load management credit(s) available in the compliance option set forth in the Alternative Compliance Method (ACM) Reference Manual.

This specification applies to electric water heating systems using either resistive or heat pump technologies.

The primary function of the electric water heating system with load management is daily load shifting for the purpose of customer bill reductions, maximized solar self-utilization, and grid harmonization.

2. Definitions: Local and Remote Load Management

This specification defines the minimum set of functions that shall be embedded into water heaters themselves to support grid services, such as demand response, that are common across the service territories of California.

Local load management:

The water heater uses on-premise time-of-use (TOU) management technology to manage water heater operation based on a TOU rate schedule. This provides automated cost management benefits to the user, and potentially also some benefit to the grid depending on how well the TOU schedule reflects grid marginal costs.

TOU rates provide a financial incentive for ongoing user participation, and the control user interface can be designed to maximize persistence. We assume fully automated load management, that does not depend on daily user actions. TOU load management is intended to operate in a "set and forget" manner: configured by the installer, and implemented to remain enabled unless temporarily overridden by the user.

Local load management does not require a remote load management dispatch service. TOU load management will still entail some grid-connectivity for periodic update of the TOU price schedule stored in the control module, for time synchronization, and for reporting purposes.

Example Local Load Management Use Case: The water heater is installed in a service territory with a specific TOU rate schedule. The building owner or consumer connects a technology that can automatically utilize load management functions embedded into water heaters to maximize performance against the building's TOU rate schedule. Enabling water heaters to provide this flexibility can provide significant benefits to the user and to the grid. Since rate structures may exclude weekends, holidays and can change from season to season, the communication architecture must allow for the technologies connected to the water heater to receive periodic updates of the applicable rate structure(s), for time synchronization, and perhaps for reporting purposes.

Note: With all California IOU customers presently scheduled to move to default time of use rates in 2019, the electric water heater system would provide automated cost management functionality for the California ratepayers.

Remote load management:

"Remote" load management use cases are designed to support dynamic grid conditions, and could be used for economic or reliability purposes. Remote load management provides maximum flexibility and grid/societal energy cost savings potential. But it also has significant infrastructure requirements, from reliable connectivity to grouping, scheduling and managing dispatchable assets.

Example Remote Load Management Use Case: A water heater automatically responds to a signal from a utility or aggregator that includes instructions to either moderately or aggressively decrease/increase demand or to stop using power altogether. For the water heaters to automatically respond in a predictable manner, the instructions sent in the dispatch signal must be mapped to specific load management functions embedded into water heaters.

This specification calls for **local** load management to be implemented and verified, and for the capability, but not necessarily the implementation of, **remote** load management. This is because remote load management depends on the availability of remote load management programs, on the customer enrolling in one, and on the availability of on-premise communications infrastructure. This approach provides a reasonable likelihood that load management benefits will be realized over the life of the water heater, justifying the attribution of a load management credit in the building code.

3 Qualification Requirements

To qualify as an electric water heating system with load management for compliance with applicable performance compliance credits, the electric water heating system and the on-premise water Heater TOU management technology shall be certified to the Energy Commission according to the following requirements:

3.1 Hardware Requirements

The electric water heater with load management shall:

a) Comply with all federal, state and local safety codes.
b) Have a nominal storage capacity of 30 gallons or more.
c) Be capable of increasing internal water temperature to 140 F or higher.

3.2 Water Heater Communication Requirements

The following requirements do not restrict the water heater manufacturer from using the same or secondary communication interface of their choice to provide additional functionality not defined herein to the building, consumers or to any third-party.

(a) The load management functionality as defined in Section 3.3.1 must be accessible to any third-party through a communication interface, physically located on the electric water heater system.
(b) The communication interface must support an Open Standard communication protocol, such as OpenADR, IEEE 2030.5, CTA-2045-A or equivalent, that is:
    i. Included in the Smart Grid Interoperability Panel (SGIP) Catalog of Standards,

ii. and/or Included in the National Institute of Standards and Technology (NIST) Smart Grid Framework Tables 4.1 and 4.2.3 and/or
iii. Adopted by the American National Standards Institute (ANSI) or another well-established international standards organization such as the International Organization for Standardization (ISO), International Electrotechnical Commission (IEC), International

b. All load management functionality and feedback as specified in Section 3.3.1 and Section 3.3.2 must be mapped to the application layer messages of the Open Standard.

(c) The mapping document as defined in Section 3.2(b)b must be publicly available
(d) All systems that use the same Open Standard must use the same map as defined in Section 3.2(b)b.
(e) The water heater system manufacturer shall provide instructions to configure, connect or disconnect technologies provided by third-parties.

3.3 Water Heater System Requirements

3.3.1 Control Requirements

This section specifies functions that would enable the equipment owner to use their water heater system to either provide services to the electric grid or be used locally to optimize performance against TOU schedules.

These functions must be enabled through the water heater's communication interface at time of purchase.

The following load management functions must be supported by water heater system:

(a) The consumer must be provided the means to override any or all control functions, either prior to or during the execution of load management.

I. The override must be temporary;
II. and must have a maximum duration of 72-hours;
III. and must remain in its normal operating mode for the duration of the override;
IV. and the override state must be made available through the communication interface.

(b) The water heating system shall always be in full control of its processes;

(c) and may either delay or reject a control request if responding would compromise safety or result in equipment damage as determined by the manufacturer.

(d) The following load management functions shall be supported:

Requirement Section	Grid Service Request	Required Response	Communication Interface Application Layer Functional Map (CTA-2045-A)
3.3.1(d)a	Decrease Stored Thermal Energy to a Low Level	Moderately reduce the stored thermal energy in the tank throughout the duration of the request For Heat Pump Water Heaters with resistive elements; on recovery, elements should not be used to return the stored thermal energy to its normal operating level. This request could be made multiple times per day, so consumer comfort level should be maintained at a high level throughout the duration of the request.	Shed <Basic> 0x01
3.3.1 (d)b	Decrease Stored Thermal Energy to a Low-Low Level	Reduce the stored thermal energy in the tank to a level less than 3.3.1(d)a throughout the duration of the event This request would occur less frequent than 3.3.1(d)a, therefore consumer comfort may be maintained at a lower level throughout the duration of the request	Critical Peak Event <Basic> 0x0A
3.3.1 (d)c	Stop Using Energy	Immediately, stop using energy. The only time this request should be made is to avoid outages. Frequency could be one request every year.	Grid Emergency <Basic> 0x0B
3.3.1 (d)d	Increase Stored Thermal Energy	Increase the stored thermal energy to a specified temperature that shall not exceed the safest maximum temperature, as determined by the manufacturer. For Heat Pump Water Heaters with resistive heating elements, the use of the elements should be avoided as much as possible to satisfy this request.	Load Up <Basic> 0x17

Requirement Section	Grid Service Request	Required Response	Communication Interface Application Layer Functional Map (CTA-2045-A)
		The frequency that this request could occur is the same as defined in 3.3.1(d)a and 3.3.1(d)b	
3.3.1 (d)e	Return to Normal Operations	End load control request execution and return to normal operation For Heat Pump Water Heaters with resistive heating elements, the use of the elements should be avoided as much as possible to satisfy this request.	End Shed/Run Normal <Basic> 0x02
3.3.1 (d)f	The next load management event is (x) and will start in (x) minutes	This message provides notification of the next load management request (3.3.1(d)a, 3.3.1(d)b, 3.3.1(d)c, 3.3.1(d)d)) and the time to (count down) to the next request. This command can be used to add additional energy to the tank prior to the event.	Pending Event Time <Basic> 0x18
3.3.1(b)g Optional	Relative Price of Energy	The Relative Price command is used in association with a range of price-based programs and lends strongly to consumer-configurability of response	Present Relative Price <Basic> 0x07

(e) If local communication across the port is lost for more than 15 minutes, e.g. if the module in unplugged, the water heater shall return to normal operations.

(f) If the water heater is under remote load management, and remote communication is lost for more than 12 hours, the water heater shall revert to local load management until remote communication is reestablished.

3.3.2 Feedback Requirements

This section specifies the information (data) required to perform closed loop control or to verify system performance.

The following information (data) must be made available through the communication interface.

(a) The data made available to technologies connected to the communication interface shall not be older than 60-seconds
(b) The following data must be made available through the communication interface:

Requirement Section	**Data Request**	**Required Response**	**Communication Interface Application Layer Functional Map (CTA-2045-A)**
3.3.2(b)a	Operational State	State 0 - Equipment is in normal operating mode and water is not being heated State 1 - Equipment is in normal operating mode and water is not being heated State 2 – Equipment is processing a request to curtail load and water is being heated State 3 – Equipment is processing a request to curtail load and water is not being heated State 4 - Equipment is processing a request to increase load and water is being heated State 5 - Customer override is in effect and water is not being heated State 6 - Customer override is in effect and water is being heated State 7 – Water heater is experiencing a fault and user intervention is required.	Query: What is your operational state? <Basic> 0x12 State Query Response <Basic> 0x13
3.3.2 (b)b	Power	Measured or estimated Instantaneous power consumption Units, Watts	GetCommodity Read Request and GetCommodity Read Reply Commodity Code = 0 <Intermediate> 0x06
3.3.2 (b)c Optional	Energy	Measured or estimated Cumulative energy consumption Units, Watt-hour	GetCommodity Read Request and GetCommodity Read Reply Commodity Code = 0 <Intermediate> 0x06
3.3.2 (b)d Optional	Total Energy Storage Capacity	Measured or estimated maximum stored energy capacity of the system Units, Watt-hour	GetCommodity Read Request and GetCommodity Read Reply Commodity Code = 6 <Intermediate> 0x06

Requirement Section	Data Request	Required Response	Communication Interface Application Layer Functional Map (CTA-2045-A)
3.2.2(b)e	Present Energy Storage Capacity	Measured or estimated present stored energy storage capacity Units, Watt-hour	GetCommodity Read Request and GetCommodity Read Reply Commodity Code = 7 <Intermediate> 0x06
3.3.2 (b)f Optional	Device Type	Option 1 - Water Heater Option 2 – Heat Pump Water Heater	Device Information Request and Reply <Intermediate> 0x01 Device Type: 0x0002 Water Heater – Electric Device Type: 0x0003 Heat Pump Water Heater
3.3.2(b)g Optional	Average Tank Temperature	Measured or estimated averaged water temperature of the tank	GetPresentTemperature Request and Reply <Intermediate> 0x03

3.4 On-premise Water Heater TOU Management Technology

The load management functions defined in section 3.3 must be usable by an external, on-premise control technology to optimize performance against TOU rate schedules.

The on-premise TOU management technology is hardware, either external or internal to the water heater, designed to manage the water heater control functions (as defined in Section 3.3) to optimize operations under different TOU rate schedules. The technology should be designed to enable the installer or customer to influence load management capabilities of the water heater system. This technology could provide additional building management services, but must;

a) Have at least two communication interfaces,
   1. One shall be compliant with the same Open Standard embedded into the water heater system (see Section 3.2); and support the application layer messages mapped to the requirements in Section 3.3.1 and Section 3.3.2.
   2. The second must be capable of retrieving or receiving TOU rate schedules that, at minimum,
      i. Supports four tables of 168-hour table, beginning for the hour ending 0100 Sunday, of any number of tiers or price values,
      ii. and a separate start date for each season

b) Have program settings implemented in non-volatile memory to be resilient to loss of power.

c) System clock shall have a battery backup.

d) Have an internal clock that can maintain accurate time by listening to WWV or GPS, with automatic DST support, and at least 20 years.

e) If price forecasts are available, the technology should optimize load management based on the forecast.

f) Automatically determine, execute and monitor the most appropriate load control strategy to use to provide the most value to the customer using their TOU rate schedule
   a. If price forecasts are available, the technology must determine, execute and monitor the most appropriate load control strategy to use to provide the most value to the customer using the forecast schedule

g) Include user interfaces with at least the following capabilities;
   a. LED to indicate the following information
      i. Communication between the Technology and water heater is healthy
      ii. Time sync has been lost
      iii. TOU table has been updated
   b. Manually setup and modify TOU rate schedules;
   c. Upload TOU rate schedules through an Open Standard, such as
      i. USB port that could enable TOU tables to be uploaded
      ii. IEEE 802.11 that can be accessed locally through a phone application that could be used to upload schedules.
   d. Provide a visualization tool to allow a building inspector or HERS rater to verify
      i. that TOU rate schedules have been entered correctly;
      ii. and the technology is successfully communicating with the water heater system; and
      iii. that all water heater control functions can be managed.

3.5 Installation Requirements

The electric water heating system with load management shall be installed with a thermostatic mixing valve complying with all federal, state and local safety codes, and that closes in a position that only allows cold water to flow on failure. The thermostatic mixing valve shall be either built into the water heater or installed separately.

The electric water heating system with load management shall be installed and setup either for local load management, or for remote load management with local load management as a fallback.

4. Field Verification

The electric water heater and on-premise water Heater TOU management technology shall be verified as model(s) certified to the Energy Commission as qualified for credit as an electric water heating system with load management.

In addition, the installation of the electric water heating system with load management shall be verified through field verification in accordance with the applicable procedures specified in Reference Residential Appendix RAX.Y.