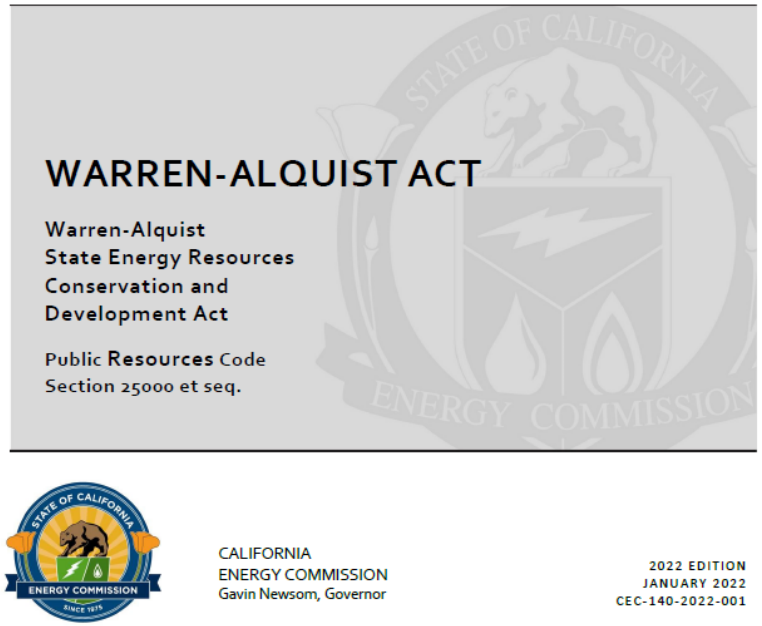
2022 Energy Code
Water Heating – Nonresidential

Title: 2022 Energy Code, Nonresidential Water Heating Overview

Presenter: Allen Wong, Associate Energy Specialist

2022 Energy Code Basics

Energy Code History

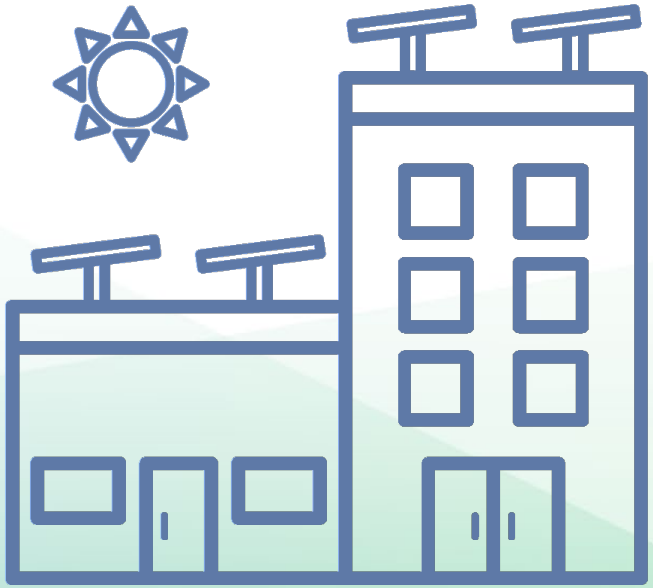


Warren-Alquist Act established CEC in 1974

- Authority to develop and maintain Building Energy Efficiency Standards (Energy Code)
- Requires CEC to update periodically, usually every 3 years
- Requires Energy Code to be cost-effective over economic life of building

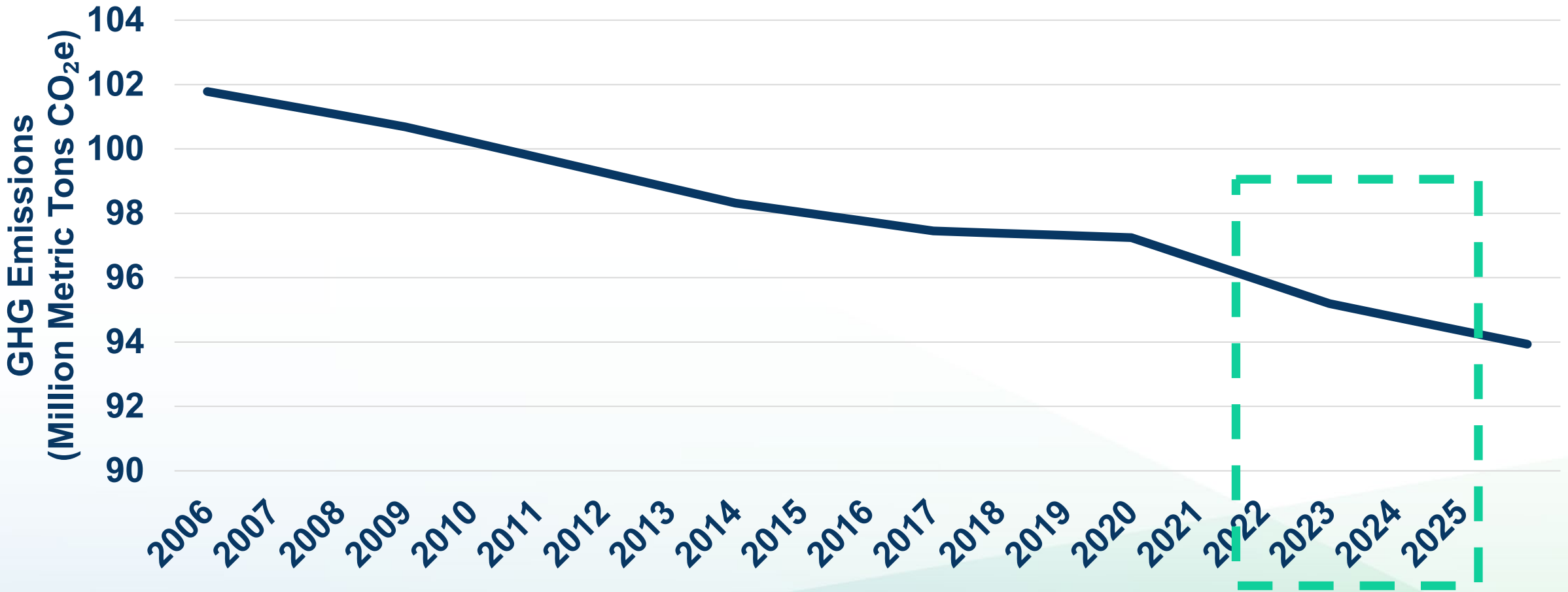
2022 Energy Code Goals

- Increase building energy efficiency cost-effectively
- Contribute to California's greenhouse gas (GHG) reduction goals
- Enable pathways for all-electric buildings
- Reduce residential building impacts on the electricity grid
- Promote demand flexibility and self-utilization of photovoltaic (PV)
- Provide tools for local government reach codes



Energy Code Environmental Benefit

Reduced Statewide Emissions

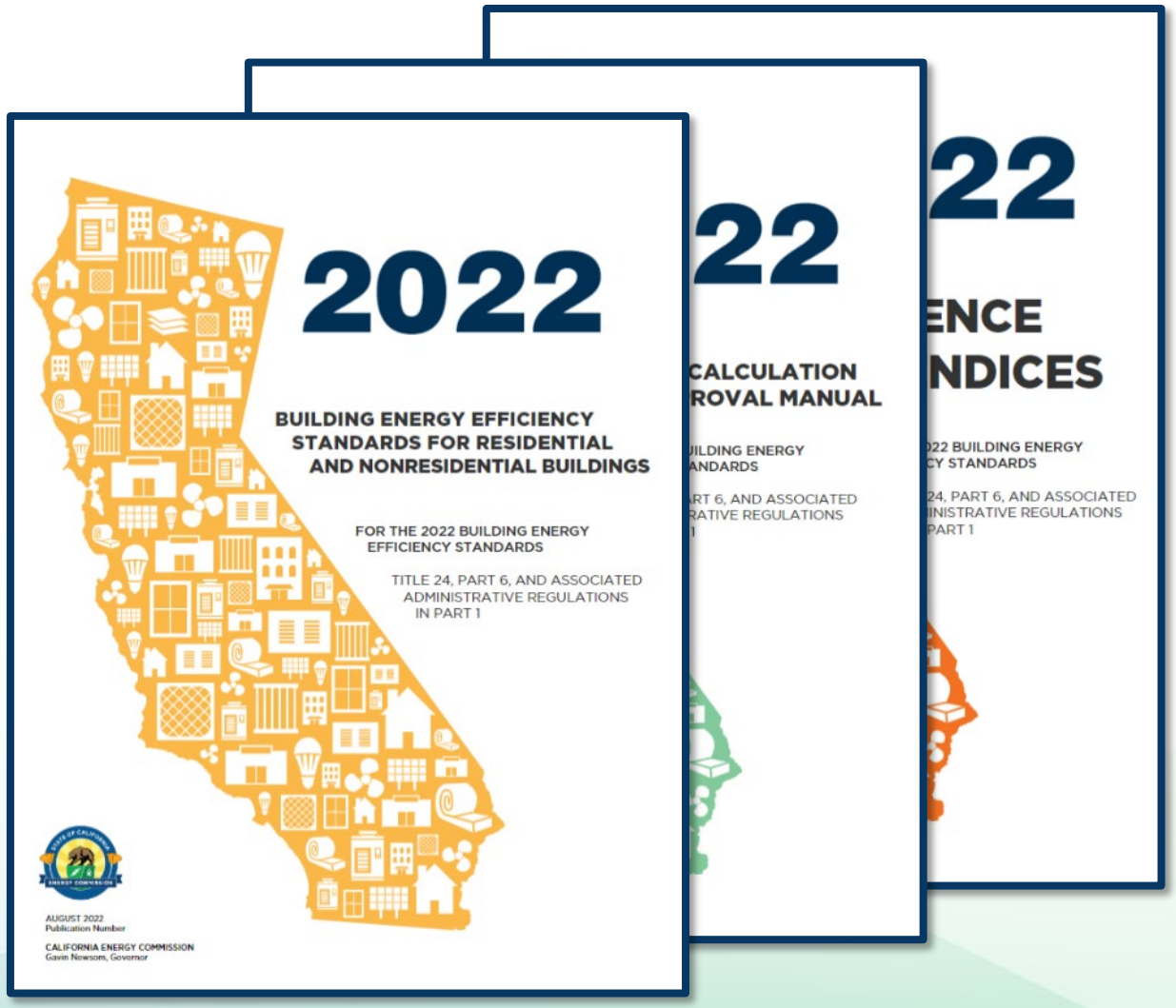


Source: CEC Impact Analysis 2005, 2008, 2013, 2016, 2019, 2022

2022 Energy Code

Effective January 1, 2023

- Building permit applications submitted on or after Jan 1, 2023
- Must use 2022 tools
  - Software
  - Forms

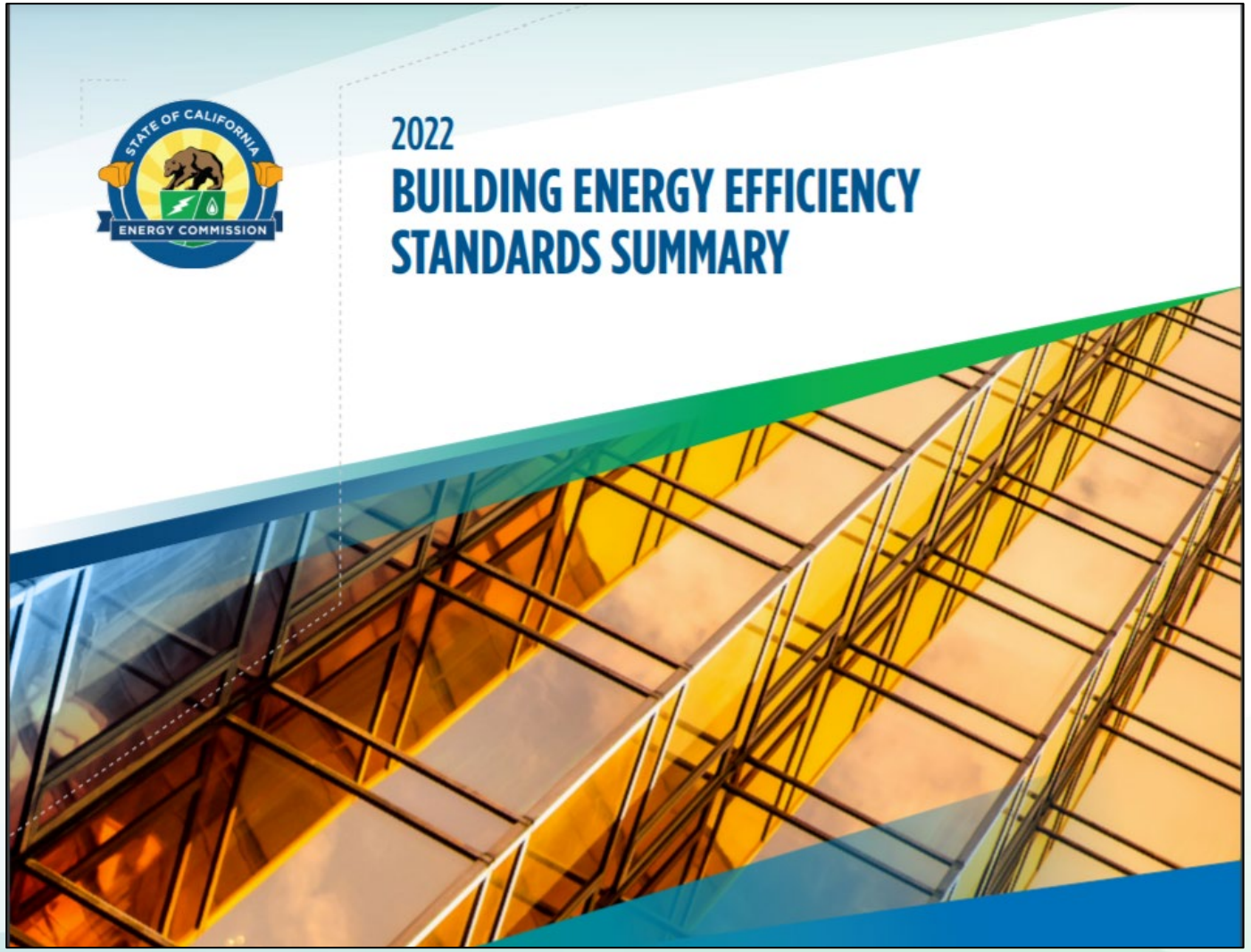


2022 Documents Online

- Energy Code
- Reference Appendices
- Compliance Manuals
- Software
- Forms

2022 Energy Code Highlights

- Heat pump baselines
- Solar and battery storage
- Ventilation requirements
- Lighting
- Multifamily restructuring



Energy Code Requirements

Mandatory requirements

- Minimum efficiency requirements must always be met
- Can never trade off

Prescriptive requirements

- Predefined efficiency requirements
- May supersede mandatory requirements
- Different requirements for newly constructed buildings, additions, and alterations

Compliance Approaches

Prescriptive approach

- Simple approach, no trade-offs
- Defines the standard building design
- 2022 heat pump baselines

Performance approach

- Most flexible approach, allows for trade-offs
- Must meet all mandatory requirements
- Requires the use of CEC-approved software
- Proposed building design meets or exceed standard building design

Performance Metrics

Energy performance calculations

- Nonresidential and multifamily
  - Hourly source energy
  - TDV efficiency
  - TDV total
    - Efficiency, PV + battery

Heat pump baselines

- Requires heat pump for either space heating or water heating
  - Depends on climate zone and occupancy type
  - For HVAC, also depends on capacity
- Ability to go all-electric prescriptively
  - Must use heat pumps for both space heating and water heating

Demonstrating Compliance

Compliance forms confirm Energy Code is met

Updated for 2022

- Completed by responsible party
  - Designers, consultants, builders, contractors, technicians, HERS raters, etc.
- Submitted to enforcement agencies for verification

Type of form	Single-family	Multifamily 3 or less habitable stories	Nonresidential Multifamily 4 or more habitable stories
Certificate of compliance	CF1R	LMCC	NRCC
Certificate of installation	CF2R	LMCI	NRCI
Certificate of verification	CF3R	LMCV	NRCV
Certificate of acceptance	-	-	NRCA

2022 Compliance Software

Performance approach must use approved compliance software versions

- Nonresidential and multifamily
  - CBECC 2022.3.0
  - EnergyPro 9.1
  - IES VE Title 24 2022 v 1.0

Table 100.0-A, Nonresidential & Hotel/Motel

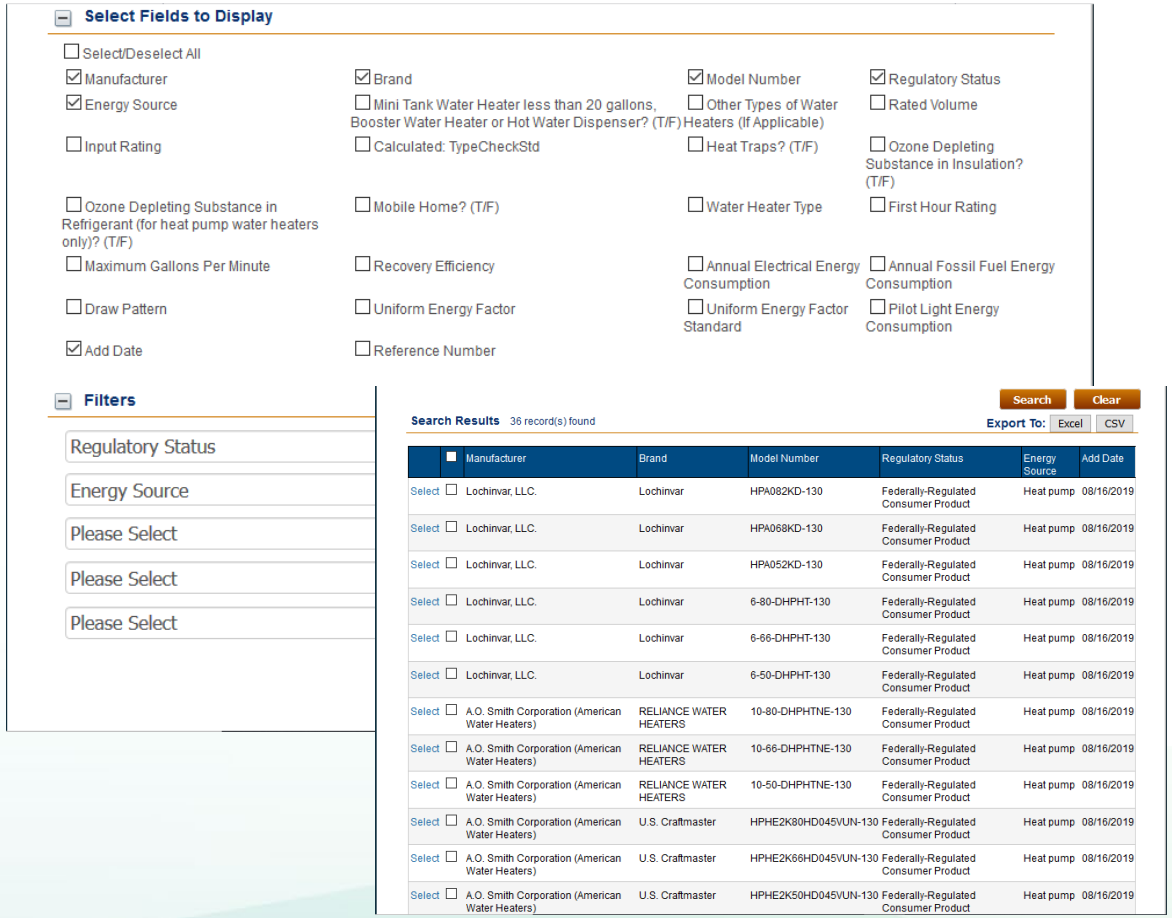
	Mandatory	Prescriptive	Performance
New Constructed Buildings	110.3, 120.3 120.8*, 120.9	140.5	140.1
Additions	110.3, 120.3, 120.9	141.0(a)1	141.0(a)2
Alterations	110.3, 120.3, 120.9	141.0(b)2N	141.0(b)3

*Commissioning requirements under §120.8 will not be covered in this presentation

Mandatory Requirements – All Occupancies §§110.1 & 110.3

§110.1(a)&(b) - Mandatory Requirements; Appliances

- Water heaters meet Title 20 minimum efficiencies (Title 20, §1605.1, Table F-2 and F-5)
- Verify efficiency via
  - Modernized Appliance Efficiency Database System (MAEDbS)
  - Equivalent federal directory, or
  - Approved trade association directory



Look up appliances on the Modernized Appliance Efficiency Database

§110.1(c) - Mandatory Requirements; Appliances

If efficiency can't be verified for these reasons, assume mandatory efficiency or follow CEC-approved procedures when:

1. Unavailable data
2. No field testing method approved by the CEC
3. Field modification
4. DOE testing waiver, but no way to determine efficiency

§110.3(a)&(b) – Mandatory Requirements; Service Water-Heating

- Manufacturer certification of:
  - Automatic temperature controls capable of temperature ranges:
    - ASHRAE Handbook, HVAC App. Vol., Ch. 50, Table 3
    - California Plumbing Code (CPC), Table 613.1 for healthcare facilities.
- All Title 20 requirements (§1605.1(f)):
  1. All listed standards
  2. All listed test methods
  3. All requirements for all functions
  4. Min/max rated capacity must be possible via controls at steady-state operation

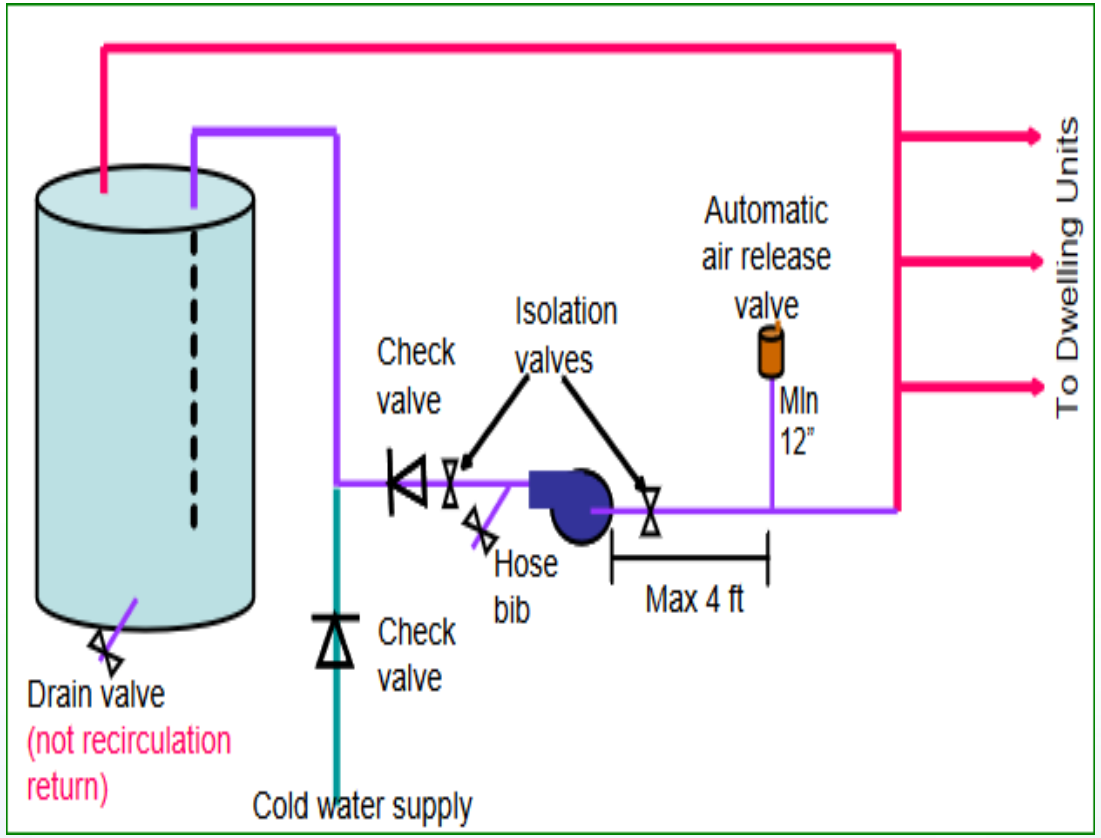
§110.3(c)1 – Mandatory Requirements; Service Water-Heating Installation

- > 167,000 Btu/h – outlets needing water temperatures higher than prescribed by ASHRAE Handbook (Applications Vol.) shall have separate remote heaters, heat exchangers, or boosters
  - EXCEPTION: Systems under CPC §613.0 (healthcare facilities) follow that section instead

§110.3(c)2&3 - Mandatory Requirements; Service Water-Heating Installation

- Systems with circulating pumps or electrical heat trace systems must have auto-shutoff capability
- Unfired water heater storage tanks; solar water heating backup tanks – meet one of the following:
  - Insulation (external, R ≥ 3.5; or internal + external, R ≥ 16)
  - Tank surface heat loss rating < 6.5 Btu/h-ft^2 (based on water-air temperature difference of 80°F)

§110.3(c)4 – Recirc. Loop



Res CM, Fig 5-6

A. Auto air release valve “burps” air from pipe before reaching pump
B. (&F) Check valves stop cold water from flowing the wrong way
C. Hose bibb bleeds air from pump when installing/replacing
D. Isolation valves close off pipes when replacing pump
E. Do NOT pipe cold water or loop into drain port

§110.3(c)5

State buildings – Water heating energy must be at least 60% site solar or recovered energy

§110.3(c)6

Instantaneous (“tankless”) water heaters > 6.8 kBtu/h (2 kW) shall have isolation valves on both water lines, with fittings for maintenance flushing

Source: homedepot.com

Mandatory Requirements – Nonresidential Buildings §§120.3 & 120.9

§ 120.3(a)3 – General Requirements for Pipe Insulation

Water-heating piping insulated per TABLE 120.3-A:

A. Recirculating system piping, including supply and return piping to water-heater

B. First 8-ft. of hot and cold outlet piping, including pipes between storage tank and heat trap for non-recirculation storage system

C. Externally heated pipes

§120.3(b)1&3 - Insulation Protection

Protect insulation from weather and maintenance

1. Insulation exposed to weather must have outdoor-suitable cover:
    - Solar-resistant and water retardant
    - Protection cannot be adhesive tape
3. Below-grade insulation must be in waterproof, uncrushable sleeve/casing

§120.3(c)1 – Insulation Thickness

Fluid Operating Temperature Range (°F)	Insulation Conductivity			Nominal Pipe Diameter (in inches)				
	Conductivity (in Btu·in/h·ft²·°F)	Mean Rating Temperature (°F)		< 1	1 to <1.5	1.5 to < 4	4 to < 8	8 and larger
Space heating and Service Water Heating Systems (Steam, Steam Condensate, Refrigerant, Space Heating, Service Hot Water)				Minimum Pipe Insulation Required (Thickness in inches or R-value)				
Above 350	0.32-0.34	250	Inches	4.5	5.0	5.0	5.0	5.0
			R-value	R 37	R 41	R 37	R 27	R 23
251-350	0.29-0.32	200	Inches	3.0	4.0	4.5	4.5	4.5
			R-value	R 24	R 34	R 35	R 26	R 22
201-250	0.27-0.30	150	Inches	2.5	2.5	2.5	3.0	3.0
			R-value	R 21	R 20	R 17.5	R 17	R 14.5
141-200	0.25-0.29	125	Inches	1.5	1.5	2.0	2.0	2.0
			R-value	R 11.5	R 11	R 14	R 11	R 10
105-140	0.22-0.28	100	Inches	1.0	1.5	1.5	1.5	1.5
			R-value	R 7.7	R 12.5	R 11	R 9	R 8

- Insulate pipes according to TABLE 120.3-A
- Example:
  - 4-in., diameter
  - Typical fluid temp. for service water heating: 105 – 140°F
  - Pipe insulation conductivity of 0.27 Btu-in./hr-sqft-°F
  - ***Insulate to 1.5-in. thick or R-9***

§120.3(c)2 – Insulation Thickness

If your insulation has conductivity range not in TABLE 120.3-A, use this equation to calculate the thickness: $T = PR\left[\left(1 + \left(\frac{t}{PR}\right)\right)^{\frac{K}{k}} - 1\right]$

T = minimum insulation thickness, for material with conductivity K (inches)

PR = pipe outer radius (inches)

t = insulation thickness, from Table 120.3-A (inches)

K = conductivity of alternate material at mean rating temperature in Table 120.3-A for applicable fluid temperature range (Btu-in./h-ft^2-°F)

k = lower value of conductivity range in Table 120.3-A for the applicable fluid temperature range (Btu-in./h-ft^2-°F)

Using Equation (§120.3(c)2), Example

What is the required thickness for insul. with a conductivity (from the mfr. spec at 200°F) of 0.40 Btu-in./h-ft²-°F on a 4" dia. pipe carrying 300°F fluid?

PR = 2"

t = 4.5" (from the table – 4" pipe, 300°F)

K = 0.40 (Btu-in.)/(h-ft²-°F) (from mfr. spec at 200°F)

k = 0.29 (Btu-in.)/(h-ft²-°F) (the lower value of the range for 300°F fluid)

TABLE 120.3-A PIPE INSULATION THICKNESS

Fluid Operating Temperature Range (°F)	Insulation Conductivity: Conductivity (in Btu·in/h·ft²·°F)	Insulation Conductivity: Mean Rating Temperature (°F)		Nominal Pipe Diameter (in inches): < 1	1 to <1.5	1.5 to < 4	4 to < 8	8 and larger
Space heating and Service Water Heating Systems (Steam, Steam Condensate, Refrigerant, Space Heating, Service Hot Water)				Minimum Pipe Insulation Required (Thickness in inches or R-value)				
Above 350	0.32-0.34	250	Inches	4.5	5.0	5.0	5.0	5.0
			R-value	R 37	R 41	R 37	R 27	R 23
251-350	0.29-0.32	200	Inches	3.0	4.0	4.5	4.5	4.5
			R-value	R 24	R 34	R 35	R 26	R 22

$$T = 2\left[1 + \left(\frac{4.5}{2}\right)^{\frac{0.4}{0.29}} - 1\right] = 8.2"$$

§120.9(a)&(b) – Commercial Boilers Combustion Air & Fans

- All newly installed boilers require combustion air positive shut-off as follows:
  - "Natural draft"/"atmospheric" boilers ≥ 2.5 MMBtu/h
    - Can interlock w/ gas valve to close when burner is off
  - One stack serves two or more boilers with a total combined input of 2.5 MMBtu/h per stack
- Combustion air fan motors ≥ 10 hp in newly installed boilers:
  - Variable-speed drive, or
  - Controls to limit power demand (≤ 30% of design wattage at 50% of design air volume)

§120.9(c)

- Newly installed boilers ≥ 5 MMBtu/h shall maintain stack-gas O_2 conc. ≤ 5.0% by volume (dry) over firing rates of 20-100%
  - Combustion air controlled per firing rate or flue gas O_2
  - No common gas and combustion air control linkage or jack shaft
- EXCEPTION: Boilers with steady state full-load thermal combustion efficiency of 90% or higher.

Prescriptive Requirements – Nonresidential Newly Constructed Buildings §140.5

§140.5(a)&(b) - Prescriptive Requirements, New Construction

Building(s)	Requirements
School buildings < 25k ft^2, < 4 stories, CZs 2-15	• ***Heat pump water heater (HPWH)*** meeting §§ 110.1, 110.3 and 120.3 • Individual bathroom spaces may use electric tankless
Nonresidential	Water heater meeting §§ 110.1, 110.3, 120.3, ***and 140.5(c)***
Hotel/Motel	Water heater meeting §170.2(d)
High-Rise Residential	Moved to §170.2 (multifamily prescriptive requirements)

§140.5(c) – High-Capacity Water Heaters

- Gas water heating systems ≥ 1 MMBtu/h – Water heater thermal efficiency ≥ 90%
  - Multiple water heaters acceptable, if whole-system capacity-weighted average thermal efficiency ≥ 90%
- Exceptions:
  1. Annual water heating energy is 25% site-solar or site-recovered
  2. Water heaters in individual dwelling units
  3. Exclude individual gas water heaters ≤ 100,000 Btu/h from calculations of total system input or efficiency

§140.5(c) Example

Example: Water heating system includes these gas water heaters:

- 110k Btu/h, 85%
- 2x 300k Btu/h, 90%
- 400k Btu/h, 95%
- 90k Btu/h, 70%

Total eligible capacity = 1.11 MMBtu/h or 1,110k Btu/h

$$\left(\frac{110}{1110}\right)(85\%) + \left(\frac{300}{1110}\right)(90\%) + \left(\frac{300}{1110}\right)(90\%) + \left(\frac{400}{1110}\right)(95\%) = 91.3\%$$

90k Btu/h water heater excluded due to Exception 3, so this system complies!

§170.2(d)1 – Newly Constructed Hotel/Motels, Individual Dwelling Units

Electric Options

- HPWH, 240V; other requirements may apply (see table below)

Gas/Propane Options

- Tankless, up to 200k Btu/h

NEEA Tier 3?	Compact Hot Water Distribution System (RA4.4.6) Required?	Drain Water Heat Recovery (RA3.6.9) Required?
No	Climate Zones 1 & 16	Climate Zone 16
Yes	No	Climate Zone 16

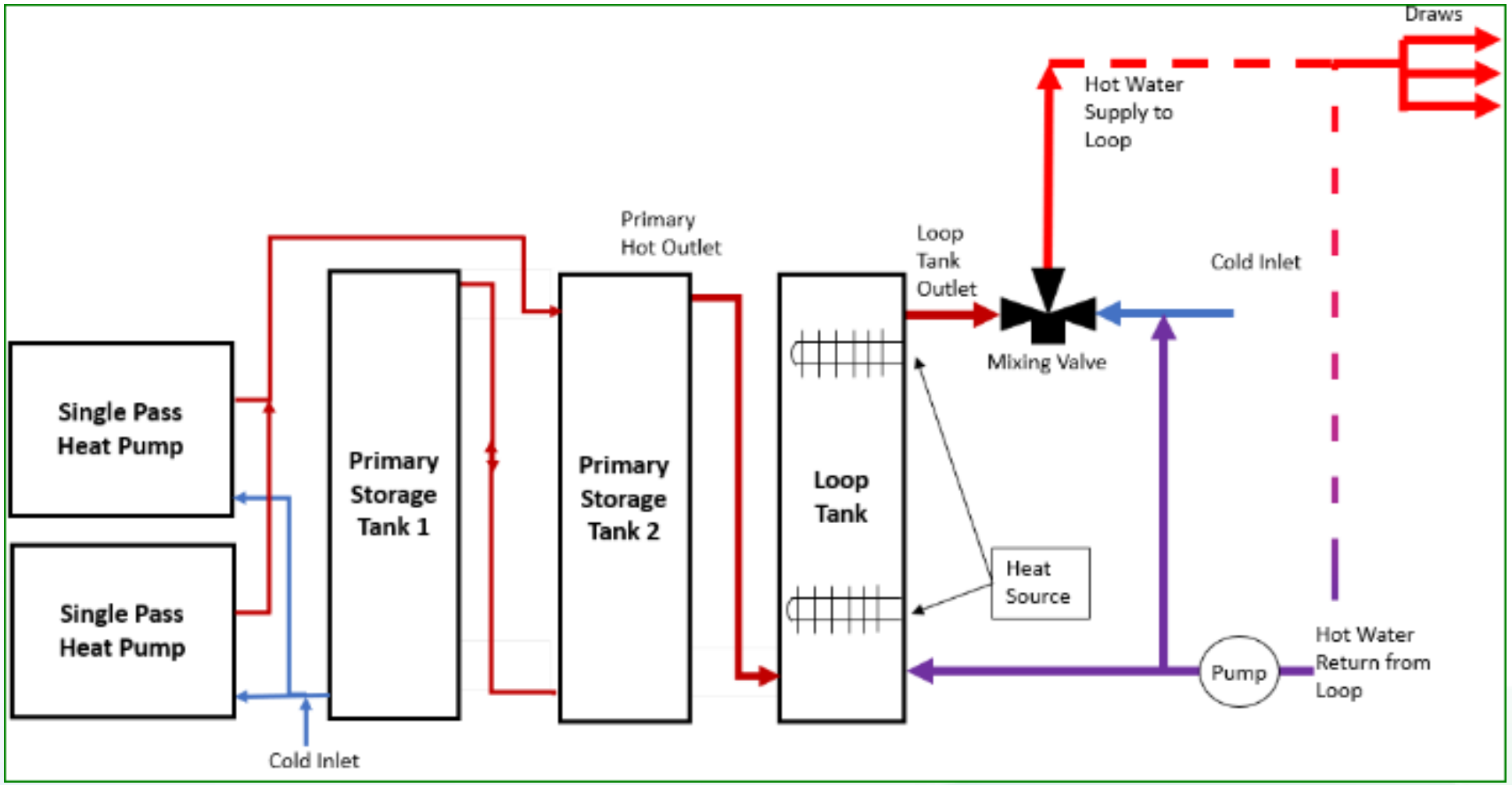
Demand recirculation with manual on/off control (RA4.4.9) only

§170.2(d)2-4 –Newly Constructed Hotel/Motels, Multiple Dwelling Units

Electric Options	Gas/Propane Options
• Central HPWH (§170.2(d)2)	• Gas/propane water heater with solar water heating (RA4) (§170.2(d)3)

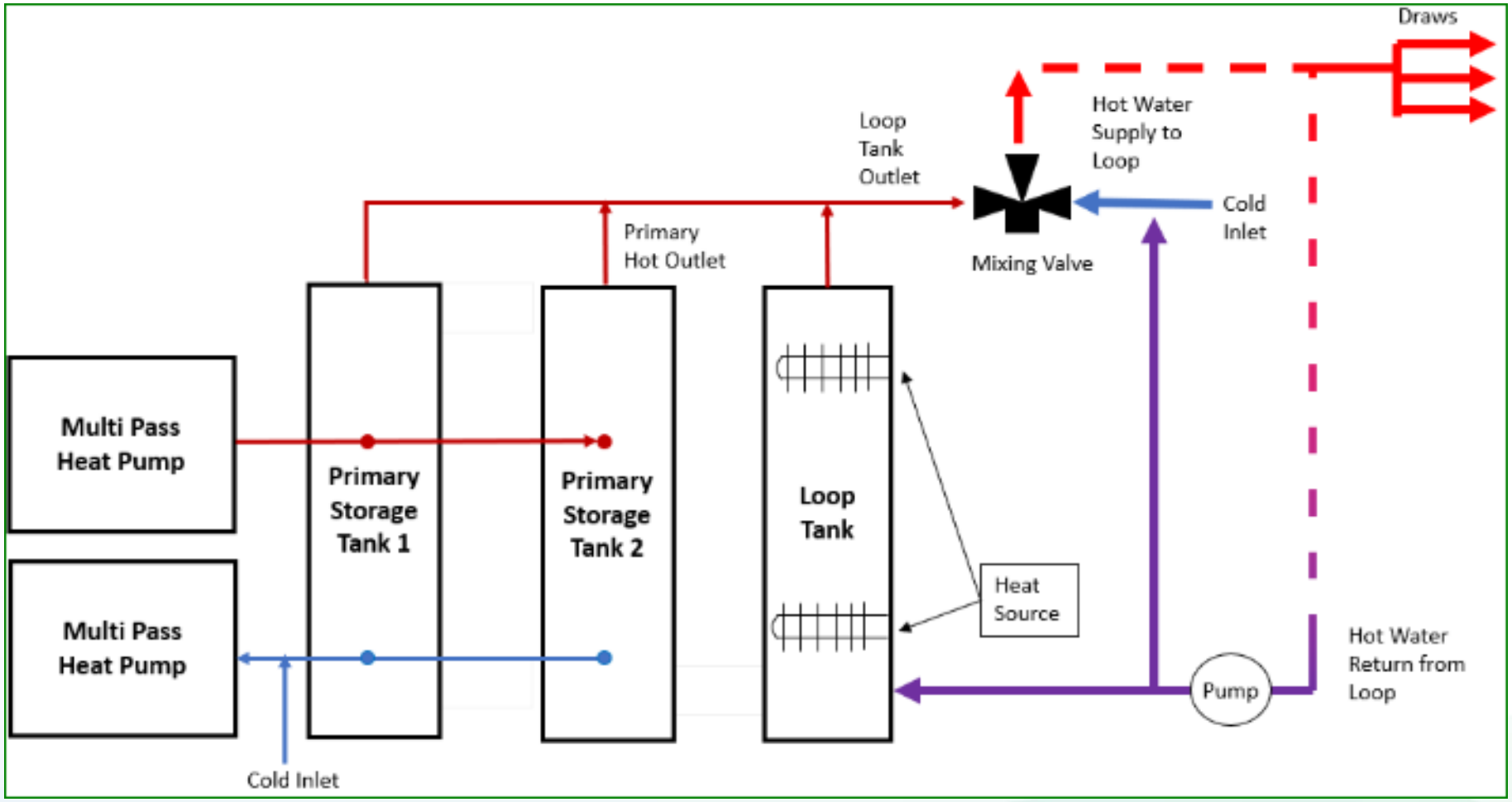
- Recirculation required if more than 8 dwelling units:
  - Meet §110.3(c)2&5
  - Auto-control pump per hot water demand and return temperature
- Executive Director can approve water heater systems that no more energy than one listed above

§170.2(d)2 – Central HPWH Diagram, Single-Pass



Source: CASE Report: Multifamily Domestic Hot Water – Central Heat Pump Water Heater

§170.2(d)2 – Central HPWH Diagram, Multi-Pass



Source: CASE Report: Multifamily Domestic Hot Water – Central Heat Pump Water Heater

§170.2(d)3 – Newly Constructed Hotel/Motels; Multiple Dwelling Units, Gas/Propane

Central systems serving multiple dwelling units

- CZs 1-9: gas systems 1 MMBtu/h or greater:
  - Water heater min. thermal efficiency 90%; can use weighted average for systems with multiple water heaters (see example)
    - Individual gas water heaters 100,000 Btu/h or less excluded from calculations of the total system input or efficiency.
  - Exception: annual water heating energy provided by at least 25% site-solar or site-recovered
- Solar water heating (RA4) meeting these requirements:

SSF (CZs 1-9)	SSF (CZs 10-16)	Additional Requirements
0.20	0.35	N/A
0.15	0.30	DWHR (RA3.6.9)

Prescriptive Requirements – Nonresidential Additions & Alterations §141.0

§141.0(a)1 – Additions, Prescriptive Approach

- Must meet applicable requirements of §§110.0-120.7, 120.9-130.5, and 140.2-140.9
  - For water heating – §§110.1, 110.3, 120.3, 120.9, and 140.5
- EXCEPTION 1: If water heating provided to addition via expanding existing systems, existing equipment exempt
- EXCEPTION 6: Gas water heating, 1 MMBtu/h or more, added to existing building exempt from §140.5(c)

§141.0(b)2 – Alterations, Prescriptive Approach

- §141.0
  - Alterations to healthcare facilities exempt from §141.0
  - Alterations that change occupancy – §141.0(b) applies to new occupancy
- (b)2: Altered components […], and any new equipment serving alteration meet applicable requirements of §§110.0-110.9, 120.0-120.6, and 120.9-130.5
  - For water heating – §§110.1, 110.3, 120.3, 120.9
- (b)2N: Water heating systems meet §140.5(a)2 & (b), except solar water heating requirements (§170.2(d)3)

Performance Standards §§140.1 & 141.0

§140.1 – Performance Approach, Newly Constructed Buildings

- Energy budget = sum of TDV for HVAC, indoor lighting, water heating, and covered process
  - Standard Design = mandatory and prescriptive requirements
  - Proposed Design energy = calculated TDV for proposed design by CEC-certified compliance software
    - Required solar PV/battery can be offset by CEC-approved (§10-115) community shared solar and/or battery system providing dedicated benefits to permitted building
- Source energy, efficiency TDV, and total TDV must be met separately

§141.0(a)2 – Performance Approach, Additions

- Additions must meet §§110.0-120.7, 120.9-130.5
  - Water heating systems must meet §§110.1, 110.3, 120.3, 120.9
- One of these must be met:
  - Addition alone must meet §140.1
  - E+A+A:

	Existing	Alterations	Additions
Standard design budget	Existing unaltered components to be kept	Whichever is more TDV-efficient: • Match existing conditions • Meet prescriptive requirements (§141.0(b)2)	Proposed addition energy use meeting §140.1
Proposed design	Existing unaltered components to be kept	Components to be altered	Proposed energy features of the addition

§141.0(b)3 – Performance Approach, Alterations

- Alterations must meet §§110.0-110.9, 120.0-120.6, and 120.9-130.5
  - Altered water heater system must meet §§110.1, 110.3, 120.3, 120.9
- Standard and proposed designs assume same shape and orientation
- When third party verification specified, all components altered for additional credit must be verified
- Existing components to be replaced considered altered

	Altered	Unaltered
Standard Design budget	Whichever is more TDV-efficient: • Match existing conditions • Meet prescriptive requirements (§141.0(b)2)	Existing conditions
Proposed Design	Actual values of altered components	Existing conditions

Compliance Forms

Certificate of Compliance (NRCC) Forms for Water-Heating

- NRCC-PLB-E: Domestic Water-Heating
  - Same form for newly constructed buildings, additions, and alterations
- NRCC-CXR-E: Building Commissioning
- NRCC-PRF-E: Performance approach
  - Generated by approved compliance software

NRCC-PLB-E, Tables A to C

A. GENERAL INFORMATION

01	Project Location (city)					02	Climate Zone				
03	Occupancy Types Within Project (select all that apply):										
☐	Office	☐	High-Rise Residential Multifamily >= 4 stories	☐	Relocatable	☐	School	☐	Restaurant/ Commercial Kitchen	☐	Religious Facility
☐	State Building	☐	Healthcare Facility	☐	Hotel/ Motel	☐	All Others	☐	Convention Center	☐	Medical Clinic
☐	Auditorium	☐	Parking Garage	☐	Warehouse	☐	Retail	☐	Sports Arena	☐	Gymnasium
☐	Classroom	☐	Library	☐	Theater	☐	Data Center	☐	Support Areas	☐	Financial Institution
☐	Commercial/ Industrial	☐	School	☐	Grocery Store						

B. PROJECT SCOPE

This table identifies any domestic water heating systems that are within the scope of the permit application and are demonstrating compliance using the prescriptive paths outlined in §140.5/ §170.2(d), and §141.0(a)/ §180.1, or §141.0(b)2N/ §180.2 for additions or alterations. Solar water heating systems should be documented on the NRCC-SAB compliance document. Combined hydronic water heating systems should be documented on the NRCC-MCH compliance document.

01		02	03		
My project consists of (check all that apply):		System Type[1,2]	System Components		
☐	New System (DHW system being installed for the first time in newly constructed building)		☐ Equipment	☐ Distribution	☐ Controls
☐	System Alteration (equipment, distribution, or controls)		☐ Equipment	☐ Distribution	☐ Controls

C. COMPLIANCE RESULTS

Table Instructions: Table C will indicate if the project data input into the compliance document is compliant with water heating requirements. This table is not editable by the user. If this table says "DOES NOT COMPLY" or "COMPLIES with Exceptional Conditions" refer to Table D., or the table indicated as not compliant for guidance.

01	02	03	04
Domestic Hot Water Equipment	Distribution Systems	Controls	**Compliance Results**
Table F	Table G	Table H	
YES/NO	YES/NO	YES/NO	**COMPLIES, COMPLIES with Exceptional Conditions or DOES NOT COMPLY**

- A – General project info
- B – Project scope
- C – Compliance results

NRCC-PLB-E, Table F

F. DOMESTIC HOT WATER EQUIPMENT

Table Instructions: Complete the following table to demonstrate compliance with mandatory equipment requirements in §110.1 and §110.3. Compliance with prescriptive requirements in §140.5(c)/§170.2(d) must also be demonstrated and with §141.0/§180.1/§180.2 for addition and alteration scopes.

Equipment Schedule

03		04					05		06	
System Name:		Exception to §140.5(c)/§170.2(d)3:					☐	Capacity-weight efficiencies for gas systems >= 1MMBtu/h[1]	Capacity-weighted Average Efficiency (%)	
07	08	09	10		11	12	13		14	15
Name or Item Tag	Equipment Type	Volume (gal)	Rated Input Capacity (Btu/h)	Max GPM/ First Hour Rating (FHR)	Rated Efficiency	Minimum Efficiency Required	Efficiency Unit		Designed Standby Loss	Maximum Standby Loss

Water Heating Equipment in Individual Dwelling Units1

Equipment Type (select all that apply):

16	☐	Gas/propane instantaneous water heater with input rating ≤ 200,000 BTUH and no storage tank. Note: Cannot comply using the prescriptive path with a storage tank per §170.2(d)1C (New Construction and Additions Only)
	☐	A single 240-volt heat pump water heater serving the dwelling unit. (New Construction and Additions Only)
	☐	A single heat pump water heater that meets the requirements of NEEA Advanced Water Heater Specification Tier 3 or higher.
	☐	A single heat pump water heater with storage tank located in the garage or conditioned space and be placed on an incompressible, rigid insulated surface with minimum R-10. The water heater shall be installed with a communication interface that meets either the requirements of 110.12(a) or has an ANSI/CTA-2045-B communication port. (Alterations Only)
	☐	If the existing water heater is an electric resistance water heater, a consumer electric water heater. (Alterations only)
	☐	Replacement or altered gas or propane water heater (Alterations only)

	Yes	No	Not Applicable	Requirement
17	☐	☐	☐	For gas or propane water heaters serving individual dwelling units, the follow components are included in the design per §160.4: (New Construction and Additions only) - Dedicated 125V, 20-amp electrical receptacle that is connected to the panel with a 120/240V 3 conductor, 10 AWG copper branch circuit within 3 ft from the water heater that's accessible and with both ends of the unused conductor labeled with the word "spare" and be electrically isolated. A single pole circuit breaker space in the panel adjacent to the circuit breaker for the branch circuit is provided labeled with the word "future 240V use"; and - Category III or IV vent, or Type B vent with straight pipe between the outside termination and where the water heater is installed; and - Condensate drain that is no more than 2in higher than the base of the water heater and drains without pump assistance; and - Gas supply line with a capacity of at least 200,000 BTUH

[1] FOOTNOTE: Dwelling units refers to hotel/ motel guest rooms and units in a multifamily residential occupancy.

- F – Water heating equipment
  - Equipment schedule
  - Individual dwelling units
  - Equipment in all occupancies
  - Central systems serving dwelling units

NRCC-PLB-01-E, Table G

G. DOMESTIC HOT WATER DISTRIBUTION SYSTEM

Table Instructions: Complete the following table to demonstrate compliance for nonresidential occupancies with distribution requirements in §120.3 and §140.5.] For multifamily and hotel/motel occupancies, compliance is demonstrated with requirements in §110.3(c), §160.4 and §170.2(d).

Recirculation Loops in Central Systems Serving Dwelling Units or Nonresidential Spaces

	Yes	No	Not Applicable	Requirement
01				Air release valve or vertical pump installation per §110.3(c)4A
02				Check valve or similar located between recirculation pump and water heating equipment to prevent backflow per §110.3(c)4B
03				Hose bibb installed between pump and equipment and isolation valve between hose bibb and equipment per §110.3(c)4C
04				Isolation valves on both sides of the pump per §110.3(c)4D
05				Cold water and recirculation loop piping shall not be connected to the hot water storage tank drain port per §110.3(c)4E
06				Check valve installed on cold water supply between hot water system and next closest tee on cold water supply per §110.3(c)4F
07				DWELLING UNITS ONLY: For central systems serving multiple dwelling units, design includes a recirculation system serving separate dwelling units per §170.2(d) unless building has ≤ 8 dwelling units.
08				DWELLING UNITS ONLY: For heat pump water heating systems, the hot water return from the recirculation loop shall connect to a recirculation loop tank and shall not directly connect to the primary heat pump water heater inlet or the primary thermal storage tanks per §170.2(d)2A.
09				DWELLING UNITS ONLY: For heat pump water heating systems, the fuel source for the recirculation loop tank shall be electricity if auxiliary heating is needed. The recirculation loop heater shall be capable of multi-pass water heating operation per §170.2(d)2B.

- G – Distribution systems
  - Central systems serving dwellings or nonresidential spaces
  - Individual dwelling units
  - Mandatory pipe insulation & insulation thickness

NRCC-PLB-01-E, Tables H & I

H. DOMESTIC HOT WATER SYSTEM CONTROLS

Table Instructions: Complete the following table to demonstrate compliance with controls requirements in §110.3 for all occupancies. For multifamily residential and hotel/motel occupancies, compliance is demonstrated with requirements in §160.4(e) and §170.2(d).

	Yes	No	Not Applicable	Requirement
01	☐	☐	☐	Construction documents require manufacturer certification that service water-heating systems are equipped with automatic temperature controls capable of adjusting temperature settings per §110.3(a).
02	☐	☐	☐	Systems with capacity > 167,000 BTUH equipped with outlet temperature controls per §110.3(c)1 unless covered by California Plumbing Code Section 613.0.
03	☐	☐	☐	Controls for circulating pumps or electrical heat trace systems are capable of automatically turning off the system per §110.3(c)2 unless system serves healthcare facility.
04	☐	☐	☐	For recirculation systems serving multiple dwelling units, design includes automatic pump controls per §170.2(d), or §180.1(b)3 for additions.
05	☐	☐	☐	For recirculation systems serving individual dwelling units, design includes manual on/off controls as specified in Reference Appendix RA 4.4.9 per §170.2(d).
06	☐	☐	☐	Combustion air positive shut-off shall be provided per §160.4(e) on all newly installed commercial boilers as follows: - Boiler with input capacity >= 2.5 MMBtu/h, in which the boiler is designed to operate with a nonpositive vent static pressure - Boilers where one stack serves two or more boilers with a total combined input capacity per stack of 2.5 MMBtu/h.
07	☐	☐	☐	Boiler combustion air fans with motors >= 10 hp shall meet one of the following for newly installed boilers: - The fan motor shall be driven by a variable speed drive OR - The fan motor shall include controls that limit the fan motor demand to <= 30% of the total design wattage at 50% of the design air volume.
08	☐	☐	☐	Newly installed boilers with an input capacity >= 5 MMbtu/h and a steady state full-load combustion efficiency < 90% shall maintain excess (stack-gas) oxygen concentrations <= 5% by volume on a dry basis over firing rates of 20-100%. Combustion air volume shall be controlled with respect to firing rate or flue gas oxygen concentration. Use of a common gas and combustion air control linkage or jack shaft is prohibited.

I. DECLARATION OF REQUIRED CERTIFICATES OF INSTALLATION

Nonresidential, Hotel/Motel, and High-rise Multifamily and Multifamily Mixed-use Certificates of Installation

Table Instructions: Selections have been made based on information provided in previous tables of this document. If any selection needs to be changed, please explain why in Table E. Additional Remarks. These documents must be provided to the building inspector during construction and can be found online.

Yes	No	Form/Title	Field Inspector	
			Pass	Fail
●	❍	NRCI-PLB-01-E - Must be submitted for all buildings	☐	☐

- H – Hot water system controls
- I – Required NRCIs

Certificate of Installation (NRCI) Forms for Water-Heating

- Consolidated into NRCI-PLB-E

*Used for all nonresidential occupancies; all others are used for high-rise residential and hotel/motel only

Sample NRCI-PLB-E, Tables A to C

A. GENERAL INFORMATION

01	Project Location (city):		05	Authority Having Jurisdiction:	
02	Zip Code:		06	Building Permit #:	
03	Date of Permit Set used for construction:		07	Date of As-built Set:	
04	Name of Permit Set used for construction:		08	Name of As-built Set:	

B. INSTALLER SCOPE

This table indicates construction systems and materials documented on this Certificate of Installation.

01		02		03	
□	Water Heating Equipment	□	Distribution (piping, valves, insulation, etc.)	□	Controls

C. COMPLIANCE RESULTS

This table indicates whether the as-built conditions documented in this form are equal or better than what was documented on the permitted Certificate of Compliance. If the installation is not equal or better, Section 10-103(a)2B requires the Certificate of Compliance to be revised accordingly to demonstrate compliance.

01	**INSTALLED FEATURES EXACTLY MATCH DESIGN ON PERMITTED CERTIFICATE OF COMPLIANCE**

Documented as-built conditions should be verified by inspector from Authority Having Jurisdiction to comply.

The Certificate of Compliance should be revised to confirm as-built conditions comply and this Certificate of Installation updated accordingly.

- A – General information
- B – Installer scope
- C – Compliance results

Sample NRCI-PLB-E, Table F

F. INSTALLATION DETAILS

The following tables indicate performance requirements as documented on the permitted Certificate of Compliance for all systems and components included in Table B. Installer Scope. Also indicated are the as-built conditions documented by the installer/ documentation author.

DOMESTIC HOT WATER EQUIPMENT EFFICIENCY

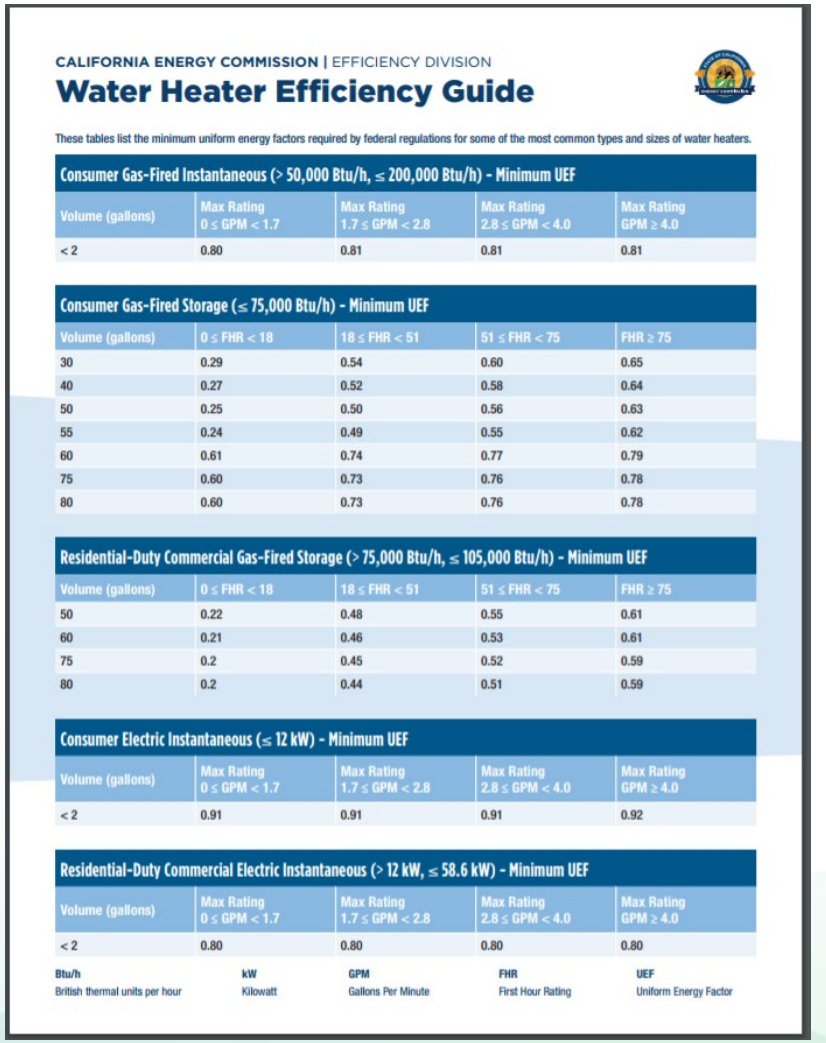
01	02	03	04	05	06	07	08	09	10	11
Name or Item Tag	Model #	Individual or Central System	Equipment Type	Volume (gal)	Rated Input Capacity (Btu/h)	Capacity Unit	Rated Efficiency	Efficiency Unit	Standby Loss	DHW Equipment Compliance
Per C of C										
As-built Conditions										

- F – Installation details
  - Water heating equipment efficiency
  - Distribution requirements
  - Individual dwelling units
  - Mandatory pipe insulation
  - Hot water system controls

Resources

Water Heater Efficiency Guide

[Download the Water Heater Efficiency Guide]



CALIFORNIA ENERGY COMMISSION | EFFICIENCY DIVISION

Water Heater Efficiency Guide

These tables list the minimum uniform energy factors required by federal regulations for some of the most common types and sizes of water heaters.

Consumer Gas-Fired Instantaneous (> 50,000 Btu/h, ≤ 200,000 Btu/h) - Minimum UEF

Volume (gallons)	Max Rating 0 ≤ GPM < 1.7	Max Rating 1.7 ≤ GPM < 2.8	Max Rating 2.8 ≤ GPM < 4.0	Max Rating GPM ≥ 4.0
< 2	0.80	0.81	0.81	0.81

Consumer Gas-Fired Storage (≤ 75,000 Btu/h) - Minimum UEF

Volume (gallons)	0 ≤ FHR < 18	18 ≤ FHR < 51	51 ≤ FHR < 75	FHR ≥ 75
30	0.29	0.54	0.60	0.65
40	0.27	0.52	0.58	0.64
50	0.25	0.50	0.56	0.63
55	0.24	0.49	0.55	0.62
60	0.61	0.74	0.77	0.79
75	0.60	0.73	0.76	0.78
80	0.60	0.73	0.76	0.78

Residential-Duty Commercial Gas-Fired Storage (> 75,000 Btu/h, ≤ 105,000 Btu/h) - Minimum UEF

Volume (gallons)	0 ≤ FHR < 18	18 ≤ FHR < 51	51 ≤ FHR < 75	FHR ≥ 75
50	0.22	0.48	0.55	0.61
60	0.21	0.46	0.53	0.61
75	0.2	0.45	0.52	0.59
80	0.2	0.44	0.51	0.59

Consumer Electric Instantaneous (≤ 12 kW) - Minimum UEF

Volume (gallons)	Max Rating 0 ≤ GPM < 1.7	Max Rating 1.7 ≤ GPM < 2.8	Max Rating 2.8 ≤ GPM < 4.0	Max Rating GPM ≥ 4.0
< 2	0.91	0.91	0.91	0.92

Residential-Duty Commercial Electric Instantaneous (> 12 kW, ≤ 58.6 kW) - Minimum UEF

Volume (gallons)	Max Rating 0 ≤ GPM < 1.7	Max Rating 1.7 ≤ GPM < 2.8	Max Rating 2.8 ≤ GPM < 4.0	Max Rating GPM ≥ 4.0
< 2	0.80	0.80	0.80	0.80

Btu/h British thermal units per hour
kW Kilowatt
GPM Gallons Per Minute
FHR First Hour Rating
UEF Uniform Energy Factor

Online Resource Center

www.energy.ca.gov/orc

- **Handouts**
- Fact sheets
- Guides
- **Tools**
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- Blueprint newsletter
- **Training**
- Presentations
- Videos
- **Links**
- Internal resources
- External resources

Field Verification & Diagnostic Testing Program

Program information

- 2022 Energy Code approvals in process
- Providers and registries for 2022 Energy Code

CalCERTS, Inc. HERS PROVIDER

- Newly constructed buildings
- Additions
- Alterations of residential and nonresidential buildings
- California whole-house home energy ratings
- HERS building performance contractors

CHEERS

- Newly constructed buildings
- Additions
- Alterations of residential and nonresidential buildings

Blueprint Newsletter

- Energy Code quarterly newsletter
- Updates
- Clarifications
- Frequently asked questions

Issue 138 | April - June 2022

BLUEPRINT

CALIFORNIA ENERGY COMMISSION

EFFICIENCY DIVISION

IN THIS ISSUE

For additional help with the Energy Code see Energy Code Ace's **online offerings** of trainings, tools, and resources.

2022 Energy Code: Multifamily Summary

The 2022 Building Energy Efficiency Standards (Energy Code) reorganizes low-rise (three or fewer habitable stories) and high-rise (four or more habitable stories) multifamily buildings into one building type, updates the multifamily buildings definition in § 100.1, and moves all requirements for multifamily buildings to §§ 160.0-180.4. This and other significant changes include:

Mandatory Requirements

- Updates minimum efficiencies for HVAC equipment; adds minimum efficiency requirements for dedicated outdoor air systems (DOAS), heat pump, and heat recovery chiller packages. § 110.2
- Changes demand responsive lighting controls trigger to 4,000 watts or more; adds requirements for controlled receptacles. §§ 110.12, 160.5(b)4E
- Unifies envelope insulation, vapor retarder, and fenestration requirements. § 160.1
- For dwelling units
  - Adds requirements for central fan integrated ventilation systems requiring a motorized controlled damper, damper controls, and variable ventilation. § 160.2(b)2Aii
  - Requires vented kitchen range hoods ventilation rates or capture efficiencies based on conditioned floor area and fuel type per Tables 160.2-E, F, G. § 160.2(b)2Avic2
  - Requires a HERS-verified maximum fan efficacy of 1.0 Watts per cfm for heat recovery ventilation (HRV) and energy recovery ventilation (ERV) systems. § 160.2(b)2Biii
  - Adds mechanical acceptance testing requirements. § 160.3(d)2
  - Adds electric-ready requirements when gas equipment is installed for space heating, cooking, and clothes dryers. § 160.9(a-c)

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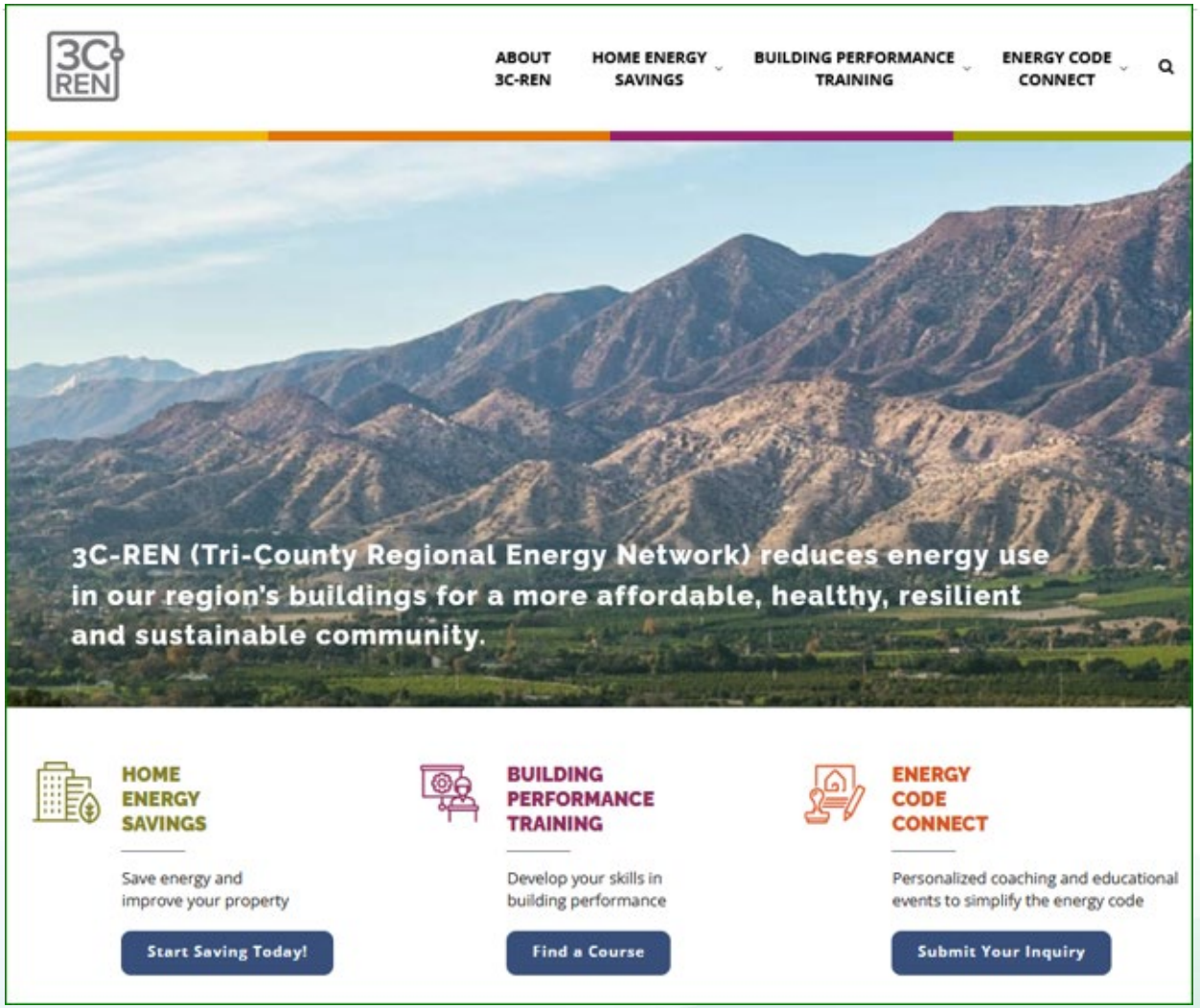
  - 8:00 a.m. to 12:00 p.m.
  - 1:00 p.m. to 4:30 p.m.
- Call
  - 800-772-3300 in CA
  - 916-654-5106 outside CA
- Email
  - Title24@energy.ca.gov

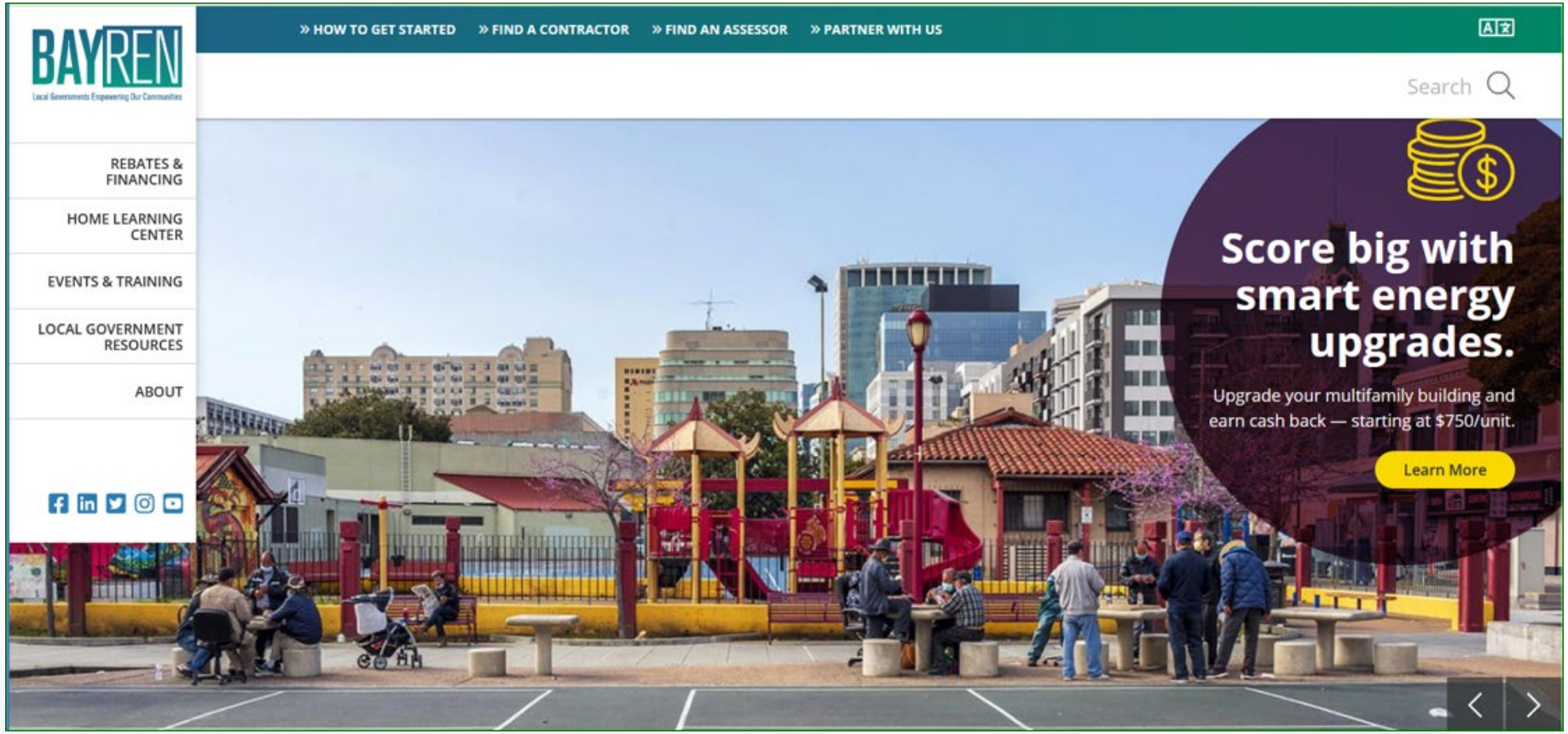
Other Available Resources – Energy Code Ace

Other Available Resources – 3C-REN



* Not affiliated with, or endorsed by, the CEC

Other Available Resources – BayREN



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Questions?

Thank you