Proposal Summary

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

2022 California Energy Code (Title 24, Part 6)

Multifamily All-Electric Compliance Pathway

Updated: April 9, 2020

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Introduction

The document summarizes proposed revisions to the California Energy Code (Title 24, Part 6) that will be discussed during a utility-sponsored stakeholder meeting on March 17, 2020. The Statewide Utility Codes and Standards Enhancement (CASE) Team is seeking input and feedback. To provide your comments, email info@title24stakeholders.com.

Measure Description

This CASE Report proposes prescriptive and performance compliance pathway(s) for all-electric multifamily buildings that use electric appliances for regulated and non-regulated end uses. This topic builds on the 2019 Title 24, Part 6 standards that allow a dual baseline strategy wherein electrically heated and water-heated buildings are compared to a code minimum electrically heated and water-heated building whereas a building with natural gas based systems for heating and water heating is compared to a code minimum natural gas-based systems. The limitation is that this dual baseline is only available for buildings with individual heat pump water heaters and only available to low-rise multifamily buildings. The 2019 Title 24, Part 6 standards did not address central water heating for both low-rise and high-rise residential buildings, HVAC, and non-regulated end uses such as appliances and plug loads for mid-rise and high-rise residential buildings.

The Statewide CASE Team investigated suitable strategies for achieving all-electric, including electric HVAC systems, domestic hot water (DHW) systems, and appliances and miscellaneous load (electric cooking and clothes dryers). The proposed measure includes the following changes for new construction multifamily buildings:

- Prescriptive alternate baselines for electric space heating and electric water heating. This effort will coordinate with the effort to unify multifamily requirements in the code.
- For the performance pathway, alternative compliance pathway for electric HVAC systems for mid-rise and high-rise multifamily buildings and baseline DHW system if Central HPWH are used in multifamily buildings.
    - Baseline system fuel type is the same as the proposed design. Proposed designs with gas water heaters and gas space heating will retain a gas baseline whereas proposed designs with electric water heaters and space heating will be compared to a baseline using electric systems with minimum efficiency levels meeting state and federal appliance standards as needed.

- Modified appliances and miscellaneous electric load (MEL) modeling rulesets in CBECC-Com to account for unregulated plug loads and appliances in mid-rise and high-rise multifamily dwelling units based on 2019 Title 24, Part 6 rulesets in CBECC-Res.

The proposed measure does not apply to alterations or additions.

The proposed code change would modify the following compliance documents.

For the prescriptive compliance approach the proposed code change will add a table to an existing Certificate of Compliance or create a new Certificate of Compliance (CR1R-PLB).

For the performance compliance approach the proposed changes will require updates to the following compliance forms:

- CF2R-PLB-01a-NonHERS-MultifamilyCentralHotWaterSystemDistribution
- CF2R-PLB-21a-HERS-MultifamilyCentralHotWaterSystemDistribution
- CF3R-PLB-21a-HERS-MultifamilyCentralHotWaterSystemDistribution
- NRCI-PLB-02-HighRiseResHotelMotel-MultifamilyCentral-HWSystemDistribution
- NRCI-PLB-21-HERS-HighRiseResHotelMotel-MultifamilyCentral-HWSystemDistribution
- NRCV-PLB-21-HERS-HighRiseResHotelMotel-MultifamilyCentral-HWSystemDistribution

The proposed code change will add descriptions and data fields for the field testing and visual inspection of central HPWH systems.

Draft Code Language

The Energy Commission plans to create a multifamily chapter for inclusion in 2022 Title 24, Part 6. The multifamily chapter will draw from the appropriate sections of the 2019 residential and nonresidential Standards. The Statewide CASE Team uses the language and section numbering from residential and nonresidential Standards and Reference Appendices to show the proposed changes below. Changes to the 2019 documents are marked with red underlining (new language) and ~~strikethroughs~~ (deletions). These changes are specific to multifamily buildings and not indicative of changes that apply to residential or nonresidential buildings.

2019 Title 24, Part 6 SECTION 150.1 PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES FOR LOW-RISE RESIDENTIAL BUILDINGS (c)

[Item (c)8]

8. Domestic Water-Heating Systems. Water-heating systems shall meet the requirements of either A B or C. For recirculation distribution systems serving individual dwelling unit, only Demand Recirculation Systems with manual on/off control as specified in the Reference Appendix RA4.4.9 shall be used:

A. For systems serving individual dwelling units, the water heating system shall meet the requirement of either i, ii, iii, iv, or v:

i. One or more gas or propane instantaneous water heater with an input of 200,000 Btu per hour or less and no storage tank.

ii. A single gas or propane storage type water heater with an input of 75,000 Btu per hour or less, rated volume less than or equal to 55 gallons and that meets the requirements of

Sections 110.1 and 110.3. The dwelling unit shall have installed fenestration products with a weighted average U-factor no greater than 0.24, and in addition one of the following shall be installed:

a. A compact hot water distribution system that is field verified as specified in the Reference Appendix RA4.4.16; or

b. A drain water heat recovery system that is field verified as specified in the Reference Appendix RA3.6.9.

iii. A single gas or propane storage type water heater with an input of 75,000 Btu per hour or less, rated volume of more than 55 gallons.

iv. A single heat pump water heater. The storage tank shall be located in the garage or conditioned space. In addition, one of the following:

a. A compact hot water distribution system as specified in the Reference Appendix RA4.4.6 and a drain water heat recovery system that is field verified as specified in the Reference Appendix RA3.6.9; or

b. For Climate Zones 2 through 15, a photovoltaic system capacity of 0.3 kWdc larger than the requirement specified in Section 150.1(c)14; or

c. For Climate Zones 1 and 16, a photovoltaic system capacity of 1.1 kWdc larger than the requirement specified in Section 150.1(c)14.

v. A single heat pump water heater that meets the requirements of NEEA Advanced Water Heater Specification Tier 3 or higher. The storage tank shall be located in the garage or conditioned space. In addition, for Climate Zones 1 and 16, a photovoltaic system capacity of 0.3 kWdc larger than the requirement specified in Section 150.1(c)14 or a compact hot water distribution system as specified in the Reference Appendix RA4.4.6.

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 heating system or

ii. Heat pump water heating system that is meeting the minimum requirements specified in Joint Appendix JA14 and field verified as specified in the Reference Appendix RA3.6.x.; and

~~ii.~~ iii A recirculation system that meets the requirements of Sections 110.3(c)2 and 110.3(c)5, includes two or more separate recirculation loops serving separate dwelling units, and is capable of automatically controlling the recirculation pump operation based on measurement of hot water demand and hot water return temperature; and

EXCEPTION to Section 150.1(c)8Biii: Buildings with eight or fewer dwelling units may use a single recirculation loop.

EXCEPTION to Section 150.1(c)8B-iii: Heat pump water heater serving eight or fewer dwelling units

~~iii~~ iv. A solar water-heating system meeting the installation criteria specified in Reference Residential Appendix RA4 and with a minimum solar savings fraction of either a or b below:

a. 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; or

b. A minimum solar savings fraction of 0.15 in Climate Zones 1 through 9 or a minimum solar savings fraction of 0.30 in Climate Zones 10 through 16. In addition, a drain water heat recovery system that is field verified as specified in the Reference Appendix RA3.6.9.

EXCEPTION to Section 150.1(c)8B-iv: Central heat pump water heater system meeting requirements specified in ii.

C. A water-heating system serving multiple dwelling units determined by the Executive Director to use no more energy than the one specified in subsection B above.

Reference Appendices

The proposed code language proposes to add a new Joint Appendix 14 to include testing, configuration, installation and control requirements for central HPWH systems. The proposed code change also includes a new Reference Appendix RA Section 3.6.x to include field verification for central HPWH systems. This additional section will be referenced in Table RA2-1 under section RA2.2 summarizing all the measures requiring HERS verification.

JA14 Qualification Requirements for Central Heat Pump Water Heater System

JA14.1 Purpose and Scope

Joint Appendix JA14 provides the qualification requirements to meet the standards for Central Heat Pump Water Heater Systems set forth in Title 24, Part 6, Section 150.1(c)8 B.

JA14.2 Central Heat Pump Water Heater Requirements

Central heat pump water heater products shall be certified to the Energy Commission to meet the following requirements:

(a) Submit heat pump water heater test data in accordance with JA14.3 to the Energy Commission.

(b) Document defrost strategy, including the method of detecting frosting conditions (onset conditions), algorithm used for defrosting, and the defrost cycle length and process.

JA14.3 Test Procedure and Reporting

The test setup, installation, calculation procedure and instruments required for the test are as described in Title 10 CFR Appendix E to Subpart G of Part 431. The central HPWH shall be tested for the following performance specifications:

- Water heater input power
- Water heater output capacity
- Water heater COP

The central HPWH shall be tested at the following conditions

- Inlet ambient air temperature: Maximum, minimum, and two midpoint temperatures of the manufacturer specified operating range. Minimum shall be equal or lower than 40 °F.
- Inlet water temperature: Maximum, minimum, and two midpoint temperatures of the manufacturer specified operating range.

- Outlet water temperature: Maximum, midpoint, and minimum of outlet water (setpoint) temperatures of the manufacturer specified operating range. Maximum shall be equal to or greater than 140 °F.

JA14.4 Design Condition Documentation Requirements

The central heat pump water heater system shall be capable of supplying hot water at design outlet water temperature under specified operating ranges for:

- Minimum and maximum ambient air temperature
- Minimum and maximum cold-water temperature
- Minimum and maximum building demand at design draw and recovery conditions and duration.
- Recirculation loop heat loss

Design documentation shall specify the operating conditions at which the primary heat pump water heater can supply hot water at design outlet water temperature without engaging auxiliary heating mechanism.

JA14.5 Plumbing Requirements

The central heat pump water heater system shall be configured as follows:

(a) Recirculation pipe return and fuel source

- The hot water return from recirculation loop shall connect to a recirculation loop tank, and shall not directly connect to the primary HPWH inlet or the primary storage tanks
- The fuel source for the recirculation loop tank shall be electricity. The recirculation loop heater shall be capable of multi-pass water heating operation.

(b) Primary storage tank configuration

- For a single-pass system, multiple primary storage tanks shall be piped in series to maximize temperature stratification in the tanks. Hot water supply from the heat pump water heater shall connect to the top of the last tank and the heat pump water heater shall draw water from the bottom of the first tank.
- For a multi-pass system, multiple primary storage tanks shall be piped in parallel.

See Figure JA 14-1 for an example of a single-pass central heat pump water heater system schematic and Figure JA 14-2 for an example of a multi-pass central heat pump water heater system schematic.

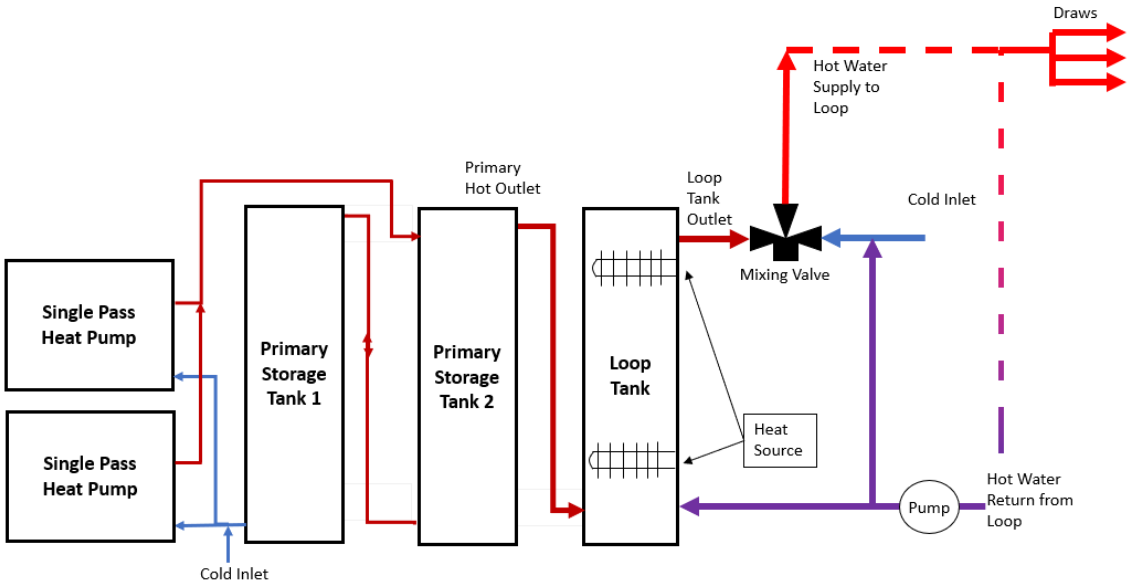

Figure JA 14 – 1: Example of central single-pass heat pump water heater system schematic

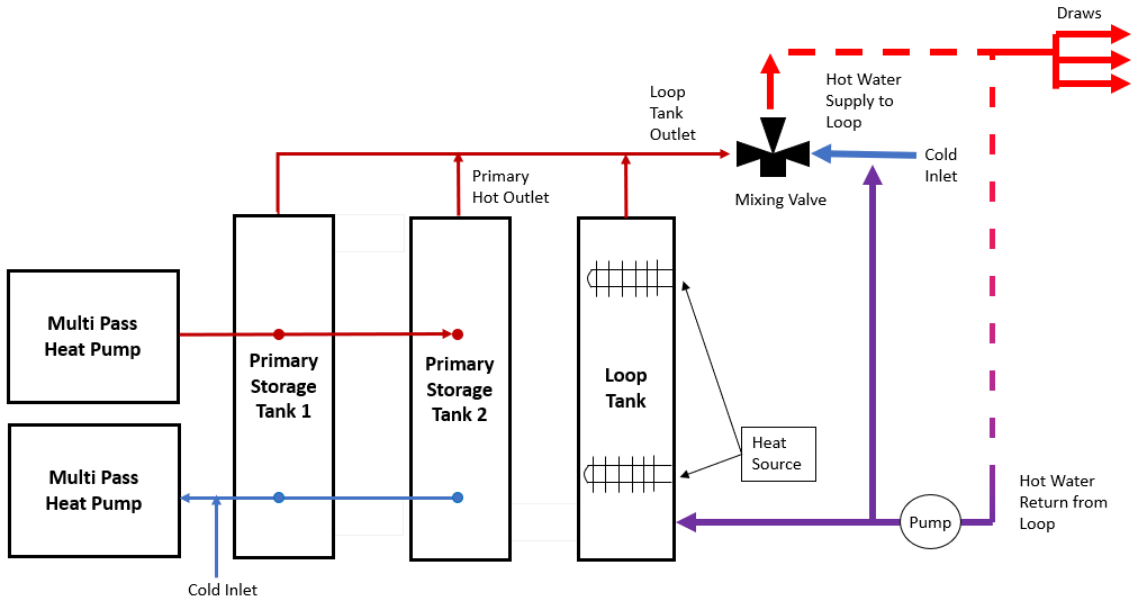

Figure JA 14 – 2: Example of central multi-pass heat pump water heater system schematic

JA14.6 Control Requirements

The following control requirements shall apply to the heat pump water heating system:

- The primary storage tank temperature setpoint shall be at least 140°F

- The recirculation loop tank temperature shall be at least 20°F lower than the primary storage tank temperature setpoint such that hot water from the recirculation loop tank is used for the temperature maintenance load before engaging the recirculation loop tank heater.
- The minimum heat pump water heater compressor cut-off temperature shall be equal or lower than 40°F.

RA2.2 Measures that Require Field Verification and Diagnostic Testing

Table RA2-1 describes the measures that require installer certification and HERS Rater field verification and diagnostic testing and identifies the protocol or test procedure in the Reference Residential Appendices that shall be used for completing installer and HERS Rater field verification and diagnostic testing.

Table RA2-1 – Summary of Measures Requiring Field Verification and Diagnostic Testing

Multi Family Domestic Hot Water Heating Measures		
~~Multiple Recirculation Loop Design for DHW Systems Serving Multiple Dwelling Units~~	~~Inspection that a central DHW system serving a building with more than eight dwelling units has at least two recirculation loops, each serving roughly the same number of dwelling units. These recirculation loops may serve the same water heating equipment or be connected to individualependent water heating equipment.~~	~~RA3.6.8~~
Verified Drain Water Heat Recovery System (DWHR-H)	Inspection to verify that the DWHR unit(s) and installation configuration match the compliance document and the DWHR(s) is certified to the Commission to have met the requirements.	RA3.6.9
Central Heat Pump Water Heating Systems Serving Multiple Dwelling Units	Visual inspection to verify a central HPWH system serving multiple dwelling units meets the minimum equipment specifications, and installation requirements.	RA3.6.x

RA3.6.X – HERS-Verified Central HPWH Systems Serving Multiple Dwelling Units

The visual inspection shall verify that the central HPWH system is installed per requirements in JA14. Unless otherwise dictated by JA14, central heat pump water heater systems shall be installed according to manufacturer design and installation guidelines.

Visual inspection shall include the following:

(a) HPWH equipment's minimum compressor operation temperature is lower than 40°F based on manufacturer equipment specifications.

(b) Multiple storage tanks are piped in series for a single-pass system, and multiple storage tanks are piped in parallel for a multi-pass system.

(c) Verify that recirculation loop return water is connected to a recirculation loop tank or heater, and no recirculation return water is plumbed directly back to the primary storage tank or primary water heater.

(d) The recirculation loop tank uses electricity as the fuel source. These may be electric resistance element or a dedicated multi-pass HPWH.

Compliance Manuals

Chapter 5.1 of the Residential Compliance Manual will be updated to add a summary of the new requirements around central heat pump water heating systems. Chapter 5.4.2 of the Residential Compliance Manual will be updated to explain prescriptive requirements around central heat pump water heating. Chapter 5.5.3 of the Residential Compliance Manual will be updated to explain the performance method requirements around central heat pump water heating.

Chapter 4.7.3 and 4.8 of the Nonresidential Compliance Manual will be updated to explain the requirements around central heat pump water heating. Details are in the companion CHPWH CASE report.

ACM Reference Manual

Nonresidential Alternative Calculation Method Reference Manual

5.1.2 HVAC System Map

The HVAC system in the standard design depends on the primary building activity, the size of the building, and the number of floors. Details about these systems are provided in subsequent sections.

Many of the building descriptors have a one-to-one relationship between the proposed design and the standard design; for example, every wall in the proposed design has a corresponding wall in the standard design. For HVAC systems, however, this one-to-one relationship generally does not hold. The HVAC system serving the proposed design and the standard design may be completely different, each with different components.

The HVAC system in the standard design shall be selected from Table 2: HVAC System Map, and be based on building type, number of floors, conditioned floor area, and heating source. Moreover, the selected system shall conform to the descriptions in Table 5: System Descriptions.

For systems 1, 2, 3, 7, 10, and 11, each thermal zone shall be modeled with a respective HVAC system. For systems 5, 6, and 9, each floor shall be modeled with a separate HVAC system. Floors with identical thermal zones and occupancies can be grouped for modeling. The standard design heating source is natural gas.

TABLE 2: HVAC System MAP

Building Type	Standard Design
Residential or hotel/motel guestrooms in a building with seven or fewer floors above grade	If a proposed design uses electricity as the space heating fuel type, the standard system shall be System 4 Otherwise, the standard system shall be System 1 - SZAC
Residential or hotel/motel guestrooms in a building with eight or more floors above grade	If a proposed design uses electricity as the space heating fuel type, the standard system shall be System 4 Otherwise, the standard system shall be System ~~2 – FPFC~~ 1 - SZAC

Retail building 2 floors or fewer	System 7 - SZVAV*
Warehouse and light manufacturing space types (per the Appendix 5.4A Schedule column) that do not include cooling in the proposed design	System 9 - HEATVENT
Covered process	See Table 4: System Map for Covered Processes
Healthcare Facilities	Same as the Proposed Design
All other space types	See Table 3: Nonresidential Spaces (Not Including Covered Processes)

TABLE 5: System Descriptions

System Type	Description	Detail
System 1 – SZAC	Residential Air Conditioner	Single zone system with constant volume fan, no economizer, DX cooling and furnace
System 2 – FPFC	Four-Pipe Fan Coil	Central plant with terminal units with hot water and chilled water coils, with separate ventilation source
System 3 – SZAC	Packaged Single Zone	Single-zone constant volume DX unit with gas heating
System 4 – ~~RESERVED~~ SZHP	Split Ducted Heat pump	Single-zone ducted split heat pump system, constant volume fan
System 5 – PVAV	Packaged VAV Unit	VAV reheat system; packaged variable volume DX unit with gas heating and with hot water reheat terminal units
System 6 – VAVS	Built-up VAV Unit	Variable volume system with chilled water and hot water coils, water-cooled chiller, tower and central boiler
System 7 – SZVAV	Packaged Single-Zone VAV Unit	Single-zone variable volume DX unit with variable-speed drive and gas heating
System 8 – RESERVED		
System 9 – HEATVENT	Heating and Ventilation Only	Gas heating and ventilation
System 10 – CRAH	Computer Room Air Handler	Built-up variable volume unit with chilled water, no heating
System 11 – CRAC	Computer Room Air Conditioner	Packaged variable volume DX unit with no heating
System 12 – LAB	Laboratory HVAC System	Laboratory spaces in a building having a total laboratory design maximum exhaust rate of 15,000 cfm or less use Table 3, Nonresidential System Map. Laboratory spaces in a building with building floor area < 150,000 ft2: System 5 – PVAV Laboratory spaces in a building with building floor Area ≥ 150,000 ft2: System 6 – VAVS
System 13 – KITCH	Kitchen HVAC System	Dedicated single-zone makeup air unit (MAU) with dedicated exhaust fan. If the building is

		VAVS per Table 3, the cooling source is chilled water and the heating source is hot water. Otherwise, cooling source is DX and heating source is a gas-fired furnace.

Draft Code Language – Plug load and MELs

Add language to Nonresidential Alternative Calculation Method Reference Manual per language from Residential Alternative Calculation Method Reference Manual Appendix E – Plug loads and lighting modeling

Table 1: User Inputs Affecting Estimated Plug Load and Lighting Energy Use

End Use	User Inputs that Determine Estimated Energy Use	Notes
Primary Refrigerator/ Freezer	- BRperUnit - Optional: rated annual kWh usage from the Energy Guide label of the installed device	- Default kWh can be overridden with the rated annual kWh usage input on the Energy Guide label; however, there is a maximum allowable kWh credit dependent on BRperUnit. - Energy use adjusted on an hourly basis depending on the indoor temperature in the kitchen simulated in the software.
Non-Primary Refrigerators and Separate Freezers	- BRperUnit - Single-family or multi-family housing	- Assumed to be installed in the garage in new, single-family homes. - Assumed to be absent in multi-family dwelling units.
Dishwasher	- BRperUnit - Presence of device - Single-family or multi-family	- Ruleset estimates machine energy use only. - Energy use is only included if user indicates the device will be present. - Assumed different usage patterns in single family and multi-family when developing algorithms.
Clothes Washer	- BRperUnit - Presence of device - Single-family or multi-family - Optional: whether installed device will comply with the 2015 federal efficiency standards (credit for installing new or nearly-new device)	- Ruleset estimates machine energy use only. - Energy use is only included if user indicates the device will be present. - Assumed different usage patterns in single family and multi-family when developing algorithms. - Default energy use can be reduced if the user specifies the device will meet the 2015 federal standard, which can be determined by looking up the model on the California Appliance Efficiency Database.

End Use	User Inputs that Determine Estimated Energy Use	Notes
Clothes Dryer	- BRperUnit - Presence of device - Fuel type (natural gas, propane, or electric) - Single-family or multi-family - Optional: percent remaining moisture content (RMC) of the clothes washer	- Energy use is only included if user indicates the device will be present. - User can select fuel type. If user indicates natural gas is available at the site (see Section 2.2.10 of RACM), then the default fuel type is natural gas. If user indicates that natural gas is not available at the site then the default fuel type is electric. User cannot select natural gas as the fuel type if natural gas is not available at the site. - Default energy use can be reduced if the user specifies that the installed clothes washer has a rated RMC of less than 50 percent.
Oven	- BRperUnit - Presence of device - Fuel type (natural gas, propane, or electric)	- Energy use is only included if user indicates the device will be present. - User can select fuel type, but default assumption is natural gas if user indicates that natural gas is available on-site and electric if user indicates natural gas is not available on-site
Cooktop		
Televisions	- BRperUnit	
Set-Top Boxes		
Computers and Monitors		
Residual MELs		
Interior Lighting	- CFAperUnit	
Exterior Lighting		
Garage Lighting	- CFAperUnit - Presence of garage	- Energy use is only included if user indicates there is a garage present. - Garage lighting is assigned to multi-family buildings if there is at least once garage present. - Carport lighting is covered under the exterior lighting ruleset.

Table 2: Algorithms for Plug Load and Lighting Annual Energy Use

End Use	Standard Design Fuel Type	kWh or therms	Intercept	Slope	Per-Unit BR or CFA
Primary Refrigerator/Freezer	Electricity	kWh	454	37.0	BR
Non-Primary Refrigerators and Separate Freezers (Single-Family only)	Electricity	kWh	0	71.0	BR
Oven	Electricity	kWh	138	16	BR
Oven	Gas	therms	6.0	0.95	BR
Oven	Gas	kWh	41	4.79	BR
Cooktop	Electricity	kWh	84	5.68	BR
Cooktop	Gas	therms	5.0	0.30	BR
Cooktop	Gas	kWh	0	0	BR
Televisions	Electricity	kWh	265	31.8	BR
Set-Top Boxes	Electricity	kWh	76	59.4	BR
Computers and Monitors	Electricity	kWh	79	55.4	BR
Residual MELs	Electricity	kWh	672	235	BR
Interior Lighting	Electricity	kWh	100	0.1775	CFA
Exterior Lighting	Electricity	kWh	8.0	0.0532	CFA
Garage Lighting	Electricity	kWh	20	0.0063	CFA

Table 3: Multi-Family Dwelling Unit Algorithms for Dishwasher, Clothes Washer, and Clothes Dryer Annual Energy Use

BRperUnit	Dishwashers (kWh/yr)	Clothes Washers (kWh/yr)	Electric Clothes Dryer (kWh/yr)	Gas Clothes Dryers	
				Natural Gas Usage (therms/yr)	Electricity Usage (kWh/yr)
0	56	66	496	17	25
1	68	70	527	19	26
2	96	99	745	26	37
3	94	97	733	26	37
4	121	118	885	31	44
5+	114	107	805	28	40

Residential Alternative Calculation Method Reference Manual

2.9.3 Multiple Dwelling Units

When the proposed design is a central water heating system, the standard design consists of the water heating devices, a recirculation system, and solar systems as follows:

Water-heating device. The standard design consists of the same number of water-heating devices as the proposed design using the efficiencies required in the Appliance Efficiency Standards. The standard design is natural gas when the proposed device is natural gas. The standard design is propane if the proposed device is propane. Each water-heating device in the proposed system is examined separately. If the proposed water-heating device is gas or propane, the standard design is set to the same type and characteristics as the proposed design.

If the proposed water-heating device is electric resistance or heat pump with no recirculating loops (fewer than eight dwelling units), then the standard design is a heat pump water heater with 2.0 UEF with no recirculation loops. If the proposed central water-heating device is electric resistance or heat pump with recirculating loops, the standard design is ~~natural gas or propane~~ central heat pump water heater system with recirculating loop.

The appropriate efficiencies and standby losses for each standard water-heating device are then assigned to match the minimum federal requirements. The standards for consumer water heaters, as defined by 42 U.S.C 6291(16), are specified in 10 CFR 430.32(d); the standards for commercial water heaters, as defined by 42 U.S.C 6291(16), are specified in 10 CFR 431.110.

Central HPWH system. The standard central HPWH system uses a heat pump water heater meeting requirement specified in JA 14.

Recirculating system. The standard design includes a recirculation system with controls that regulate pump operation based on measurement of hot water demand and hot water return temperature, and

capable of turning off the system as described in Appendix B4 Hourly Recirculation Distribution Loss for Central Water Heating Systems. The standard design has one recirculation loop.

Solar thermal water-heating system. The standard design has a solar water heating system meeting the installation criteria specified in Residential Reference Appendix RA4 and with a minimum solar savings fraction of 0.20 in Climate Zones 1-9, or 0.35 in Climate Zones 10-16.

VERIFICATION AND REPORTING

All modeled features and the number of devices modeled for the water heating system are reported on the CF1R. Electric resistance and heat pump water heaters indicate the location of the water heater. NEEA-rated heat pumps are identified by the brand and model, which must be verified by the building inspector. Where water heating system features or distribution systems specify or require HERS verification, those features are listed in the HERS required verification listings on the CF1R.