



# CALIFORNIA STATEWIDE UTILITY CODES AND STANDARDS PROGRAM

*2016 Title 24 Codes & Standards Enhancement (CASE) Proposal*

## Instantaneous Water Heaters

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## Stakeholder Meeting: Agenda

- Code change overview
- Summary of current code requirements
- Trends
- Methodology for analyses
- Initial data and findings
- Proposed code requirements
- Specific stakeholder requests



# Proposed Code Change Overview

- Instantaneous Water Heaters (IWHs)
  - Natural gas, non-condensing, whole house
- Modification of prescriptive requirements for domestic hot water systems
- New residential construction
  - Single Family
  - Multi-family (individual dwelling units with dedicated water heater)
- Prescriptive requirement is baseline for performance approach (i.e. establishes energy budget for building)
  - Baseline is federal minimum Energy Factor (EF) rating of 0.82 for gas IWHs (2015)



## Proposed Code Change Overview continued

- Developing alternative prescriptive path
- Performance path
  - Can meet energy budget via other strategies
    - Installation of condensing storage water heater (EF 0.82 or higher)
    - Combination of upgrades that meet the energy budget



# Water Heating Product Types

## Types

- **Instantaneous** (typical EF 0.82+)
- High efficiency storage (ENERGY STAR®, EF 0.68)
- Standard storage (typical EF less than 0.67)
- Condensing storage (typical EF 0.82+)
- Condensing instantaneous (typical EF 0.90+)
- Point of use instantaneous (vs. whole house)
- Indoor or outdoor

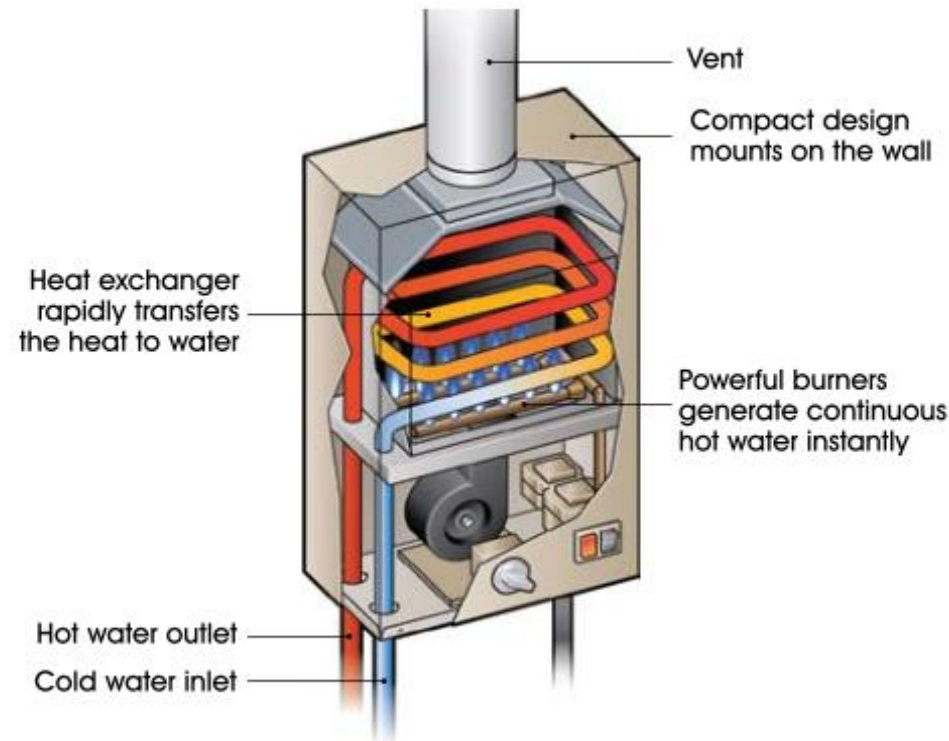
## Fuel sources

- **Natural Gas**
- Electric
- Liquid Propane
- Solar

## This proposed code change:

Whole house gas, non-condensing instantaneous water heater  
(also known as “tankless” and “on-demand” water heater)

## GAS TANKLESS WATER HEATER



*Reference and photo credit: AHRI*



## Reasons for Proposed Code Change

- Water heating accounts for 49% of natural gas energy consumption in California homes (RASS 2009)
- IWHs are typically more energy efficient than storage gas water heaters (no standby heat loss)
- IWH market share has expanded; lower unit costs
- This measure builds on the 2013 Title 24 mandatory requirements for domestic hot water systems
- By the time the 2016 Title 24 standards take effect in 2017, builders will be accustomed to designing for higher-efficiency water heaters



# Current Code Requirements: State

- **2013 Title 24 Requirements**

- Subchapter 7, Section 150.0(n) Water Heating System (mandatory requirements)

(n) **Water Heating System.**

1. Systems using gas or propane water heaters to serve individual dwelling units shall include the following components:
  - A. A 120V electrical receptacle that is within 3 feet from the water heater and accessible to the water heater with no obstructions; and
  - B. A Category III or IV vent, or a Type B vent with straight pipe between the outside termination and the space where the water heater is installed; and
  - C. A condensate drain that is no more than 2 inches higher than the base of the installed water heater, and allows natural draining without pump assistance, and
  - D. A gas supply line with a capacity of at least 200,000 Btu/hr.

- Subchapter 8, Section 150.1(c)8 Domestic Water-Heating Systems (**prescriptive** requirements)

- Currently, can install storage water heater or IWH



# Current Code Requirements: Federal

- **Existing Standards**

- Gas IWH (< 2 gal):
  - $EF = 0.62 - 0.0019 * V_s$  or higher
- Gas Storage (20 to 100 gal):
  - $EF = 0.67 - 0.0019 * V_s$  or higher

- **Future Standards**

*(effective April 2015)*

- Gas IWH (< 2 gal)
  - $EF = 0.82 - 0.0019 * V_s$  or higher
- Gas Storage:
  - 20 to 55 gal  $EF = 0.675 - 0.0015 * V_s$  or higher
  - 55 to 100 gal  $EF = 0.8012 - 0.00072 * V_s$  or higher

- **Current ENERGY STAR**

- Gas IWH:
  - $EF \geq 0.82$
- Gas Storage (20 to 100 gal):
  - $EF \geq 0.67$

$V_s = \text{Rated Storage Volume (gallons)}$





## Federal Preemption

- This measure would not violate federal building code preemption provisions in EPCA (42 USC 6297(f))
  - Measure would not establish a standard level that exceeds the federal minimum for equipment
  - Measure would not prohibit the installation of storage water heaters
  - Measure will provide an alternative for prescriptive compliance
- Instead, measure resets baseline building design to reflect EF rating for IWH, which meets but does not exceed the federal minimum standard



## Trends

### Increased market penetration

- 1995 – 2005 - **24%** increase in number of IWHs installed (Kema, 2008)
- 2004 – 2011 - **61%** increase in Internet searches for IWHs (NEEA 2011)
- 2015 - **~43%** natural market share for IWHs (DOE 2010)

### Drivers

- Update of Federal standards
- ENERGY STAR and rebate programs
- Title 24 compliance credits
- Decreasing unit costs
- Growing interest in other benefits (e.g., lower utility bills)



# Methodology for Energy Savings

## Assumptions

- For first year and annual statewide energy savings
  - Comparing natural gas consumption of the 2015 federal minimum efficiencies for (1) 50 gallon storage and (2) instantaneous
- Prototype Building
  - Residential: 2,500 SF, two-story
- Hot water draw schedule and distribution loss multipliers (found in RACM Appendix E)
- New construction forecasts
- Product lifespan



# Methodology for Cost Analysis

The following inputs will be included in the cost analyses for storage and instantaneous equipment:

- Equipment costs
- Installation costs
- Maintenance costs
- Equipment lifetime
- Natural gas TDV



# Initial Data and Findings

IWHs were determined to be cost-effective for new single-family construction in every California climate zone

Level	EF	Climate Zone																Average
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
<b>Gas-fired Storage Water Heater</b>																		
S2	0.63	\$420	\$428	\$428	\$431	\$429	\$436	\$441	\$439	\$440	\$440	\$435	\$432	\$441	\$435	\$461	\$411	\$434
S3	0.64	\$309	\$321	\$322	\$327	\$323	\$334	\$342	\$339	\$342	\$341	\$333	\$328	\$343	\$333	\$375	\$294	\$332
S4	0.65	\$281	\$298	\$299	\$305	\$301	\$316	\$327	\$323	\$326	\$326	\$314	\$308	\$328	\$314	\$373	\$261	\$313
S5	0.67	\$732	\$757	\$759	\$789	\$761	\$784	\$802	\$794	\$800	\$800	\$782	\$772	\$803	\$781	\$871	\$701	\$779
S6	0.77	(\$134)	(\$72)	(\$67)	(\$42)	(\$62)	(\$9)	\$38	\$20	\$34	\$32	(\$11)	(\$35)	\$42	(\$13)	\$207	(\$209)	(\$17)
<b>Gas-fired Instantaneous Water Heater</b>																		
14	0.82 (0.75)	(\$1,857)	(\$1,810)	(\$1,805)	(\$1,783)	(\$1,801)	(\$1,749)	(\$1,709)	(\$1,726)	(\$1,713)	(\$1,714)	(\$1,755)	(\$1,776)	(\$1,705)	(\$1,756)	(\$1,554)	(\$1,996)	(\$1,760)
15	0.84 (0.77)	(\$1,097)	(\$1,034)	(\$1,029)	(\$1,004)	(\$1,024)	(\$967)	(\$923)	(\$941)	(\$927)	(\$928)	(\$973)	(\$996)	(\$919)	(\$974)	(\$752)	(\$1,174)	(\$979)
16	0.85 (0.78)	(\$1,005)	(\$939)	(\$933)	(\$908)	(\$928)	(\$868)	(\$822)	(\$841)	(\$827)	(\$828)	(\$875)	(\$899)	(\$818)	(\$876)	(\$643)	(\$1,084)	(\$881)
17	0.92 (0.85)	(\$1,192)	(\$1,108)	(\$1,101)	(\$1,068)	(\$1,095)	(\$1,017)	(\$959)	(\$983)	(\$964)	(\$966)	(\$1,026)	(\$1,057)	(\$954)	(\$1,027)	(\$730)	(\$1,294)	(\$1,034)
18	0.95 (0.87)	(\$1,038)	(\$946)	(\$939)	(\$903)	(\$932)	(\$848)	(\$785)	(\$811)	(\$791)	(\$793)	(\$858)	(\$881)	(\$779)	(\$859)	(\$536)	(\$1,148)	(\$866)

Figure 13. LCC of Water Heater Options (New Construction)



## Initial Data and Findings continued

- Preliminary energy savings calculation
  - Estimated statewide energy savings from proposed measure: **2.6 million therms**
- Widespread availability of qualifying IWHs
  - CEC Appliance Database (April 2014)
    - 12 manufactures
    - 30 unique brands
    - 817 models
  - ENERGY STAR Qualified Products List (April 2014)
    - 1,248 models



# Initial Data and Findings continued

## Equipment Cost Comparison and Assumptions

- Prices vary by WH type, brand, retailer, fuel source, max. BTU, storage capacity
  - Condensing storage heaters (EF = 0.90+) and LP/Propane heaters (storage & IWHs) are more expensive
  - Least expensive products may no longer meet Federal standards in 2015
  - Outdoor is less expensive
- Cost data from top 3 retailers
  - Sears
  - Lowes
  - Home Depot



# Initial Data and Findings continued

Incremental equipment cost: ~\$500

Retailer	Type	Manufacturer	EF	Storage (gal.)	Max. BTUs	Cost (\$)
<a href="#">Home Depot</a>	Instantaneous	Rheem (Paloma)	0.82	N/A	180,000	1,048
<a href="#">Home Depot</a>	Storage	Rheem (Paloma)	0.62	50	40,000	456
-					<b>Cost Difference</b>	<b>592</b>
<a href="#">Lowes</a>	Instantaneous	Rinnai	0.82	N/A	180,000	848
<a href="#">Lowes</a>	Storage	American Water Heater Co.	0.6	50	40,000	662
-					<b>Cost Difference</b>	<b>186</b>
<a href="#">Sears</a>	Instantaneous	Noritz	0.84	N/A	180,000	975
<a href="#">Sears</a>	Storage	AO Smith	N/A	50	40,000	561
					<b>Cost Difference</b>	<b>414</b>

*\* Note: The incremental cost includes only the cost difference between gas storage and gas IWHs. Since the Title 24 mandatory standards require the installation of components to accommodate gas IWHs and condensing storage water heaters, those costs are not considered as part of the incremental cost of moving from a gas storage to gas IWH as proposed by this code change.*





# Proposed Code Requirements

## Section 150.1(c)(8)

8. **Domestic Water-Heating Systems.** Water-heating systems shall meet the requirements of either A, B C, or D.

~~A.~~ For systems serving individual dwelling units, a single gas or propane storage type water heater with an input of 75,000 Btu per hour or less, and that meets the tank insulation requirements of Section 150.0(j) and the requirements of Sections 110.1 and 110.3 shall be installed. For recirculation distribution systems, only Demand Recirculation Systems with manual control pumps shall be used.

~~B.~~ A. For systems serving individual dwelling units, a single gas or propane instantaneous water heater with an input of 200,000 Btu per hour or less and no storage tank, and that meets the requirements of Sections 110.1 and 110.3 shall be installed. For recirculation distribution systems, only Demand Recirculation Systems with manual control pumps shall be used.

~~C.~~ B. For systems serving multiple dwelling units, a central water-heating system that includes the following components shall be installed:

i. Gas or propane water heaters, boilers or other water heating equipment that meet the minimum efficiency requirements of Sections 110.1 and 110.3; and

ii. A water heating recirculation loop that meets the requirements of Sections 110.3(c)2 and 110.3(c)5 and is equipped with an automatic control system that controls the recirculation pump operation based on measurement of hot water demand and hot water return temperature and has two recirculation loops each serving half of the building; and

**EXCEPTION to Section 150.1(c)8Cii:** Buildings with eight or fewer dwelling units are exempt from the requirement for two recirculation loops.

iii. A solar water-heating system meeting the installation criteria specified in Reference Residential Appendix RA4 and with a minimum solar savings fraction of 0.20 in Climate Zones 1 through 9 or a minimum solar savings fraction of 0.35 in Climate Zones 10 through 16. The solar savings fraction shall be determined using a calculation method approved by the Commission.

~~D.~~ C. For systems serving individual dwelling units, an electric-resistance storage or instantaneous water heater may be installed as the main water heating source only if natural gas is unavailable, the water heater is located within the building envelope, and a solar water-heating system meeting the installation criteria specified in the Reference Residential Appendix RA4 and with a minimum solar savings fraction of 0.50 is installed. The solar savings fraction shall be determined using a calculation method approved by the Commission. Recirculation pumps shall not be used.

Note: *TBD. An alternative prescriptive option that does not include instantaneous water heaters is currently being developed for this code change proposal.*



# Proposed Code Requirements

## 2013 Residential Alternative Calculation Method Reference Manual

### STANDARD DESIGN

Individual dwelling units: The standard design is based on § 150.1(c)8. For single family dwelling or dwelling units served by a dedicated water heating system, each dwelling unit has ~~one small storage (<75,000 Btu), 50-gallon gas storage~~ a gas instantaneous water heater, meeting minimum federal Energy Factor standard ~~(0.575 in 2014, 0.60 in 2015).~~ (0.82 in 2015).



# Requests from Stakeholders

- *We would like your input...*
  - Percentage of single family and multi-family dwellings that specify IWHs in the design
  - Average useful life of IWHs and storage water heaters
  - Typical maintenance practice and costs for IWHs and storage water heaters
- Please provide input at [Title24Stakeholders.com](http://Title24Stakeholders.com)



# Questions?

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# Appendix: Initial Savings Calculation for Proposed Measure

Calculations		
Homes	108,849	Construction Forecast
Storage Penetration	74%	2009 RASS
AEC (Therms/yr)	147	2009 RASS
Savings from Instantaneous Water Heaters	22%	Consumer Reports Testing
Total Savings (MTherms)	2.60	Calculation