Table of Contents

8 Performance Method

8.1 Overview

This chapter explains the performance method of complying with the *Building Energy Efficiency Standards* (Energy Standards). The performance method provides maximum flexibility to trade off the energy performance of different building components to achieve compliance. For new construction, the energy budget is expressed in terms of the Energy Design Ratings (EDR), which are based on source energy and time-dependent valuation (TDV) energy. The EDR is a score from 0 to 100, where 0 represents a building that has zero net energy consumption based on the TDV energy consumption and 100 represents a building that meets the 2006 International Energy Conservation Code. This is the same criteria for a score of 100 for the National Home Energy Rating System. Energy Commission-approved compliance software programs calculate an EDR for the building (proposed efficiency) and compare it to the energy budget (standard efficiency). Approved compliance programs also calculate an EDR for proposed photovoltaic (PV)/demand flexibility and compare it to the standard PV/flexibility budget.

Energy Design Rating 1 (EDR1) is based on hourly source energy. Energy Design Rating 2 (EDR2) is based on TDV energy and has two components, the Energy Efficiency Design Rating and the Solar Electric Generation and Demand Flexibility Design Rating. The Total Energy Design Rating accounts for both the Energy Efficiency Design Rating and the Solar Electric Generation and Demand Flexibility Design Rating. The proposed building must separately comply with the Source Energy Design Rating (EDR1), Energy Efficiency Design Rating (Efficiency EDR2) and the Total Energy Design Rating (Total EDR2).

The standard efficiency includes water heating, space heating, space cooling, indoor air quality (IAQ) fan energy, and solar generation. Energy use from lighting and appliances is not eligible to be traded off.

The Energy Commission-approved compliance software programs calculate space-conditioning and water-heating energy use in accordance with a set of rules. Modeling capabilities are in the *Residential Alternative Calculation Method (ACM) Reference Manual*. All approved software programs use the California simulation engine to simulate the energy use, and the same report generator to create the certificate of compliance (CF1R), as the public domain program, California Building Energy Code Compliance - Residential (CBECC-Res). Approved software vendors have can create their own user interface, documentation, and additional forms. Each approved program is required to have a compliance supplement with information on how to use the software, as specified in the *ACM Approval Manual*.

A discussion of the performance method for additions and alterations is in Chapter 9.

8.2 What's New for 2022

8.2.1 Determining Compliance – Energy Design Rating (EDR)

The EDR1 score is a metric of a building's hourly source energy divided by the reference design hourly source energy budget. An EDR1 score is calculated for the proposed design and a second EDR1 score is calculated for the standard design. The proposed design EDR1 must be equal to or less than the standard design EDR1.

An EDR2 score of zero represents a building that has zero-net-energy performance based on the TDV energy consumption, and an EDR2 score of 100 represents a building that is minimally compliant with the 2006 International Energy Conservation Code. The EDR2 score is a ratio of a building's TDV budget to reference design TDV budget.

An Efficiency EDR2 and Total EDR2 score are calculated for the proposed design and a second Efficiency EDR2 and Total EDR2 score are calculated for the standard design. Compliance with EDR2 requires meeting two criteria:

1. Proposed design Efficiency EDR2 must be equal to or less than standard design Efficiency EDR2. The EDR2 is established by the ratio of the standard design or space heating, space cooling, IAQ ventilation, water heating, and self-utilization credit energy consumption, and reference design energy consumption of the same end uses.
2. Total EDR2 (Efficiency EDR2, plus PV/flexibility EDR2) of the proposed design must be equal to or less than the Total EDR2 of the standard design. The Total EDR2 is established by the ratio of the standard design or proposed design efficiency end uses plus interior lighting, appliances, cooking, plug loads, exterior lighting, and PV generation and flexibility measures energy consumption of the standard design and the total EDR2 of the reference design.

8.2.2 Major Changes Affecting Standard Design Efficiency

The standard design efficiency is based on the prescriptive requirements in Table 150.1-A. The 2022 Energy Code prescriptively requires heat pump space heating in climate zones 3, 4, 13 and 14, and heat pump water heaters for domestic hot water (DHW) systems in all other climate zones. Additionally, a new exception for cooling ventilation has been added for new single family dwellings with a conditioned floor area of 500 square feet or less. There also is a new exception for an instantaneous electric resistance water heater with point of use distribution for new single family dwellings with a conditioned floor area of 500 ft2 or less.

8.2.3 New HERS Verification Requirements

Variable capacity heat pumps will require verification of the following features: (1) installed system must have refrigerant charge verified according to the applicable procedures in RA3.2; (2) ducted indoor units shall be verified to meet the verified

low-leakage ducts in conditioned space requirements according to the procedure in RA3.1.4.3.8; (3) ductless systems shall be verified to visually confirm ductless indoor units are located entirely in conditioned space, (4) confirm that all habitable rooms are provided with conditioned airflow; (5) confirm zones greater than 150 square feet have a wall mounted thermostat; (6) confirm that the manufacturer's model number of installed ducted units are included in listings of certified low-static pressure VCHP system published on the Energy Commission's website; (7) if non-continuous fan operation is claimed for credit in the compliance software, verification shall confirm that the installed system's indoor unit + outdoor unit combination is certified to the Energy Commission and listed on the Energy Commission website as a type that does not operate the fan continuously by default; (8) each new ducted indoor unit must have airflow verified to confirm the airflow at full capacity in cooling mode is equal to or greater than 350 cfm/ton of nominal cooling capacity of the indoor unit, and 300 cfm/ton for altered systems; and (9) verification shall confirm the air filter sizing is correct, and confirmed the installed air filter label specifies performance that meets a clean filter pressure drop less than or equal to 0.1 inch wc. at design airflow rate.

8.3 Compliance Basics

8.3.1 Compliance Process

Any approved computer program may be used to show compliance with the Energy Code using the performance method. The following steps are an outline of the typical computer program procedure:

1. Collect all necessary data on each component.
    a. For the building envelope, the area of each fenestration, wall, door, roof, ceiling, and floor is needed. For each component, the applicable energy characteristics needs to be defined including U-factor, solar heat gain coefficient (SHGC), solar reflectance, and thermal mass values.
    b. For HVAC systems, the equipment type and efficiency are required. For hydronic space heating, the specific water heater type and efficiency are required. For fan-forced air conditioning systems, the location and amount of insulation on the duct system are needed.
    c. For DHW systems, the water heater type, number, efficiency, and area served are required, along with the information about the hot water distribution system. Additional information will be required for features such as solar thermal systems and drain water heat recovery devices. More information is in Chapter 5.
    d. For PV systems, size and location information--such as roof slope and orientation-- are required. Battery storage capacity and control information must be described if battery storage is proposed. Refer to Chapter 7 for more information.

2. Enter the basic building envelope data such as square footage, number of stories, occupancy type, and climate zone. Define each opaque surface with the orientation, area, and thermal performance properties. Add the doors and fenestration associated with each opaque surface, including any fixed shading such as overhangs and side fins. Enter the data of the equipment and distribution systems for the space conditioning and water-heating systems. The input values and assumptions must correspond to the information on the final approved plan set, and the inputs must be at least as energy efficient as the relevant mandatory measures. (Software compliance programs may not automatically check for compliance with mandatory measures.)
3. Launch a computer simulation to calculate the source EDR1, efficiency EDR2, and total EDR2 of the standard design and the proposed design.

For additions and alterations, compliance is based on TDV energy, and not the EDR criteria that is used for newly constructed buildings. In existing buildings, where the values of installed features are unknown, default values may be used based on the year of the construction. Refer to Table 8-1, Default Assumptions for Year Built (Vintage), at the end of this chapter. The proposed design complies if all mandatory measures are met and the total TDV energy use is the same as or less than the standard design TDV energy budget.

When creating a computer input file, use the space provided for the project title information to concisely describe the building being modeled. User-designated names should be clear and internally consistent with other orientations and/or surfaces being analyzed. Title names and explanatory comments should assist in the compliance and enforcement processes.

8.3.2 Defining the Standard Design Efficiency

Approved compliance software programs automatically calculate the standard design efficiency based on data entered for the proposed building.

The program defines the standard building by modifying the geometry of the proposed building and inserting the features of Table 150.1-A of the Energy Standards. Details on how the proposed and standard design energy budget are established can be found in the *Residential ACM Reference Manual*.

Note the details of how the standard design efficiency is determined. Deviations from the prescriptive requirements will be reflected in the compliance margin. For example, if the prescriptive requirements from Table 150.1-A include a heat pump space heating system, and the proposed building is modeled with a central gas furnace, it will significantly increase the heating source energy and result in a compliance penalty.

The standard design assumes the same total conditioned floor area and volume as the proposed design and the same gross exterior wall area as the proposed design, except that the wall area in each of the four cardinal orientations is divided equally. The standard design uses the same roof/ceiling area, raised floor area, slab-on-

grade area, and perimeter as the proposed design, but uses the standard insulation R-values from Table 150.1-A of the Energy Code.

The standard design includes all features of the prescriptive compliance tables, including quality installation of insulation, walls with the prescriptive U-factor, below-deck roof insulation or radiant barrier, and a solar PV system.

Total fenestration area in the standard design is equal to that in the proposed design if the fenestration area in the proposed design is less than or equal to 20 percent of the conditioned floor area (CFA), Otherwise, the fenestration area is equal to 20 percent of the CFA. Fenestration area in the standard design is evenly distributed among the four cardinal orientations. SHGC and U-factors in the standard design are the same as those listed in the prescriptive tables, with no overhangs.

The standard design includes minimum efficiency heating and cooling equipment, as well as the minimum duct insulation R-value required for Option B from Table 150.1-A of the Energy Code. Ducts are assumed to be sealed as required by §150.0(m). The standard design also assumes correct refrigerant charge as required by §150.1(c)7A**.**

For water-heating systems that serve dwelling units, the standard design is a NEEA Tier 3 heat pump water heater with a uniform energy factor equal to 2.0, and the distribution system meets all mandatory requirements specified in §150.0.

8.3.2.1 Standard Reports

For consistency and ease of enforcement, the way building features are reported by compliance software programs is standardized. Energy Commission-approved compliance software programs produce compliance reports in a standard format. The principal report is the certificate of compliance (CF1R-PRF-01-E).

The CF1R-PRF-01-E includes two feature summary sections, one for required special features and modeling assumptions, and a second for features requiring HERS field verification and/or diagnostic testing. These sections provide a general overview during compliance verification by the local enforcement agency and the HERS Rater. Items in the special features and modeling assumptions section indicate that if such features or assumptions used for compliance are not installed, the building would not comply, and they call for special consideration by the local enforcement agency. Items in the HERS verification section rely on diagnostic testing and verification by an approved HERS Rater to ensure proper field installation. Diagnostic testing and verification by HERS Raters is separate from local enforcement agency inspections.

8.3.3 Professional Judgment

Some modeling techniques and compliance assumptions applied to the proposed design are fixed or restricted. At other times, professional judgment may be acceptable or necessary.

Enforcement agencies can reject a particular input if the permit applicant cannot substantiate the value with supporting documentation or demonstrate that appropriate professional judgment was applied.

A simplified approach or assumption should be consistent with what is used by the compliance software to generate the standard design. If simplification increases the predicted energy use of the proposed building or reduces the compliance margin when compared to a more detailed modeling assumption, the simplification is acceptable. Simplification must reflect a worse case than a more detailed model and result in the same or lower compliance margin.

Any unusual modeling approach, assumption, or input value should be documented with published data and conform to standard engineering practice.

For assistance evaluating the appropriateness of input assumptions, contact the provider of your compliance software or the Energy Commission's Energy Standards Hotline (Title24@energy.ca.gov or (800) 772-3300).

Example 8-1

Question

Three different-sized windows in the same wall of a new home are designed without exterior shading. They have the same National Fenestration Rating Council-rated U-factors and SHGC values. Is it acceptable to simplify the computer model by adding the areas of the windows and inputting them as a single fenestration area?

Answer

Yes. Because modeling the windows as a single window will not increase or decrease the modeled energy consumption, this is acceptable. However, plan checking and finding errors when windows are combined is much more difficult. If the software has a multiplier, identical window sizes with identical shading features can be combined. Otherwise, it is best practice to model each window individually.

8.4 Subdivisions and Master Plans

Subdivisions often require a special approach to energy compliance because they have one or a few basic building or unit plans repeated in a variety of orientations. The basic floor plans may also be used in a mirrored or reversed configuration.

There are two compliance options for subdivisions:

- Model each individual building, or building condition, separately according to the actual orientation.
- Model all four cardinal orientations for each building or plan type with identical conservation features for no orientation restrictions.

8.4.1 Individual Building Approach

The most straightforward option for subdivisions is analyzing each building in the project separately using any compliance method. This may be practical for

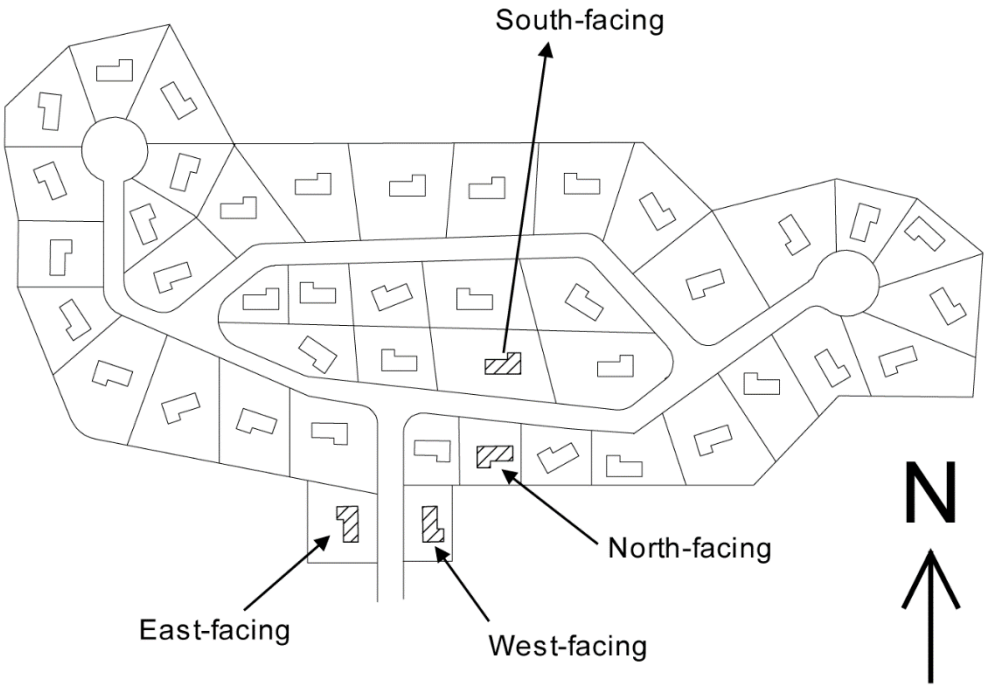
subdivisions with only custom buildings, or with only one or two specific orientations for each building plan. This approach requires that each unit comply separately, with separate documentation submitted for each unit plan in the orientation in which it will be constructed.

8.4.2 Multiple Orientation Alternative: No Orientation Restrictions

§150.1(b)

The performance method may be used to demonstrate that a building plan complies regardless of its orientation within the same climate zone. To ensure compliance in any orientation, the annual energy consumption must be calculated using all four cardinal orientations (a single CF1R with results for north, east, south, and west). The building must have the identical efficiency measures and levels, and comply with the energy budget in all orientations. Cardinal compliance can be used to show compliance for a reversed floor plan.

Figure 8-2: Subdivisions and Master Plans Compliance Option



Demonstrate Compliance for Each Cardinal Orientation for Each Basic Model Type

Source: California Energy Commission

For compliance, submit certificate of compliance documentation of the energy budgets for each of the four orientations to the enforcement agency. Only one CF1R compliance document that shows compliance for all four orientations is required to be submitted to the enforcement agency for each unique or reverse plan.

Master plans that use the multiple orientation alternative must establish a connection to the CF1R in the HERS registry. For the multiple orientation compliance approach in a master plan subdivision, the required documentation for each dwelling unit should be a multiple orientation master plan certificate of compliance (CF1R), a dwelling-specific certificate of installation (CF2R), and a dwelling-specific certificate of verification (CF3R).

8.5 HVAC Issues

8.5.1 No Cooling Installed

When a building has no cooling system, the software simulates a hypothetical system with the characteristics required by Table 150.1-A as if a cooling system were installed. The result is neither a penalty nor a credit.

8.5.2 Wood Heat

When natural gas is not available, and all other eligibility criteria are met (see Chapter 4), a wood heating system is simulated as a hypothetical system with the characteristics required by Table 150.1-A or -B for a typical heating system. When all eligibility criteria are met, the backup system is not modeled; otherwise, see Section 8.5.3.

8.5.3 Multiple HVAC Systems

Buildings with multiple HVAC systems are treated as follows:

1. For buildings with more than one system type, equipment type, or fuel type, where the types do not serve the same floor area, model the building zone or floor area served by each unique type separately.
2. Supplemental heating may be ignored if (1) the capacity of the supplemental unit does not exceed 2 kilowatts (kW) or 7,000 British thermal units per hour, and (2) the supplemental unit is controlled by a time-limiting device that does not allow it to run for more than 30 minutes. (§150.1[c]6.)

   In a building with a central gas furnace and an appliance-rated gas fireplace, the furnace is the primary system, and the fireplace is the supplemental system. In this case, the controls for the fireplace would not need to meet the setback thermostat requirements (Exception to §110.2[c]).
3. For single family buildings served by more than one heating or cooling system, equipment type, or fuel type, model the least efficient system. For any areas served by electric resistance heat and another heating system (except for wood heating meeting all eligibility criteria), the electric resistance system is the least efficient system.

   When there is more than one system meeting the heating or cooling load for the same space, all systems must meet all mandatory requirements of the Energy Standards.

8.5.4 HERS Verified Efficiency

When higher than minimum efficiency is modeled, a HERS Rater must verify the efficiency. This includes:

- Seasonal Energy Efficiency Ratio (SEER) or Seasonal Energy Efficiency Ratio 2 (SEER2)
- Energy Efficiency Ratio (EER) or Energy Efficiency Ratio 2 (EER2)
- Combined Energy Efficiency Ratio (CEER)
- Heating Seasonal Performance Factor (HSPF) or Heating Seasonal Performance Factor 2 (HSPF2)

8.5.5 Existing + Addition + Alteration Approach

The performance approach may be used to show compliance for alterations to existing buildings, additions, and existing + addition + alteration as discussed in Chapter 9. When existing conditions are unknown, the default assumptions in Table 8-1 must be used. The standard design for an altered component shall be the higher efficiency of existing conditions or the requirements stated in Table 8-1 Standard Design for an Altered Component. For components not being altered, the standard design shall be based on the existing conditions. When the third-party verification option is specified as a requirement, all components proposed for alteration for which the additional credit is taken must be verified.

Table 8-1 Standard Design for an Altered Component

Altered Component	Standard Design Without Third Party Verification of Existing Conditions Shall be Based On	Standard Design With Third Party Verification of Existing Conditions Shall be Based On
Ceiling Insulation, Wall Insulation, and Raised-floor Insulation	The requirements of Sections 150.0(a), (c), and (d)	The existing insulation R-value
Fenestration	The U-factor of 0.40 and SHGC value of 0.35. The glass area shall be the glass area of the existing building.	If the proposed U-factor is ≤ 0.40 and SHGC value is ≤ 0.35, the standard design shall be based on the existing U-factor and SHGC values as verified. Otherwise, the standard design shall be based on the U-factor of 0.40 and SHGC value of 0.35. The glass area shall be the glass area of the existing building.
Window Film	The U-factor of 0.40 and SHGC value of 0.35.	The existing fenestration in the alteration shall be based on Table 110.6-A and Table 110.6-B.
Doors	The U-factor of 0.20. The door area shall be the door area of the existing building.	If the proposed U-factor is < 0.20, the standard design shall be based on the existing U-factor value as verified. Otherwise, the standard design shall be based on the U-factor of 0.20. The door area shall be the door area of the existing building.
Space-Heating and Space-Cooling Equipment	TABLE 150.1-A for equipment efficiency requirements; Section 150.2(b)1C for entirely new or complete replacement systems; Section 150.2(b)1F for refrigerant charge verification requirements.	The existing efficiency levels.
Air Distribution System – Duct Sealing	The requirements of Sections 150.2(b)1D and 150.2(b)1E	The requirements of Sections 150.2(b)1D and 150.2(b)1E
Air Distribution System – Duct Insulation	The proposed efficiency levels.	The existing efficiency levels.
Water Heating Systems	The requirements of Section 150.2(b)1Hii	The existing efficiency level.
Roofing Products	The requirements of Section 150.2(b)1I.	The requirements of Section 150.2(b)1I
All Other Measures	The proposed efficiency levels.	The existing efficiency levels.

SOURCE: California Energy Commission Energy Code Table 150.2-D