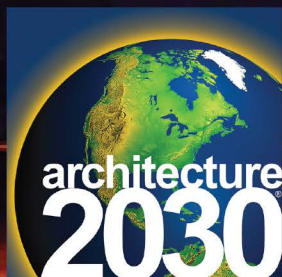


2022 ZERO CODE™ for CALIFORNIA

A California building energy standard for
new nonresidential, high-rise residential and
hotel/motel buildings.



in collaboration with



AIA
California



ZERO CODE™ for California, 2022 Version

August, 2020

CONTENTS

Introduction..... 1

Base ZERO Code..... 2

 1. Purpose..... 2

 2. Scope..... 2

 3. Definitions and Terms..... 2

 4. Administration and Enforcement..... 3

 5. Minimum Energy Efficiency 3

 6. Renewable Energy 3

Modifications for Beyond-Code Energy Efficiency 7

 Sections 1 through 4 7

 5. Minimum Energy Efficiency 7

 6. Renewable Energy 7

Notes and Supporting Information..... 8

ZERO CODE DEVELOPMENT:

Charles Eley, FAIA, PE, Architecture 2030 Senior Fellow

Architecture 2030 Support:

 Edward Mazria FAIA, FRAIC, CEO

 Vincent Martinez, COO

 Review: Lindsay Rasmussen

AIA California Support:

 Michael F. Malinowski FAIA

 William Leddy, FAIA

 Scott Shell, FAIA

 Mark Christian, Hon. AIA CA

DISCLAIMER

Architecture 2030 does not guarantee, certify, or assure the safety or performance of any buildings, products, components, or systems installed in accordance with the ZERO Code or referenced standards.

In referring to the ZERO Code and in the design of any building or use of any product, no claim shall be made, either stated or implied, that the building or product has been approved by Architecture 2030.

The ZERO Code standard is presented solely as a guide, which may be modified and consequently adopted as such by appropriate legal jurisdictions. In utilizing the ZERO Code standard, practitioners must research and ensure compliance with ordinances and codes applicable in their jurisdictions.



INTRODUCTION

The 2022 ZERO Code for California is a reach standard that applies to new commercial, institutional, high-rise residential, and hotel/motel buildings, the prevalent building types being constructed in cities today. The ZERO Code expands on the cost-effective 2022 energy efficiency standards adopted by the California Energy Commission by:

- requiring on-site or off-site renewable energy,
- eliminating the direct use of fossil fuels in buildings, and
- specifying beyond-code energy efficiency (optional).

Zero Carbon Building

A highly efficient building that uses no on-site fossil fuels and produces on-site, or procures, enough carbon-free renewable energy to meet building operations energy consumption annually.

The ZERO Code for California is different from the national and international version in two important respects: (1) hourly source energy is used for measuring building energy consumption and production from on-site renewable energy systems and (2) minimum energy efficiency is defined by the California Building Energy Efficiency Standards (BEES). Hourly source energy is proportional to the greenhouse gas emissions of the long-run, marginal resource and represent an accurate proxy for carbon emissions.

Adoption of the ZERO Code is an important tool for local governments to address climate change and reduce greenhouse gas emissions. The ZERO Code can either be incentivized or mandated by implementing jurisdictions through building codes, municipal codes or zoning regulations.

New buildings place an additional load on the electric grid and the ZERO Code requires that this load be small and be offset by additional renewable energy production, resulting in near zero carbon impact. In effect, the ZERO Code accelerates progress toward a clean electric grid in California by requiring new renewable energy generating capacity over and above that already required by state renewable portfolio standards (RPS).

The electricity used by ZERO Code buildings is clean and carbon free. For this reason, the California ZERO Code prohibits the use of gas appliances.

The base energy efficiency standard for the ZERO Code is 2022 Title 24, Part 6, the state Building Energy Efficiency Standards, but if local governments want to require more than code-minimum energy efficiency, they can require that all new building use the performance approach and set a beyond-code target. Otherwise, the ZERO Code supports both the prescriptive and performance approaches to compliance.

The ZERO Code provides a flexible approach for incorporating renewable energy, both through on-site generation and/or off-site procurement, making it applicable to all new commercial and institutional buildings, and mid- to high-rise housing, including those buildings with limited on-site renewable energy generating potential because of shading, building height or other factors.

Technical support documents are available that explain the concepts of the ZERO Code and describe potential options for off-site procurement of renewable energy.



BASE ZERO CODE

1. PURPOSE

New nonresidential, high-rise residential and hotel/motel buildings shall be energy efficient and install on-site renewable energy systems and/or procure off-site renewable energy of adequate capacity to encourage zero net carbon.

2. SCOPE

This standard applies to new commercial, institutional, high-rise residential, and hotel/motel buildings that are addressed by the California Building Energy Efficiency Standards (BEES). See Section 100.0—Scope of the BEES.

3. DEFINITIONS AND TERMS

The definitions from the California BEES shall apply to this standard and are supplemented by the definitions below.

authority having jurisdiction (AHJ): the agency or agent responsible for enforcing this standard.

building electricity: the electricity use of the proposed design without consideration of on-site or off-site renewable energy contributions.

hourly source energy (HSE): one of two performance metrics used to determine compliance with the 2022 California BEES. The hourly energy consumption and/or electricity production from on-site renewable energy is multiplied times an HSE weight for each hour and summed for the year. The HSE weight is a proxy for long-term marginal carbon emissions for each hour and aligns with the standard weather files used for code compliance.

eligible hydro: hydroelectric generating facilities with a capacity of 30 MW or smaller that qualify for credit under the California renewable portfolio standards.

net electricity: the *building electricity* less the *on-site renewable electricity*.

on-site renewable electricity (RE_{on-site}): the annual electricity production from on-site renewable energy systems. On-site renewable energy system shall be located on any of the following:

- the building,
- the property upon which the building is located,
- a property that shares a boundary with and is under the same ownership or control as the property on which the building is located, or
- a property that is under the same ownership or control as the property on which the building is located and is separated only by a public right-of-way.

renewable energy certificate (REC): a tradable instrument that represents the environmental attributes of one megawatt hour of renewable electricity generation and is transacted separately from the electricity generated by the renewable energy source; also known as “energy attribute” and “energy attribute certificate.”



4. ADMINISTRATION AND ENFORCEMENT

4.1 Compliance

New buildings shall comply with Section 5 (minimum energy efficiency) and Section 6 (renewable energy).

4.2 Compliance Software

The California Building Energy Code Compliance (CBECC-Com) software (or other software approved by the CEC) may be used to demonstrate compliance with the energy efficiency requirements of the ZERO Code for California and to calculate the hourly source energy from on-site photovoltaic systems and battery storage.

5. MINIMUM ENERGY EFFICIENCY

Buildings shall be designed and constructed with no gas or fossil-fuel fired equipment and shall comply with the 2022 California BEES using either the performance requirements of Section 140.1 or the prescriptive requirements of Section 140.2.

6. RENEWABLE ENERGY

Building designs shall comply with 6.1 and either 6.2 or 6.3.

Exception to 6.2 and 6.3:

When none of the off-site renewable energy procurement methods listed in Table 6.2 or Table 6.3 are available, the building owner may sign a 20-year contract to annually purchase each year double the number of unbundled renewable energy certificates (RECs) needed to offset *net electricity*.

6.1 Minimum On-Site Renewable Energy

Building projects shall contain on-site photovoltaic systems as required by the California 2022 BEES, but with a rated capacity of not less than 2.0 W/ft² multiplied by the horizontal projection of the gross roof area over conditioned spaces. For the purposes of this section, the building roof area may exclude the following:

- a. Shaded areas, defined as roof area where direct-beam sunlight is blocked by structures or natural objects for more than 1500 annual hours between 8 a.m. and 4 p.m.
- b. Green roofs and areas of vegetated terrace.
- c. Areas designated for public occupancy. Parking areas shall not qualify for this exclusion.

6.2 Community Solar, Green Pricing and Utility Renewable Energy Contracts

Net electricity shall be provided by one of the methods described in Table 6.2.



Table 6.2 Community Solar, Green Pricing and Utility Renewable Energy Contracts

<i>Procurement Method</i>	<i>Description</i>
Community Solar	A program, often offered in partnership with the local utility or community choice aggregator, whereby a large solar system is installed at a common location within a community and property owners subscribe to the program so that renewable energy production is assigned to their property.
Green Pricing	A special electric tariff offered by the local utility, community choice aggregator or other electricity supplier that delivers 100% renewable energy to the property.
Utility Renewable Energy Contract	A special bilateral tariff negotiated with the local utility, community choice aggregator or other electricity supplier that delivers 100% renewable energy to the property.

6.3 Self-Owned, Virtual Power Purchase Agreements and REIFS

Net electricity shall be procured by one of the methods described in Table 6.3. For the purposes of Section 6.3, *net electricity* shall be determined using the procedures in either 6.3.1 or 6.3.2.

Table 6.3 Self-Owned, Virtual Power Purchase Agreements and REIFS

<i>Procurement Method</i>	<i>Description</i>
Self-Owned Off-site	A renewable energy system that is installed on separate property from the building but under the same ownership or control.
Virtual Power Purchase Agreement	This option is available to large, credit-worthy building owners. The buyer guarantees a minimum price to the renewable energy developer for the electricity sold by a new solar or wind farm so that the renewable energy developer can establish financial feasibility and secure funding.
Renewable Energy Investment Fund (REIF)	A program by local government or other entity to buy 100% renewable energy on behalf of a group of customers who pay into or subscribe to the program.

6.3.1 Prescriptive Compliance

When the proposed building complies with the California BEES using the prescriptive requirements of Section 140.2, *net electricity* shall be calculated by multiplying the conditioned floor area times the prescriptive renewable energy requirement from Table 6.4 and subtracting the *on-site renewable electricity*.



Table 6.4 Prescriptive Renewable Energy Requirement by Building Type and Climate (kBtu/ft²-y)¹

Climate Zone	Office	Retail	School	Restaurant	Hotel	Warehouse	Residential
1	38	35	39	186	31	26	29
2	41	37	36	177	29	20	30
3	38	33	33	177	26	19	27
4	40	35	34	175	27	18	29
5	39	32	33	179	26	18	27
6	39	33	31	174	25	14	28
7	38	32	30	168	24	13	27
8	40	35	32	174	26	14	28
9	41	37	33	171	27	15	29
10	42	38	34	175	28	15	30
11	44	42	39	183	32	22	33
12	42	39	38	175	30	21	31
13	44	41	39	182	32	20	32
14	45	42	39	184	32	21	32
15	46	44	38	192	32	14	34
16	46	45	45	187	36	31	35

6.3.2 Performance Requirement

When the proposed building complies with the California BEES using the performance requirements of Section 140.1, *net electricity* shall be determined California Energy Commission approved software.

6.4 General Requirements for Off-Site Procurement of Renewable Energy ²

The following requirements shall apply to off-site renewable energy procurement methods described in Tables 6.2 and 6.3 as well as unbundled RECs allowed under the exception to Section 6.

- a. Documentation of off-site renewable energy procurement shall be submitted to the *authority having jurisdiction*.
- b. The procurement purchase contract shall have duration of not less than 20 years and be structured to survive a partial or full transfer of property ownership.
- c. Renewable energy certificates and other environmental attributes shall be assigned to the initial and subsequent building owner(s) for a period of not less than 20 years. The building owner(s) may transfer renewable energy certificates to building tenants while they are occupying the building.
- d. The renewable energy generating source shall be photovoltaic systems, solar thermal power plants, geothermal power plants, *eligible hydro*, wind turbines or other technologies recognized for credit by the California renewable portfolio standards.
- e. The generation source shall be located where the energy can be delivered to the building site by any of the following:
 - 1. By direct connection to the off-site renewable energy facility
 - 2. By the local utility or distribution entity

¹ These data are based on the 2019 BEES. They will be somewhat lower for the 2022 BEES.

² These requirements are generally consistent with the requirements in the Building Energy Efficiency Standards.



3. By an interconnected electrical network where energy delivery capacity between the generator and the building site is available
- f. Transparent accounting shall be maintained that clearly assigns renewable energy production to the building. Records on power sent to or purchased by the building shall be retained by the building owner and made available for inspection by the authority having jurisdiction (AHJ) upon request.

6.4 Future Adjustments to Off-Site Procurement

Where the off-site renewable energy producer ceases operation, the building owner shall procure alternative qualifying renewable energy. The duration of renegotiated contract(s) shall continue until a date at least 20 years after the initial certificate of occupancy was issued.



MODIFICATIONS FOR BEYOND-CODE ENERGY EFFICIENCY

SECTIONS 1 THROUGH 4

NO CHANGES.

5. MINIMUM ENERGY EFFICIENCY

Buildings shall be designed and constructed with no gas or fossil-fuel fired equipment and shall comply with the 2022 California BEES using the performance requirements Section 140.1. The *hourly source energy* of the proposed design shall be at least 10% less than the baseline building.³

6. RENEWABLE ENERGY

NO CHANGES EXCEPT THAT SECTION 6.3 SHALL READ AS FOLLOWS.

6.3 Self-Owned, Virtual Power Purchase Agreements and REIFS

Net electricity shall be procured by one of the methods described in Table 6.3. For the purposes of Section 6.3, *net electricity* shall be determined using California Energy Commission approved software.

Table 6.3 Self-Owned, Virtual Power Purchase Agreements and REIFS

<i>Procurement Method</i>	<i>Description</i>
Self-Owned Off-site	A renewable energy system that is installed on separate property from the building but under the same ownership or control.
Virtual Power Purchase Agreement	This option is available to large, credit-worthy building owners. The buyer guarantees a minimum price to the renewable energy developer for the electricity sold by a new solar or wind farm so that the renewable energy developer can establish financial feasibility and secure funding.
Renewable Energy Investment Fund (REIF)	A program by local government or other entity to buy 100% renewable energy on behalf of a group of customers who pay into or subscribe to the program.

³ The 10% improvement over code minimum may be modified by local jurisdictions



NOTES AND SUPPORTING INFORMATION

Adoption

The 2022 ZERO Code can be implemented as soon as the CEC has published the 2022 Building Energy Efficiency Standard.

Qualifying Off-Site Procurement Programs

The following programs qualify for 100% renewable energy under Section 6.2 of the ZERO Code. This determination is made based on a review of the 2018 power content labels published by the California Energy Commission. While these programs provide 100% renewable energy, they have not been verified to comply with all the requirements of Section 6.4.

Type	Organization	Program
CCA	CleanPowerSF	Super Green
CCA	East Bay Community Energy	Renewable 100
CCA	Lancaster Choice Energy	LCE Smart Choice
CCA	Marin Clean Energy	MCE Deep Green
CCA	Marin Clean Energy	MCE Local Solar
CCA	Monterey Bay Community Power	MBprime
CCA	Peninsula Clean Energy	ECO100
CCA	Silicon Valley Clean Energy	Green Prime
CCA	Sonoma Clean Power	SCP Evergreen
Direct Access	3 Phases	3PR 100 Renewables Product
IOU	PG&E	100% Solar Choice
IOU	SCE	SCE Green Rate 100% Option
IOU	SDG&E	EcoChoice
Muni	Anaheim	Green Power Program
Muni	Healdsburg	Green Rate
Muni	LADWP	2018 Green Power
Muni	Palo Alto	Palo Alto Green
Muni	Pasadena	PWP Green
Muni	SMUD	Greenery Partner Plus
Muni	SMUD	Greenery Partner
Muni	SMUD	SolarShares
Muni?	Pacific Power	Blue Sky
Muni?	Ranco Mirage Energy Authority	REMA Renewable Choice
Muni?	Redwood Coast Energy Authority	REpower+
Muni?	San Jacinto Power	SJP Pure Green
Muni?	Solana Beach	SEA Green
Muni?	Valley Clean Energy	Ultra Green

Programs are considered acceptable when 100% of electric generation is from renewable energy sources as defined in Section 6.4d. Other programs may qualify if the California Energy Commission publishes a power content label that shows that the program uses 100% renewable energy.



Biomass

The ZERO Code recognizes biomass generators as renewable energy if they qualify for credit under the California renewable portfolio standards and are listed as renewable energy on the mandatory Power Content Label published by the CEC. Most of the programs listed in the above table do not include biomass in the renewable energy generation mix, but a few do. Unlike wind, solar, geothermal and eligible hydro, biomass power plants require combustion and the CO₂ stack emissions from biomass power plants per MWh produced are extreme, even greater than natural gas or even coal. Other air pollutants are also significant. There are two cases for biomass (1) that the wood will grow back and as it does it will sequester the carbon that was released during combustion or (2) the counterfactual would result in significant carbon emissions as opposed to burning the biomass in a power plant. While limited use of biomass is credited as renewable energy, renewable energy programs that avoid biomass should be used when possible.

Zero Net Carbon and Hourly Source Energy

Hourly source energy is used as the metric for estimating *building electricity* and *on-site renewable electricity*, but for simplicity, all off-site renewable energy procurement is treated the same, regardless of the generating source. However, when off-site renewable energy procurement is assessed on an hourly basis, not all generating sources are the same because the time pattern of renewable energy production is different. Electricity production from solar occurs in the middle of the day when grid carbon emissions are low, while wind production actually has a slight lull in the middle of the day with peaks in the morning and early evening. As result a MWh of wind production has greater avoided hourly source energy and avoided carbon emissions than solar. Geothermal power plants provide baseload, a constant level of electricity 24x7. Hydro plants also tend to be operated as baseload plants, although they are capable of modulating to meet peak loads. While the 2022 ZERO Code treats all off-site renewable energy the same, a preference should be given to programs that are based on wind, geothermal or eligible hydro since they are more effective in avoiding carbon emissions.

Possible Simplification

When community solar, green pricing and/or utility renewable energy contracts are available, local governments may choose to delete Section 6.3 and require all projects to use a method from Table 6.2. Section 6.3 is provided so that the ZERO Code can be implemented in where the programs described in Table 6.2 are unavailable. Subsequent sections would be renumbered if 6.3 is deleted.

Beyond-Code Energy Efficiency

The 10% target is a place-holder and can be modified by an adopting jurisdiction as suitable for their situation.