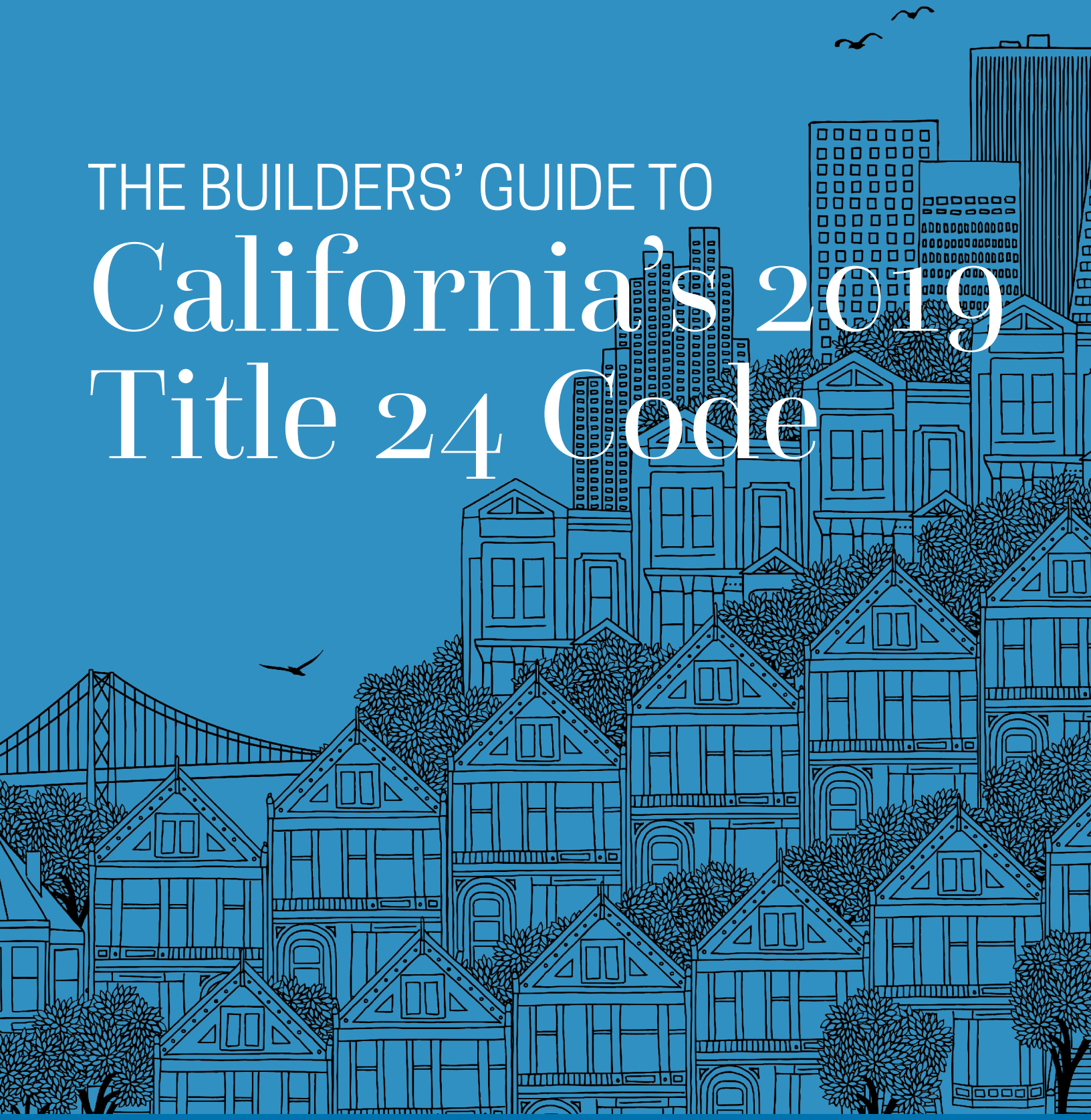
THE BUILDERS' GUIDE TO California's 2019 Title 24 Code



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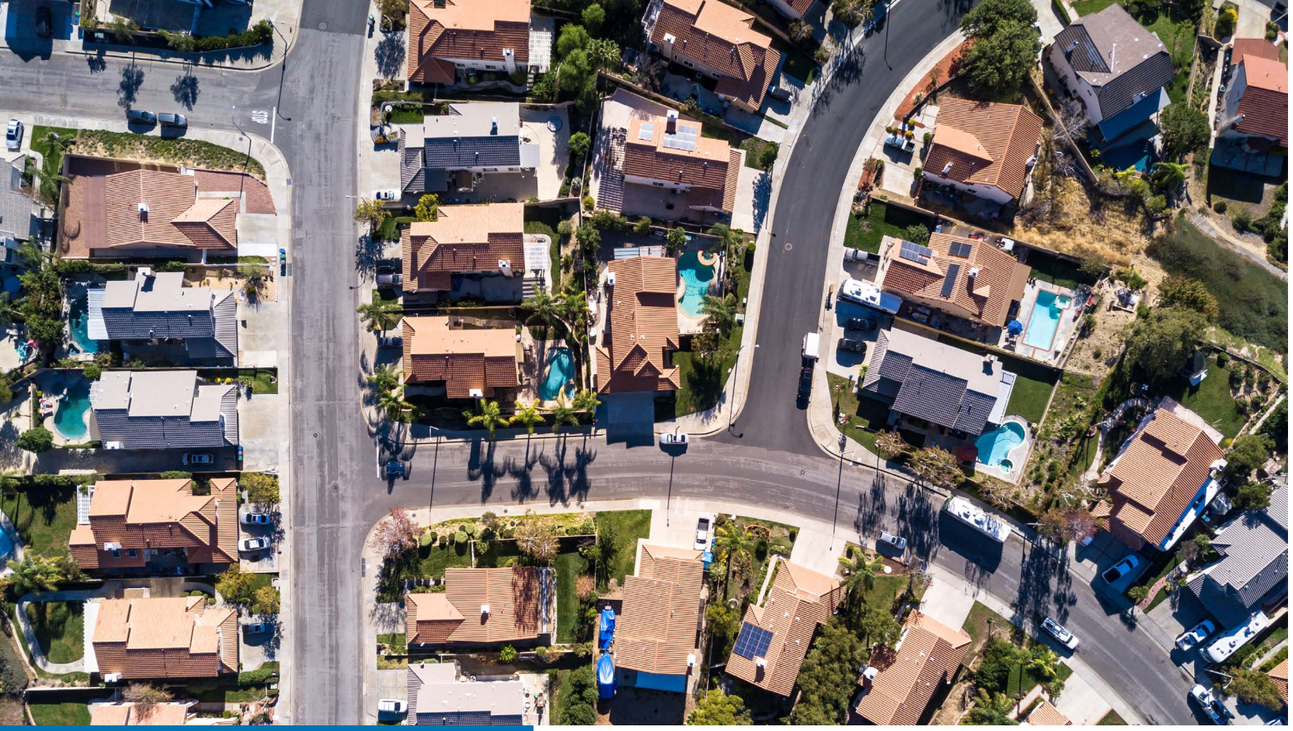
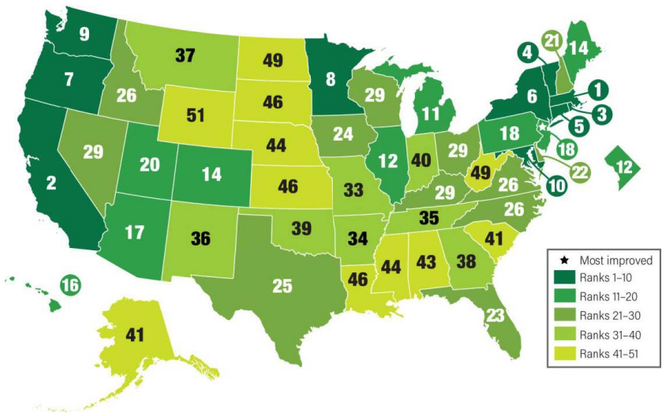


The 2019 Title 24 Code brings 50 % more stringency to residential housing in just one code cycle. It's all done in the noble interest of cost-effective energy efficiency, but it is challenging to building professionals who must balance new requirements with profitability.

Here's the definitive guide to the major changes the 2019 code brings, pitfalls to avoid, and ways to comply.

THE CALIFORNIA ENERGY Code (Title 24, Part 6) was created by the California Building Standards Commission in 1978. It mandated that the code be renewed every three years and that each new iteration be more energy efficient than the previous one. This stringency has resulted in California's building code being a leading example in energy efficiency according to ACEEE scorecard.



With greatness comes hard work for the California building industry, but keeping up with the new code doesn't have to be an onerous process. According to the experts interviewed for this guidebook—which focuses on low-rise residential (single-family homes and multi-family three stories or less)—if builders plan properly, use building science best practices, and lean on strong manufacturers with reputable products, they can meet the 2019 code.

"Now that the state is forcing PV investment in residential, homeowners are asking, 'Do I do the minimum required of me or do I add more energy efficient electric appliances such as a heat pump water heater?'"
—Gina Rodda, Gabel Energy

QUANTUM LEAP

According to energy consultant Martyn Dodd of Energy Soft in his webinar "2019 Title 24: Where We're Headed With the Residential Standards," the changes from 2016 to 2019 are significant.

"This marks the biggest stringency change we've had since the code's inception. The California Energy Commission (CEC) in its blueprint has published that it is a 52% change in compliance, which means, for instance, a home built to the 2016 code would be "out of compliance" by at least 100% under the 2019 code," Dodd says. "Compliance with 2019 requirements will require close attention to the energy efficiency of the building envelope and inclusion of PV production."

Energy consultant Gina Rodda, principal of Castro Valley, Calif.-based Gabel Energy, agrees that the move to 2019 is not a simple upgrade from one code to the next. But she takes the long view when considering the impact of the new version.

"It's a complex code. But I take faith that the 2019 requirements, when measured against payback, will be cost effective," she explains, alluding to the myriad pathways to compliance. "Homeowners and developers need to know that code-required items will pay for themselves over the lifetime of the building."

This is an important point many people don't realize about Title 24. "The code must be based on cost-effectiveness studies," Rodda notes. "For example, they did studies on loading dock doors for refrigerated warehouses and determined everything that could be changed on the doors that would save energy. But the studies could not prove these changes would pay for themselves, and so the [potential code change] was thrown out."

This also holds true for remodeling. "QII [the 2019 insulation installation requirements] must be used for all new construction, but not for alterations or additions 700 square feet or less. An addition over 700 is not exempt because studies have shown the QII requirement can pay for itself," Rodda says.

Two big changes worth a closer look are the solar

continued on page 6

BIG CHANGES

In addition to the two new additions to the code outlined in "Brand New For 2019," the following details the main updates builders should know about, adapted from "2019 Title 24: Where We're Headed With the Residential Standards."

Residential Envelope

ABOVE DECK AND BELOW DECK ROOF INSULATION

- Above Deck Roof Insulation is no longer a prescriptive option
- Below deck insulation is still a prescriptive option. New insulation requirements below the roof deck increased from R-13 to R-19 in climate zones 4, 8-16. For multifamily, R-13 is allowed in Zones 10 and 16.
- The location of ducts and AHU in conditioned space is still an option
- Builders can still use above deck insulation with performance modeling

WALL INSULATION IN HARSH CLIMATES

In Climate Zones 1-5 and 8-16 requires more wall insulation. High-performance walls are specified with a u-factor reduced to 0.048. That reps a 2x6 wall with R-21 insulation in the cavity and additional 1" rigid (R-5) installed on the outside of the wall.

ABOVE GRADE MASS WALLS

This is any wall with density greater than 45 lbs/cu.ft. There are two options for compliance:

- Interior insulation R-13 Continuous (R-17 in Zone 16)
- Exterior insulation R-8 Continuous (R-13 in Zone 16)
- Below Grade Mass Walls
- Two options for compliance:
  - Interior insulation R-13 Continuous (R-15 in Zone 16)
  - Exterior insulation R-5 Continuous (R-10 in Zones 14-15, R-19 in Zone 16)

QII

Quality Insulation Installation (QII) is now required on most residential buildings under prescriptive compliance.

- Insulation can have no voids
- It requires insulation by a HERS Inspection of insulation in under floor, wall, roof ceiling, air barrier. Inspections must be done before the walls are closed up.
- It will set the baseline in performance approach. This is prescriptive Not mandatory but if you don't do it you will have a 10-15% hit in terms of compliance.
- Applies to new construction as well as additions larger than 700 square feet
- It is not required for multifamily in Climate Zone 7 (Coastal San Diego)

WINDOWS

- Maximum U-Factor 0.30
- Maximum SHGC 0.23
- No requirement in Zones 1, 3, 5, and 16
- Zone 16 is now treated like the other heating zones (above), not like the cooling climate zones. In all the heating zones, passive design to take advantage of heat gain is encouraged.

OPAQUE DOORS

- All climate zones basically require an R-5 insulated door; includes doors to outside and to unconditioned spaces but does not apply to doors from the house to the garage.
- Subject to a maximum NFRC rated U-factor of 0.20
- Doors with 25% or more glass now treated as a window and must follow the window requirements.

ADDITIONS

- Extended walls that are 2x6 require R-21 insulation
- QII required on additions larger than 700 square feet
- Attic insulation in additions 700 square feet or less:
  - Zones 1, 11-16 require R-38
  - Zones 2-10 require R-30
- Rafter roofs can be R-22 using the performance approach offsetting the penalty.

Mechanical

DUCTS AND FILTERS

- An exception for ducts in support platforms and wall cavities to be uninsulated.
- Minimum 2" filter (larger face area formula will allow for 1")
- Minimum MERV 13 filtration
- Filter not required if 10 feet or less of ductwork. MERV 13 filter not required for alterations to existing systems, only to new systems (new ducting, AHU and condensor)

FAN PERFORMANCE

Fan wattage must be HERS tested on forced air system with cooling to be no more than 0.45 W/cfm if the unit is a gas furnace aligning with the new furnace efficiency requirements starting in July, 2019 for the Department of Energy.. Other air handlers such as heat pumps and fan coils can still be 0.58 W/cfm. Small Duct High Velocity Forced Air Systems must test at 250 cfm per ton and no more than 0.54 W/cfm.

SINGLE FAMILY IAQ FANS

The CEC released a more stringent calculation for how airflow is calculated. It will result in significantly more IAQ CFM (or airflow) required for the home.

(For new multifamily dwelling units must include either a balanced ventilation system, a continuously operating supply ventilation system or a continuously operating exhaust ventilation system. If using a continuous system, it requires HERS blower door testing to show no more than 0.3 cfm/sf leakage based upon the envelope surface area.)

RANGE HOODS

Hoods must be HERS inspected in the field to verify:

- Minimum airflow per ASHRAE 62.2 (100 cfm)
- Maximum sound ratings per ASHRAE 62.2 (3.0 sones)
- Other airflow options are provided in ASHRAE 62.2 for continuous ventilation

HERS VERIFICATIONS

- Heat pumps that are high efficiency (HSPF greater than 8.2) must be HERS verified in the field.
- Heat pump heating capacity values at 47 degree and 17 degree ratings must be HERS verified in the field when non-default sizes are used in performance modeling.
- Whole House Fan airflow and rated wattage must be HERS verified in the field.
- Central Fan Integrated Cooling systems must be HERS verified in the field.

DOMESTIC HOT WATER

- Applicable to units serving individual dwelling units
- Any number of gas or propane tankless water heaters
- A large gas or propane water heater (greater than 55 gallons) must be accompanied by windows with a U-factor of 0.24 or less and one of the following (all of which must be HERS verified):
  - Compact hot water distribution
  - All piping insulated
  - A drain water heat recovery system

HEAT PUMP WATER HEATER

There are two pathways to compliance. Mixed fuel pathway with the baseline being a gas water heater, and electric. The most viable approach is to use a Tier III NEEA rated unit (must increase the PV size by 0.3 kW in Zones 1 and 16)

Others include:

- Compact hot water distribution HERS verified plus
- A drain water heat recovery system HERS verified
- Or in Zones 2-15 increase PV size by 0.3 kW
- Or in Zones 1 and 16 increase PV size by 1.1 kW

REPLACEMENT WATER HEATERS

A replacement water heater can be one of the following:

- Natural gas or propane unit
- An electric resistance unit if no gas is at the water heater location
- If no natural gas, may replace an electric water heater (60 gallons or less)
- A heat pump water heater located indoors in climate zones 1-15

RESIDENTIAL LIGHTING

Luminaire Requirements: Night lights, step lights, and path lights require a vacancy sensor if light is over 5 watts or 150 lumens.

Light source internal to drawers, cabinetry or linen closets require a vacancy sensor if light is over 5 watts or 150 lumens unless they are equipped with controls that automatically turn the lighting off when closed.

In bathrooms, garages, laundry rooms and utility rooms there needs to be at least one luminaire controlled by either a vacancy sensor or an occupancy sensor (must be configured in Vacancy Sensor mode before final).

MULTIFAMILY SOLAR HOT WATER SYSTEM

This is applicable to units serving multiple dwelling units (central system), and still requires a solar system:

- 20% net solar fraction in Zones 1-9
- 35% net solar fraction in Zones 10-16

You can reduce the NSF by 5% if each dwelling unit has a drain water heat recovery system HERS verified.

"Heat pump technology is tried-and-true technology we know well. Bradford White has taken that technology and adapted it to our water heater and run it in reverse from how a refrigerator works. You take a little bit of warmth—anything above 35 degrees F—and you can use that to heat your water up to a maximum of 140 degrees."
—Gregg Holladay, Bradford White Water Heaters

requirements and the new rules for water heaters. These two requirements go hand in hand, Rodda explains: "Now that the state is forcing PV investment in residential, homeowners are asking, 'Do I do the minimum required of me or do I add more energy efficient electric appliances such as a heat pump water heater?'"

Rodda believes that the solar mandates empower homeowners, and that many who live in existing homes—who are not required to comply with some of the 2019 rules—may opt to anyway. And that's because many of the energy-efficient products or practices make sense and reduce energy bills.

A STAR IS BORN

While the solar mandate has garnered the lion's share of media attention regarding the 2019 code, it was certainly not a surprise to anyone. The 2016 code was apt foreshadowing with its mandate that all roofs be designed and sized to accommodate PV.

Heat pump water heaters, on the other hand, are the surprise star of the new Title 24 code, particularly after years of gas tankless water heaters being touted as the solution to greenhouse gas reduction.

But then "decarbonization" became the rallying cry in California.

"The Energy Commission originally said that the state's goals were zero net energy," Rodda reminds. "Now the new goals are reduced carbon or even zero carbon. We are ending a little of the neutrality on gas and becoming the parent who has a favorite child."

The CEC took a closer look at water heating solutions and found much to extol about heat pump water heaters. For 2019, the CEC added heat pump water heaters to the code as an alternative to tankless systems. According to Gregg Holladay, Business Development Manager, Bradford White Water Heaters, two reasons stand out:

1. Electric-to-electric replacement. The incredible efficiency of heat pump water heaters (550 watts to heat water versus 4500 watts used by electric resistance units) means energy savings can be had without the use of fossil fuels. The CEC seized the opportunity to promote the use of a product that takes 70 percent of the energy use out of the second-highest-energy-consuming component of a house.
2. The potential use of Heat Pump Water heaters for load control by utilities, both shedding load during peak times, and storage of hotter water during "off peak" creating a thermal "battery". Unlike gas tank water heaters with flue stacks that allow heat to escape, heat pump water heater tanks are well insulated with very little heat loss over long periods of time in standby. Utilities, which know that moving heat is cheaper than creating heat, want to use these water-storage units as "batteries" – the perfect place to offload excess solar heat gathered from the expanding number of PV systems. The grid has the potential to send excess power directly to customers' water heaters where it can remain hot all day.

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BRAND NEW FOR 2019

OUT OF THE GATE, 2019 Title 24 added two rules not found in previous codes. (For a look at the updates that will have the most impact this year, see "Big Changes," on page 4.)

The first new item is Community Shared Solar or Battery System. This allows for a common shared system to offset any solar and/or battery requirements of a building. Because the CEC is now requiring that new homes have PV production, this provides an opportunity to provide for the needs of a project without doing so directly on the building site. A builder, for example, could choose to locate solar off site on less valuable land.

To use community shared solar, the system must:

- Be operational before the final permit is signed off on the building
- Provide equivalent or better performance than what is specified for the building
- Directly benefit the building (not other properties), although it doesn't need to be directly tied into the building, it can be fed to the grid though its benefit can't transfer to another building.
- Provide benefit to the building for 20 years minimum

The second important change is the way builders show compliance in the performance approach. 2019 uses Energy Design Rating (EDR). Currently, it is TDV (Time Dependent Valuation).

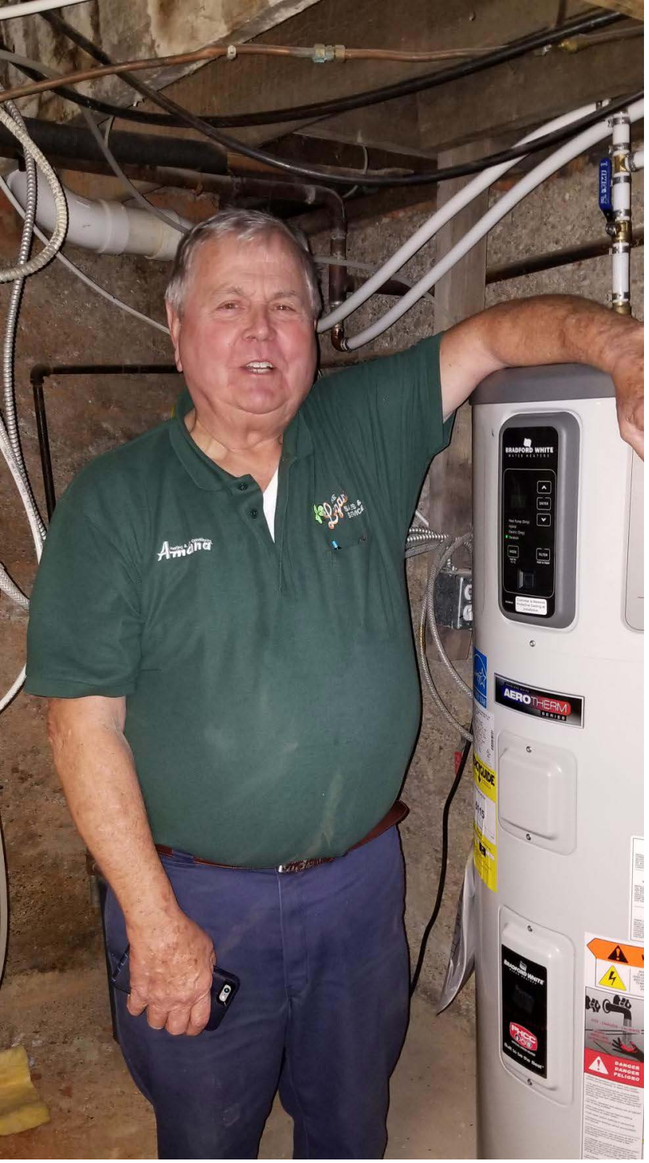
The EDR rating is scored on two aspects:

1. Performance of heating, cooling, and domestic hot water systems
2. Performance of heating, cooling, and domestic hot water PLUS appliances, lighting, plug loads and PV.

So it might play out like this: A builder could design a high-performance home but not include PV. The first goal is passed, but because he doesn't have the necessary PV production required by code, the house will fail.

In another situation, say a builder puts up a home that has lots of windows but offsets their energy use with a huge PV system. While he will clear goal two, he will be wildly out of compliance with goal one, and the house will fail.

The idea behind the two goals is that the CEC is looking for a balance of energy efficiency and PV production. (Additions and alterations will still be rated via TDV and not subject to the PV or use of appliances and receptacles rules).



"When you consider the schemes to get compliance and the flexibility with the heat pump water heaters, it is amazing," Rodda says. "If you want extra windows or something else you can get a demand response utility rate by allowing utilities to charge the water heater during the day, which helps manage the grid." (This example Rodda gives could be done through a performance software strategy coordinated with local utility and demand response controls allowing communication between utility and home.)

Title 24 code promotes heat pump water heater technology because of its energy savings and greenhouse gas reduction opportunities. Because this is new, not everyone is aware heat pump water heaters are a prescriptive option in the code.

WINNING HEARTS AND MINDS

From the 40,000-foot view, heat pump water heaters are the perfect solution for reducing California's energy use. But farther down, in the trenches, the message gets tricky.

Tom Alkire, owner of RepWest, serving Bradford White in Northern California and Northern Nevada, says the challenges the code has presented to builders and manufacturers has created winners and losers by technology or in the field, which can inhibit innovation and fair competition.

Alkire points out that builders already resisted the change, then got over it, and now contractors are the ones who fight the move. "Going to heat pump from tankless ... it's a foreign object to them," Alkire says. "Contractors are busier than ever, and now there are additional trades involved. But we can educate them," he adds. (See "Product Spotlight," page 3)

Holladay says the education process is ongoing, but that making the case for the superiority of heat pump technology is simple. It comes down to technology and cost savings.

Regarding technology, any resistance to heat pump water heating technology can be handily dismissed. "I always ask builders how many heat pumps they have in their houses," Holladay says. When he gets blank stares, he rattles off a few: refrigerators, wine chillers, freezers.

"This is tried-and-true technology we know well," he explains. "We have taken that technology and adapted it to our water heater and run it in reverse from how a refrigerator works. You take a little bit of warmth—anything above 35 degrees F—and you can use that to heat your water up to a maximum of 140 degrees."*

The cost savings story is also compelling. "Electric heat pump technology is more efficient because it is moving heat, not generating heat," Holladay says. "It comes in at 3.39 UEF. A higher UEF will decrease your cost and result in a faster payback on the product. Bradford White's AeroTherm® Series heat pump water heater will save an average of $300* in energy each year when compared to a standard electric water.

"It's a product that helps homeowners," Holladay summarizes. "It's bigger than the product itself. Heat pump water heating is the best green technology out there because it pays for itself so quickly." ■

* Water temperature over 125 F (52 C) can cause severe burns instantly or death from scalds. Children, disabled, and elderly are at highest risk of being scalded. Review product instruction manual before setting temperature at water heater. Feel water before bathing or showering. Temperature limiting valves are available.

*Information provided by the Air Conditioning, Heating and Refrigeration Institute (AHRI) and Bradford White. Savings based on the estimated annual operating cost of a standard 50-gallon electric tank water heater using 3531 kWh per year vs. the 50-gallon, 3.39 UEF AeroTherm® heat pump water heater using 958 kWh per year and national average electricity rate of 12 cents per kWh. For FTC guide information, please visit www.ahrinet.org

NEW SOLAR RULES

THE CEC'S 2019 directive calls for a minimum system size of "2 to 3 kilowatts, depending mostly on the size of the home." However, builders installing batteries would get "compliance credits," allowing them to further reduce the size of the solar system. A storage battery can reduce the PV sizes from Equation 150.1-C by 25% if installed in conjunction with a PV system. The battery storage must have a minimum capacity of 7.5 kWh.

At first glance, the PV requirement might seem like an incredible cost burden to place on new home buyers. However, the CEC sees this as a net positive. Some have estimated this will increase the sticker price of new homes by $8,000 to $16,000.

However, since most homes are mortgaged, one has to examine the effect on the monthly mortgage payment. According to the CEC, the new requirement should raise the monthly mortgage payment by $40. That increase will be offset by an estimated $80 monthly savings in utility bills.

C.R. Herro, Meritage's Vice President of Environmental Affairs, told the *OC Register* that "the new energy standards add about $25,000 to $30,000 to the construction costs compared with homes built to the 2006 code, but that increased cost will result in $50,000 to $60,000 in the owner's reduced operating costs over the 25-year life of the home's solar system."

Two important notes about the solar requirement:

1. **Not every home will need to comply.** Exceptions or alternatives will be allowed when homes are shaded by trees or buildings or when the home's roof is too small to accommodate solar panels.
2. **Builders have a couple of design options.** They can either have solar panels installed on the individual home, or build a shared solar-power system serving a group of homes. In the case of rooftop panels, they can either be owned outright and rolled into the home price, or made available for lease on a monthly basis.

For more information on the renewables portion of Title 24, watch the webinar "Decoding Talk on Renewables."

ENERGY CONSULTANTS TO THE RESCUE

GINA RODDA of Gabel Energy believes that the intensiveness of the 2019 code is pushing builders to use energy consultants to meet the requirements, but that unfortunately many use the "$99-no-matter-the-project" consultants and are not getting quality work and, in many cases, not getting through the building department.

Energy Code Ace's Jill Marver encourages the industry to engage Certified Energy Analysts (CEAs). People can find CEAs on CABEC's website.

This is welcome news to Jeremy Crane, Sales Manager/Partner for Signature Sales, representing Bradford White in Southern California, who thinks education is good but consultants are even better.

"Most builders punt to a consultant," he says. "I understand that because I have gone to some education seminars and it's like going to a 200 level college course without taking the 100 level first. We work in plumbing and now they have created a whole new industry with the different codes, abbreviations, and language. For many builders, it's a little over their heads."

RESOURCES ABOUND

Builders have a variety of online and in-person Title 24 education tools at their disposal.

THE FIRST PLACE for information on Title 24 is the California Energy Commission, which administers the code. Its website includes all the forms and compliance resources, and also offers a hotline.

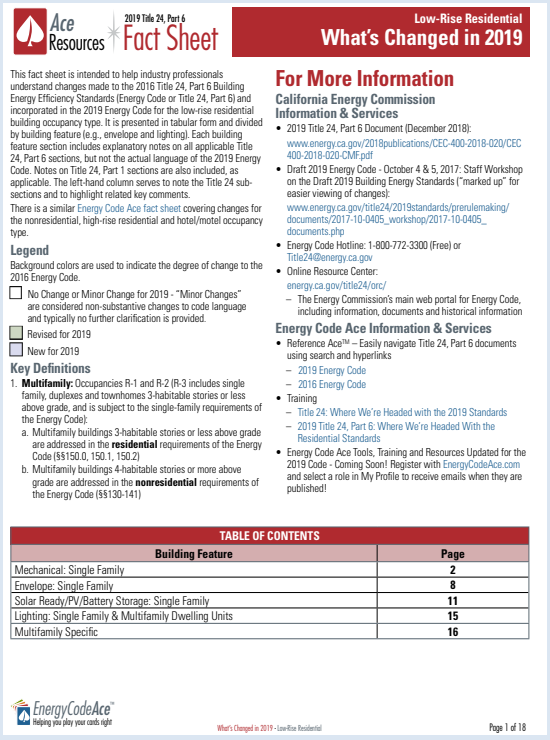
A third-party go-to source for Title 24 is Energy Code Ace, which is a website developed and provided by the California Statewide Codes & Standards Program. The site offers free energy code training, tools and resources for those who need to understand and meet the requirements of Title 24, Part 6 and Title 20.

Jill Marver, Energy Code Ace Program Manager, touts the broad and deep resources offered to help the building industry. "We recognize that codes and standards are one of the most effective pathways to ensuring sustained market transformation – and that the key to making them work are well-informed industry professionals and consumers," she says. "That's why I'm doubly excited about what's coming in the next few years. The codes are getting stronger, and we are providing more targeted help through our tools, training and resources."

She calls attention to the following helpful resources: Two new fact sheets to help you decode "What's Changed" for the 2019 Energy Code.

- What's Changed: Low-Rise Residential
- What's Changed: Nonresidential, High-Rise Multifamily and Hotel & Motel.

2019 Title 24, Part 6 Reference Ace: Our tool is designed to help you navigate Title 24, Part 6 Standards documents. Keyword search capabilities along with hyperlinks allow you to jump directly to related sections to make using the Standards documents easier.



Ace Resources 2019 Title 24, Part 6 Fact Sheet

Low-Rise Residential
What's Changed in 2019

This fact sheet is intended to help industry professionals understand changes made to the 2016 Title 24, Part 6 Building Energy Efficiency Standards (Energy Code or Title 24, Part 6) and incorporated in the 2019 Energy Code for the low-rise residential building occupancy type. It is presented in tabular form and divided by building feature (e.g., envelope and lighting). Each building feature section includes explanatory notes on all applicable Title 24, Part 6 sections, but not the actual language of the 2019 Energy Code. Notes on Title 24, Part 1 sections are also included, as applicable. The left-hand column serves to note the Title 24 subsections and to highlight related key comments.

There is a similar Energy Code Ace fact sheet covering changes for the nonresidential, high-rise residential and hotel/motel occupancy type.

Legend

Background colors are used to indicate the degree of change to the 2016 Energy Code.

- No Change or Minor Change for 2019 - "Minor Changes" are considered non-substantive changes to code language and typically no further clarification is provided.
- Revised for 2019
- New for 2019

Key Definitions

1. **Multifamily:** Occupancies R-1 and R-2 (R-3 includes single family, duplexes and townhomes 3-habitable stories or less above grade, and is subject to the single-family requirements of the Energy Code):
   a. Multifamily buildings 3-habitable stories or less above grade are addressed in the **residential** requirements of the Energy Code (§§150.0, 150.1, 150.2)
   b. Multifamily buildings 4-habitable stories or more above grade are addressed in the **nonresidential** requirements of the Energy Code (§§130-141)

For More Information

California Energy Commission Information & Services

- 2019 Title 24, Part 6 Document (December 2018): www.energy.ca.gov/2018publications/CEC-400-2018-020/CEC400-2018-020-CMF.pdf
- Draft 2019 Energy Code - October 4 & 5, 2017: Staff Workshop on the Draft 2019 Building Energy Standards ("marked up" for easier viewing of changes): www.energy.ca.gov/title24/2019standards/prerulemaking/documents/2017-10-0405_workshop/2017-10-0405_documents.php
- Energy Code Hotline: 1-800-772-3300 (Free) or Title24@energy.ca.gov
- Online Resource Center: energy.ca.gov/title24/orc/
  - The Energy Commission's main web portal for Energy Code, including information, documents and historical information

Energy Code Ace Information & Services

- Reference Ace™ – Easily navigate Title 24, Part 6 documents using search and hyperlinks
  - 2019 Energy Code
  - 2016 Energy Code
- Training
  - Title 24: Where We're Headed with the 2019 Standards
  - 2019 Title 24, Part 6: Where We're Headed With the Residential Standards
- Energy Code Ace Tools, Training and Resources Updated for the 2019 Code - Coming Soon! Register with EnergyCodeAce.com and select a role in My Profile to receive emails when they are published!

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EnergyCodeAce Helping you play your cards right

What's Changed in 2019 - Low-Rise Residential Page 1 of 18

ENERGY CODE ACE OVERVIEW GUIDE

- 2019 Title 24, Part 6: Where We're Headed With the Residential Standards (offered on-demand and live)
- 2019 Title 24, Part 6: Where We're Headed With the Nonresidential Standards (offered on-demand and live)
- Title 24: Where We're Headed with the 2019 Standards (offered live)

The California Energy Alliance (CEA) is another place to get Title 24 information. This organization unites representatives from a broad range of organizations concerned about energy and the built environment. CEA focuses on the promotion and realization of deep energy savings, sustainable energy generation, and integration through pragmatic means.

"This group is important to understand," says John Busch, Regional Sales Manager of Leviton's Southwest Region and Chair of the Code Compliance Subcommittee for CEA. "What's happened to date is the utilities have dominated the code. CEA brought together stakeholders to assist the CEC in the development of codes."

Another organization is NEEA (Northwest Energy Efficiency Alliance), an alliance of more than 140 Northwest utilities and energy efficiency organizations. "We work on progressive initiatives, such as Title 24, and partner with organizations to support them with technical information," says Geoff Wickes, NEEA's Senior Product Manager, Emerging Technologies.

He sees Title 24 as a harbinger of where energy efficiency is going in the West and across the country. "We provide lab-to-field analysis and product performance." This testing allows the CEC to determine which technologies have potential Title 24 application. The organization provides education throughout the Northwest. You can learn more about their initiatives at https://neea.org.