2022 CODE BREAKER

Solving the Energy Code Puzzle One Piece at a Time

Multifamily All Electric & Zero Net Carbon Design

Participant Handout

June 2023

Energy Code Ace™

SDGE™

Southern California Edison®
Energy for What's Ahead®

Pacific Gas and Electric Company®

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ABOUT THE STATEWIDE CODES AND STANDARDS PROGRAM

The Statewide Codes and Standards Program (C&S Program) is jointly managed by PG&E, SDG&E, and SCE. The C&S Program saves energy on behalf of ratepayers by directly influencing standards and code-setting bodies to strengthen energy efficiency regulations, by improving compliance with existing codes and standards, and working with local governments to develop ordinances that exceed statewide minimum requirements.

This class is one of many free courses, tools, and resources that the C&S Program offers. Please visit http://energycodeace.com/ or contact info@energycodeace.com to find out more about all program offerings.

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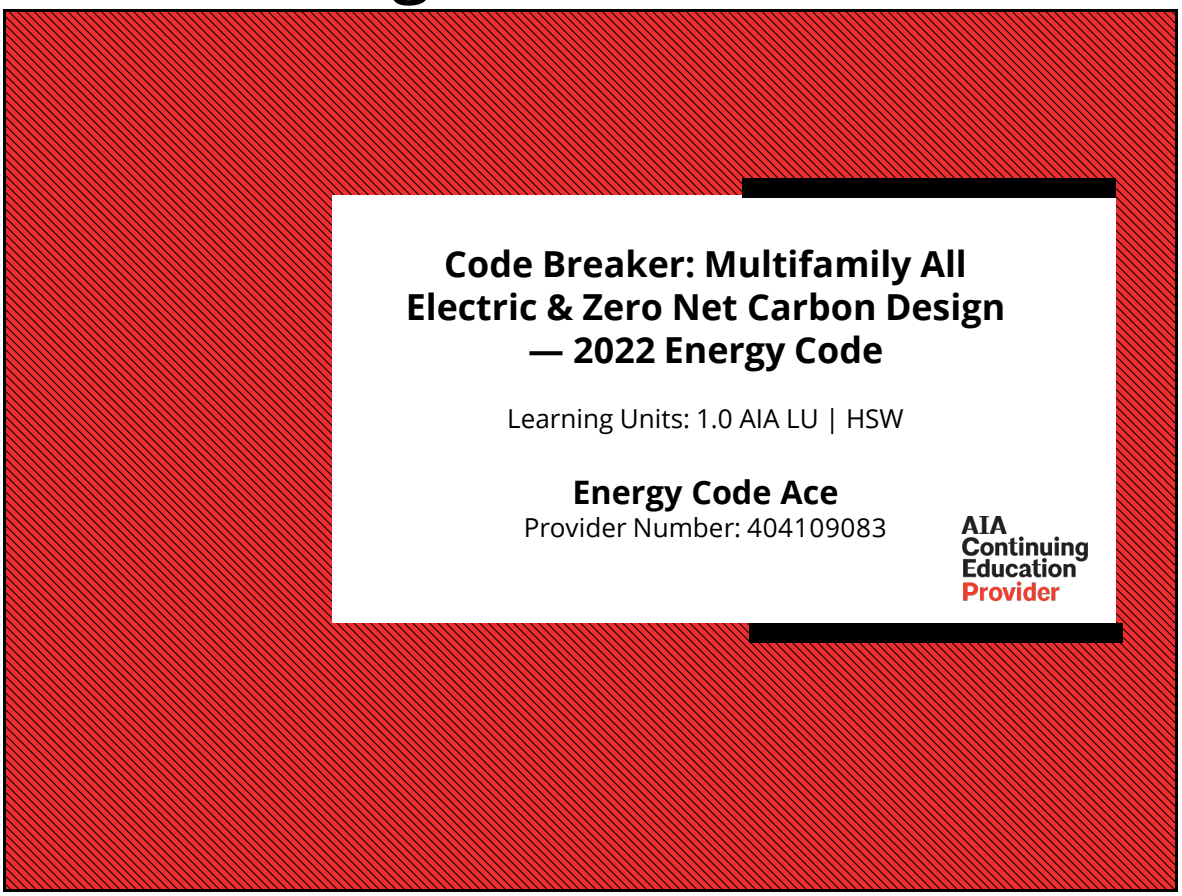
AIA Continuing Education



Course Description

The 2022 Energy Code has introduced significant changes for multifamily occupancies, from how these occupancies are to be classified and organized within the code to the introduction of new Mandatory and Prescriptive measures facilitating preparation for future multifamily all-electric buildings and zero net carbon design (ZNCD). Join us for this one-hour presentation where we review the all-electric preparation requirements of the Energy Code, associated solar photovoltaic (PV) exemptions, requirements for heat pump space heating and domestic hot water, and battery-ready electrical panel configuration, as well as how all-electric homes relate to ZNCD.

Course Objectives

- Describe how Residential occupancy classifications have been reorganized in 2022 Energy Code.
- Discuss updates to the 2022 Energy Code that set the stage for future all electric multifamily buildings, including Mandatory requirements and Prescriptive requirements involving heat pump space heating and domestic hot water.
- Recognize when solar photovoltaic and battery systems are required in multifamily buildings.
- Explain how "all electric" is a necessary, but not necessarily sufficient, requirement for achieving zero net carbon design, or ZNCD.
- Given examples of alternative design options for a multifamily building, identify which, if any, of the options achieve ZNCD.
- Identify online resources for more guidance on these topics.

AIA Continuing Education Provider

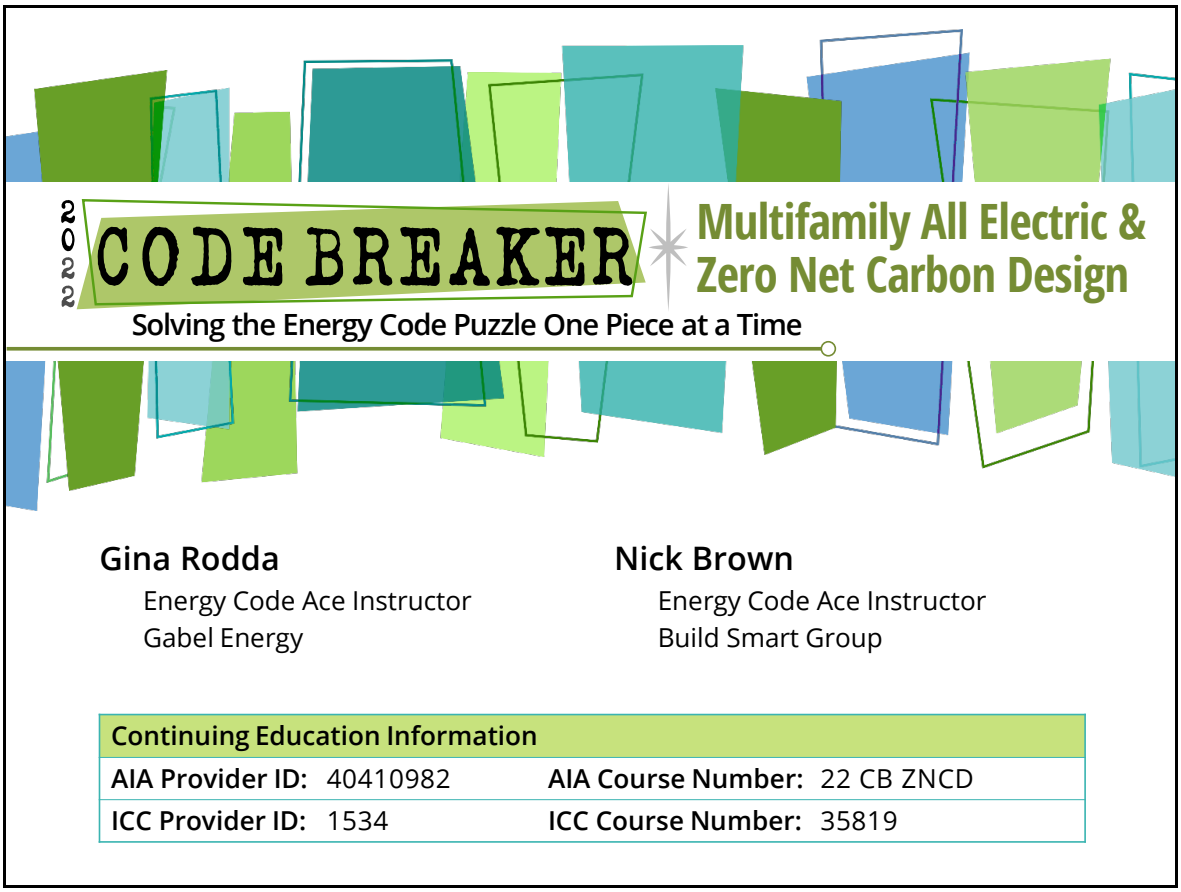
Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

This course is registered with AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

AIA Continuing Education Provider

Welcome


2022
CODE BREAKER
Multifamily All Electric & Zero Net Carbon Design
Solving the Energy Code Puzzle One Piece at a Time
Gina Rodda
Energy Code Ace Instructor
Gabel Energy
Nick Brown
Energy Code Ace Instructor
Build Smart Group
Continuing Education Information
AIA Provider ID: 40410982
AIA Course Number: 22 CB ZNCD
ICC Provider ID: 1534
ICC Course Number: 35819

Ace Training™

Training Objectives:

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EnergyCodeAce™ Comply With Me

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Your one-stop shop for no-cost tools, training and resources to help you comply with California's Title 24, Part 6 building energy code and Title 20 appliance standards.

We're powered by the California Statewide Codes & Standards Program and vetted by the California Energy Commission.

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A suite of interactive tools to help you understand the compliance process, required forms, installation techniques and energy efficiency regulations applicable to building projects and appliances in California

Our Tools include:

- Energy Code Product Finder
- Forms Ace
- Image Ace
- Navigator Ace
- Nonres. Indoor Lighting Wheel
- Q&Ace
- Reference Ace
- Timeline Ace
- Virtual Compliance Assistant

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- Checklists
- Fact Sheets
- Submit a Question
- Trigger Sheets
- Useful Links

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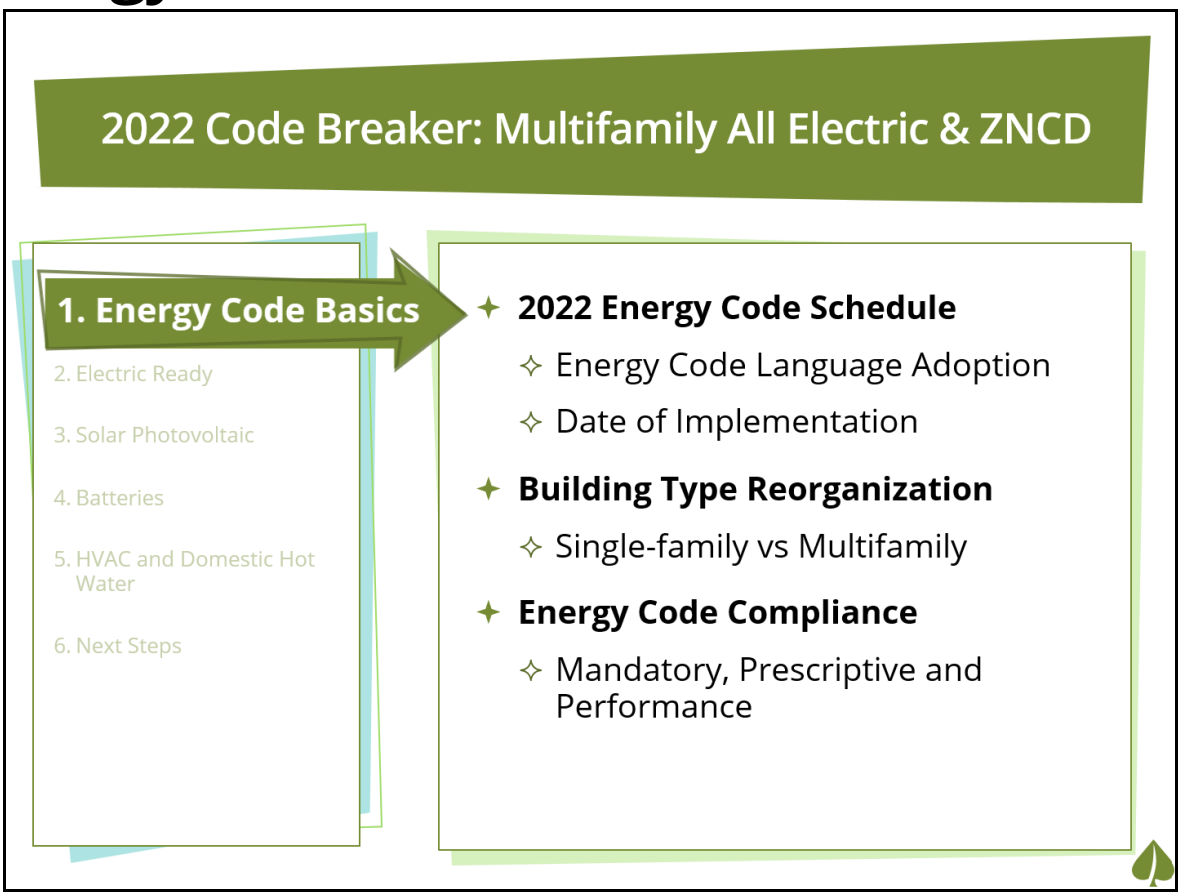
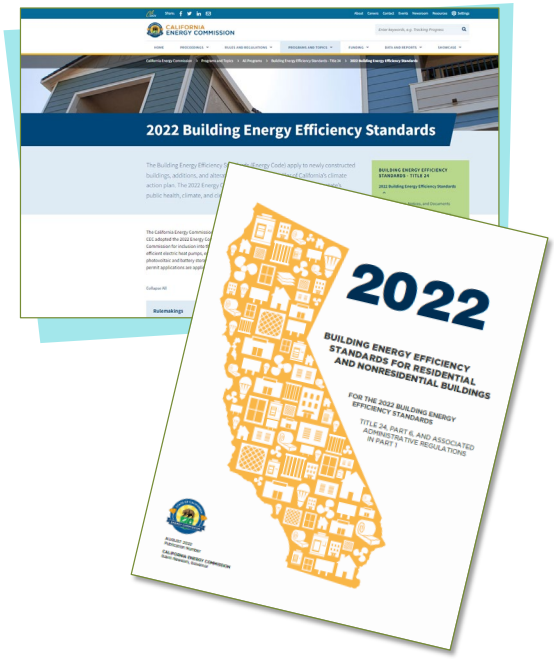
Energy Code Basics



2022 Energy Code



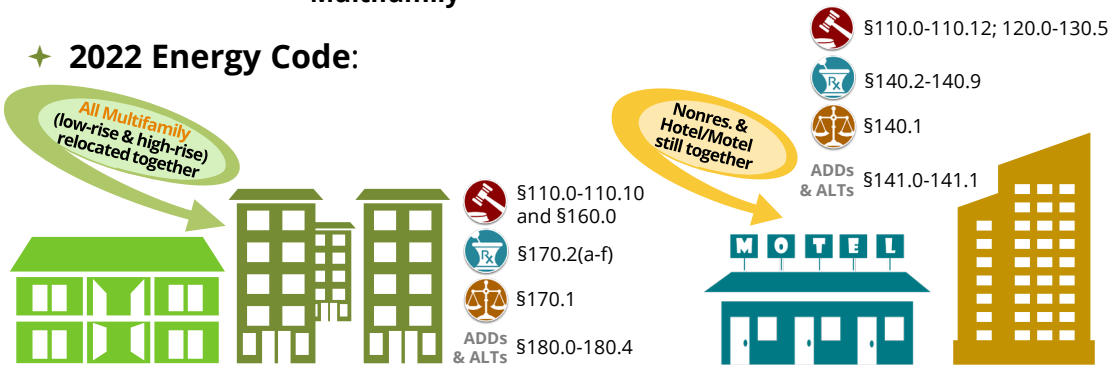
- **Implementation Date**
  - **January 1, 2023**
  - Any projects that apply for a permit on or after this date will be subject to the 2022 Energy Code requirements
- Information and documents available on the CA Energy Commission website at:
  - https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency

Building Type Reorganization

- **2019 Energy Code**:

Hotel/Motel | **High-rise Multifamily** | **Nonresidential**

- **2022 Energy Code**:



Multifamily Buildings
§160.0-180.4

Hotel/Motel & Nonresidential Buildings
§120.0-141.1

Course Conventions

Mandatory	Prescriptive	Performance
✦ Always required regardless of compliance approach used	✦ Required when using the Prescriptive compliance approach	✦ Optional feature accounted for when doing Performance-based computer modeling

Evolving Building Energy Efficiency Ratings

For Multifamily Construction

Energy Code	New Construction	Additions	Alterations
2019	TDV Energy	TDV Energy	TDV Energy

Time Dependent Valuation (TDV):
"TDV Energy" is the time varying energy used by the building to provide space conditioning, water heating and specified building lighting. It accounts for the energy used at the building site and consumed in producing and delivering energy to a site, including, but not limited to, power generation, transmission and distribution losses.

Evolving Building Energy Efficiency Ratings

For Multifamily Construction

Energy Code	New Construction	Additions	Alterations
2019	TDV Energy	TDV Energy	TDV Energy
2022	**TDV**e, **TDV**t, **Source**t	TDV Energy	TDV Energy

e = "efficiency" TDV metric

Enables measure of emissions in some form

t = "total" TDV metric (also factors in PV and flexibility)

Time Dependent Valuation (TDV):
"TDV Energy" is the time varying energy used by the building to provide space conditioning, water heating and specified building lighting. It accounts for the energy used at the building site and consumed in producing and delivering energy to a site, including, but not limited to, power generation, transmission and distribution losses.

Source Total Metric (Sourcet**):**
A separate metric based on "hourly source energy," which establishes a "carbon-proxy" analysis of the building in kBTU/sf-yr units to support decarbonization and electrification policy goals.

Performance Compliance Metrics (2022)

Source Total

a score representing the building energy efficiency expressed in terms of an hourly source carbon based metric

Includes energy used by:
- Envelope
- IAQ
- HVAC
- DHW
- Unregulated loads

TDV Efficiency

a score representing the building energy efficiency expressed in terms of TDV energy based metric

Includes energy used by:
- Envelope
- IAQ
- HVAC
- DHW
- Unregulated loads

TDV Total

a score representing the building's Total TDV while also factoring in PV + Flexibility

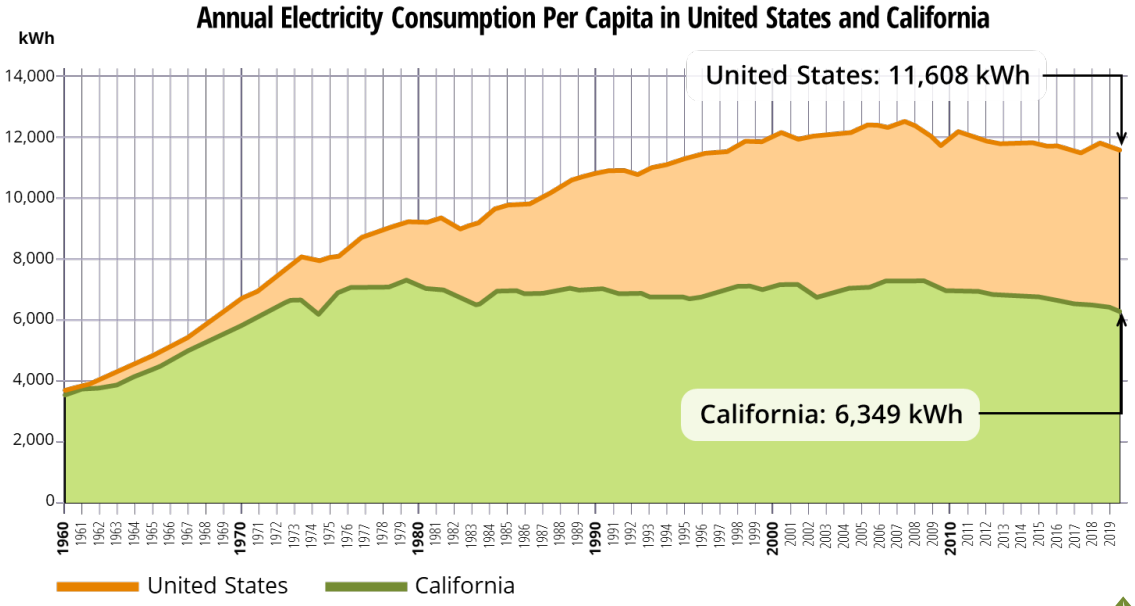
Includes energy used by:
- Efficiency measures
- Photovoltaics
- Batteries
- Precooling

A building complies ONLY if **all three** compliance scores are met
(**each** Proposed Design score is **lower or equal** to Standard Design score)

Californians Use a Lot Less Energy than the National Average

Compared to the average American, Californians use about:

- 46% less electricity
- 31% less energy overall



Source: 2022 BUILDING ENERGY EFFICIENCY STANDARDS SUMMARY; California Energy Commission (CEC); August 2021
https://www.energy.ca.gov/sites/default/files/2021-08/CEC_2022_EnergyCodeUpdateSummary_ADA.pdf

Check Your Understanding #1

Check Your Understanding #1

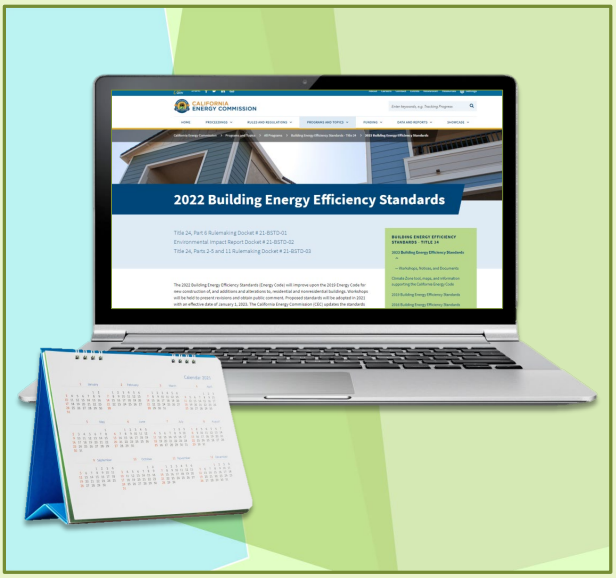
What do you think?

On what date did enforcement of the new Energy Code begin?

a) January 1, 2022

b) January 1, 2023

c) Immediately after the California Energy Commission officially adopted the language



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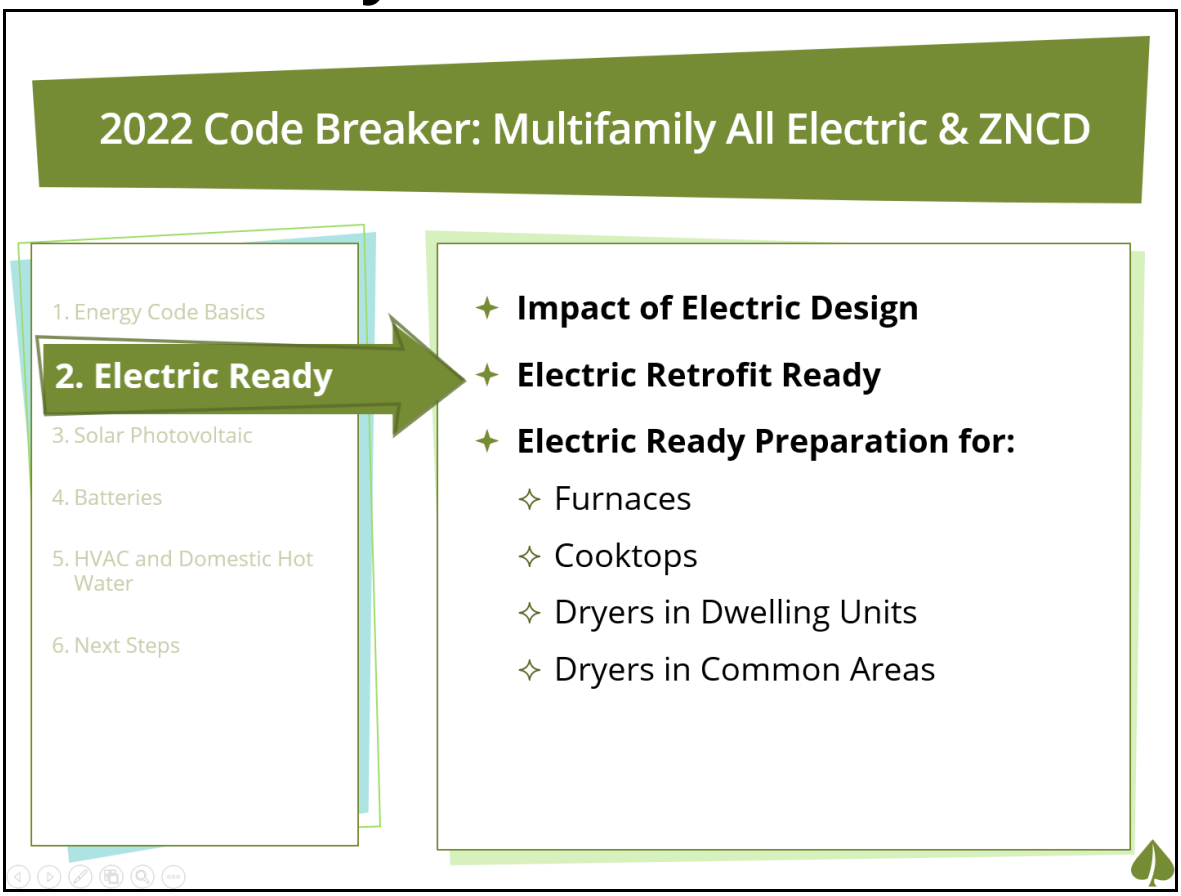
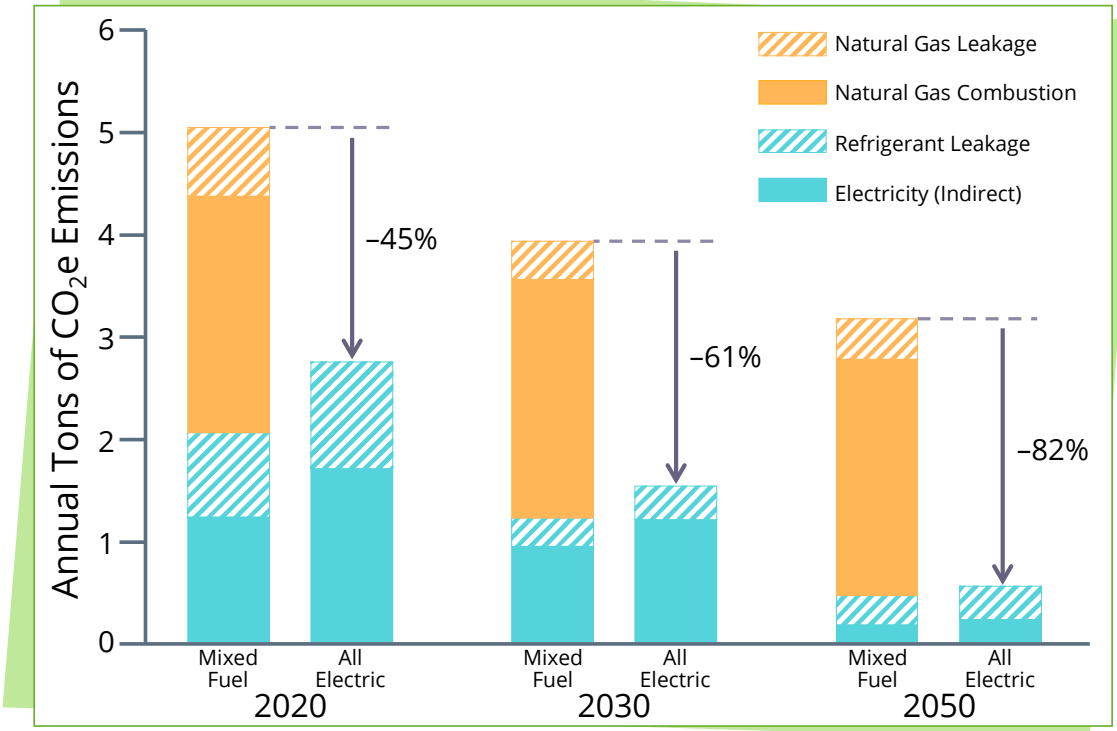
Electric Ready



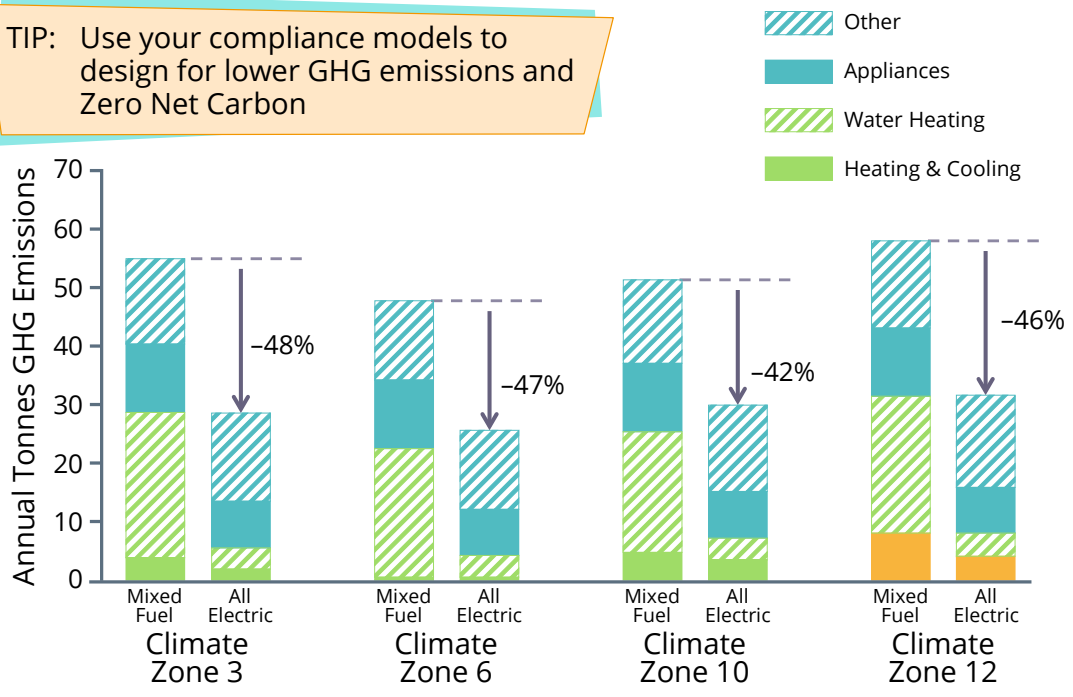
Electric Homes Have 45% Lower GHG Emissions



Source: Energy & Environmental Economics Inc., "Residential Building Electrification in California," Key Findings: Greenhouse Gas Savings, 2019. Available: https://www.ethree.com/wp-content/uploads/2019/04/E3_Residential_Building_Electrification_in_California_April_2019.pdf [accessed January 6, 2023].

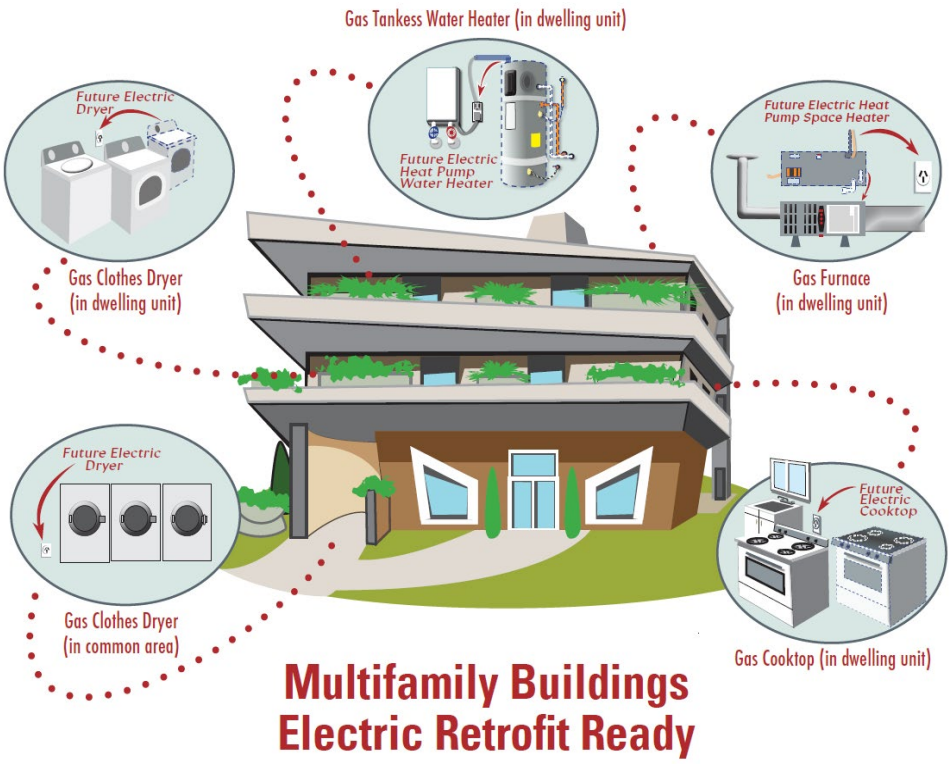
All-Electric Designs Reduce GHG Emissions ~47%

TIP: Use your compliance models to design for lower GHG emissions and Zero Net Carbon



Source: CBECC 2022 modeling results: New construction 36-unit 3-story multifamily building with standard efficiency gas furnace or heat pump, central gas boiler with solar thermal or central ganged HPWHs, central gas or electric laundry, gas or electric appliances, and code-required PV systems.

Electric Retrofit Ready



Furnaces

Mandatory Measures for New Construction §160.9(a)

If your design includes a furnace (central or wall style)

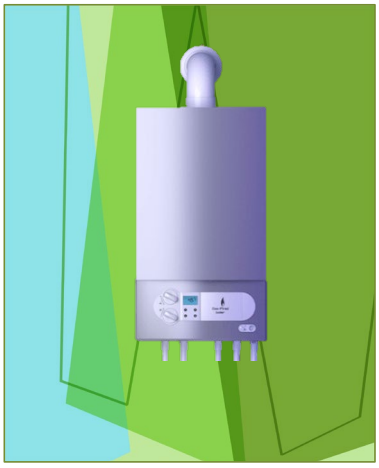
- **Power Requirements**
  - Provide a dedicated **240 volt branch circuit** wiring **within 3 feet** from the furnace and accessible to the furnace with **no obstructions**
  - The branch circuit conductors shall be rated at **30 amps** minimum
    - The blank cover shall be identified as *"240V ready"*
    - All electrical components shall be installed in accordance with the California Electrical Code
  - The main electrical service panel shall have a reserved space to allow for the installation of a **double pole** circuit breaker for a future heat pump space heater installation
    - The reserved space shall be permanently marked as *"For Future 240V use"*

There are no space heating electric ready requirements for Multifamily Common Areas nor additions & alterations

Water Heaters

Mandatory Measures §160.4(a)

If your design includes a gas water heater in each dwelling unit (does not apply to central systems)



- **Power Requirements**
  - A dedicated **125 volt, 20 amp electrical receptacle** that is connected to the electric panel with a **120/240 volt 3 conductor**, 10 AWG copper branch circuit, within 3 feet from the water heater and accessible to the water heater with no obstructions
  - Both ends of the unused conductor shall be labeled with the word *"spare"* and be electrically isolated; and
  - A reserved **single pole** circuit breaker space in the electrical panel adjacent to the circuit breaker for the branch circuit in A above and labeled with the words *"Future 240V Use"*
- **Condensate Drain**
  - The drain must be no more than 2 inches higher than the base of the installed water heater
  - The drain must drain without pump assistance

There are no water heating electric ready requirements for Multifamily Common Areas nor additions & alterations

Cooktops

Mandatory Measures for New Construction §160.9(b)

If your design includes a gas or propane cooktop

- **Power Requirements**
  - Provide a dedicated **240 volt** branch circuit wiring that shall be installed **within 3 feet** from the cooktop and accessible to the cooktop with **no obstructions**
  - The branch circuit conductors shall be rated at **50 amps** minimum
    - The blank cover shall be identified as *"240V ready"*
    - All electrical components shall be installed in accordance with the California Electrical Code
  - The main electrical service panel shall have a reserved space to allow for the installation of a **double pole** circuit breaker for a future electric cooktop installation
    - The reserved space shall be permanently [illegible] *"For Future 240V use"*

There are no cooktop electric ready requirements for Multifamily Common Areas nor additions & alterations

Dryers in Dwelling Units

§160.9(c)1

Mandatory Measures for New Construction

If any dwelling unit dryer location is plumbed with gas or propane

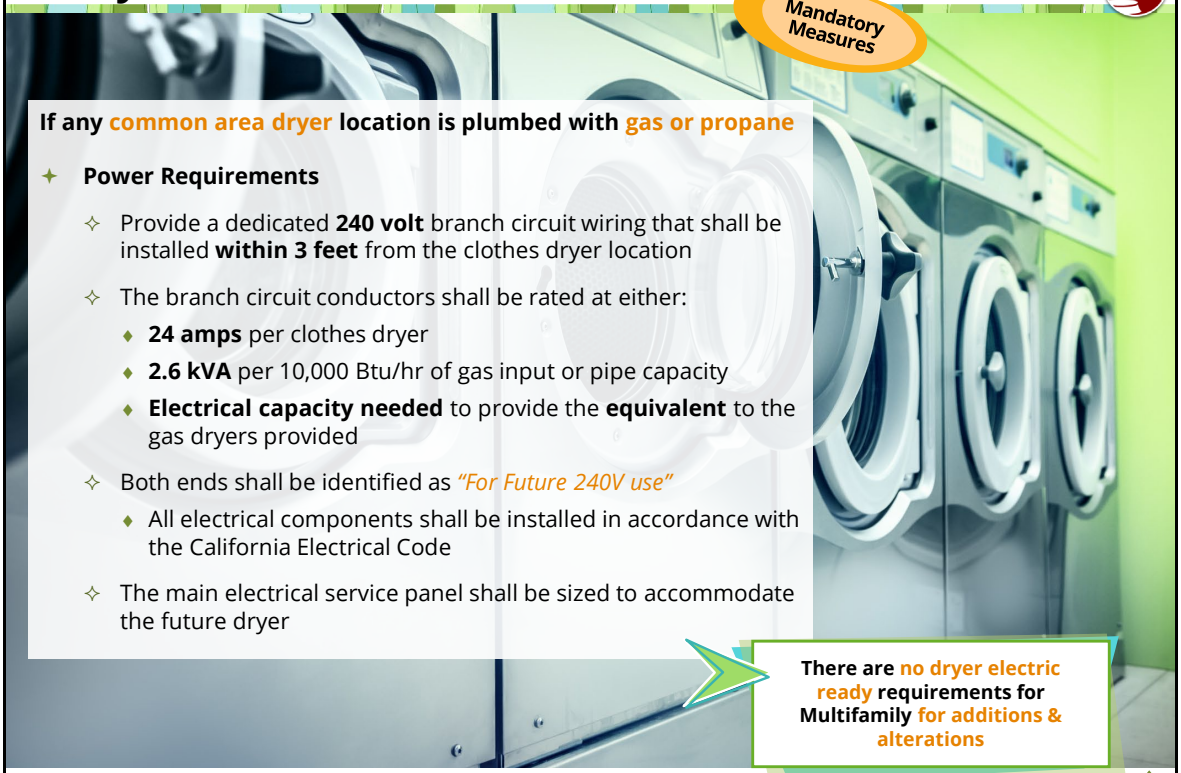
- **Power Requirements**
  - Provide a dedicated **240 volt** branch circuit wiring that shall be installed **within 3 feet** from the clothes dryer location and accessible to the clothes dryer location with **no obstructions**
  - The branch circuit conductors shall be rated at **30 amps** minimum
    - The blank cover shall be identified as *"240V ready"*
    - All electrical components shall be installed in accordance with the California Electrical Code
  - The main electrical service panel shall have a reserved space to allow for the installation of a **double pole** circuit breaker for a future electric clothes dryer installation
    - The reserved space shall be permanently marked as *"For Future 240V use"*

There are no dryer electric ready requirements for Multifamily for additions & alterations

Dryers in Common Areas

§160.9(c)2

Mandatory Measures



If any common area dryer location is plumbed with gas or propane

- **Power Requirements**
  - Provide a dedicated **240 volt** branch circuit wiring that shall be installed **within 3 feet** from the clothes dryer location
  - The branch circuit conductors shall be rated at either:
    - **24 amps** per clothes dryer
    - **2.6 kVA** per 10,000 Btu/hr of gas input or pipe capacity
    - **Electrical capacity needed** to provide the **equivalent** to the gas dryers provided
  - Both ends shall be identified as *"For Future 240V use"*
    - All electrical components shall be installed in accordance with the California Electrical Code
  - The main electrical service panel shall be sized to accommodate the future dryer

There are no dryer electric ready requirements for Multifamily for additions & alterations

Check Your Understanding #2

Check Your Understanding #2

What do you think?

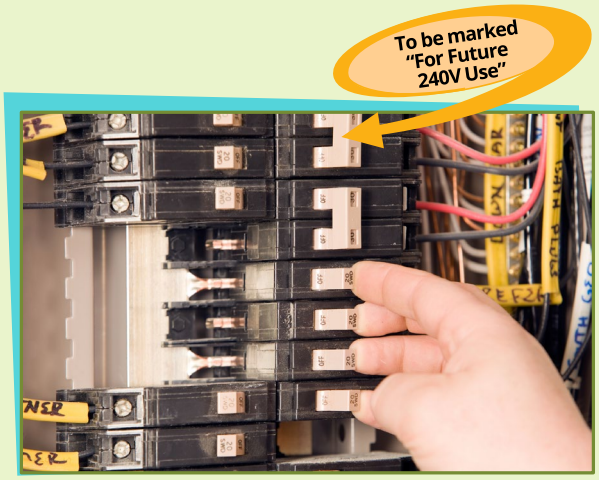
Which of the following will require a reserved double pole circuit breaker in the main electrical panel to allow for a future electric installation?

a) Furnace

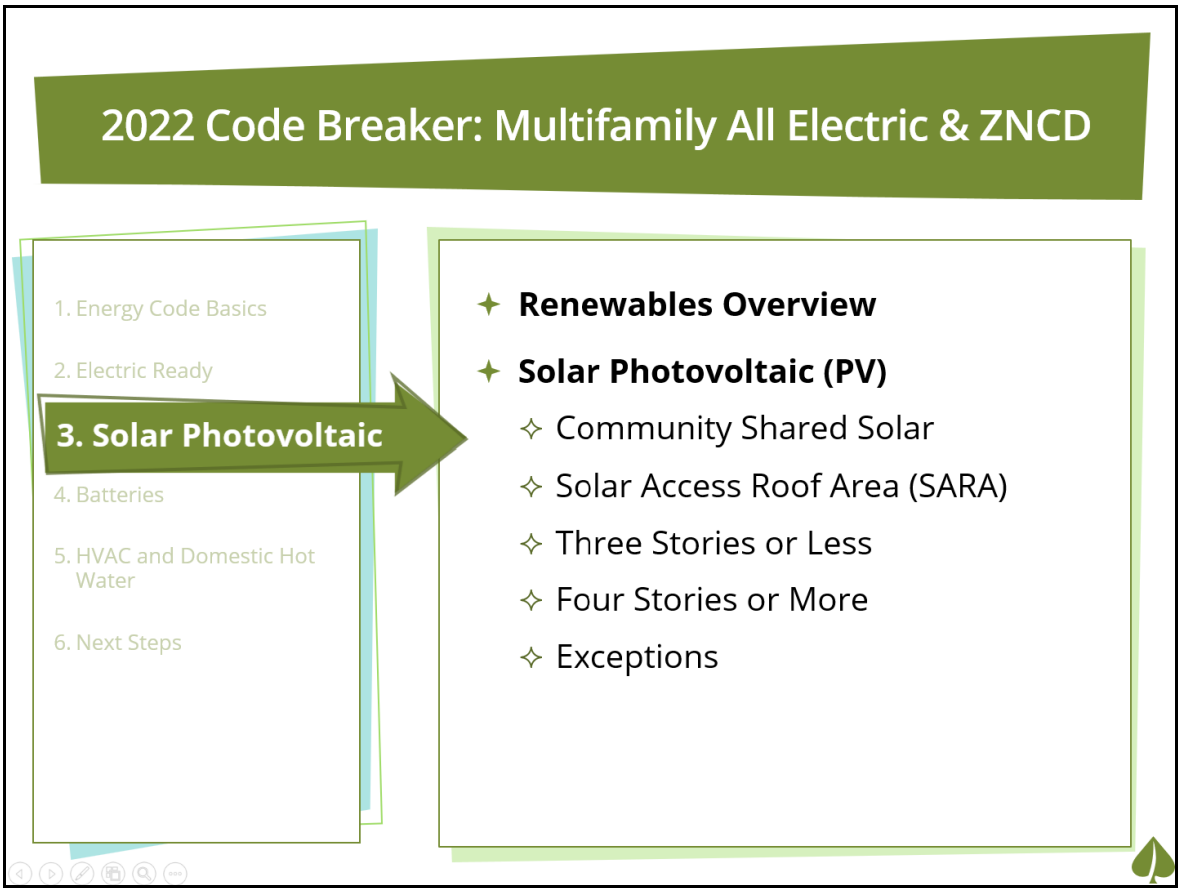
b) Cooktop

c) Dryer (in Dwelling Unit)

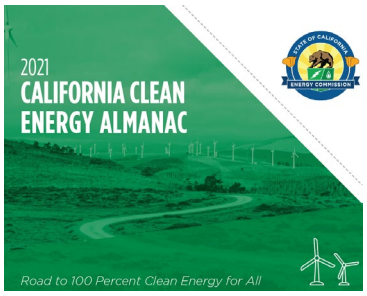
d) All of the above



Solar Photovoltaic (PV)



Why Energy Code Requires Renewables



Source: https://www.energy.ca.gov/data-reports/energy-almanac

- California legislature has committed us to:
  - 40% reduced GHG emissions by 2030
  - 40% reduced GHG emissions in buildings by 2030
- Onsite renewable energy production reduces greenhouse gas emissions and provides for Zero Net Carbon buildings.
- Onsite PV on rooftops has advantages over utility scale PV (less distribution losses, improved resiliency when paired with batteries)
- Solar plus storage has Grid harmony benefits

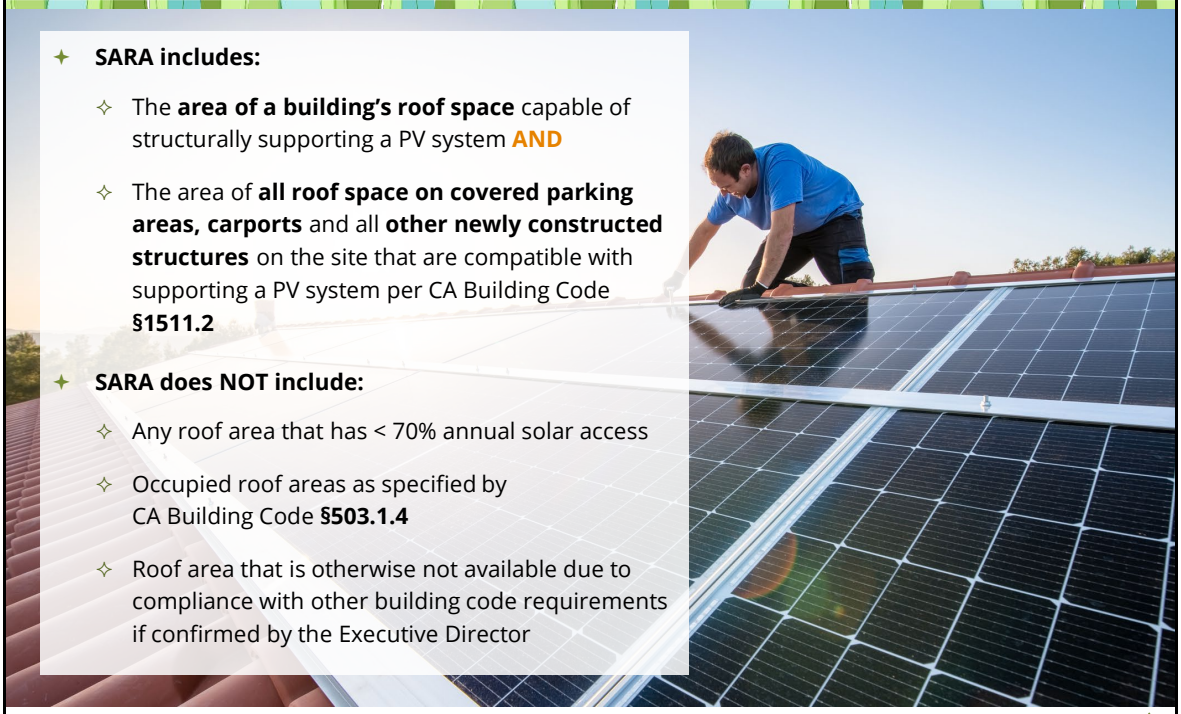
Community Shared Solar or Battery Systems

§10-115

- **Allows a common shared system to offset solar and/or battery requirements**
  - Must be **operational before final permit** signed off on building
  - Must provide **equivalent or better performance** than what is specified for building
  - Must provide benefit to the building for **20 years minimum**
  - **Cannot transfer** benefit to another building
  - Located on a **distribution system** of the participating buildings
  - No larger than **20 MW**

Solar Access Roof Area (SARA)

§170.2(f)



- **SARA includes:**
  - The **area of a building's roof space** capable of structurally supporting a PV system **AND**
  - The area of **all roof space on covered parking areas, carports** and all **other newly constructed structures** on the site that are compatible with supporting a PV system per CA Building Code **§1511.2**
- **SARA does NOT include:**
  - Any roof area that has < 70% annual solar access
  - Occupied roof areas as specified by CA Building Code **§503.1.4**
  - Roof area that is otherwise not available due to compliance with other building code requirements if confirmed by the Executive Director

SARA: Calculating Annual Solar Access

§170.2(f),(g)

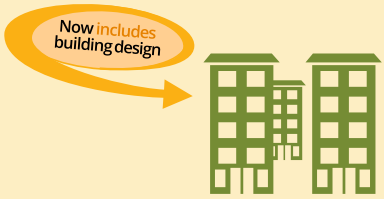
Which obstructions shall be considered for annual solar access calculations?

3 Stories or Less

- **Steep-slope Roofs:**
  - Only shading from **existing permanent** obstructions **external** to the dwelling
    - Natural or manmade
    - Includes trees, hills, adjacent structures
- **Low-slope Roofs:**
  - **All obstructions** that are part of the building design and elevation features

4 Stories or More

- **All Roofs (Low- and Steep-slope):**
  - **All obstructions** that are part of the building design and elevation features



2022 Title 24, Part 6 Essentials — Power Slide

PV System Size – 3 Stories or Less

§170.2(f)

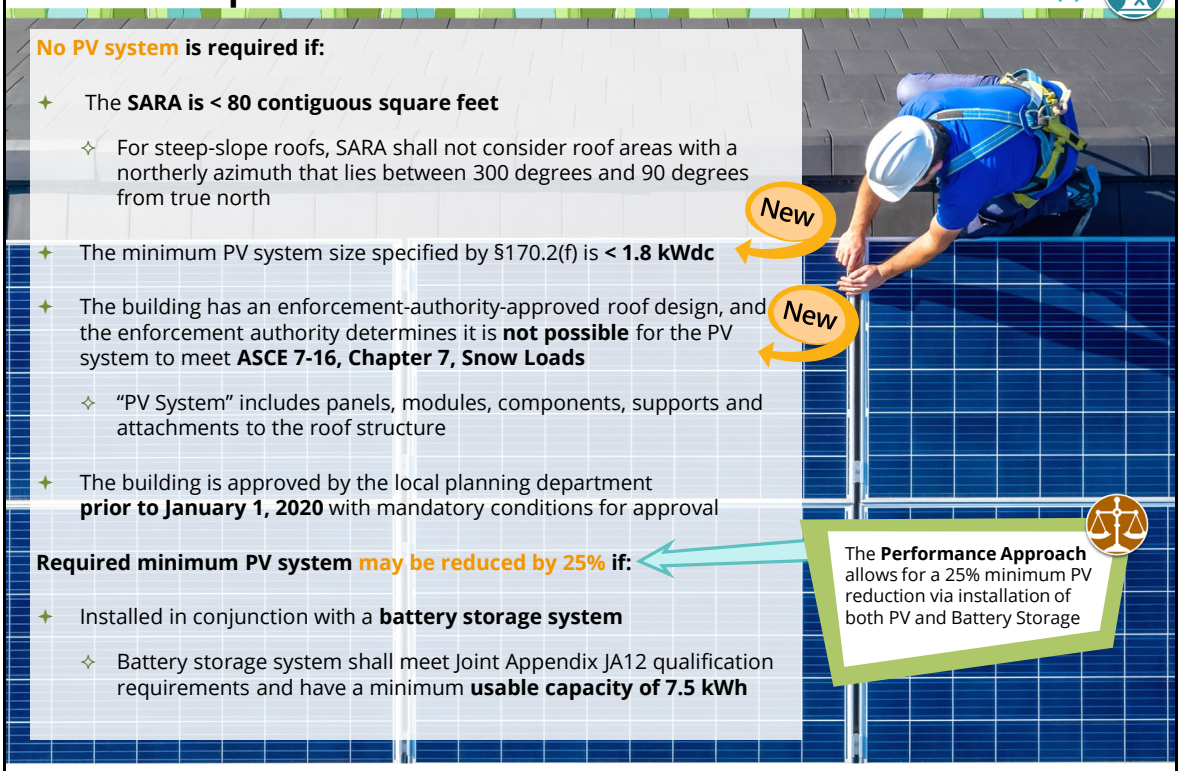
Table 170.2-T: *CFA and Dwelling Unit Adjustment Factors*

Climate Zone	A – CFA	B – Dwelling Units
1	0.793	1.27
2	0.621	1.22
3	0.628	1.12
4	0.586	1.21
5	0.585	1.06
6	0.594	1.23
7	0.572	1.15
8	0.586	1.37
9	0.613	1.36
10	0.627	1.41
11	0.836	1.44
12	0.613	1.40
13	0.894	1.51
14	0.741	1.26
15	1.56	1.47
16	0.59	1.22

- **Prescriptive requirement** is expressed as a kW (DC Rating)
- **DC Rating = (CFA x A) / 1000 + (N_{DU} x B)**
  - **CFA** = Conditioned floor area
  - **N_{DU}** = Number of dwelling units
  - **A** = CFA adjustment factor from Table 170.2-T
  - **B** = Dwelling unit adjustment factor from Table 170.2-T
- **Exceptions** (listed on next slide):
  - PV exceptions based on number of stories is now removed

PV Exceptions – 3 Stories or Less

§170.2(f)



No PV system is required if:

- The **SARA is < 80 contiguous square feet**
  - For steep-slope roofs, SARA shall not consider roof areas with a northerly azimuth that lies between 300 degrees and 90 degrees from true north
- The minimum PV system size specified by §170.2(f) is **< 1.8 kWdc** (New)
- The building has an enforcement-authority-approved roof design, and the enforcement authority determines it is **not possible** for the PV system to meet **ASCE 7-16, Chapter 7, Snow Loads** (New)
  - "PV System" includes panels, modules, components, supports and attachments to the roof structure
- The building is approved by the local planning department **prior to January 1, 2020** with mandatory conditions for approval

Required minimum PV system may be reduced by 25% if:

- Installed in conjunction with a **battery storage system**
  - Battery storage system shall meet Joint Appendix JA12 qualification requirements and have a minimum **usable capacity of 7.5 kWh**

The **Performance Approach** allows for a 25% minimum PV reduction via installation of both PV and Battery Storage

PV System Size – 4 Stories or More

§170.2(g)

- **Two methods** for calculating **Prescriptive** PV system size – use whichever is **smaller**
  - **DC Rating = (CFA x A) / 1000 OR** the **total SARA x 14 W/ft²**
    - **CFA** = Conditioned floor area in square feet
    - **A** = PV capacity factor specified in **Table 170.2-U** for the building type and climate zone
  - **Applies to:**
    - All **New Construction** building types specified in **Table 170.2-U**, **OR**
    - **Mixed occupancy** buildings where one or more of these building types constitute **at least 80%** of the floor area of the building

Table 170.2-U: *PV Capacity Factors*

Building Type	Factor A – Minimum PV Capacity (W/ft² of CFA) Climate Zones 1, 3, 5, 16	Factor A – Minimum PV Capacity (W/ft² of CFA) Climate Zones 2, 4, 6-14	Factor A – Minimum PV Capacity (W/ft² of CFA) Climate Zone 15
Grocery	2.62	2.91	3.53
High-rise Multifamily	1.82	2.21	2.77
Office, Financial Institutions, Unleased Tenant Space	2.59	3.13	3.80
Retail	2.62	2.91	3.53
School	1.27	1.63	2.46
Warehouse	0.39	0.44	0.58
Auditorium, Convention Center, Hotel/Motel, Library, Medical Office Building/Clinic, Restaurant, Theater	0.39	0.44	0.58

An Example: Method 1

§170.2(g)

- **For a Multifamily Building:**
  - 4 Stories in Climate Zone 3
  - CFA of **100,000 ft²**
  - SARA of **25,000 ft²**
  - Minimum PV Capacity of **1.82**
    *(**Factor A** per table below)*

- **Method 1:** Use DC Rating Formula
  - **DC Rating = (CFA x A) / 1000**
  - **DC Rating = (100,000 ft² x 1.82 W/ft²) / 1000**
  - **DC Rating = 182 kW**

Method 1 Answer

Table 170.2-U: *PV Capacity Factors*

Building Type	Factor A – Minimum PV Capacity (W/ft² of CFA) Climate Zones 1, 3, 5, 16	Factor A – Minimum PV Capacity (W/ft² of CFA) Climate Zones 2, 4, 6-14	Factor A – Minimum PV Capacity (W/ft² of CFA) Climate Zone 15
Grocery	2.62	2.91	3.53
High-rise Multifamily	**1.82**	2.21	2.77
Office, Financial Institutions, Unleased Tenant Space	2.59	3.13	3.80
Retail	2.62	2.91	3.53
School	1.27	1.63	2.46
Warehouse	0.39	0.44	0.58
Auditorium, Convention Center, Hotel/Motel, Library, Medical Office Building/Clinic, Restaurant, Theater	0.39	0.44	0.58

An Example: Method 1 vs. Method 2

§170.2(g)

- **For a Multifamily Building:**
  - 4 Stories in Climate Zone 3
  - CFA of **100,000 ft²**
  - SARA of **25,000 ft²**
  - Minimum PV Capacity of **1.82**

- **Method 1:** Use DC Rating Formula
  - **DC Rating = (CFA x A) / 1000**
  - **DC Rating = (100,000 ft² x 1.82 W/ft²) / 1000**
  - **DC Rating = 182 kW**

Method 1 Answer

- **Method 2:** SARA Method
  - **DC Rating = Total SARA x 14 W/ft²**
  - **DC Rating = 25,000 ft² x 14 W/ft²**
  - **DC Rating = 350,000 W**
  - **DC Rating = 350 kW**

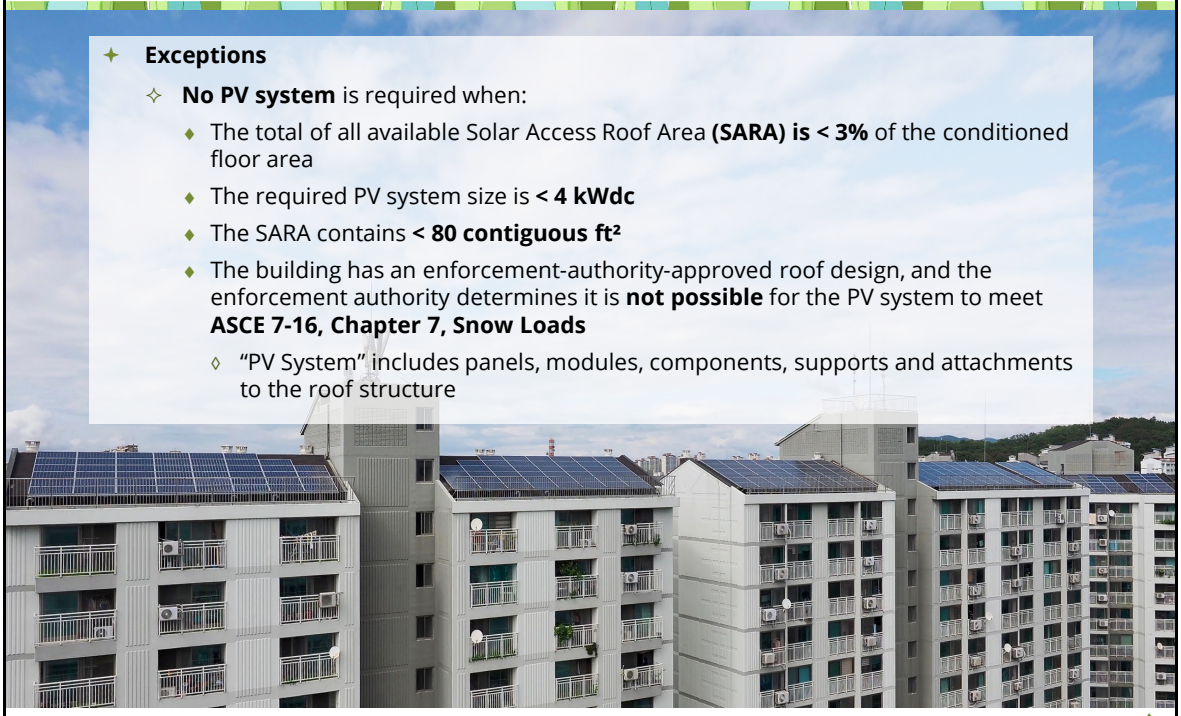
Method 2 Answer

Then pick the smaller value

182 kW (Method 1)

PV Exceptions – 4 Stories or More

§170.2(g)



- **Exceptions**
  - **No PV system** is required when:
    - The total of all available Solar Access Roof Area **(SARA) is < 3%** of the conditioned floor area
    - The required PV system size is **< 4 kWdc**
    - The SARA contains **< 80 contiguous ft²**
    - The building has an enforcement-authority-approved roof design, and the enforcement authority determines it is **not possible** for the PV system to meet **ASCE 7-16, Chapter 7, Snow Loads**
      - "PV System" includes panels, modules, components, supports and attachments to the roof structure

Check Your Understanding #3

Check Your Understanding #3

What do you think?

For which types of buildings is solar photovoltaic Prescriptively required in New Construction?

a) Multifamily (3 stories or less)

b) Multifamily (4 stories or more)

c) All of the above

Check Your Understanding #4

Check Your Understanding #4

What do you think?

The compliance modeling software can be used to design for lower Carbon emissions and Zero Net Carbon.

If you were building a new 3-story 36-unit multifamily building in CZ12 and had modeled Carbon emissions of 57.9 mt/yr for a typical mixed fuel design, what upgrades would you choose from the list as part of a Zero Net Carbon package?

a) Add a battery

b) All of these features

c) Add PV panels

Feature	Upgrade	Carbon Emissions Savings (mt/yr)
HVAC	Ducted code minimum heat pumps	3.7
Water Heating	Central Heat Pump Water Heaters ganged	19.7
Battery	72 kWh in Time of Use (TOU) control mode	5.1
PV panels	Additional 12 kW (~34 panels)	0.8

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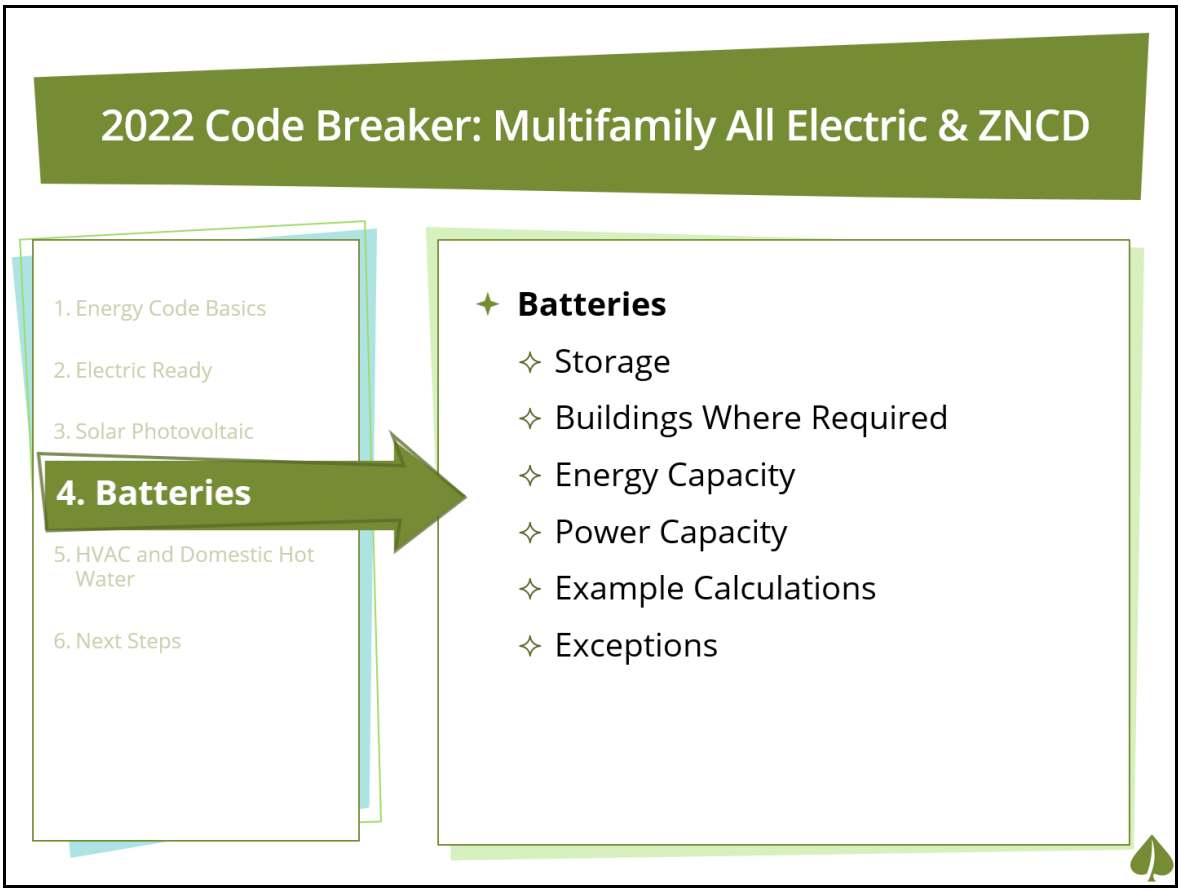
Batteries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1. Energy Code Basics
2. Electric Ready
3. Solar Photovoltaic
4. Batteries
5. HVAC and Domestic Hot Water
6. Next Steps
Batteries
Storage
Buildings Where Required
Energy Capacity
Power Capacity
Example Calculations
Exceptions

Battery Storage

- Batteries store renewable energy produced by onsite PV to promote 'self-consumption' of renewable energy onsite later in the day during peak grid periods.
  - Buildings with PV and battery have lower GHG emissions than buildings with PV alone
- Additional demand response controls on battery system can be used to respond to critical peak periods on the grid by exporting electricity back to the grid.

This is called 'grid harmonization.'

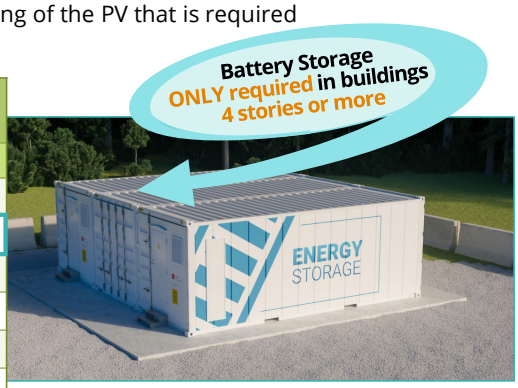
Buildings Where Battery Storage is Required

§170.2(h)

- **All buildings 4 stories or more** required by §170.2(g) to have a **PV system shall also have** a **battery storage system** meeting the minimum qualification requirements of Reference Joint Appendix JA12
  - The **rated energy capacity** and **rated power capacity** shall be **not less than** the values determined by **Equation 170.2-E** and **Equation 170.2-F** (shown on next set of slides)
  - If the building includes **more than one of the space types** listed below:
    - The total battery system capacity for the building shall be determined by applying Equations 170.2-E and 170.2-F to **each** of the listed space types and **summing the capacities** determined for each space type and equation
- Battery values are based upon a **ratio** of the kW rating of the PV that is required

Table 170.2-V: *Battery Storage Capacity Factors*

Building Type	Storage-to-PV Ratio
Grocery	
High-rise Multifamily	
Office, Financial Institutions, Unleased Tenant Space	
Retail	
School	
Warehouse	
Auditorium, Convention Center, Hotel/Motel, Library, Medical Office Building/Clinic, Restaurant, Theater	



Battery Energy Capacity Formula

§170.2(h)

- **Minimum rated energy capacity (Equation 170.2-E)**
  - **kWh = kW_{PVdc} x B / $D^{0.5}$**
    - **kWh** = Rated Useable Energy Capacity of the battery storage system in kWh
    - **kW_{PVdc}** = PV system capacity required by Section 170.2(g) in kWdc
    - **B** = Battery **energy capacity factor** specified in **Table 170.2-V** for the building type
    - **D** = Rated single charge-discharge cycle AC to AC (round-trip) efficiency of the battery storage system

Factor B

Table 170.2-V: *Battery Storage Capacity Factors*

Building Type	Factor B – Energy Capacity
Storage-to-PV Ratio	**Wh/W**
Grocery	1.03
High-rise Multifamily	1.03
Office, Financial Institutions, Unleased Tenant Space	1.68
Retail	1.03
School	1.87
Warehouse	0.93
Auditorium, Convention Center, Hotel/Motel, Library, Medical Office Building/Clinic, Restaurant, Theater	0.93

Example Calculation (Energy Capacity)

§170.2(h)

- **For the Same Multifamily Building:**
  - 4 Stories
  - PV Size = **182 kW**
  - Round trip battery efficiency = **95%**
  - Energy Capacity Factor = **1.03**
    *(**Factor B** per table below)*

- **Minimum rated energy capacity is:**

  kWh = kW_{PVdc} x B / $D^{0.5}$

  kWh = 182 x 1.03 / $0.95^{0.5}$

  kWh = 192.3 kWh

Answer

Table 170.2-V: *Battery Storage Capacity Factors*

Building Type	Factor B – Energy Capacity
Storage-to-PV Ratio	**Wh/W**
Grocery	1.03
High-rise Multifamily	**1.03**
Office, Financial Institutions, Unleased Tenant Space	1.68
Retail	1.03
School	1.87
Warehouse	0.93
Auditorium, Convention Center, Hotel/Motel, Library, Medical Office Building/Clinic, Restaurant, Theater	0.93

Battery Power Capacity Formula

§170.2(h)

- **Minimum rated power capacity (Equation 170.2-F)**
  - **$kW = kW_{PVdc} \times C$**
    - **kW** = Power capacity of the battery storage system in kWdc
    - **kW_{PVdc}** = PV system capacity required by Section 170.2(g) in kWdc
    - **C** = Battery **power capacity factor** specified in **Table 170.2-V** for the building type

Factor C

Table 170.2-V: *Battery Storage Capacity Factors*

Building Type	Factor B – Energy Capacity	Factor C – Power Capacity
Storage-to-PV Ratio	**Wh/W**	**W/W**
Grocery	1.03	0.26
High-rise Multifamily	1.03	0.26
Office, Financial Institutions, Unleased Tenant Space	1.68	0.42
Retail	1.03	0.26
School	1.87	0.46
Warehouse	0.93	0.23
Auditorium, Convention Center, Hotel/Motel, Library, Medical Office Building/Clinic, Restaurant, Theater	0.93	0.23

Example Calculation (Power Capacity)

§170.2(h)

- **For the Same Multifamily Building:**
  - 4 Stories
  - PV Size = **182 kW**
  - Power Capacity Factor = **0.26** (***Factor C*** *per table below)*

- **Minimum rated power capacity is:**
  - **$kW = kW_{PVdc} \times C$**
  - **$kW = 182 \times 0.26$**
  - **kW = 47.3 kW**

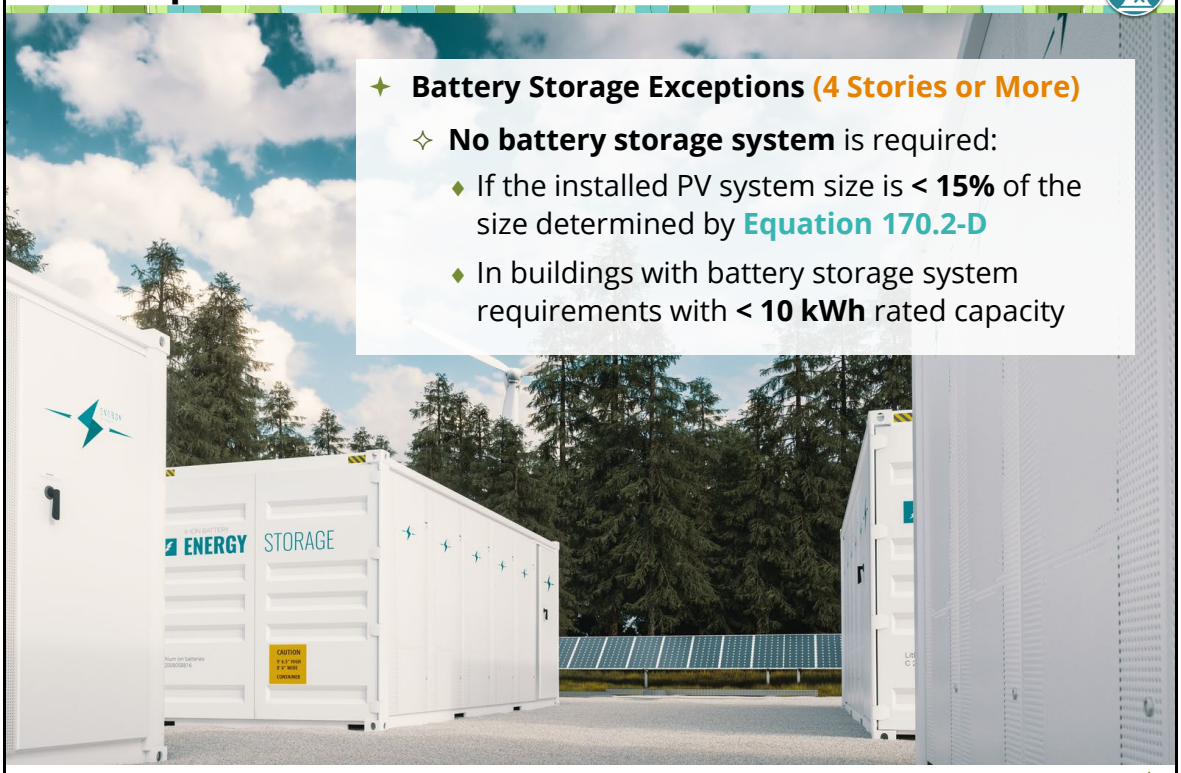
Answer

Table 170.2-V: *Battery Storage Capacity Factors*

Building Type	Factor B – Energy Capacity	Factor C – Power Capacity
Storage-to-PV Ratio	**Wh/W**	**W/W**
Grocery	1.03	0.26
High-rise Multifamily	1.03	**0.26**
Office, Financial Institutions, Unleased Tenant Space	1.68	0.42
Retail	1.03	0.26
School	1.87	0.46
Warehouse	0.93	0.23
Auditorium, Convention Center, Hotel/Motel, Library, Medical Office Building/Clinic, Restaurant, Theater	0.93	0.23

Exceptions

§170.2(h)



- **Battery Storage Exceptions (4 Stories or More)**
  - **No battery storage system** is required:
    - If the installed PV system size is **< 15%** of the size determined by **Equation 170.2-D**
    - In buildings with battery storage system requirements with **< 10 kWh** rated capacity

Check Your Understanding #5

Check Your Understanding #5

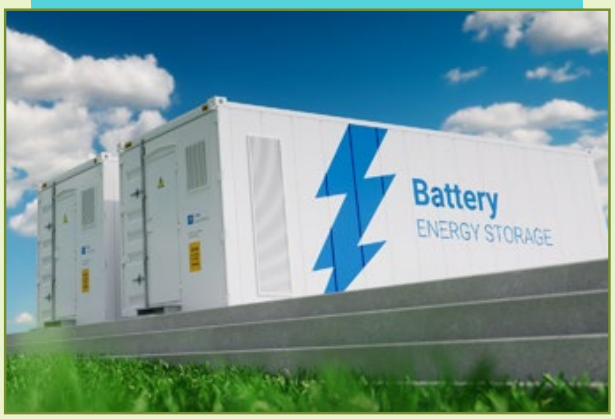
What do you think?

For which types of buildings is battery storage Prescriptively required in New Construction?

a) Multifamily (3 stories or less)

b) Multifamily (4 stories or more)

c) All Multifamily buildings over 50,000 ft^2



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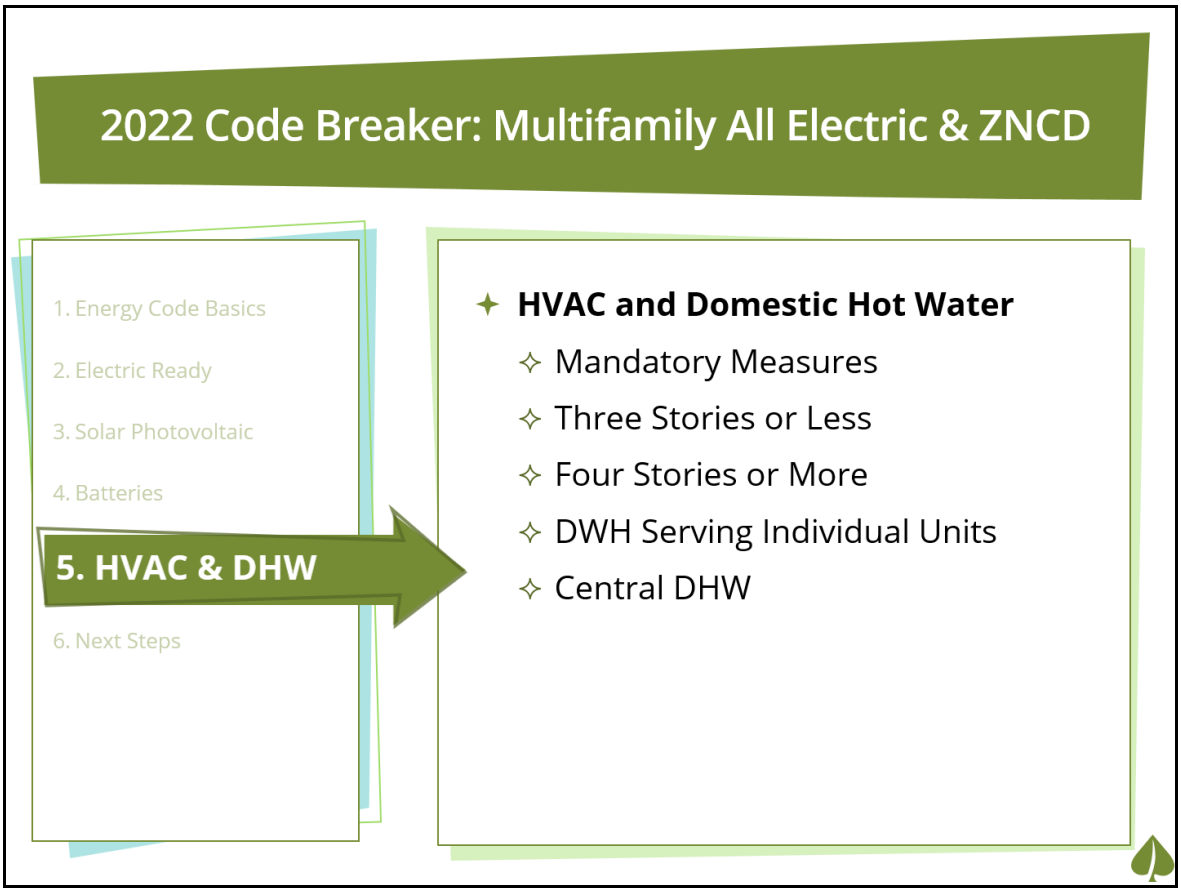
HVAC & DHW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4. Batteries
5. HVAC & DHW
6. Next Steps
HVAC and Domestic Hot Water
Mandatory Measures
Three Stories or Less
Four Stories or More
DWH Serving Individual Units
Central DHW

Mandatory Measures

§160.2(b)

- **New Kitchen Hood Table 160.2-G**, which is based on:
  - Home size
  - Fuel type: higher air flow required over gas ranges
- Capture Efficiency (CE) comes from ASTM testing

Home size

Fuel type: Electric

Fuel type: Gas

Dwelling Unit Floor Area (ft^2)	Hood Over Electric Range	Hood Over Natural Gas Range
> 1500	50% CE or 110 cfm	70% CE or 180 cfm
> 1000 – 1500	50% CE or 110 cfm	80% CE or 250 cfm
750 – 1000	55% CE or 130 cfm	85% CE or 280 cfm
< 750	65% CE or 160 cfm	85% CE or 280 cfm

Table 160.2-G: *Kitchen Range Hood Airflow Rates (cfm) and ASTM E3087 Capture Efficiency (CE) Ratings According to Dwelling Unit Floor Area and Kitchen Range Fuel Type*

Capture Efficiency

Space Conditioning (Dwelling Units Only)

§170.2

3 Stories or Less

Prescriptive Requirement

- **Climate Zones 1-15:**
  - Space conditioning system shall be a **heat pump**
- **Climate Zone 16:**
  - Space conditioning system shall be an **air conditioner with furnace**

4 Stories or More

Prescriptive Requirement

- **Climate Zones 2-15:**
  - Space conditioning system shall be a **heat pump**
- **Climate Zones 1 and 16:**
  - Space conditioning system shall be a **dual-fuel heat pump**

There are no Prescriptive heat pump space conditioning requirements for Multifamily Common Areas

DHW (Individual Dwelling Units Only)

§170.2(d)1

- **Individual Water Heater Prescriptive Requirements Serving Dwelling Units:**

1. A **single 240 volt Heat Pump Water Heater** (HPWH) with:
   - **Climate Zones 1 and 16:** Compact hot water distribution system
   - **Climate Zone 16:** Drain water heat recovery system

   OR

2. A **single NEEA-rated Tier 3 Heat Pump Water Heater** with:
   - **Climate Zone 16:** Drain water heat recovery system

   OR

3. A **gas or propane instantaneous** water heater with an input of 200,000 Btu/hr or less

There are no Prescriptive DHW requirements for Multifamily Common Areas

Central Heat Pump Water Heater

§170.2(d)2

Heat Pump Water Heater(s) Compressor	Primary Storage Tank(s)	Temperature Maintenance System	Recirculation Loop Tank
Single-pass primary heat pump water heater, the primary thermal storage tanks shall be piped *in series* for multiple tanks	The primary storage tank **temperature setpoint** shall be ≥ 135°F	Recirculation system meeting mandatory requirements of §110.3(c) required for buildings with **nine or more dwelling units**	**Must be electric** (if auxiliary heating is needed) and be capable of **multi-pass water heating operation**
Multi-pass primary heat pump water heater, the primary thermal storage tanks shall be piped *in parallel* for multiple tanks *(Performance baseline is single-pass)*	Meet the mandatory requirements for **tank insulation** of §110.3(c)3	Capable of **automatically controlling the recirculation pump** operation based on hot water demand and hot water return temperature	**Temperature setpoint shall be at least 10°F lower** than the primary thermal storage tank temperature setpoint
Minimum heat pump water heater **compressor cut-off temperature** ≤ 40°F	**Recirculation return loop** shall not directly connect to the primary thermal storage tanks	**Recirculation return loop** shall not directly connect to the primary heat pump water heater inlet	The hot water **return from the recirculation loop** shall connect to a recirculation loop tank

- **Design documentation** shall be provided in accordance with **JA14.4**

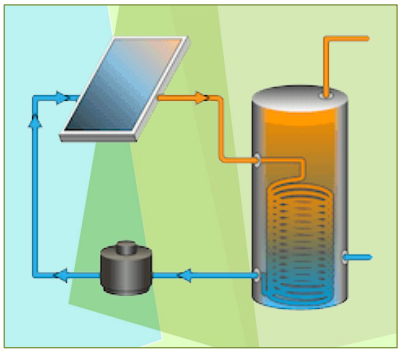
Central Domestic Hot Water (cont.)

§170.2(d)3

- **Required Prescriptively in Central System Serving Multiple Dwelling Units:**

  Gas or Propane System with the following components:

  1. **Climate Zones 1-9:**
     Total input rating **≥ 1,000,000 Btu/hr** with minimum thermal efficiency of **90%**
  2. **A recirculation system**
     - Required for buildings with **9 or more** dwelling units
       - No longer required to be dual loop
  3. **A solar water-heating system** with a minimum solar savings fraction of:
     - **Climate Zones 1-9:** 0.20
     - **Climate Zones 10-16:** 0.35
     - Solar can be reduced by 5% with a **drain water heat recovery system**



Check Your Understanding #6

Check Your Understanding #6

What do you think?

What type of water heater is allowed Prescriptively for use in individual dwelling units, regardless of climate zone?

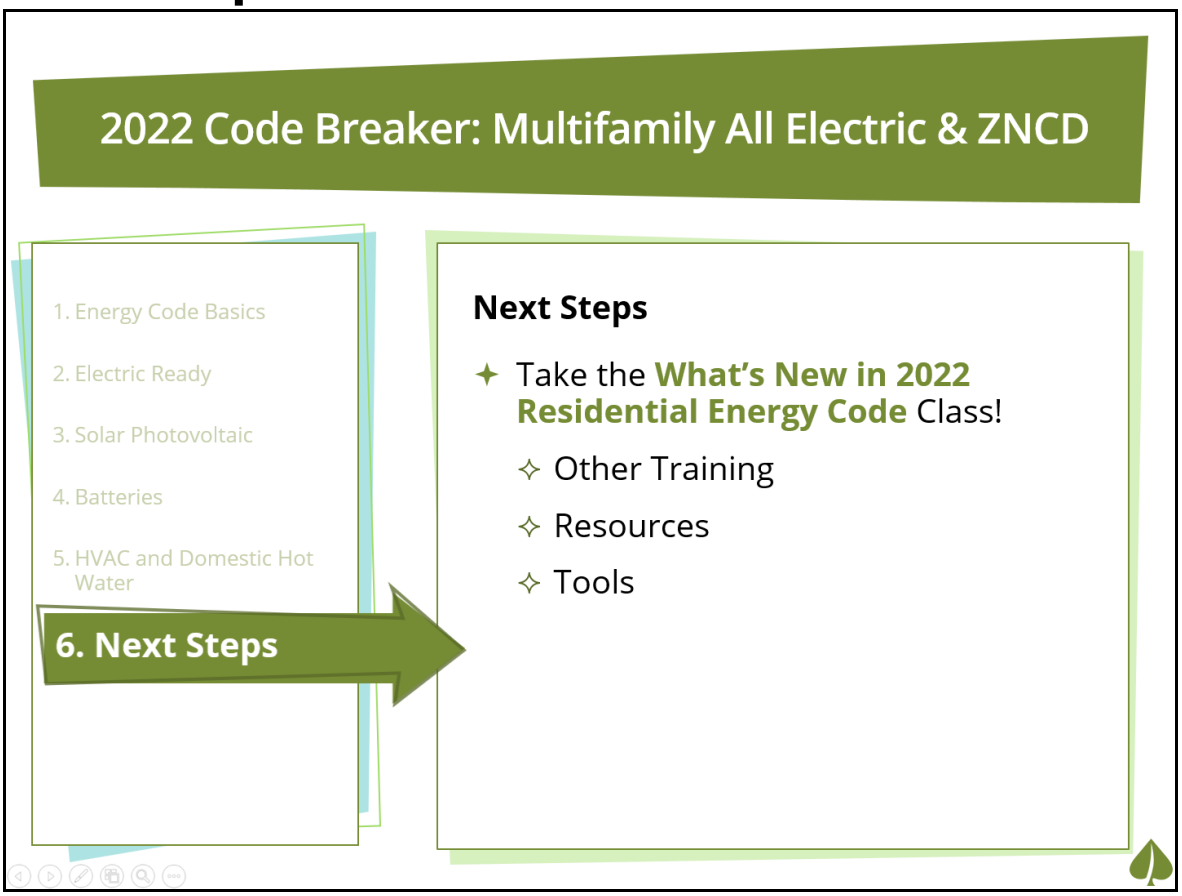
a) Single 240-volt heat pump water heater

b) Single NEEA-rated Tier 3 heat pump water heater

c) Gas or propane instantaneous water heater

d) All of the above

Next Steps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6. Next Steps
Next Steps
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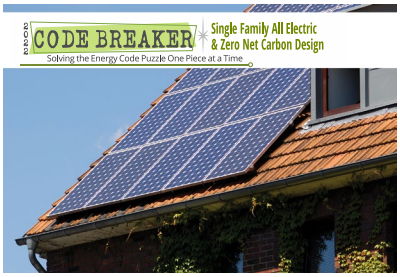

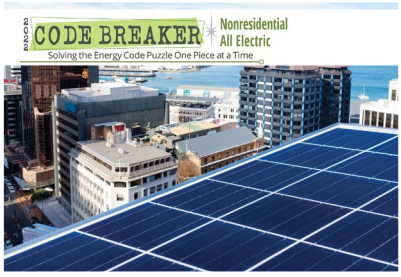

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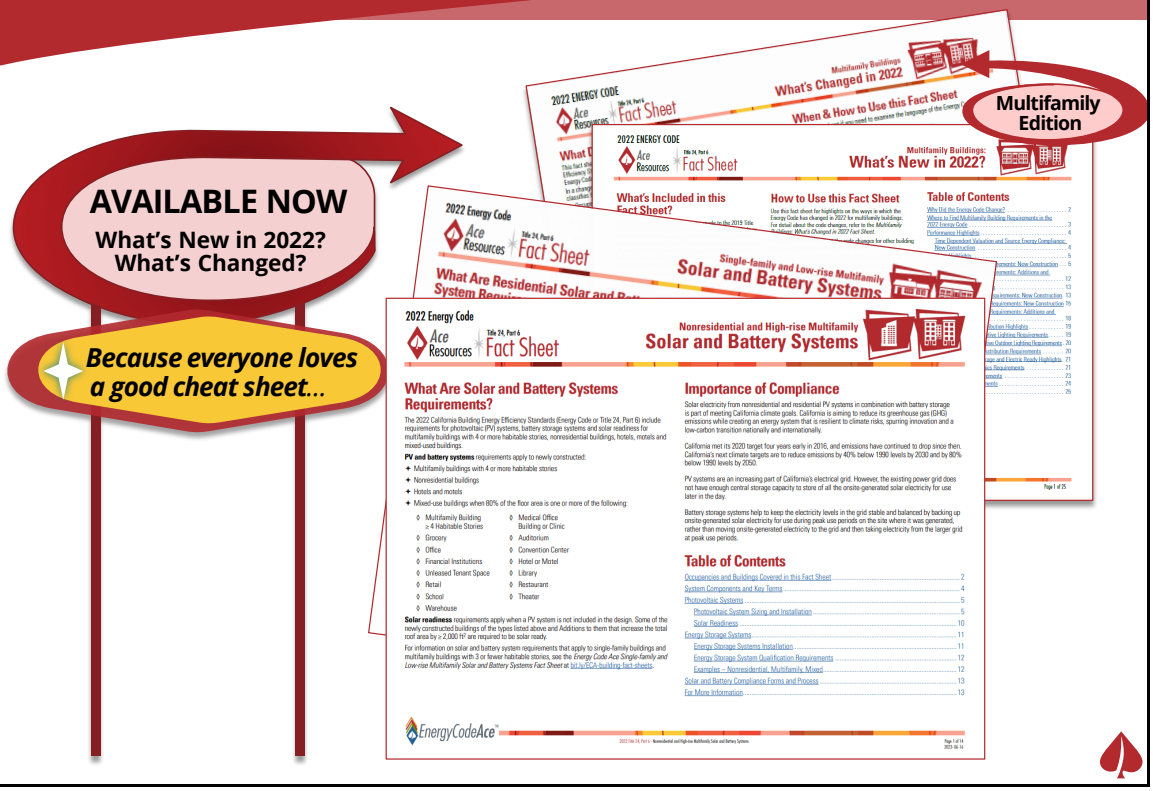
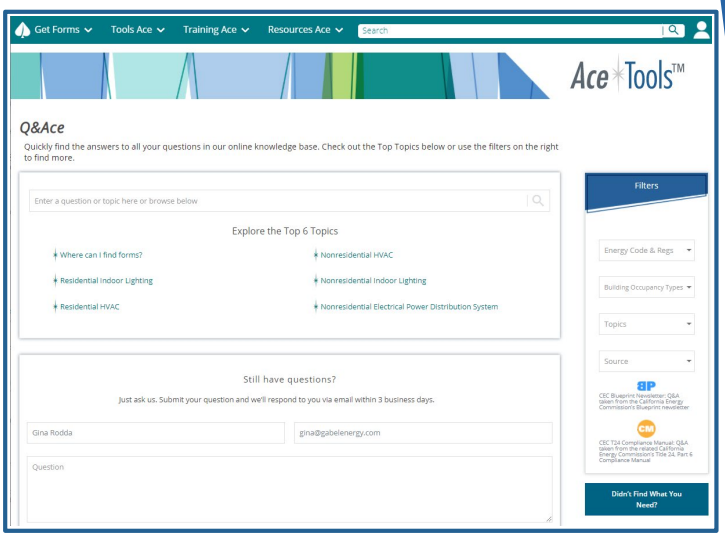
Fact Sheets on Energy Code Ace



Q & Ace



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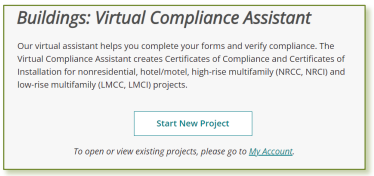

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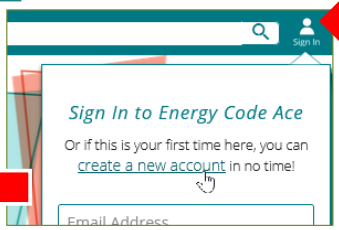

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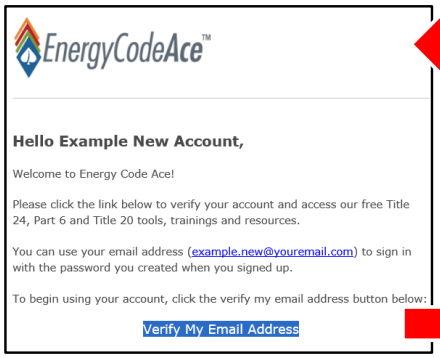
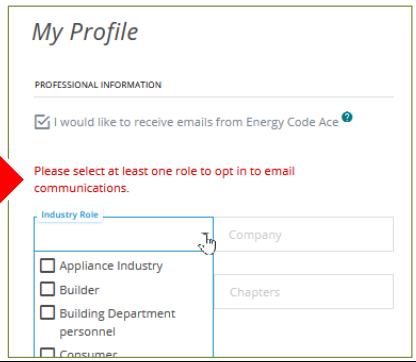


3 Be sure to select at least one Role under "Professional Information"



Contacts & Course Information

Thank you

Please feel free to reach out to us with your questions and comments!

Contact	Role	Email	Phone
Gina Rodda	Instructor	Decoding.request@energycodeace.com	
Nick Brown	Instructor	nick@buildsmartgroup.com	(714) 984-3397
Dave Intner	Senior Advisor Building Electrification & Codes and Standards	Dave.Intner@sce.com	(626) 995-7431
Jill Marver	Energy Code Ace Program Manager	Jill.Marver@PGE.com	(925) 415-6844
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