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Introduction

This compliance manual is intended to help plans examiners, inspectors, owners, designers, builders, and energy consultants comply with and enforce California's 2022 Building Energy Efficiency Standards (Energy Code) for single-family residential buildings. The lighting, domestic hot water, and indoor air quality requirements in this compliance manual also apply to low-rise multifamily buildings, three stories or less. The manual is written as a reference and instructional guide and can be helpful for anyone that is directly or indirectly involved in the design and construction of energy-efficient single-family residential buildings.

The compliance manual has 10 chapters:

Chapter 1 introduces the Energy Code and discusses the application and scope of the standards for single-family residences.

Chapter 2 analyzes the compliance and enforcement process, including design and preparation of compliance documentation through field verification and diagnostic testing.

Chapter 3 details the building envelope.

Chapter 4 discusses heating, ventilation, and air-conditioning (HVAC) systems.

Chapter 5 outlines water-heating systems requirements, including the requirements for swimming pool systems.

Chapter 6 looks at requirements for hardwired interior lighting and for outdoor lighting permanently attached to the building.

Chapter 7 examines photovoltaics, battery storage systems, and shared solar electric systems or community-shared battery system compliance option and solar-ready requirements for single-family residential buildings.

Chapter 8 outlines the performance approach to compliance.

Chapter 9 goes over additions, alterations, and repairs.

Chapter 10 covers the mandatory electric readiness requirements for mixed-fuel single-family buildings.

1.1 Related Documents

This compliance manual supplements four other related documents that are available from the California Energy Commission. These are:

A. *The 2022 Building Energy Efficiency Standards, Title 24, Part 6* (Energy Code). This compliance manual supplements and explains and clarifies California's energy efficiency standards for buildings; it does not replace them. Readers should have a copy of the Energy Code to refer to while reading this manual, as well as a copy of the *2022 Reference Appendices.*

B. 2022 Reference Appendices — The reference appendices have three main subsections: Reference Joint Appendices, Reference Residential Appendices, and Reference Nonresidential Appendices:

1. *The 2022 Reference Joint Appendices* contain information common to single-family residential, nonresidential, and multifamily buildings including, but not limited to, definitions, climate zone information, weather data, assembly properties, qualification requirements for high-efficacy light sources, compliance documentation registration procedures, qualification requirements for photovoltaic systems, and qualification requirements for battery storage systems.
2. The *2022 Reference Residential Appendices* contain information for single-family residential and low-rise multifamily buildings. The Reference Residential Appendices contain Home Energy Rating System (HERS) field verification and diagnostic testing procedures for HVAC equipment, air distribution ducts, and quality insulation installation.
3. The *2022 Reference Nonresidential Appendices* contain information for both nonresidential and high-rise multifamily buildings. The reference nonresidential appendices contain HERS field verification and diagnostic testing procedures for HVAC equipment and air distribution ducts, acceptance testing procedures, and luminaire power default values.

C. The 2022 Residential Alternative Calculation Method (ACMs or Compliance Software) Approval Manual. The 2022 Residential ACM Approval Manual describes the process for certifying and decertifying the compliance software programs.

D. *The 2022 Residential Alternative Calculation Method Reference Manual* lays out the technical rules for implementing the 2022 performance compliance path in software programs.

Material from related documents is not repeated in this compliance manual; rather, it is referenced. If you are using the electronic version of this compliance manual, there are hyperlinks throughout the manual that will take you directly to the document that is referenced.

1.2 The Technical Chapters

Each of the technical chapters (Chapters 3 through 10) begins with an overview, followed by a presentation of a specific topic in each subsection. For the building envelope, subsections include fenestration, opaque surfaces (walls, floors, and roofs), air leakage and infiltration, radiant barriers, cool roofs, and quality insulation installation (QII) verification. For HVAC, the subsections include heating equipment, cooling equipment, air distribution and fans, controls, indoor air quality, alternative systems, refrigerant charge, and verification. For water heating, subsections include equipment efficiencies and distribution systems. Lighting subsections include high-

efficacy lighting, light-emitting diode (LED) lighting, switching devices and controls, and recessed luminaires. Mandatory requirements and prescriptive requirements (defined in Section 1.6 of this chapter) are described within each subsection or component. For photovoltaics (PV), the subsections include qualification requirements for photovoltaic systems, battery storage systems, shared solar electric system, or community-shared battery system compliance option and solar-ready requirements for low-rise residential buildings. Chapter 8 describes the computer performance approach. Chapter 9 covers requirements for additions and alterations. Chapter 10 outlines the mandatory electric readiness requirements for single-family buildings when mixed-fuel space heating, water heating, cooking and clothes drying is used. Chapter 2, although not a technical chapter, covers important compliance and enforcement topics.

Each technical chapter or subsection also has a compliance options section. The compliance options section includes information on how to design a building that goes beyond the prescriptive energy efficiency requirements and mandatory energy efficiency requirements. Compliance options are used for compliance credit through the performance approach. There are also design recommendations for which no compliance credit is offered. However, following the recommendations will significantly impact building energy use or peak demand.

Table 1-1: Compliance Options vs. Design Recommendations

Compliance Options	Design Recommendations, such as interior fenestration shading devices
Credit offered through the performance approach	No credit but may still affect energy or demand.

Source: California Energy Commission

1.3 Why California Needs Building Energy Efficiency Standards

Energy efficiency reduces energy costs, increases reliability and availability of electricity, improves building occupant comfort, and reduces impacts to the environment, making the Energy Code important and necessary for California's energy future.

1.3.1 Energy Savings

Reducing energy use benefits everyone. Homeowners save money, Californians have a more secure and healthy economy, the environment is less negatively impacted, and the state electrical system can operate in a more stable manner. The 2022 Energy Code (for residential and nonresidential buildings) are expected to reduce the growth in electricity use and natural gas use.

1.3.2 Electricity Reliability and Demand

Buildings are one of the major contributors to electricity demand. During the 2000–2001 California electricity crisis and the East Coast blackout in the summer of 2003, California Energy Commission (CEC) staff learned that the electric distribution network is fragile and system overloads caused by excessive demand from buildings can create unstable conditions. Furthermore, resulting blackouts can seriously disrupt business and cost the economy billions of dollars.

Since the California electricity crisis, the CEC has placed increasing emphasis on demand reduction.

1.3.3 Comfort

Comfort is an important benefit of energy-efficient homes. Energy-efficient houses are well-insulated, are less drafty, and use high-performance windows or shading or both to reduce solar gains and heat loss. Poorly designed building envelopes result in less comfortable homes. Even with oversized heating and cooling systems, comfort cannot be achieved in older, poorly insulated, and leaky homes.

1.3.4 Economics

For the homeowner, energy efficiency helps ensure that a home is affordable now and into the future. Banks and other financial institutions recognize the effect of energy efficiency through energy-efficient mortgages; they look at the total cost of owning the home, including paying the utility bills. If the utility bills are lower, lenders can qualify borrowers for a larger loan.

From a larger perspective, the less California depends on depletable fossil resources such as natural gas, coal, and oil, the stronger and more stable the economy will remain in the face of energy cost increases. A cost-effective investment in energy efficiency helps everyone. In many ways, it is far more cost-effective for the people of California to invest in saving energy than it is to invest in building new power plants.

1.3.5 Environment

In many parts of the world, energy use has led to oil spills, acid rain, smog, and other forms of environmental pollution that have ruined the natural beauty people seek to enjoy. California is not immune to these problems, but appliance standards, building standards, and utility programs that promote efficiency and conservation help maintain environmental quality. Other benefits include reduced destruction of natural habitats, which helps protect animals, plants, and natural systems.

1.3.6 Global Warming

Burning fossil fuels contributes greatly to global warming; carbon dioxide is being added to an atmosphere already containing 35 percent more than it did two centuries ago. Carbon dioxide and other greenhouse gases create an insulating layer around the Earth that leads to global climate change. CEC research shows that most

sectors of the state economy face significant risk from climate change, including water resources (from reduced snowpack), agriculture, forests, and the natural habitats of several indigenous plants and animals.

Scientists recommend that actions be taken to reduce emissions of carbon dioxide and other greenhouse gases. While adding scrubbers to power plants and catalytic converters to cars reduces other emissions, they do not limit the carbon dioxide emitted into the atmosphere. Using energy efficiently is a far-reaching strategy that can make an important contribution to reducing greenhouse gases.

The National Academy of Sciences has urged the United States to follow California's lead on such efforts, saying that conservation and efficiency should be the chief element in energy and global warming policy. Its first efficiency recommendation was simple: Adopt nationwide energy-efficient building codes. Energy conservation will not only increase comfort levels and save homeowners money, but it will also play a vital role in creating and maintaining a healthy environment.

The Energy Code is expected to have a significant impact on reducing greenhouse gas and other air emissions. Carbon dioxide (CO_2), one of the more prevalent greenhouse gases, would be reduced.

1.3.7 Building Decarbonization

California has nearly 14 million homes and 7.5 million square feet of commercial buildings. These buildings produce a quarter of the state's greenhouse gas (GHG) emissions, making homes and businesses a major factor in climate change. Reducing these emissions, also referred to as building decarbonization, is a key part of California's climate strategy.[1] Of the many tools in the state's building decarbonization toolbox, the Building Energy Efficiency Standards stand out as a proven solution of significance.

In August 2021, the CEC adopted the 2022 Energy Code for newly constructed and renovated buildings. This code blazes a trail for states and governments seeking to decarbonize the building sector aggressively, feasibly and cost-effectively. This update encourages efficient electric heat pumps, establishes electric-ready requirements for new homes, and strengthens ventilation standards. For the first time in the nation, this update also requires solar photovoltaic systems plus battery systems as the performance standards baseline for select nonresidential building types. Over the next 30 years, this code is estimated to provide the state with $1.5 billion in environmental benefits; equivalent to taking nearly 2.2 million cars off the road for a year. The development of this code was a multiyear effort led by the CEC through a robust public process and with support from an

[1] AB3232, https://www.energy.ca.gov/media/5968

expansive network of key market partners such as California's largest utilities, the building community, and environmental advocates.[2]

1.3.8 The Warren-Alquist Act

Section 25402 of the Public Resources Code

Section 25402 of the California Public Resources Code (the code) authorizes the CEC to develop and maintain the Energy Code for new buildings. This section of the code, commonly referred to as the Warren-Alquist Act (the act), is direction from the Legislature on the development of the Energy Code in California.

The act created the CEC in 1974 and gave it authority to develop and maintain building energy efficiency standards for new buildings. The act directs the CEC to "prescribe, by regulation, lighting, insulation, climate control system, and other building design and construction standards which increase the efficiency in the use of energy for new residential and new nonresidential buildings." Additionally the act states that the "standards shall be performance standards and shall be promulgated in terms of energy consumption per gross square foot of floorspace, but may also include devices, systems, and techniques required to conserve energy and water."

The act also requires that the Energy Code be cost-effective "when taken in their entirety and amortized over the economic life of the structure," and it requires that the CEC periodically update the standards and develop manuals to support them. The act directs local building permit jurisdictions to withhold permits until the building satisfies the Energy Code.

1.4 What's New for 2022

The most significant change in the *2022 Building Energy Efficiency Standards* affecting single-family residential buildings is the change to a single fuel baseline with heat pump being prescriptively required for either water heating or space heating, depending on the climate zone. A new Energy Design Rating (EDR) metric, EDR1, was added that is based on hourly source energy. There are numerous new requirements for additions and alterations. There are also significant changes in requirements related to indoor air quality.

1.4.1 Summary of Changes for Residential Buildings Include:

A. Mandatory Requirements:

1. Mandatory roof deck insulation in newly constructed attic systems in Climate Zones 4 and 8–16 to meet an area-weighted average U-factor no greater than 0.184 (§150.0[a]1).

[2] 2022 code adoption script, https://www.energy.ca.gov/event/meeting/2021-08/energy-commission-business-meeting

2. Ducts in conditioned space can be uninsulated if specific conditions are met as explained in Section 4.4.1 (§150.0[m]1B).
3. Electric readiness is now required for space heating, cooking, and clothes dryers when gas equipment is installed. Electrical infrastructure must be provided to the equipment location for the future installation of electrical appliances. (§150.0[t]-[v]).
4. The electric-ready requirements for gas water heaters have been revised (§150.0[n]).
5. Updated mechanical ventilation requirements based on the 2019 version of ASHRAE 62.2 (§150.0[o]).
6. New requirements for central fan integrated ventilation systems requiring a motorized controlled damper (§150.0[o]1B).
7. Updated local exhaust requirements for kitchen range hoods. Gas ranges require higher ventilation rates or capture efficiencies than electric ranges. (§150.0[o]1G).
8. Simplify the hot water piping language and align with the Plumbing Code (§150.0[j]).
9. Updated HPWH-ready requirements for gas water heater installations that include providing a designated space for a future HPWH installation. (See Electric Readiness — Chapter 10.)
10. New battery storage-ready infrastructure requirements. (§150.0[s]).

B. Prescriptive Compliance:

1. Under the prescriptive compliance approach, the heating equipment is required to be a heat pump in Climate Zones 3, 4, 13, and 14. In other climate zones, it can be either a heat pump or a gas heating system (§150.1[c]6).
2. Under the prescriptive compliance approach, water heating equipment is required to be a heat pump water heater or a solar water heating system with electric backup and minimum 70 percent solar fraction. In Climate Zones 3, 4, 13, and 14 a gas instantaneous water heater is allowed (§150.1[c]8).

C. Performance Compliance:

1. All compliance software programs approved by the CEC use the same compliance engine as the public domain software. The technical details and information about how the energy budget is determined are included in the 2022 Single-Family Residential Buildings Alternative Compliance Manual (ACM) Reference Manual.
2. A new Energy Design Rating (EDR) metric, EDR1, was added that is based

on hourly source energy. What was referred to as just "Efficiency EDR" in the 2019 code is now efficiency EDR2.

D. Compliance requires meeting three components of an Energy Design Rating (EDR): (1) EDR (source), (2) Efficiency EDR2, and (3) Total EDR2 (§150.1(b)1). For more information, see Chapter 8.

E. Additions and Alterations:

1. An exception was added that not require junior accessory dwelling units (JADUs) that are classified as additions to an existing building to meet the whole-building mechanical ventilation requirements. JADUs are dwelling units that are no more than 500 square feet and contained entirely within an existing single-family building,
2. New language clarifying when mechanical ventilation requirements apply to alterations.
3. Ceiling insulation in additions 700 square feet or less must meet R-38 in Climate Zones 1, 2, 4, and 8–16 and R-30 in Climate Zones 3 and 5–7.
4. Expand the cool roof requirements for steep-sloped roof replacements to Climate Zones 4 and 8–9. The allowable exceptions were also revised.
5. Expand the cool roof requirements for low-sloped roof replacements to Climate Zones 4, 6–12, and 14. The allowable exceptions were also revised.
6. Add a new requirement for roof deck insulation for low-sloped roof replacements in Climate Zones 1, 2, 4, and 8–16. R-14 continuous roof deck insulation or and equivalent assembly roof assembly U-factor of 0.039 is required. Various exceptions to this requirement are allowed.
7. New language modifying when replacement electric resistance space heating equipment is allowed.
8. Reduce the duct sealing target for altered duct- and space-conditioning systems from 15 percent to 10 percent of total duct leakage in all climate zones.
9. Increase the prescriptive duct insulation from R-6 to R-8 in Climate Zones 1–2, 4, 8–10, and 12-13.
10. Reduce the 40-foot trigger for prescriptive duct sealing and insulation to 25 feet for altered systems. Eliminate the minimum length requirement for additions and require duct sealing whenever an existing duct system is extended to serve an addition.
11. Add a prescriptive requirement for insulation and sealing in vented attics for altered ceilings or when an entirely new or complete replacement duct system is installed in a vented attic. The requirements apply in all climate

zones except 5 and 7. Various exceptions to this requirement are allowed.

12. New doors that result in an increase in exterior door area must meet the newly constructed building requirements of a maximum U-factor of 0.20.

1.5 Scope and Application

1.5.1 Building Types

Though the Energy Code applies to nonresidential and residential buildings, this compliance manual addresses only the requirements for single-family residential buildings. A companion compliance manual addresses the requirements for nonresidential buildings, including hotels, motels, and multifamily buildings.

A. **Mixed Low-Rise Residential and Nonresidential Occupancies.** When a building includes both low-rise residential and nonresidential occupancies, the requirements are different depending upon the percentages of the conditioned floor that is occupied by each occupancy type:

   1. **Minor Occupancy** (Exception 1 to §100.0[f]). When a residential occupancy occurs in the same building as a nonresidential occupancy, and if one of the occupancies is less than 20 percent of the total conditioned floor area, the smaller occupancy is considered a "minor" occupancy. Under this scenario, optionally, the entire building may be treated as if it is the major occupancy for envelope, HVAC, and water heating. Lighting requirements in §140.6 through §140.8 or §150.0(k) must be met for each occupancy separately. The mandatory requirements applicable to the minor occupancy, if different from the major occupancy, would still apply.
   2. **Mixed Occupancy.** When residential occupancy is mixed with a nonresidential occupancy, and if neither occupancy is less than 20 percent of the total conditioned floor area, these occupancies fall under different sets of standards and must be considered separately. Two compliance submittals must be prepared, each using the calculations and forms of the respective standards. Separate compliance for each occupancy, to the respective standards, is an option when one of the occupancies is a minor occupancy, as discussed in the paragraph above.

B. The definition of **a habitable story** in the California Building Code (CBC) is used with the Energy Code. Mezzanines are not counted as separate habitable stories, nor are minor conditioned spaces, such as an enclosed entry stair that leads to an apartment or dwelling unit on the next floor. A habitable story is one that contains space in which people may live or work in reasonable comfort and that has at least 50 percent of the associated volume above grade.

C. **Live/work buildings** are a special case since they combine residential and nonresidential uses within units. Such newly constructed buildings are common in San Francisco and other urban areas of the state. Even though live/workspaces may be used for an office or a studio, they are typically heated

or cooled or both like a residential building. For this reason, the residential standards are more suitable, and the CEC has made this determination: Either the low-rise or high-rise residential standards apply, depending on the number of habitable stories.

However, lighting in designated workspaces in live/work lofts must comply with the nonresidential prescriptive lighting requirements. See Chapter 5 of the *Nonresidential Compliance Manual* and §140.6 for more information.

Table 1-2: Building Types Covered by the Low-Rise Residential and Nonresidential Energy Code

Low-Rise Residential Energy Code (covered in this compliance manual)	Nonresidential Energy Code (covered by Nonresidential Compliance Manual)
All low-rise residential occupancies including single-family homes, duplexes, garden apartments, and other housing types with three or fewer habitable stories.	All nonresidential CBC occupancies (Group A, B, E, F, H, I, M, S, or U), as well as high-rise residential (Groups R-1 and R-2 with four or more habitable stories), and all hotel and motel occupancies.
Includes: All single-family dwellings of any number of stories (Group R-3) All duplex (two-dwelling) buildings of any number of stories (Group R-3) All multifamily buildings with three or fewer habitable stories (Groups R-1 and R-2) Additions and alterations to all of the above buildings. Lighting requirements for living quarters in high-rise multifamily buildings (more than three stories) and water-heating requirements for high-rise multifamily buildings (more than three stories) Ventilation and filtration (indoor air quality) requirements are similar for single-family and all nontransient multifamily occupancies.	**Includes:** Offices Retail and wholesale stores Grocery stores Restaurants Assembly and conference areas Industrial work buildings Commercial or industrial storage Schools and churches Theaters Hotels and motels Healthcare facilities Apartment and multifamily buildings with four or more habitable stories (envelope and HVAC requirements) Long-term care facilities (group R-2) with four or more habitable stories Dormitories or other congregate residences, or any building with dormitory-style sleeping quarters, with four or more habitable stories Private garages, carports, sheds, and agricultural buildings.

1.5.2 Explanation of Terms

The term *building type* refers to the classification of buildings defined by the CBC and applicable to the requirements of the *Building Energy Efficiency Standards*. This manual is concerned with the Energy Code that applies to all low-rise residential buildings. The multifamily building is under the scope of the nonresidential requirements, but the dwelling units must meet the lighting, water-heating, and setback thermostat requirements for low-rise residential buildings. A multifamily building contains multiple dwelling units that share common walls (single-family attached) and may also share common floors or ceilings (apartments).

All residential buildings not in the above low-rise category are covered in the 2022 edition of the Energy Commission's *Nonresidential Compliance Manual.* (See Parts 1.1 and 1.2.)

A. A **Single-Family Building** is any of the following:
   - A residential building of Occupancy Group R-3 with two or less dwelling units,
   - A building of Occupancy Group R-3, other than a multifamily building or hotel/motel building,
   - A townhouse,
   - A building of Occupancy Group R-3.1, or
   - A building of Occupancy Group U when located on a residential site.

B. A **Multifamily Building** is any of the following:
   - A building of Occupancy Group R-2, other than a hotel/motel building or timeshare property,
   - A building of Occupancy Group R-3 that is a nontransient congregate residence, other than boarding houses of more than 6 guests and alcohol or drug abuse recovery homes of more than 6 guests,
   - or A building of Occupancy Group R-4.

C. An **addition** to an existing building increase both the conditioned floor area and volume of a building, which can be new construction or added space conditioning to an existing unconditioned space. See Chapter 9 for more information on energy compliance of additions.

D. An **existing building** is "... a building erected prior to the adoption of [the current] code, or one for which a legal building permit has been issued." (CBC, Part 2)

1.5.3 Building Orientation

Building orientation can affect the energy use of a building, particularly in cooling-dominated climate zones with a high amount of west-facing glass. Some prescriptive requirements and performance modeling inputs for compliance with the Energy Code require a description of the building orientation.

A. East-Facing

"East-facing is oriented to within 45 degrees of true east, including 45°0'0" south of east (SE), but excluding 45°0'0" north of east (NE)." (§100.1)

B. North-Facing

"North-facing is oriented to within 45 degrees of true north, including 45°0'0" east of north (NE), but excluding 45°0'0" west of north (NW)." (§100.1)

C. South-Facing

"South-facing is oriented to within 45 degrees of true south, including 45°0'0" west of south (SW), but excluding 45°0'0" east of south (SE)." (§100.1)

D. West-Facing

"West-facing is oriented to within 45 degrees of true west, including 45°0'0" due north of west (NW) but excluding 45°0'0" south of west (SW)." (§100.1)

1.5.4 Historical Buildings

Exception 1 to §100.0(a)

Exception 1 to §100.0(a) states that qualified historic buildings, as regulated in the California Historical Building Code (Title 24, Part 8) or California Building Code, Title 24, Part 2, Volume I, Chapter 34, Division II, are not covered by the *Building Energy Efficiency Standards*. Section 140.6(a)3 clarifies that lighting systems in qualified historic buildings are exempt from the lighting power allowances only if they consist solely of historical lighting components or replicas of historical lighting components. If lighting systems in qualified historic buildings contain some historical lighting components or replicas of historical components, combined with other lighting components, only those historical or historical replica components are exempt. All other lighting systems in qualified historic buildings must comply with the *Building Energy Efficiency Standards.*

The California Historical Building Code (CHBC) Section 8-102.1.1 specifies that all nonhistorical additions must comply with the regular code , including the *Building Energy Efficiency Standards*. CHBC Section 8-901.5 specifies that when new or replacement mechanical, plumbing, and electrical (including lighting) equipment or appliances are added to historic buildings, they should comply with the *Building Energy Efficiency Standards,* including the *Appliance Efficiency Regulations.*

The California State Historical Building Safety Board has final authority in interpreting the requirements of the CHBC and determining to what extent the requirements of the *Building Energy Efficiency Standards* apply to new and replacement equipment and other alterations to qualified historic buildings. In enacting the State Historical Building Code legislation, one of the intents of the Legislature was to encourage energy conservation in alterations to historic buildings (Health and Safety Code Section 18951).

Additional information about the CHBC can be found at

https://www.dgs.ca.gov/DSA/Resources/Page-Content/Resources-List-Folder/SHBSB

Or contact the SHBSB at (916) 445-7627.

Example 1-1

Question

Are additions to historic buildings also exempt?

Answer

If the addition adjoins the qualified historic building, then the enforcement agency at its discretion may exempt those requirements that they determine could damage the historical value of the building. However, "additions which are structurally separated" from the historic building are not exempt from the Energy Code and must comply with building codes, including the Historical Building Code, Title 24, Part 8, Section 8-704.

Example 1-2

Question

A sunroom addition is designed with no mechanical heating or cooling and a glass sliding door separating it from all existing conditioned space. Under what conditions will the Energy Code not apply to this addition?

Source: CEC Photographer: Andersen Windows

Answer

The mechanical and envelope requirements of the Energy Code do not apply if a building inspector determines that the space is unconditioned. Whether conditioned or unconditioned, per §100.0(c)2, the sunroom must still comply with the applicable lighting requirements of §150.0(k). The sunroom is unconditioned if one of the following apply:

- The new space is not provided with heating or cooling (or supply ducts).
- The new space can be closed off from the existing house with weather-stripped doors.
- The addition is not indirectly conditioned space.

A building official has the discretion to determine whether a sunroom like this qualifies as conditioned space based on the regulatory criteria above. If the building official determines the sunroom is conditioned space, the Energy Code would apply.

1.5.5 Buildings Not Required to Meet Prescriptive and Performance Standards

The following building types are not required to meet the prescriptive and performance standards:

A. Seasonally occupied agricultural housing limited by state or federal agency contract to occupancy not more than 180 days in any calendar year (Exception 1 to §100.0[e]2D); however, these buildings must comply with the applicable mandatory requirements.

B. Based on discretion of building officials, temporary buildings, temporary outdoor lighting or temporary lighting in an unconditioned building, or

structures erected in response to a natural disaster (Exception 2 to §100.0[a]). These buildings may also may not be required to meet the mandatory and prescriptive requirements of the Energy Code.

1.5.6 Building Systems Covered

The single-family residential standards affect the design of the building envelope; the heating, ventilation and air-conditioning (HVAC) system; the water-heating system; and the lighting system. The Energy Code does not apply to residential appliances (*Appliance Efficiency Regulations* may apply), elevators or dumbwaiters, or portable lighting systems that are plugged into a wall outlet. Only hardwired lighting is regulated, which includes lighting that is a permanent part of the building.

1.5.7 Additions, Alterations, and Repairs

§100.1(b)
§150.2(a)
§150.2(b)

Additions, alterations, and repairs are common construction projects for California homeowners. The Energy Code applies to both additions and alterations, but not to repairs. See Chapter 9 for details.

A. **Additions** are changes to an existing building that increase both conditioned floor area and volume.

   Chapter 9 includes detailed guidance on showing compliance for accessory dwelling units and converting an existing space to conditioned space.

B. **Alterations** that are not additions are changes to the envelope, space-conditioning system, water-heating system. or lighting system of a building.

C. **Repairs** are the reconstruction or renewal of any part of an existing building for maintenance purposes and are not under the scope of the standards. Replacement of any component systems (such as reroofing) or equipment for which there are requirements in the Energy Code is considered an alteration and not a repair.

Example 1-3

Question

The Energy Code does not specify whether buildings damaged by natural disasters can be reconstructed to the original energy performance specifications. What requirements apply under these circumstances?

Answer

Buildings destroyed or damaged by natural disasters must comply with the energy code requirements in effect when the builder or owner applies for a permit for those portions of the building that are being rebuilt.

Example 1-4

Question

Does the Energy Code apply to an addition to a manufactured ("mobile") home?

Source: CEC Photgrapher: Brian Vahey

Answer

No. Title 25 requirements, not Title 24, govern manufactured homes, including additions to the unit. Jurisdiction in a mobile home park comes under the authority of the Department of Housing and Community Development. Jurisdiction of a mobile home on private property may come under the authority of the local building department.

Example 1-5

Question

Three stories of residential dwelling units are planned over a first story that includes retail and restaurant occupancies. Do the residential apartments need to comply with the residential standards?

Answer

Yes and No. The building envelope and HVAC equipment must comply with the nonresidential (high-rise residential) standards since the structure contains four habitable stories and, as a whole structure, is a high-rise building. The dwelling units, however, must comply with the lighting and water-heating requirements for low-rise residences.

Example 1-6

Question

Does a four-story townhouse need to comply with the low-rise residential standards or the high-rise residential standards?

Answer

It depends on how the townhouse is classified by the enforcement agency. If the enforcement agency classifies the townhouse as a group R-3 occupancy, the low-rise residential standards will apply. If the townhouse is classified by the enforcement agency as another group R occupancy (i.e., group R-2) and all four stories are habitable, the high-rise residential standards will apply. If the enforcement agency classifies the townhouse as a group R-2 occupancy but three or less of the stories are habitable, the low-rise residential standards will apply.

Example 1-7

Question

A 2,100 ft² manager's residence is being constructed as part of a new 14,000 ft² conditioned warehouse building. Which Energy Code applies?

Answer

The whole building can comply with the nonresidential standards, and the residential unit is not required to comply separately since it is a subordinate occupancy containing less than 20 percent of the total conditioned floor area. However, the residential dwelling unit must meet all single-family residential mandatory requirements, as well as the lighting and water-heating requirements.

Example 1-8

Question

Assume the same scenario as in the previous example, except that the dwelling unit is new, and the remainder of the building is existing. Do the residential standards apply?

Answer

Yes. Since 100 percent of the addition being permitted is a single-family residential occupancy, compliance under the residential standards is required.

Example 1-9

Question

A residence is being moved to a different location. What are the applicable compliance requirements?

Answer

Because this is an existing conditioned space, the requirements applicable to alterations would apply to any alterations being made. The building does not need to show compliance with the current Energy Code applicable to new buildings or additions.

Example 1-10

Question

A previously conditioned retail space is remodeled to become a residential dwelling. What are the applicable compliance requirements?

Answer

The remodeled dwelling is treated as if it were previously a residential occupancy. In this case, the rules that apply to residential alterations are applied.

Example 1-11

Question

A 10,000 ft², 16-unit motel is constructed with an attached 1,950 ft² manager's residence. What are the applicable compliance requirements?

Source: http://www2.sjsu.edu/faculty/wooda/calpark.jpeg

Answer

The manager's unit is less than 20 percent of the total floor area, so compliance of the whole building as the predominant motel occupancy would satisfy the requirements of the Energy Code. Either the entire building must comply with the nonresidential and hotel/motel standards, or the manager's residence must comply with the single-family residential standards, and the motel occupancy portion of the building must comply with the nonresidential standards.

Example 1-12

Question

A subdivision of detached homes includes several unit types, each of which may be constructed in any orientation. What are the applicable compliance requirements?

Answer

The single-family residential standards are applied to each building type. All four cardinal orientations may be shown to comply, or each unit in the planned orientation must comply.

Example 1-13

Question

A four-story apartment building has three stories of apartments and a garage on the first floor. What are the applicable compliance requirements?

Answer

For compliance with the Energy Code, the low-rise residential standards apply since the building has fewer than four habitable stories. However, for other non-energy codes and standards, this may be considered a four-story building.

Example 1-14

Question

If, in Example 1-13 above, there was a small air-conditioned elevator lobby at the garage floor, what would be the applicable compliance requirements?

Answer

Section 100.1 defines a habitable story as a story that contains space for living, sleeping, eating, or cooking, excluding bathrooms, toilets, hallways, storage areas, closets, utility rooms, and similar areas, and that has at least 50 percent of the volume therein above grade. The small elevator lobby does not meet this definition for habitable story; therefore, the building contains fewer than four habitable stories, and the low-rise residential standards still apply.

Example 1-15

Question

If, in Example 1-13 above, there was a receptionist station in the conditioned elevator lobby at the garage floor. what would be the applicable compliance requirements?

Answer

In this case, the lobby with the receptionist meets the habitable story definition of §100.1; therefore, the building contains four or more habitable stories and must be considered a high-rise residential occupancy. The building envelope and HVAC equipment must comply with the nonresidential (high-rise residential) standards, and the dwelling units must comply with the lighting and water-heating requirements for low-rise residential buildings.

1.6 Compliance Approaches and Mandatory Requirements

In addition to the mandatory requirements (Section 1.6.2), the Energy Code provides two basic methods for complying with low-rise residential energy budgets: the prescriptive approach and the performance approach. The mandatory requirements must be installed with either of these approaches, but mandatory requirements may be superseded by more stringent requirements under either approach.

1.6.1 Approaches

A. The **prescriptive approach**, composed of a climate zone-dependent

prescriptive package (Section 1.6.3), is less flexible but simpler than the performance approach. Each energy component of the proposed building must meet a prescribed minimum efficiency. The prescriptive approach offers relatively little design flexibility but is easy to use. There is some flexibility for building envelope components. For example, if a portion of a wall does not meet the prescriptive insulation requirement, an area-weighted average of all walls can be used to meet the prescriptive requirement.

B. The **performance approach** (Section 1.6.4) is more complicated but offers considerable design flexibility. The performance approach uses an approved software program to model a proposed building and compare it to a calculated energy budget. Performance compliance is based on window efficiency and orientation, shading from overhangs, space-conditioning equipment and water-heating system efficiencies, and house configuration. This approach is popular with production builders because it's flexibility and it provides a way to find the most cost-effective solution for complying with the Energy Code.

For additions and alterations, see Chapter 9 for details of compliance approaches that are available.

1.6.2 Mandatory Requirements

With either prescriptive or performance compliance, there are mandatory requirements that must always be met. Some deal with infiltration control and lighting; others require minimum insulation levels or equipment efficiencies. New for the *2022 Building Energy Efficiency Standards* are mandatory requirements that require R-20 insulation values for 2' x 6' wood-framed walls, air-filtration devices on most ducted mechanical systems, and kitchen range hoods meeting airflow and sound ratings specified in ASHRAE 62.2. For detailed information on these changes, see applicable sections within this manual.

Minimum mandatory levels are sometimes superseded by more stringent prescriptive or performance approach requirements. For example, if mandatory requirements specify R-22 ceiling insulation and the prescriptive approach is used, then R-38 ceiling insulation (depending on climate zone) must be installed. Conversely, the mandatory requirements may be of a higher efficiency than permitted under the performance approach; in these instances, the higher mandatory levels must be installed. For example, a building may comply using the performance computer modeling only R-7 insulation in a raised floor, but R-19 must be installed because that is the mandatory minimum.

1.6.3 Prescriptive Approach

§150.1(c)

The prescriptive requirements are represented in Table 150.1-A for single-family . The prescriptive approach is the simplest but least flexible compliance path. The

2019 Energy Code instituted the requirement for a PV system. See Chapter 7 for more information on solar generation, community solar, and battery storage.

The prescriptive approach is a set of predefined performance levels for various building components. Each component meets or exceeds the minimum efficiency level specified in Table 150.1-A and related footnotes in the Energy Code. In some climate zones, these prescriptive requirements specify that many cooling system types are HERS-tested to verify that they have the correct refrigerant charge.

1.6.4 Performance Approach

The performance approach, also known as the *computer compliance method*, requires that the building comply with the Hourly Source Energy Design Rating (EDR1), Efficiency Energy Design Rating (Efficiency EDR2), and Total Energy Design Rating (Total EDR2). (Additions and alterations continue to meet a time-dependent valuation [TDV] energy budget.) EDR1 is a dimensionless metric. EDR1 is based on hourly source energy; the hourly values for EDR 1 are similar in magnitude to the marginal greenhouse gas emissions of the electricity system. The proposed design EDR1 must be equal to or less than the standard design EDR1. The efficiency EDR2 is the efficiency of the building excluding the benefits from any solar generation. The total EDR2 includes the building plus any solar electric generation. The Energy Design Rating is described in more detail in the *2022 Single-Family Residential Buildings Alternative Calculation Method Reference Manual.*

Annual Time-Dependent Valuation (TDV) energy shall be calculated for the proposed building and compared to the standard TDV energy budget. TDV energy is the "currency" for the performance approach. TDV energy not only considers the type of energy that is used (electricity, gas, or propane), but when it is used. The two independent EDR metrics are based on hourly source energy and TDV, respectively. Energy saved during periods when California is likely to have a statewide system peak is worth more than energy saved at times when supply exceeds demand. Reference Joint Appendix JA3 has more information on TDV energy.

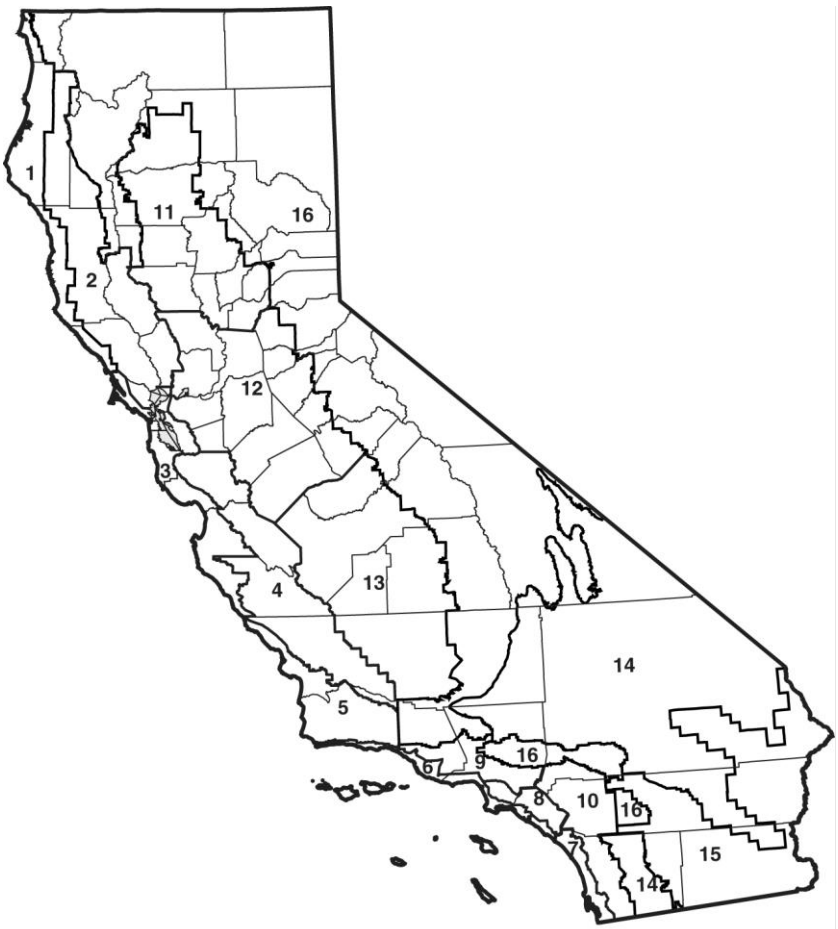
The use of Energy Commission-approved software represents the most detailed and sophisticated method of compliance. While this approach requires the most effort, it also provides the greatest flexibility. The programs automatically calculate the energy budget for space conditioning and water heating, and the minimum required PV size to receive credit toward meeting the efficiency EDR. The budget is determined from the standard design, a computer model of the building using prescriptive requirements. The computer software allows manipulation of the proposed building's energy features to achieve compliance. See Chapter 8 of this manual for more information on the performance method.

1.7 Climate Zones

To standardize calculations and provide a basis for presenting the prescriptive requirements, the Energy Commission has established a set of standard climate data for each of the 16 climate zones. More information is provided in *Reference Joint*

Appendix JA2 (also included in Appendix B of this document), including a listing of climate zones for all California ZIP codes. *Reference Joint Appendix JA2* gives other climate information, such as design temperatures for sizing HVAC equipment. The climate zone definitions and data are the same for single-family residential, multifamily, and nonresidential standards.

Figure 1-1: California Climate Zones



Source: California Energy Commission

1.7.1 Building Location Data

Building location data refer to specific outdoor design conditions used in calculating heating and cooling loads. Different from the climate zone used for compliance (see *Climate Zones* above), design data include the typically warmest and coolest outdoor temperatures that a building is likely to experience in an average year in a particular location.

Temperatures are from the ASHRAE publication, *SPCDX, Climatic Data for Region X - Arizona, California, Hawaii, Nevada*, May 1982 edition. (See Appendix E.) For heating, the outdoor design temperature is the Winter Median of Extremes. A higher temperature is permitted but no lower than this value. For cooling, the outdoor design temperatures must be the 1.0 percent Summer Design Dry Bulb and the 1.0 percent Wet Bulb columns.

If a building location is not listed, the local enforcement agency may determine the location for which data are available that is closest in its design characteristics to the actual building site.

1.8 Conditioned Floor Area

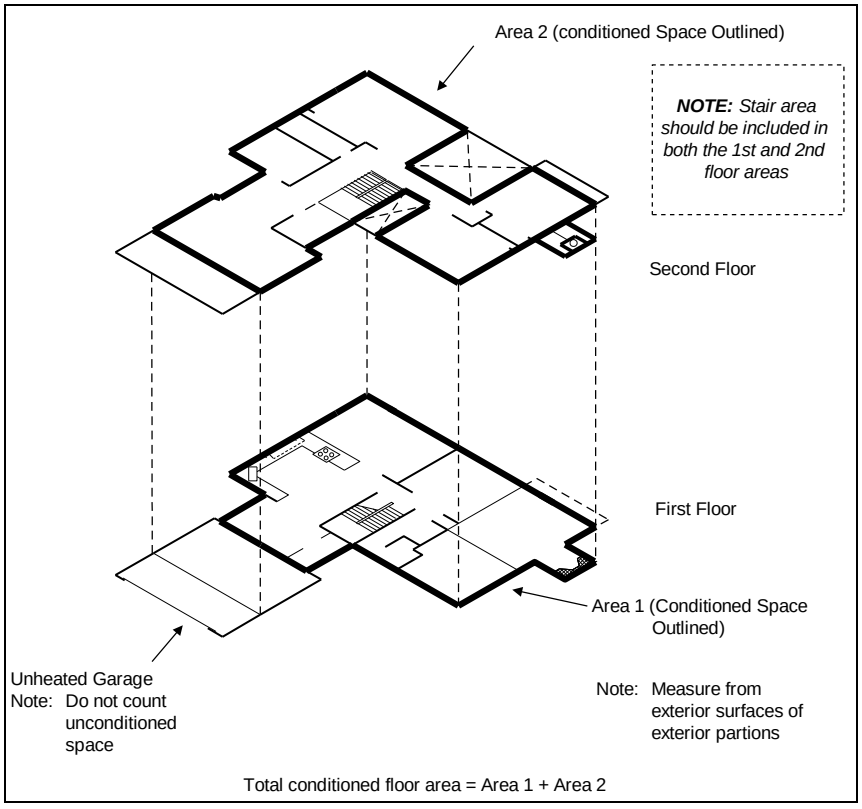
Conditioned floor area (CFA) is the total floor area (in square feet) of enclosed conditioned space on all floors of a building, as measured at the floor level of the exterior surfaces of exterior walls enclosing the conditioned space (§100.1). This term is also referred to in the Energy Code simply as the *floor area*.

This is an important value for compliance since annual energy use is divided by this value to obtain the energy budget. In the prescriptive package, the maximum fenestration and west-facing fenestration area requirements are expressed as a percentage of this value.

CFA is calculated from the plan dimensions of the building, including the floor area of all conditioned and indirectly conditioned space on all floors. It includes lofts and mezzanines but does not include covered walkways, open roofed-over areas, porches, pipe trenches, exterior terraces or steps, chimneys, roof overhangs, or parking garages. Unheated basements or closets for central gas-forced air furnaces are also not included, unless shown to be indirectly conditioned.

The floor area of an interior stairway is determined as the CFA beneath the stairs and the tread area of the stairs themselves. See Figure 1-2 below for an example of how CFA is calculated.

Figure 1-2: Total Conditioned Floor Area



1.9 Where to Get Help

The Energy Commission has several resources to help designers, builders, homeowners, and others understand and apply the Energy Code.

1.9.1 Energy Commission Publications and Support

1.9.2 Telephone Hotline

If the information contained in the Energy Code or this compliance manual are not sufficient to answer a specific question concerning compliance or enforcement, technical assistance is available from the Energy Code Hotline.

You can reach the Energy Code Hotline on weekdays from 8 a.m. – noon and 1 p.m. – 4:30 p.m.:

(800) 772-3300

(916) 654-5106

A. Publications

Publications, including the 2022 Building Energy Efficiency Standards, the *2022 Reference Appendices*, and the *2022 Residential ACM Approval and Reference Manuals,* and others, are available from the Energy Commission's website at http://www.energy.ca.gov/title24. Paper copies may also be ordered from:

Publications Unit

California Energy Commission

715 P Street, MS-5Sacramento, CA 95814

(916) 654-5200

B. Blueprint

The Energy Commission publishes the *Blueprint*, a newsletter that answers questions and addresses issues related to enforcement and compliance. The *Blueprint* also provides updated information on technical assistance and computer compliance programs and lists training opportunities offered throughout the state. The *Blueprint* is available online at https://www.energy.ca.gov/newsSroom/blueprint-newsletter.

Figure 1-3: Energy Commission Blueprint Newsletter

Issue 134 | April - June 2021

BLUEPRINT

CALIFORNIA ENERGY COMMISSION

EFFICIENCY DIVISION

IN THIS ISSUE

- Nonresidential Acceptance Testing
- New Resources on ORC
- Repeal of Title 20 Self-Contained Lighting Controls
- 2019 Energy Code Software Approved
- Q&A
  - Nonresidential Indoor Lighting Alterations
  - PV for Accessory Dwelling Units (ADU)

For additional help with the 2019 Energy Code see Energy Code Ace's **online offerings** of trainings, tools, and resources.

Nonresidential Acceptance Testing

The mandatory requirement that any person performing a mechanical systems acceptance test in a nonresidential building must be certified as an acceptance test technician (ATT) took effect on April 14, 2021. In order to allow a reasonable time for training and implementation of additional ATTs, the California Energy Commission (CEC) expects authorities having jurisdiction to enforce the mechanical systems ATT requirements for all nonresidential permit applications submitted on or after October 1, 2021.

What is acceptance testing?

Acceptance testing for nonresidential buildings was adopted in 2005 as part of the Building Energy Efficiency Standards (Energy Code) **Section 10-103.2.** Lighting controls acceptance testing by an ATT became mandatory on July 1, 2014.

Acceptance testing generally includes three phases: documentation inspection, construction inspection, and functional testing. Acceptance testing confirms that contractors install equipment, controls, and systems that operate as required by the Energy Code. Acceptance testing verifies the installed energy efficient equipment is performing as expected, achieving lasting cost savings.

What is an ATT?

An ATT is an installation technician that is trained, certified, and overseen by an acceptance test technician certification provider (ATTCP) to perform nonresidential acceptance testing for lighting controls or mechanical systems. ATTs conduct required tests, submit test results and certificates to enforcement agencies, and are employed by certified acceptance test employers. These employers are trained and certified by an ATTCP.

What is the role of the ATTCP?

ATTCPs are professional organizations approved by the CEC to provide a training curriculum for technicians, employers, certification procedures,

Source: California Energy Commission

C. Appliance Standards

Appliances, as defined by the CEC, include everything from dishwashers and refrigerators to air conditioners and boilers. The performance of some appliances, such as air conditioners, water heaters, and furnaces, is critical to the *Building Energy Efficiency Standards*. The energy efficiency of other appliances, such as refrigerators, dishwashers, and clothes dryers, is important to homeowners but does not affect the *Building Energy Efficiency Standards* since these are considered home furnishings.

The CEC has comprehensive standards that affect the performance of many appliances. Appliance Standards information is available from the CEC website at https://www.energy.ca.gov/rules-and-regulations/appliance-efficiency-regulations-

title-20.

D. Appliance Directories

The CEC publishes information on the energy efficiency of appliances. CEC-approved directories can be used to determine if appliances meet the mandatory requirements or the prescriptive requirements or both. Data may also be used in performance calculations. The Energy Code Hotline can verify certification of appliances and provide information on appropriate directories.

The complete appliance database (including manufacturer, brand codes, rated efficiencies, and so forth) can be searched from the Energy Commission's website at

http://www.appliances.energy.ca.gov/cacertappliances.energy.ca.gov/Pages/ApplianceSearch.aspx.

E. Directory of Certified Insulation Materials

Manufacturers whose insulating materials are certified for sale in California are listed in the Department of Consumer Affairs' *Consumer Guide and Directory of Certified Insulation Material*. Each building department receives a copy of this directory. If an insulating product is not listed in the directory, or if you want to purchase a directory, contact the Department of Consumer Affairs, Bureau of Household Goods and Services (BHGS), at (916) 999-2041 or visit https://bhgs.dca.ca.gov/

1.9.3 Training Opportunities

California utilities, organizations of energy consultants, building industry, trade associations, and organizations that serve building officials often sponsor or conduct classes on compliance and enforcement of the Energy Code. These classes are linked on the CEC's Online Resource Center at http://www.energy.ca.gov/title24/orc.

Energy Code Ace offers free tools, training, and resources to help identify the compliance documents, installation techniques, and standards relevant to building projects in California. Energy Code Ace resources provide fact sheets, trigger sheets, and checklists to help readers understand when Title 24, Part 6 is "triggered" and how to correctly comply when it is.

This program is funded by California utility customers under the auspices of the California Public Utilities Commission and in support of the Energy Commission.

http://energycodeace.com/

1.9.4 Energy Consultants

The California Association of Building Energy Consultants (CABEC) maintains a directory of consultants who provide compliance assistance. The listing is available at http://www.cabec.org.

1.9.5 Online Videos

The CEC has a series of streaming videos that explain energy efficiency concepts and the application of the Energy Code. These videos cover topics including lighting, and HVAC. They can be viewed at https://www.energy.ca.gov/title24/orc/.

1.9.6 HERS Raters and Providers

To comply with the Energy Code, some buildings require third-party diagnostic testing or field verification of energy-efficient systems or devices. HERS Raters are required to be hired by the builder or building owner to perform this work. Installing contractors may hire the HERS Rater for HVAC changeouts only if the homeowner agrees that the installing contractor may do so on his or her behalf. The CEC approves HERS providers who train, certify, and monitor HERS Raters. For a list of the current HERS providers, please go the Energy Commission website at http://www.energy.ca.gov/HERS/. To find a Rater, go to the website of the approved HERS provider available on the Energy Commission's website at the link above, or contact the Energy Code Hotline at (800) 772-3300 (for calls within California) or (916) 654-5106 for assistance.