Energy Code Implementation: Non-Residential

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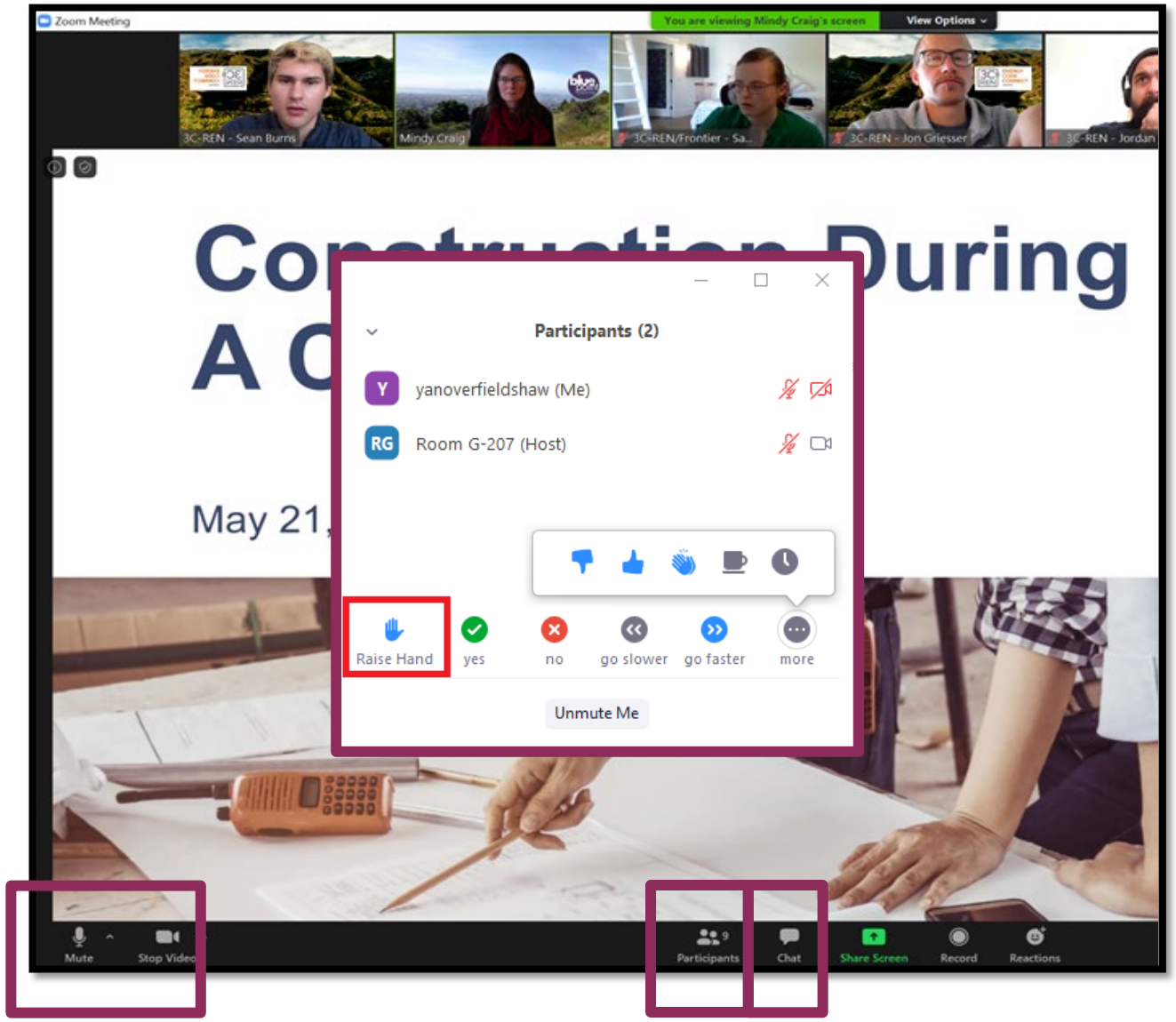
August 14th, 2024, 9:30 – 11am

Zoom Orientation

- Please be sure your full name is displayed
- Please mute upon joining
- Use "Chat“ box to share questions or comments
- Under "Participant" select "Raise Hand" to share a question or comment verbally
- The session may be recorded and posted to 3C-REN's on-demand page. Feel free to ask questions via the chat and keep video off if you want to remain anonymous in the recording.



3C-REN: Tri-County Regional Energy Network

- Three counties working together to improve energy efficiency in the region
- Services for –
  - **Building Professionals:** industry events, training, and energy code compliance support
  - **Households:** free and discounted home upgrades
- Funded by ratepayer dollars that 3C-REN returns to the region

3C REN ENERGY CODE CONNECT

3C REN BUILDING PERFORMANCE TRAINING

3C REN HOME ENERGY SAVINGS

3C REN ENERGY CODE CONNECT

- Serves all building professionals
- Three services –
  - **Energy Code Coach**
  - **Training and Support**
  - **Regional Forums**
- Makes the Energy Code easy to follow

Energy Code Coach:
3c-ren.org/codes
805.781.1201

Event Registration:
3c-ren.org/events

BUILDING PERFORMANCE TRAINING

- Serves current and prospective building professionals
- Expert instruction:
  - **Technical skills**
  - **Soft skills**
- Helps workers to thrive in an evolving industry

Event Registration:
3c-ren.org/events

3C REN HOME ENERGY SAVINGS

Multifamily (5+ units)

- No cost technical assistance
- Rebates up to $750/apartment plus additional rebates for specialty measures like heat pumps

Single Family (up to 4 units)

- Sign up to participate!
- Get paid for the metered energy savings of your customers

Enrollment:
3C-REN.org/contractor-participation

Energy Code Implementation Series

Since the energy code update took effect in January 2023, the industry is adjusting to design, detailing and construction to meet compliance. In this series, we'll review the code requirements with a focus on what to include in construction documents to streamline the permitting process and tips for construction to ease sign-offs and occupancy.

- Energy Code Implementation: Single Family New Construction
- Energy Code Implementation: Single Family Additions and Alterations
- Energy Code Implementation: ADUs
- Energy Code Implementation: Multi-Family
- **Energy Code Implementation: Non-Residential**

https://www.3c-ren.org/calendar-of-events-and-trainings/

Today's Learning Objectives

- Understand the current metrics and standards used in the energy code for evaluating energy performance and indoor air quality, and how choices for electric or gas equipment may impact compliance with those standards.
- Within each building type, review key mandatory measures related to energy performance, ventilation, refrigerants, and insulation and review potential challenges for integration into design and construction.
- Review the prescriptive "recipe card" approach versus a building performance approach and discuss when to use each strategy to best incorporate energy efficiency and healthy interior environments into the specific project design.
- Recognize where barriers or stumbling blocks may occur within permitting and construction and tips for documentation to smooth out the process, ultimately increasing the energy efficiency, health and safety of our buildings.

1.5 AIA HSW LU approved for this course
0.15 ICC CEU approved for this course

Agenda

1. 2022 Energy Code –Overview
2. Mandatory Measures
3. New Construction: Prescriptive and Performance Measures
4. Additions and Alterations

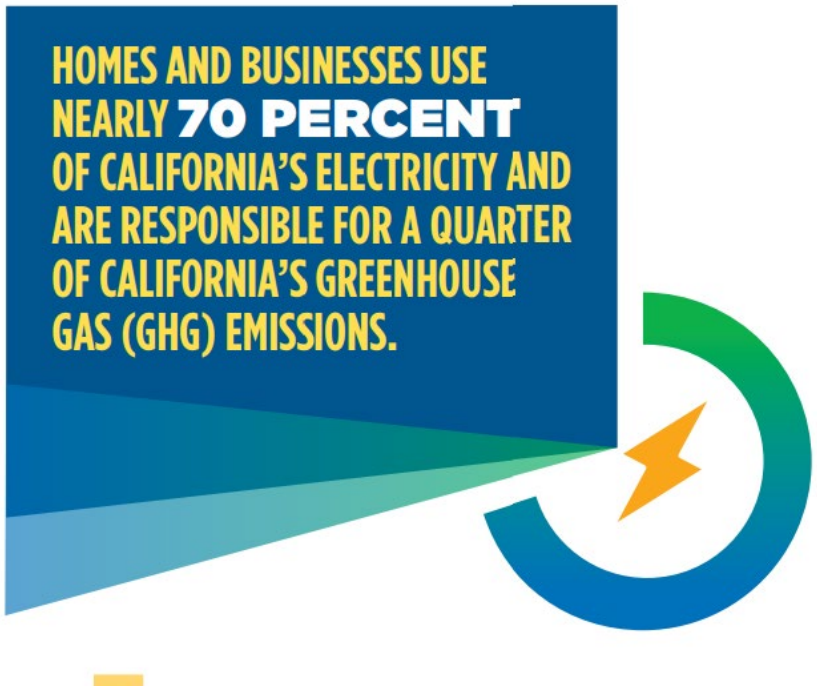
2022 Energy Code Overview

California Energy Commission (CEC)

energy.ca.gov

California's Building Energy Efficiency Standards (aka the Energy Code) is updated every three years the by CEC. The process includes engagement with the public, industry experts, in-house expertise, and other stakeholders.

Big Picture Goals for the 2022 Code Updates



- Encourage heat pump technology for space and water heating
- Establish electric-ready requirements for single family and multifamily projects
- Expand PV systems and battery storage standards
- Strengthen ventilation standards

T24 Part 6 Energy Code – Subchapter Organization

All [*regulated*] Occupancies
(A, B, E, F, H, I M, R, S, or U, except I-3 and I-4)

Subchapter 1 –All Occupancy –Scope, Definitions

Subchapter 2 –All Occupancies – Mandatory Requirements

Sec 100.0-100.3 & Sec 110.0-110.12

Not Residential

Subchapter 3 – Nonresidential, Hotel/Motel, Covered Process –Mandatory Requirements [*HVAC and Ventilation*]

Sec 120.0-120.9

Subchapter 4 – Nonresidential, Hotel/Motel –Mandatory Requirements [*Lighting and Power*]

Sec 130.0-130.5

Subchapter 5 –Performance and Prescriptive [*New Construction*]

Sec 140.0-140.9

Subchapter 6 – Additions and Alterations

Sec 141.0-141.1

Single Family Res

Subchapter 7 –Single Family Residential Mandatory Measures

Sec 150.0

Subchapter 8 – Performance and Prescriptive [*New Construction*]

Sec 150.1

Subchapter 9 – Additions and Alterations

Sec 150.2

Multifamily Res

Subchapter 10 – Multifamily Residential Mandatory Measures

Sec 160.0-160.9

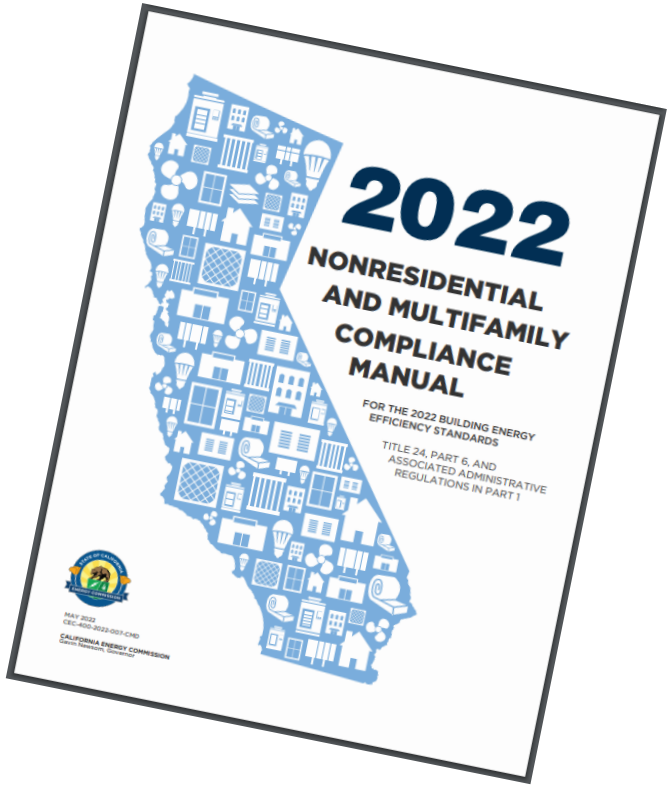
Subchapter 11 – Performance and Prescriptive [*New Construction*]

Sec 170.0-170.2

Subchapter 12 – Additions and Alterations

Sec 180.0-180.4

Non-Residential High-Level Changes



- Envelope and Fenestration
- HVAC –Heating System, Fans, and Outside Air Ventilation
- Lighting –Indoor and Outdoor
- Covered Processes
- Photovoltaic (PV) and Battery Systems
- Reminder: Includes Hotel/Motel. Some of the code language specifies whether it applies to Guest Rooms only or to the Nonresidential spaces in general

The Energy Code –Three Compliance Terms

Mandatory Requirements

Energy efficiency measures that are applicable to all projects.

Prescriptive Component Package	Performance Method
Mandatory Requirements are applicable	Mandatory Requirements are applicable
Follow all the parts of the prescriptive package	Other components or measures can be traded-off as long as the Proposed Design Building can be shown to be more energy efficiency than a similar sized Standard Design Building (baseline building)
Note: used to determine the Standard Design Building	
Essentially a **checklist** approach	**Energy modeling** approach

Performance Metrics (Computer Modeling)

Compliance is demonstrated via regulated energy:

- Space Heating and Cooling
- Ventilation
- Water Heating
- Indoor Lighting
- Solar PV
- Battery Storage
- Covered Process Loads

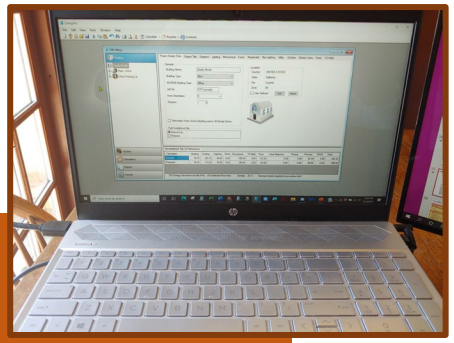
Compliance software has changes to the **Standard Design** which now **varies by climate zone** and includes **heat pumps**

Community shared solar electric and/or battery system is allowable with specific requirements. See EXCEPTION Section 140.1(b)

Performance Method (Computer Modeling)

Two Metric Types:

- **Source Energy Budget** is the efficiency of the energy used by the building (site energy) as well the energy used to produce, procure, and distribute it from a particular source. It serves as **proxy for carbon-based metric.**
- **TDV Energy Budget** is the efficiency of the building's source energy and brings in TDV multipliers based on when the energy is being used to reflect the actual cost, supply, and demand. It serves to **encourage better performance during peak hours.**



Key Changes:

- **Solar Electric PV and Battery** Storage Systems were **added** to TDV-Total
- **Source Energy** metric **added** to Performance Compliance

Example Office Building Project Results

CBECC-com 2022

Efficiency TDV **Total TDV** **Source Energy**

Overall Result[3]: **COMPLIES**

(not current)

	Time Dependent Valuation: Efficiency[1] (kBtu/ft²-yr)	Time Dependent Valuation: Total[2] (kBtu/ft²-yr)	Source Energy use: Total[2] (kBtu/ft²-yr)
Standard Design	134.03	12.73	6.13
Proposed Design	131.10	1.06	5.66
Compliance Margins	**2.93**	**11.67**	**0.47**
	Pass	Pass	Pass

[1] Efficiency measures include improvements like a better building envelope and more efficient equipment

[2] Compliance Totals include efficiency, photovoltaics and batteries

[3] Building complies when all efficiency and total compliance margins are greater than or equal to zero and unmet load hour limits are not exceeded

Standard Design PV Capacity: 167.9 kWdc / Battery System Capacity: 296.8 kWh (power 70.50 kW)

Mandatory Measures

Increased HVAC Efficiencies:

- Various cooling systems
- Cooling towers
- Furnaces
- Boilers (starting 1/10/23)

New tables for:

- Dedicated Outdoor Air Systems (DOAS)
- Computer room units
- Heat pump and heat recovery chillers

Heat Pump with Waste Heat Recovery

Dedicated Outdoor Air System (DOAS)

Fenestration

NFRC certification of fenestration products and exterior doors other than field-fabricated

For U-factor, SHGC, and VT:

- NA6 formula can only be used for skylights ≤200 ft^2

Note: NA6 formula is no longer valid for vertical fenestration

Key Take Away:

Nearly all projects will be using **NFRC** rated windows through out the building.

Fenestration –Compliance, Installation, and Acceptance – NRCC, NRCI, and NRCA

Envelope Component Approach

CALIFORNIA ENERGY COMMISSION

CEC-NRCI-ENV-E

CERTIFICATE OF INSTALLATION

This Certificate of Installation documents the installation of envelope features, materials, components, and manufactured devices required to demonstrate compliance with Title 24, Part 6 per §10-103(a)3 for nonresidential, hotel/motel and high-rise residential occupancies.

Project Name:	Enforcement Agency:
Dwelling Address:	Permit Number:
City and Zip Code:	Permit Application Date:

A. GENERAL INFORMATION

01	Project Location (city):		05	Authority Having Jurisdiction:	
02	Zip Code:		06	Building Permit #:	
03	Date of Permit Set used for construction:		07	Date of As-built Set:	
04	Name of Permit Set used for construction:		08	Name of As-built Set:	

B. INSTALLER SCOPE

This table indicates construction systems and materials documented on this Certificate of Installation.

01 Roofs		02 Walls		03 Fenestration		04 Doors		05 Floors	
□	Above Deck Insulation	□	Assembly type	□	Vertical/ Glazed Doors	□	New solid doors	□	Assembly type
□	Below Deck Insulation	□	Insulation	□	Skylights			□	Insulation
□	Surface Material								

CALIFORNIA ENERGY COMMISSION **FENESTRATION ACCEPTANCE** 2022-CEC-NRCA-ENV-02-F

Project Name and Address	Authority Having Jurisdiction
Name:	Enforcement Agency:
Address:	
City, Zip:	

Building: Floor:

☐ Construction inspection co
☐ Does not comply

Intent:	Each fenestr… California En… performance… 111. The lab… enforcement… Fenestration… thermal perf… matches the… plans. A copy… given to the…
Responsible Party	The responsi… a) Verify… and C… appro… b) For no… coeffi… fenest…

INSTALLER AND INSPECTOR QUICK-REFERENCE:
2022 NRCA-ENV-02-F
Fenestration Acceptance

Purpose and Scope of the Test

This test is to verify that an NFRC Label Certificate or the California Energy Commission (CEC) Fenestration Certificate (NRCC-ENV-E) is provided for each site-built fenestration product being installed. These certificates identify the thermal performance of the fenestration product (e.g., U-factor, SHGC, and VT).
This test also verifies that the thermal performance of installed fenestration products matches the label certificate, energy compliance documentation, and plan specifications.

Test trigger

This test is required for newly installed site-built fenestration, window film, and dynamic glazing in new construction, additions, and alterations for nonresidential, high-rise residential, and hotel/motel buildings.

Relevant Energy Code References and Required Compliance Documents

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards (Energy Code) sections 110.6, 140.3(a)5, 141.0(b)2A; NA7.4.1, NA7.4.2, NA7.4.3; NRCC-ENV-E Table K

Who Can Perform the Test

There are no restrictions.

Required Tools

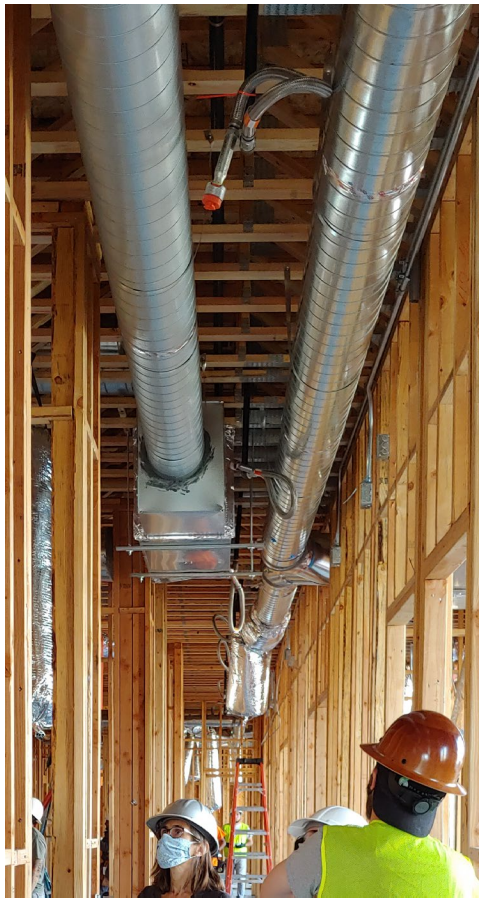
…t visually verifies products are installed correctly, and according to …ations, and does not require special instrumentation.

…ed Time to Complete Test

…ction inspection: 0.25-0.5 hours (per fenestration/window film/dynamic

NRCI-ENV-E (Installation) is applicable to Opaque Envelope, Daylighting, and Fenestration.
NRCA-ENV-02-F (Acceptance) is the only applicable to the Fenestration

Duct Leakage Testing



New duct systems meeting the following must be "**HERS**" tested to verify no more than **6% leakage**:

- Provides conditioned air to an occupiable space for a constant volume, single zone space conditioning system
- Serves <5,000 ft^2 of CFA
- Have more than 25% of ducts in unconditioned space or outdoors

Exemptions:

- Healthcare facilities
- New duct systems not subject to testing under Section 120.4(g)1 shall instead meet the duct leakage testing requirements of CMC 603.10.1

Key Update:
Duct leakage was a previously a Prescriptive component under the prior code (2019) cycle, but now it is a Mandatory measure.

Duct Leakage Verification: NRCV-MCH-04-H

Nonresidential Certificates of Verification (NRCV) are to demonstrate compliance with HERS verification

STATE OF CALIFORNIA
DUCT LEAKAGE DIAGNOSTIC TEST
CEC-NRCV-MCH-04-H (Revised 01/19) CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF VERIFICATION		NRCV-MCH-04-H
Duct Leakage Diagnostic Test		(Page 1 of 2)
Project Name:	Enforcement Agency:	Permit Number:
Project Address:	City:	Zip Code:

A. System Information		
01	Space Conditioning System Identification or Name	
02	Space Conditioning System Location or Area Served	
03	Indoor Unit Name	
04	Verified Low Leakage Air-Handling Unit Credit from NRCC-PRF-01-E	
05	Duct System Compliance Category	

B. Duct Leakage Diagnostic Test - MCH-04a - Completely New Duct System		
01	Condenser Nominal Cooling Capacity (ton)	
02	Heating Capacity (kBtu/h)	
03	Leakage Factor	
04	Air-Handling Unit Airflow (AHU Airflow) Determination Method	
05	Calculated Target Allowable Duct Leakage Rate (cfm25)	
06	Actual Duct Leakage Rate from Leakage Test Measurement (cfm25)	
07	Compliance Statement:	

C. Additional Requirements for Compliance		
01	System was tested in its normal operation condition.	
02	All supply and return register boots sealed to the surrounding material.	
03	Cloth backed rubber adhesive duct tape may not be used as the primary air sealing method for duct connections.	
04	All connection points between the air handler and the supply and return plenums are completely sealed.	
05	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable

Duct Leakage Testing Equipment: Calibrated Fan Flowmeter

NRCA-MCH-04-A was Established with an Acceptance Test Technician (ATT) in Mind

CALIFORNIA ENERGY COMMISSION **DUCT LEAKAGE** 2022-CEC-NRCA-MCH-04-A

Project Name and Address	Authority Having Jurisdiction
Name: Project Name	Enforcement Agency: Agency
Address: Project Address	Permit Number: Permit Number
City, Zip: City, Zip Code	Permit Application Date: Date

Building: Enter Value	Floor: Enter Value	Room: Enter Value	Control/tag: Value

☐ Construction inspection and functional testing comply ☐ Does not comply	Date Submitted to AHJ: Date

Intent:	Submit one Certificate of Acceptance testing duct leakage rate for each newly installed, repaired, or altered heating, ventilating or air conditioning (HVAC) duct system. Either an NRCC-MCH-E for nonresidential construction that is completed and approved by the authority having jurisdiction or an LMCC-MCH-E for multifamily construction that is registered with a CEC approved HERS data registry is required prior to beginning this acceptance test. Submit one Certificate of Acceptance for each system that must demonstrate compliance. Reference: §120.4(g), 141.0(b)2D, 141.0(b)2E, §160.3(c)2Hi, §160.3(b)5, §180.2(b)2Bii, §180.2(b)2Biii, and NA7.5.3. NOTE: Only ATT certified technicians my perform this acceptance test. HERS rater verification is permitted at the discretion of the project owner and authority having jurisdiction.

Table A: Construction Inspection
Prior to functional testing, verify and document all of the following

Step	Entry	Item	Code Reference
1.0	☐ Pass ☐ Fail	Confirm access to design drawings, cut-sheets, NRCC-MCH-E, approved by the authority having jurisdiction	§10-103(a)2A
2.0	No Entry	System Installation Type (Select **one** of Steps 2.1, 2.2 or 2.3)	N/A
2.1, or	☐	Qualifying newly constructed system	§120.4(g)1 §160.3(c)2Hi
2.2, or	☐	Qualifying altered duct systems	§141.0(b)2D §180.2(b)2Bii
2.3	☐	Qualifying altered space-conditioning systems	§141.0(b)2E §141.0(b)2Biii
3.0	No Entry	System operational capacity	N/A
3.1, or	Enter Value	Condenser Nominal Cooling Capacity (ton)	NA2.1.4.1
3.2	Enter Value	If heating only; Heating Capacity (kBtu/h)	NA2.1.4.1

INSTALLER and INSPECTOR QUICK-REFERENCE: 2022 NRCA-MCH-04-A Air Distribution System Acceptance Testing

Purpose and Scope of the Test

This test verifies all duct work associated with all nonexempt constant volume, single-zone HVAC units (i.e., air conditioners, heat pumps, and furnaces) meet the material, installation, insulation R-values, and leakage requirements specified by the Energy Code.

Test trigger

This test is only for single-zone units serving less than 5,000 ft² of floor area where 25 percent or more of the duct surface area is in one of the following spaces:

- Outdoors.
- In a space directly under a roof where the U-factor of the roof is greater than the U-factor of the ceiling.
- In a space directly under a roof with fixed vents or openings to the outside or unconditioned spaces.
- In an unconditioned crawlspace.
- In other unconditioned spaces.

Within these criteria, this test applies to both new duct systems and existing duct systems that are either being extended, or the space conditioning system is altered by the installation or replacement of space conditioning equipment. This includes the replacement of the air handler, outdoor condensing unit of a split-system air conditioner or heat pump, cooling or heating coil, or the furnace heat exchanger.

Relevant Energy Code References and Required Compliance Documents

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards (Energy Code) sections 120.4, 141.0(b)2D, 140(b)2E, 140.4(l), 141.0(b)2D, 141.0(b)2E, 160.3(c)2Hi, 160.3(b)5, 180.2(b)2Bii, 180.2(b)2Biii; NA2.1, NA7.5.3 and NRCC-MCH-E Table L.

Who Can Perform the Test

This test is intended to be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-MCH-04-A. At the discretion of the AHJ, a sampling of the units may be tested by the installing technician, and certified by a HERS rater.

Required Tools

- Performance of this test will require measuring duct leakage equipment:
  - Fan flowmeter (a fan with a calibrated orifice used to pressurize the

HVAC Ventilation

- Ventilation rate based on Equation 120.1-F based on min ventilation rate and occupiable square footage
  - Alternate method based on occupants for spaces with fixed seating or subject to CBC 1004.5
- Design and control requirements for quantities of outdoor air:
  - Variable air volume (VAV) systems to be capable of maintaining measured outside air rates within 10% of designed minimum
  - **ALL** mechanical ventilation and space conditioning systems are to be tested to confirm they operate within 10% of the designed minimum outside air rate

Key Update:
Capabiliy and testing had only applied to constant volume systems under the previous code (2019) cycle.

NRCA-MCH-07-A for VAV's Requires an Acceptance Test Technician (ATT)

CALIFORNIA ENERGY COMMISSION **SUPPLY FAN CONTROLS** 2022-CEC-NRCA-MCH-07-A

Project Name and Address	Authority Having Jurisdiction
Name: Project Name	Enforcement Agency: Agency
Address: Project Address	Permit Number: Permit Number
City, Zip: City, Zip Code	Permit Application Date: Date

Building: Enter Value	Floor: Enter Value	Room: Enter Value	Control/tag: Value

☐ Construction inspection and functional testing comply ☐ Does not comply	Date Submitted to AHJ: Date

Intent:	Verify that the supply fan speed in a variable air volume system modulates to meet system airflow demand. Either an NRCC-MCH-E for nonresidential construction that is completed and approved by the authority having jurisdiction or an LMCC-MCH-E for multifamily construction that is registered with a CEC approved HERS data registry is required prior to beginning this acceptance test. Submit one Certificate of Acceptance for each system that must demonstrate compliance. NRCA-MCH-07-A can be performed in conjunction with NRCA-MCH-02-A Outdoor Air Acceptance since testing activities overlap. Reference: §140.4(c)2, §170.2(c)4Aii, and NA7.5.6

Table A: Construction Inspection
Prior to functional testing, verify and document all of the following for each system or control.

Step	Entry	Item	Code Reference
1	☐ Pass ☐ Fail	Verify that the NRCC-MCH-E as approved by the authority having jurisdiction or LMCC-MCH-E as registered by a CEC approved HERS data registry is available for reference.	N/A

INSTALLER and INSPECTOR QUICK-REFERENCE: 2022 NRCA-MCH-07-A Supply Fan Variable Flow Controls Systems

Purpose and Scope of the Test

The purpose of the test is to ensure that the supply fan in a variable air volume application modulates to meet system airflow demand. In most applications, the individual variable air volume (VAV) boxes serving each space will modulate the amount of air delivered to the space based on heating and cooling requirements. As a result, the total supply airflow provided by the central air handling unit must also vary to maintain sufficient airflow through each VAV box. Airflow is typically controlled using a variable frequency drive (VFD) to modulate supply fan speed and vary system airflow. The most common strategy for controlling the VFD is to measure and maintain static pressure within the duct.

Test trigger

Newly Constructed and Additions/Alterations: All new fan systems moving air into, out of, or between conditioned spaces or circulating air for purpose of condition air within the space are prescriptively required to have VAV systems. Fan controls installed on new or existing systems must be tested.

Relevant Energy Code References and Required Compliance Documents

Title 24, Part 6 of the California Building Code, Building Energy Efficiency Standards (Energy Code) sections 140.4(c)2, 170.2(c)4Aii; NA7.5.6; NRCC-MCH-E
Related acceptance tests for these systems include the following:

- NA7.5.1.1 Variable Air Volume Systems Outdoor Air Acceptance

Who Can Perform the Test

This test must be performed by an acceptance test technician certified by a CEC-approved Acceptance Test Technician Certification Provider, using compliance document NRCA-MCH-07-A.

Demand Response Lighting and Controlled Receptacles

(c) Lighting Demand Response Controls

New – Lighting systems of total installed lighting power of **4,000 watts** or greater (subject to Sec 130.1(b)) ***--prior threshold was 10,000 sf***

(e) Controlled Receptacles

Receptacles must be connected to the **demand response** system if the building is required to have demand controlled lighting (subject to Sec 130.1(b))

- Except where health or life safety statute/ordinance/regulation does not allow for demand response

Demand control response shall reduce the lighting power by 15% or greater

Reminder: Section 130.1(b) covers the mandatory controls for indoor lighting where **multilevel controls are required**

Indoor Lighting Controls

(a) Manual Area Controls

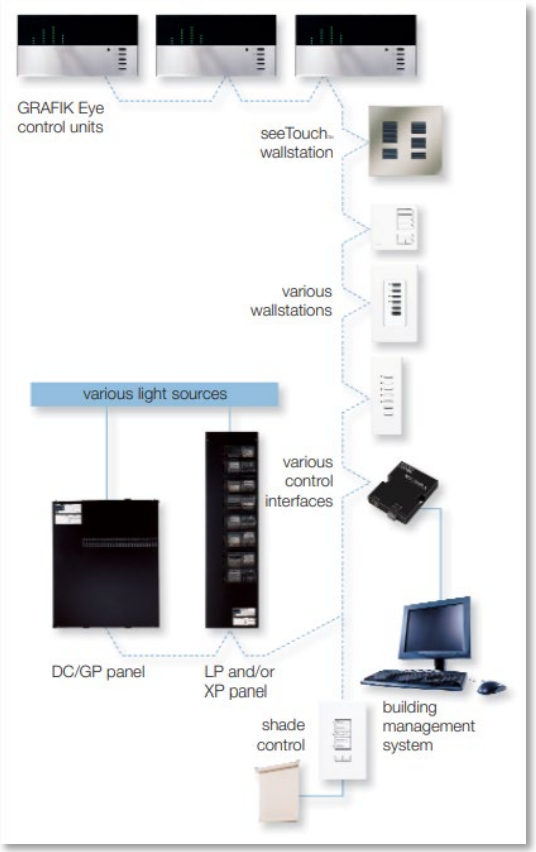
- Included language that specifies that **scene controllers** can be used if at least one scene turns on general lighting only, and the control provides a means to manually turn off all lighting
- Changed the exemption for **egress illumination to 0.1 watts/sf allowable** for continuous illumination (*previously 0.2 w/sf were allowable*)

(c) Shut-OFF Controls

- New requirements for offices > 250 ft^2

(d) Automatic Daylighting Controls

- Automatic daylighting controls are NOW mandatory in secondary daylit zones



Example of Lutron Controls

Controlled Environmental Horticulture (CEH)

New Mandatory Requirements

Indoor Growing:

- Dehumidification
- Lighting
- Electrical power distribution

Conditioned Greenhouses:

- Envelope
- Space conditioning
- Lighting

Key Highlights:

- Grow lights must have **high photosynthetic photon efficacy** (PPE), is spectrum efficient, and have **dimming and timeclock controls.**
- Dehumidifiers must **meet federal dehumidifier standards;** or integrated HVAC and chillers shall **recover at least 75% of the heat** used for reheat; or use **desiccant dehumidification** when systems require a dew point below 50 deg F.
- Non-opaque conditioned greenhouses must have at least **two glazing** layers separated by air or gas**.**

Note:
This new section has a focus on cannabis growing. The space definition does not include building spaces where plants are grown for decoration.

Additional Resource

energycodeace.com

2022 ENERGY CODE

Ace Resources | Title 24, Part 6 Fact Sheet

Nonresidential

Controlled Environment Horticulture

What Are the Requirements for Controlled Environment Horticulture (CEH) Spaces?

This fact sheet explains the California Building Energy Efficiency Standards (Energy Code or Title 24, Part 6) requirements for CEH spaces and buildings.

Controlled Environment Horticulture (CEH) is a building space dedicated to plant production by manipulating indoor environmental conditions, such as through electric lighting, irrigation, mechanical heating, mechanical cooling, or dehumidification. CEH space does not include building space where plants are grown solely to decorate that same space.

When CEH space is either 1) New Construction and conditioned or 2) newly conditioned within an existing enclosed building, all applicable CEH and nonresidential requirements must be met.

For Alterations, the Energy Code is triggered when HVAC equipment is replaced or when lighting loads are added. The requirements are also triggered for lighting when 10% or more of the existing lighting is replaced.

Applicable Energy Code requirements for CEH are as follows:

- Nonresidential envelope (for enclosed conditioned spaces)

Figure 1. *Illustration of an Indoor Grow Building Used in CEH*

Table of Contents

Computer Rooms

New HVAC controls and efficiencies:

- Reheat controls shall prevent reheating, recooling, and simultaneous heating
- Humidification shall be adiabatic
- Variable fan controls when unitary mechanical cooling capacity > 60,000 Btu/hr and limits on fan motor demand

Reminder:
Computer Rooms are conditioned floor areas with electronic equipment having a 20 W/sf of connected power density

Under construction: Server/Computer Rm with a connected load >20W/sqft

Commissioning Required for:

- Non-Residential Occupancies
  - Including Non-Res portions of Hotel/Motel and Highrise Multifamily
  - Except Healthcare which must comply with Title 24, Part 1 Chapter 7.
- New Construction
  - Includes INITIAL interiors build-out of shell construction
- 10,000 SF Trigger:
  - **“Full” commissioning** is required for conditioned floor area (CFA) of **10,000 SF or greater**
  - **“Cx-lite”** is required for CFA of **less than 10,000 SF**

Note:
This is in addition to any CALGreen commissioning requirements under Title 24, Part 11, Section 5.410.2, 5.410.4, and subsections.

Systems to be Commissioned – Required under CALGreen (Part 11) but references the Energy Code (Part 6)

Things that use energy!

- HVAC –Mechanical Systems (Sec 120.5)
  - Outdoor Air (OA), Ventilation, Air Distribution and Fans
  - Controls (occupancy, energy management, variable fans), and Fault Detection
  - Hydronic and Chiller Systems, Economizers and Heat Recovery, etc
- Commercial Kitchen Exhaust Systems, Fume Hoods, etc (Sec 140.9)
- Lighting Controls (Sec 130.4)
  - Indoor Lighting Controls, Receptacles, and Outdoor Lighting Controls

CALGreen additionally includes:

- *Covered Process (Sec 120.6 of the Energy Code)*
- *Renewable Energy*
- *Irrigation systems*
- *Water Reuse Systems*

Commissioning Documentation as part of 'Title 24'

2019 Code Fillable Form – OLD, offline .pdf

STATE OF CALIFORNIA

Nonresidential Building Commissioning

NRCC-CXR-E (Created 12/19) CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE NRCC-CXR-E

This document is used to demonstrate compliance with mandatory commissioning requirements in §120.8 for nonresidential buildings and hotel/motel or high-rise residential buildings with nonresidential spaces. This document does not demonstrate compliance with commissioning requirements within Title 24, Part 11, which need to be documented separately if they apply.

Project Name:		Report Page:	Page 1 of 6
Project Address:		Date Prepared:	

A. GENERAL INFORMATION

01	Project Location (city)		04	Building Size (ft²)	
02	Occupancy Type		05	Nonresidential Conditioned Floor Area (ft²)	10,000 - 49,999 ft²
03	Project Type		06	HVAC System Type	

B. PROJECT SCOPE

Table Instructions: Based on project information provided in Table A, Table B indicates which commissioning related requirements apply per §120.8. Table B is not editable by the user.

Commissioning Requirements per §120.8

01	Table F: Design Review Kickoff	§120.8(d)1 and §120.8(d)2	The design review kickoff meeting establishes who will play the role of the design reviewer, the project schedule and identify owner's requirements. This meeting should be conducted during schematic design.
02	Table G: Owner's Project Requirements (OPR)	§120.8(b)	The owner's project requirements establish the owner's goals, requirements, and expections for everything related to energy consumption and operation. This should be completed during schematic design.
03	Table H: Basis of Design (BOD)	§120.8(c)	The basis of design documents the design elements such as calculations and product selections that meet the owner's project requirements and applicable regulatory requirements. This should be completed during schematic design.
04	Table I: Design Review	§120.8(d) and §120.8(e)	The design reviewer(s) reviews the construction documents for clarity, completeness, and adherence to the owner's goals. Commissioning measures must be included in the construction documents to faciliate the design review and commissioning process. For projects with ≥ 10,000 ft² of nonresidential conditioned floor area, or with complex mechanical systems, the design review is for adherence with the Owner's Project Requirements (OPR) and Basis of Design (BOD). This should be conducted during design.
05	Table J: Commissioning Plan	§120.8(f)	The commissioning plan is developed by the commissioning provider with input from the designer and defines the scope of commissioning the project. This should be drafted during design and completed during early construction.
06	Table K: Functional Performance Testing	§120.8(g)	Functional performance testing is conducted on building systems to demonstrate correct installation and operation.
07	Table L: Documentation and Training	§120.8(h)	Documentation of the operational aspects of the building shall be completed within the Systems Manual and delivered to the building owner or representative and facilities operator.
08	Table M: Commissioning Report	§120.8(i)	A complete report of commissioning process activities undertaken through the design, construction and reporting recommendations for post-construction phases of the building project shall be completed and provided to the owner or representative.

CA Building Energy Efficiency Standards - 2019 Nonresidential Compliance: http://www.energy.ca.gov/title24/2019standards/ December 2019

2022 Code On-Line Interview – New

Building Commissioning

Okay, let's get started documenting mandatory commissioning requirements. Completing this document may require coordination with other project team members such as the Owner or Owner's Representative, Architect, Mechanical Engineer, Lighting Designer, Plumbing Engineer, Commissioning Provider and Energy Analyst.

Which of the following occupancy types are included in your project? (Select all that apply)

Choose all that apply

Which of the following describes your project's scope?

Select one

Does this project include any of the following?

Select one

Is the building electric only?

Select one

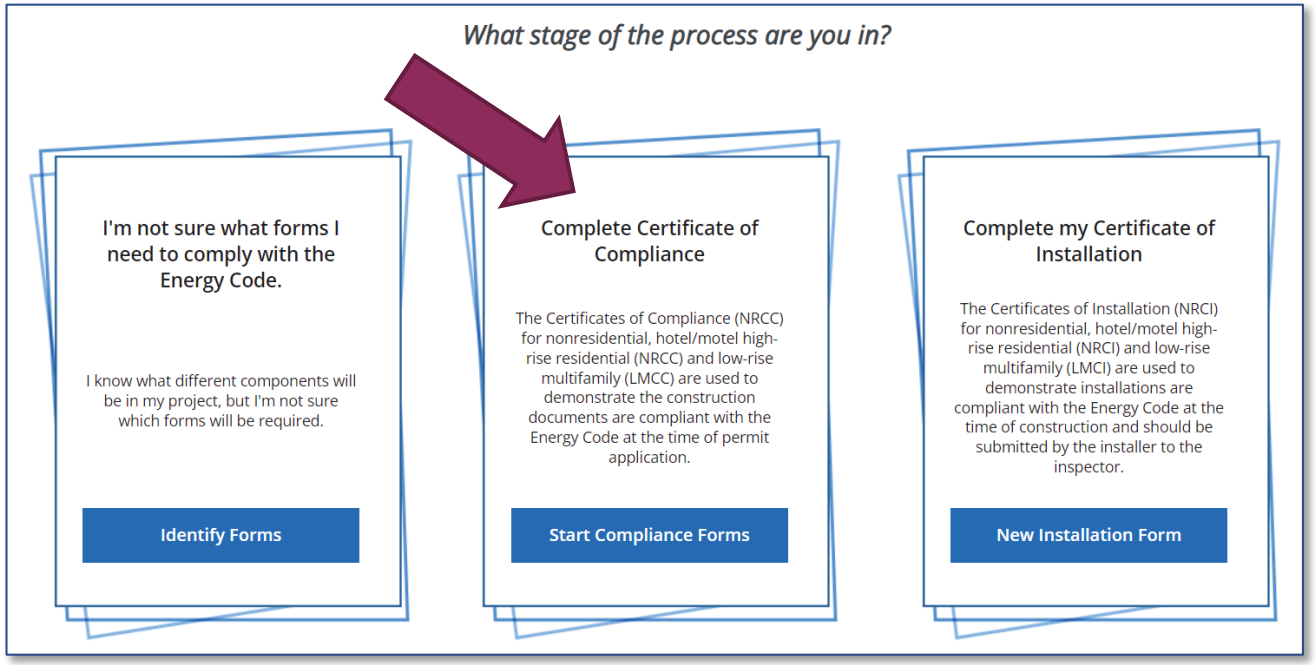
Select which fuel is available at site:

Select one

STOP! Occupancy types that are not nonresidential, hotel/motel with nonresidential occupancies, or mixed-use, and project types which are additions or alterations, are not

NRCC-CXR-E – How to Access the Commissioning Certificates

- Fill in online at www.energycodeace.com/nonresidentialforms/2022
- You have to create an account on Energy Code Ace
- Locate the 2022 Nonresidential & High-rise Multifamily forms
- Select the 2022-NRCC-CXR-E: Commissioning ‘Fill in Online’
- ‘Design Reviewer’ signs the Design Review Kick-Off and Con Docs Design Review Checklist Certificates



New Construction
Prescriptive and Performance

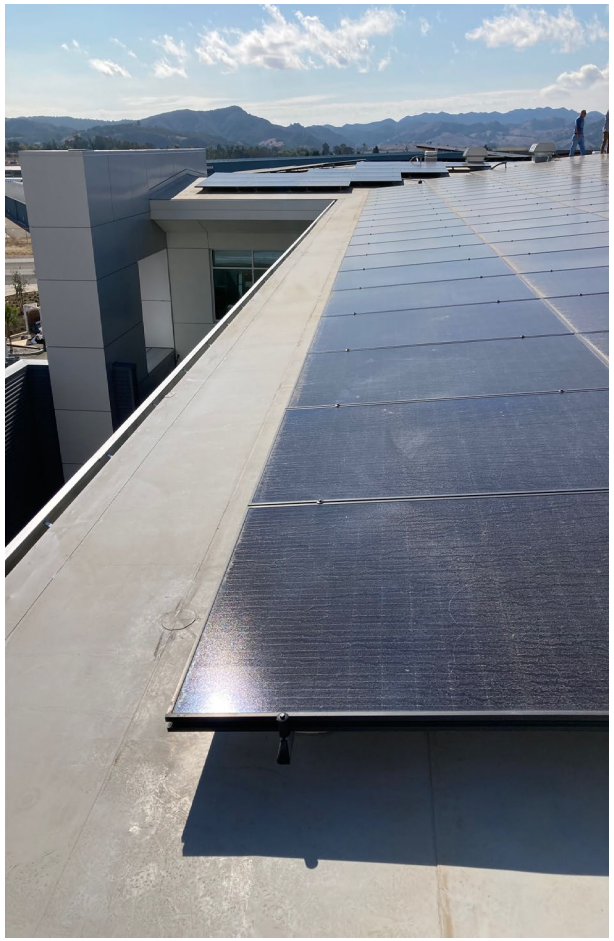
Section 140.0

- Section 140.0 –General
- Section 140.1 –Performance Approach
- Section 140.2 –Prescriptive Approach

- Nonresidential occupancies in a mixed occupancy building shall comply with nonresidential requirements in Sections 120.0 through 141.1.

Organization of Prescriptive Measures

140.3 Building Envelope
140.4 Space Conditioning Systems
140.5 Service Water Heating Systems
140.6 Indoor Lighting
140.7 Outdoor Lighting
140.8 Signs
140.9 Covered Processes
140.10 Photovoltaic and Battery Storage Systems



Roofing Products –Solar Reflectance Index (SRI)

Change for Non-Res Steep-sloped roofs

Steep-slope roofs in **CZ 1 and 3**:

- minimum aged solar reflectance of **0.20** and
- minimum thermal emittance of **0.75**, or
- minimum SRI of **16**

Steep-slope roofs **CZ 2 and 4-16:**

- minimum aged solar reflectance of **0.25** and
- minimum thermal emittance of **0.80**, or
- minimum SRI of **23**

Main Take-aways:
CZ 2, 4-16 have new requirements for steep-slope roofs.
CZ 6,7,8 have new requirements for low-slope trade-off for aged solar reflectance.

Note: Separate sections for Guest Rooms of Hotel/Motel and Relocatable Public School Bldgs. (High-Rise Res has been removed.)

Change for Non-Res Steep-sloped roofs

Low-slope roofs in **CZ 1-16**:

- minimum aged solar reflectance of 0.63 and
- minimum thermal emittance of 0.75, or
- minimum SRI of 75

TABLE 140.3 ROOF/CEILING INSULATION TRADEOFF FOR AGED SOLAR REFLECTANCE – NONRESIDENTIAL BUILDINGS

Aged Solar Reflectance	Metal Building Climate Zone 1-16 U-factor	Wood framed and Other Climate Zone ~~6 & 7~~ 8 U-factor	Wood Framed and Other All Other Climate Zones U-factor
0.62-0.56	0.038	0.045	0.032
0.55-0.46	0.035	0.042	0.030
0.45-0.36	0.033	0.039	0.029
0.35-0.25	0.031	0.037	0.028

Envelope

Updates to Table 140.3-B

Reminder: Separate Table 140.3-C for Guest Rooms of Hotel/Motel (High-Rise Res has been removed); and Table 140.3-D Relocatable Public School Bldgs

Lower min U-factor reqs

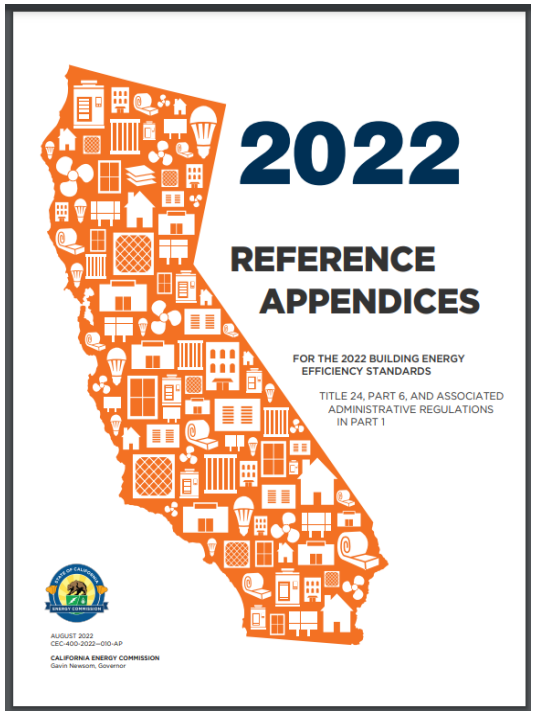
Higher min reqs

Req'd in all CZs now

				Climate Zone															
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Envelope	Maximum U-factor	Roofs/ Ceilings	Metal Building	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
			Wood Framed and Other	0.034	0.034	0.034	0.034	0.034	0.049	0.049	0.049	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.034
		Walls	Metal Building	0.113	0.061	0.113	0.061	0.061	0.113	0.113	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.057	0.061
			Metal-framed	~~0.069~~ 0.060	~~0.062~~ 0.055	~~0.082~~ 0.071	~~0.062~~ 0.055	~~0.062~~ 0.055	~~0.069~~ 0.060	~~0.069~~ 0.060	~~0.062~~ 0.055	~~0.062~~ 0.055	~~0.062~~ 0.055	~~0.062~~ 0.055	~~0.062~~ 0.055	~~0.062~~ 0.055	~~0.062~~ 0.055	~~0.062~~ 0.055	~~0.062~~ 0.055
			Mass Light[1]	0.196	0.170	0.278	0.227	0.440	0.440	0.440	0.440	0.440	0.170	0.170	0.170	0.170	0.170	0.170	0.170
			Mass Heavy[1]	0.253	0.650	0.650	0.650	0.650	0.690	0.690	0.690	0.690	0.650	0.184	0.253	0.211	0.184	0.184	0.160
			Wood-framed and Other	0.095	0.059	0.110	0.059	0.102	0.110	0.110	0.102	0.059	0.059	0.045	0.059	0.059	0.059	0.042	0.059
		Floors/ Soffits	Raised Mass	0.092	0.092	0.269	0.269	0.269	0.269	0.269	0.269	0.269	0.269	0.092	0.092	0.092	0.092	0.092	0.058
			Other	0.048	0.039	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.039	0.071	0.071	0.039	0.039	0.039
	Roofing Products	Low-sloped	Aged Solar Reflectance	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
			Thermal Emittance	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
		Steep- Sloped	Aged Solar Reflectance	0.20	~~0.20~~ 0.25	0.20	~~0.20~~ 0.25	~~0.20~~ 0.25	~~0.20~~ 0.25	~~0.20~~ 0.25	~~0.20~~ 0.25	~~0.20~~ 0.25	~~0.20~~ 0.25	~~0.20~~ 0.25	~~0.20~~ 0.25	~~0.20~~ 0.25	~~0.20~~ 0.25	~~0.20~~ 0.25	~~0.20~~ 0.25
			Thermal Emittance	0.75	~~0.75~~ 0.80	0.75	~~0.75~~ 0.80	~~0.75~~ 0.80	~~0.75~~ 0.80	~~0.75~~ 0.80	~~0.75~~ 0.80	~~0.75~~ 0.80	~~0. 75~~ 0.80	~~0.75~~ 0.80	~~0.75~~ 0.80	~~0.75~~ 0.80	~~0.75~~ 0.80	~~0.75~~ 0.80	~~0.75~~ 0.80
	Air Barrier			REQ~~NR~~	REQ~~NR~~	REQ~~NR~~	REQ~~NR~~	REQ ~~NR~~	REQ ~~NR~~	~~NR~~ ~~NR~~REQ	~~NR~~ REQ	REQ ~~NR~~	REQ	REQ	REQ	REQ	REQ	REQ	REQ
	Exterior Doors, Maximum U-factor		Non-Swinging	0.50	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	0.50
			Swinging	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70

Translation... Prescriptive U-0.060, U-0.071 and U-0.055 Nonresidential Metal Stud Wall Assemblies

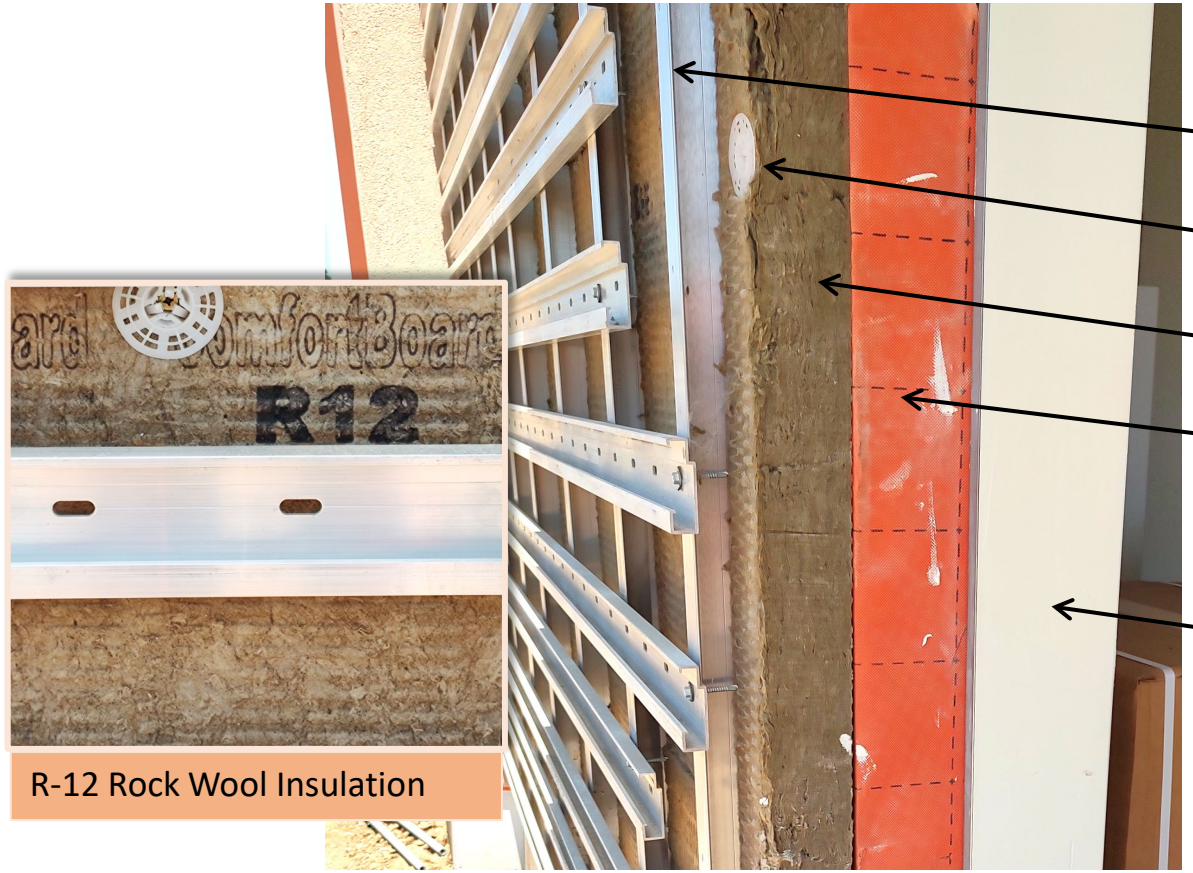
Metal Stud	Cavity Insulation	Exterior Insulation	U-Factor	Climate Zone
2x4 @ 16" o.c.	R-13 -high density batt	R-10	0.068	3
	R-13 or R-15 batt or cellulose	R-12	0.060	1, 3, 6, 7
	R-11 –batt or cellulose	R-14	0.054	All CZ's
2x6 @ 16" o.c.	R-19 -low density batt	R-10	0.065	3
	R-21 - high density batt or dense-packed cellulose	R-10	0.064	3
2x4 @ 24" o.c.	R-13 -high density batt	R-14	0.053	All CZ
2x6 @ 24" o.c.	R-19 -low density batt	R-8	0.071	3
	R-19 -low density batt	R-12	0.055	All CZ



Mandatory Minimum Metal-Framed Wall is a weighted average U-factor of **U-0.151** (i.e. R-8 continuous insulation, or R-13 cavity insulation and 1/2" of continuous rigid insulation of R-2).

Prescriptive Metal Framed Wall Example

Allowable Component in Climate Zones 1, 3, 6, 7
(For the other climate zones, increase the CI to R-14)



R-12 Rock Wool Insulation

Rain Screen – Panelized Cladding System

(CI) Fastener –with large plastic washer

R-12 Exterior Continuous Insulation (CI)

Self-adhering WRB Air Barrier – Adhered to sheathing and wrapped into door and window jams

Pre-primed Jam Extension

Not visible:
2x studs with cavity filled insulation

Prescriptive Mass Heavy Wall (8” NW CMU Solid Grout) Example

An allowable assembly in all Climate Zones.

- R-5 CI, U-0.155 covers all CZ.
- For CZ 2-5 and 10, add a layer of sheetrock with or without firring strips.
- For CZ 6-9, CMU wall can be painted –2 coats of paint meet air-barrier requirements.

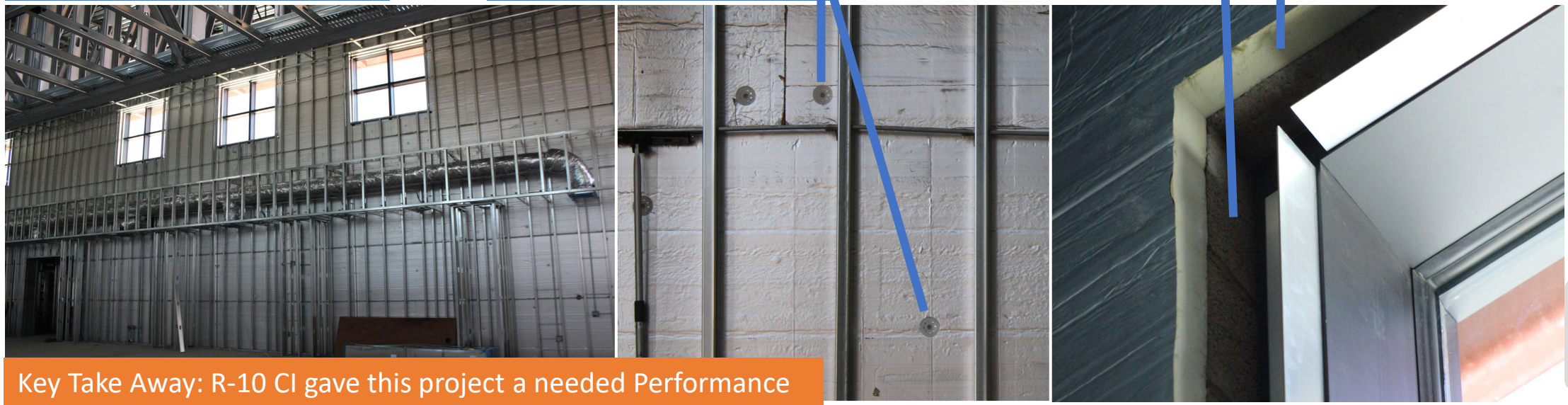
	Climate Zone															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mass Heavy[1]	0.253	0.650	0.650	0.650	0.650	0.690	0.690	0.690	0.690	0.650	0.184	0.253	0.211	0.184	0.184	0.160

CMU with Interior Metal Stud

R-10 CI – Held in place with CI masonry fasteners

CMU Solid Grout

R-10 Continuous Insulation (CI)



Key Take Away: R-10 CI gave this project a needed Performance Credit; Metal stud cavity left open for easy electrical installation.

Vertical Fenestration –Con't Table 140.3-B

Reminder: Window performance is climate zone specific for fixed windows, and curtainwalls or storefronts

Envelope	Fenestration				Climate Zone															
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		Vertical			Fixed Window															
			Area-weighted Performance Rating	Max U-factor	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.34	0.36	0.34	0.34	0.34	0.34	0.34	0.36
				Max RSHGC	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.22	0.25	0.22	0.22	0.22	0.22	0.22	0.25
				Min VT	0.42															
					Curtainwall or Storefront															
				Max U-factor	0.38	0.41	0.41	0.41	0.41	0.41	0.38	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
				Max RSHGC	0.25	0.26	0.26	0.26	0.26	0.26	0.25	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
				Min VT	0.46															
					Operable Window															
				Max U-factor	0.46															
				Max RSHGC	0.22															
				Min VT	0.32															
					Glazed Doors															
				Max U-factor	0.45															
				Max RSHGC	0.23															
				Min VT	0.17															
			Max WWR%		40%															

CZ 9,11-15 new values

CZ 1 and 7 new values

Space Conditioning

140.4(a)2 For Single zone systems with direct expansion (dx) cooling ≤ 240,000 Btu/hr:

- School building spaces:
  - CZ 2-15: Heat pump
  - CZ 1 and 16: Dual-fuel heat pump
- Retail and Grocery building spaces
  - CZ 2-15: Heat pump
  - CZ 1 and 16: cooling capacity <65,000 Btu/hr: Furnace A/C; cooling capacity ≤ 65,000 Btu/hr: Dual-fuel heat pump
- Office, Financial Institutions and Library building spaces:
  - CZ 1-15: Heat pump
  - CZ 16: cooling capacity <65,000 Btu/hr: Furnace A/C; cooling capacity ≥ 65,000 Btu/hr: Dual-fuel heat pump
- Office Spaces within the Warehouses
  - CZ 1-16: heat pump

Takeaway:
Where demonstrated to be cost effective, the baseline is a heat pump.

EXCEPTION to Section 140.4(a)2: Systems utilizing recovered heat for space heating.

Fan Power Budget –new calculation method for Systems ≥ 1kW

- Applies to **all fans** moving air in, out, and between conditioned spaces or circulating air to condition space
- Allowances vary by **system type, CFM, and floors served**
- At system design, flow cannot exceed budget
- See **Table 140.4-A Supply Fan Power Allowances** (Watts/cfm)-extensive—Includes 100% OA, Energy Recovery, low turndown single zone VAV, etc
- For elevations >3,000 feet, multiply fan budget by **Correction Factor listed in Table 140.4-C**

Takeaway:
New method of calculating fan power budget is more nuanced.
Applies to fans 1kW or larger –previously 5 hp (3.7 kW)

Excerpt from Table 140.4-A

Airflow	Multi-Zone VAV Systems ≤5,000 cfm[1]	Multi-Zone VAV Systems >5,000 and ≤10,000 cfm[1]	Multi-Zone VAV Systems >10,000 cfm[1]	All Other Fan Systems ≤5,000 cfm	All Other Fan Systems >5,000 and ≤10,000 cfm	All Other Fan Systems >10,000 cfm[1]
Supply System Base Allowance for AHU serving spaces ≤ 6 floors away).	0.395	0.453	0.413	0.232	0.256	0.236
Supply system base allowance for AHU serving spaces > 6 floors away	0.508	0.548	0.501	0.349	0.356	0.325
MERV 13 to MERV 16 Filter upstream of thermal conditioning equipment (~~mid-life~~two times the clean filter pressure drop)[2]	0.136	0.114	0.105	0.139	0.120	0.107

Economizers –Update to Cooling Air Handler Threshold

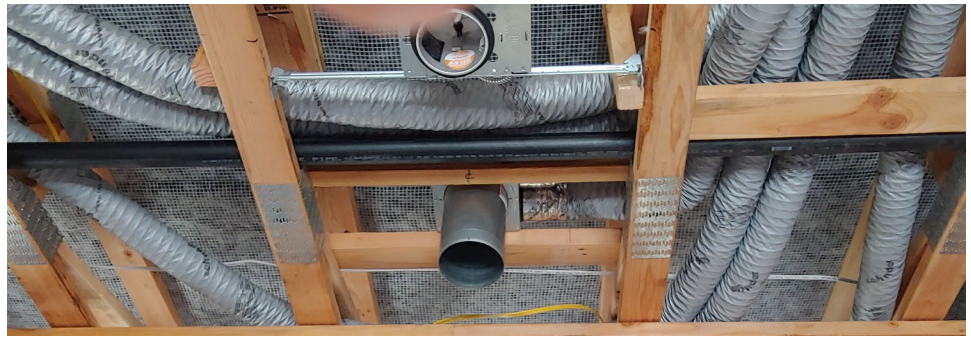
- Prescriptively required when the air handler has a **cooling capacity > 33,000 Btu/hr** (previously 54,000 Btu/hr)
  - Design criteria
  - Smaller rooftop units
  - Smaller split DX air handlers
  - VRFs and mini-splits
- Economizer **trade-off** for cooling system efficiency allowed –**Table 140.4-F**
- **New Exception** for air handlers that have a design **cooling capacity < 54,000 Btu/hr** and ventilation provided by a **DOAS with exhaust air heat recovery** –Refer to Sections 140.4(p),(q) and 120.1(c)3
- Guest Rms of Hotel/Motel and Computer Rms excluded from 140.4(e)
- **New Exception** for **controlled environment horticulture** spaces where carbon dioxide enrichment is required

Takeaway:
Broadening application of requirements for economizers to lower capacity units

3C REN

Dedicated Outdoor Air System (DOAS) –Section has been re-written

Units that are used to filter, condition or temper 100% outside air and are separate from space conditioning systems serving the same space:



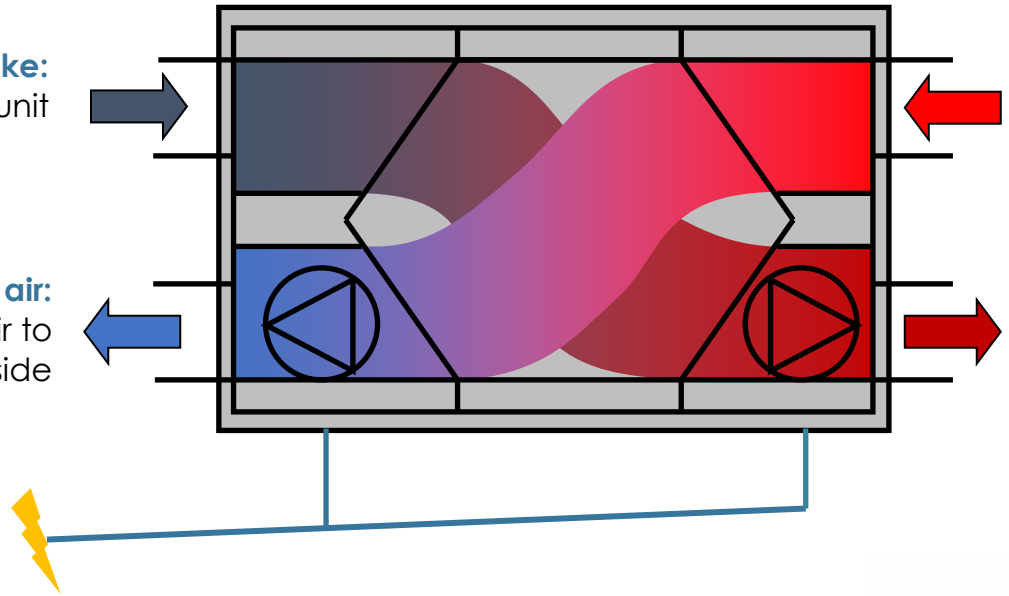
- Supply & exhaust fans:
  - ERV, HRV, DX-DOAS
  - Minimum of 3 speeds to facilitate system balancing
- DOAS with mechanical cooling providing ventilation to multiple zones and operating in conjunction with zone heating and cooling systems shall **not use heating or heat recovery** to warm supply air above 60ºF when representative building loads or outdoor air temperature indicate that **majority of zones require cooling**

Meant to limit reheating, and conserve energy

Example of One Type of Energy / Heat Recovery Ventilation (ERV / HRV)

Outdoor air intake: fresh air into unit

Exhaust / Extract air: post-recovery air to outside



Exhaust / Extract air: From inside conditioned space

Supply air (Outdoor air): outside air into living rooms, offices, classrooms

HRV –Heat Recovery Ventilator
ERV –Energy Recovery Ventilator

- Thin membrane, multi-channel pathway for the Outdoor/Supply air going in and the Exhaust/Extracted air going out
- The air pathways do not mix

Dedicated Outdoor Air System (DOAS) –con't

- DOAS unit fan systems:
  - If input power < 1 kW, shall not exceed a total combined fan power of 1.0 W/cfm
  - In input power ≥ 1 kW, shall meet requirements of 140.4(c)
- Supply air:
  - Shall be delivered directly to the occupied space or at the outlet of any terminal heating or cooling coils
  - Shall cycle off any zone heating and cooling equipment fans, circulation pumps and terminal unit fans when there is no call for heating or cooling in the zone.
  - Exceptions apply- 140.4(p)2

Meant to eliminate energy waste

New –Exhaust Air Heat Recovery

Fan systems designed to operate to the criteria listed in either Table 140.4-J or K **shall include an exhaust air heat recovery** system. Tables are based on Climate Zone and the percent of outdoor air at full design airflow.

Table 140.4-J (< 8,000 hrs/yr)

Table 140.4-K (≥ 8,000 hrs/yr)

Values are the design supply fan airflow rate in CFM

Table 140.0-K ENERGY RECOVERY REQUIREMENTS BY CLIMATE ZONE AND PERCENT OUTDOOR AIR AT FULL DESIGN AIRFLOW (≥8,000 HOURS / YEAR)

% Outdoor Air at Full Design Airflow	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
≥10% and <20%	≥10,000	≥10,000	NR	NR	NR	NR	NR	NR	NR	≥40,000	≥40,000	≥20,000	≥10,000	≥10,000	≥10,000	≥10,000
≥20% and <30%	≥2,000	≥5,000	≥13,000	≥9,000	≥9,000	NR	NR	NR	NR	≥15,000	≥15,000	≥5,000	≥5,000	≥5,000	≥5,000	≥5,000
≥30% and <40%	≥2,000	≥3,000	≥10,000	≥6,500	≥6,500	NR	NR	NR	≥15,000	≥7,500	≥7,500	≥3,000	≥3,000	≥3,000	≥3,000	≥3,000
≥40% and <50%	≥2,000	≥2,000	≥8,000	≥6,000	≥6,000	NR	NR	NR	≥12,000	≥6,000	≥6,000	≥2,000	≥2,000	≥2,000	≥2,000	≥2,000
≥50% and <60%	≥2,000	≥2,000	≥7,000	≥6,000	≥6,000	NR	NR	≥20,000	≥10,000	≥5,000	≥5,000	≥2,000	≥2,000	≥2,000	≥2,000	≥2,000
≥60% and <70%	≥2,000	≥2,000	≥6,000	≥6,000	≥6,000	NR	NR	≥18,000	≥9,000	≥4,000	≥4,000	≥2,000	≥2,000	≥2,000	≥2,000	≥2,000
≥70% and <80%	≥2,000	≥2,000	≥6,000	≥5,000	≥5,000	NR	NR	≥15,000	≥8,000	≥3,000	≥3,000	≥2,000	≥2,000	≥2,000	≥2,000	≥2,000
≥80%	≥2,000	≥2,000	≥6,000	≥5,000	≥5,000	NR	NR	≥12,000	≥7,000	≥3,000	≥3,000	≥2,000	≥2,000	≥2,000	≥2,000	≥2,000

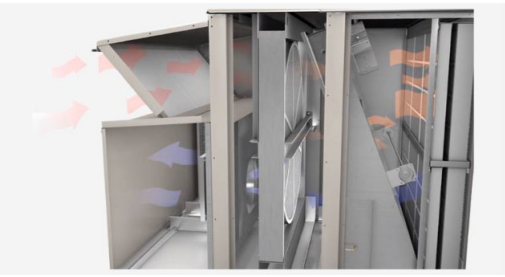
New Section–Exhaust Air Heat Recovery

- Fan System must meet either
  - Sensible energy recovery ration of at least 60% OR
  - Enthalpy recovery ratio of at east 50% for both heating and

cooling design conditions, and be rated in accordance to AHRI 1060

- AND Energy recover bypass or control to:
  - Disable energy recovery AND directly economize with ventilation air based on outdoor air temperature limits specified in Table 140.4-G
  - For energy recovery systems where the transfer of energy cannot be stopped, bypass shall prevent total airflow rate of either outdoor air or exhaust air through the energy recovery exchanger from exceeding 10% of the full design airflow rate

Heat recovery flywheel for improved efficiency



Many Exceptions included, see Section 140.4(q)

Domestic Hot Water –Prescriptive (140.5) or Performance (140.1)

Hotel/Motel

- Same requirements as multifamily section 170.2(d) for individual or central system

Other Occupancies

- Any water heater that meets the Mandatory requirements
- **Thermal efficiency of 90%** required when a combined input rate is ≥ **1,000,000 Btu/hr,** with some exceptions
- **Exception**: A water heating system serving an **individual bathroom** space may be an **instantaneous electric** water heater

School Buildings <25,000 ft^2 and <4 stories

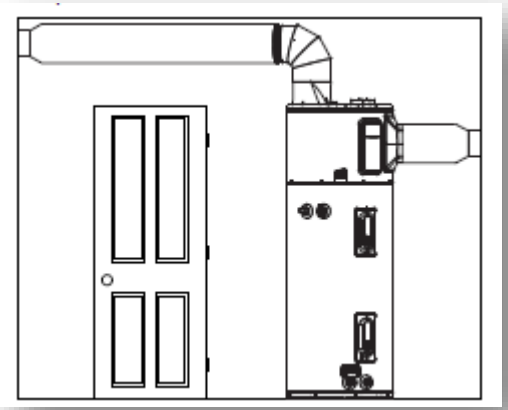
- CZ 2-15: a **HPWH** system

Residential – Single and Multifamily

Commercial – Hospitality, Retail, Schools

Design Considerations – Integrated HPWH

- Integrated HPWH tanks taller than standard gas or electric units
- Requires clearances on the sides, top and back, for air flow and access to the air filters
- Operating Temp between 45 F and 90 -110F
- Noise typically around 50 db
- System creates cold dehumidified air and condensate
- Needs 750 – 1000 cubic feet volume, or ducted vent kit



Central Domestic Hot Water (>8 units)

Gas or propane system is allowed with the following:

- A recirculation system (does not have to be dual loop)
- CZ 1-9: Total input rating ≥1,000,000 Btu/hr with a minimum thermal efficiency of 90%
- Solar water heating system with a minimum solar savings fraction of:
  - CZ 1-9 require 0.20 SSF
  - CZ 10-16 require 0.35 SSF
  - Solar can be reduced by 5% with a drain water heat recovery system

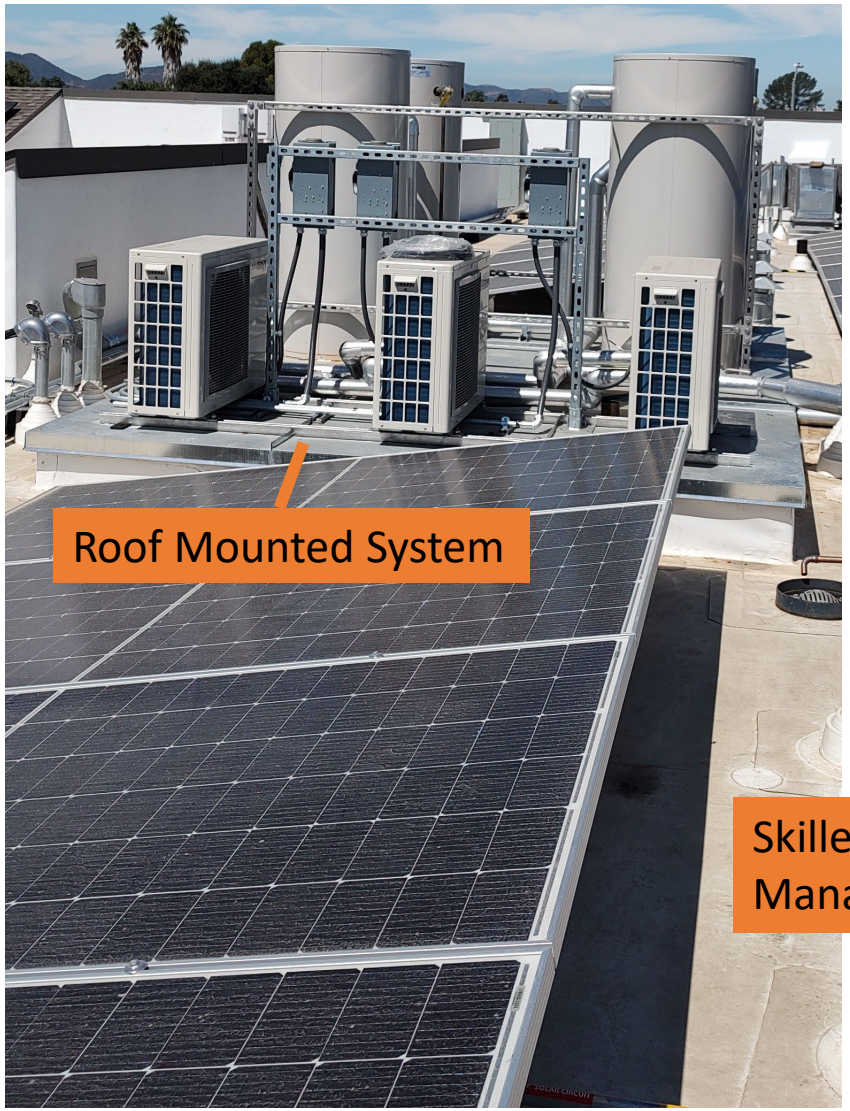
Performance Method is often used to avoid the solar thermal system requirement.

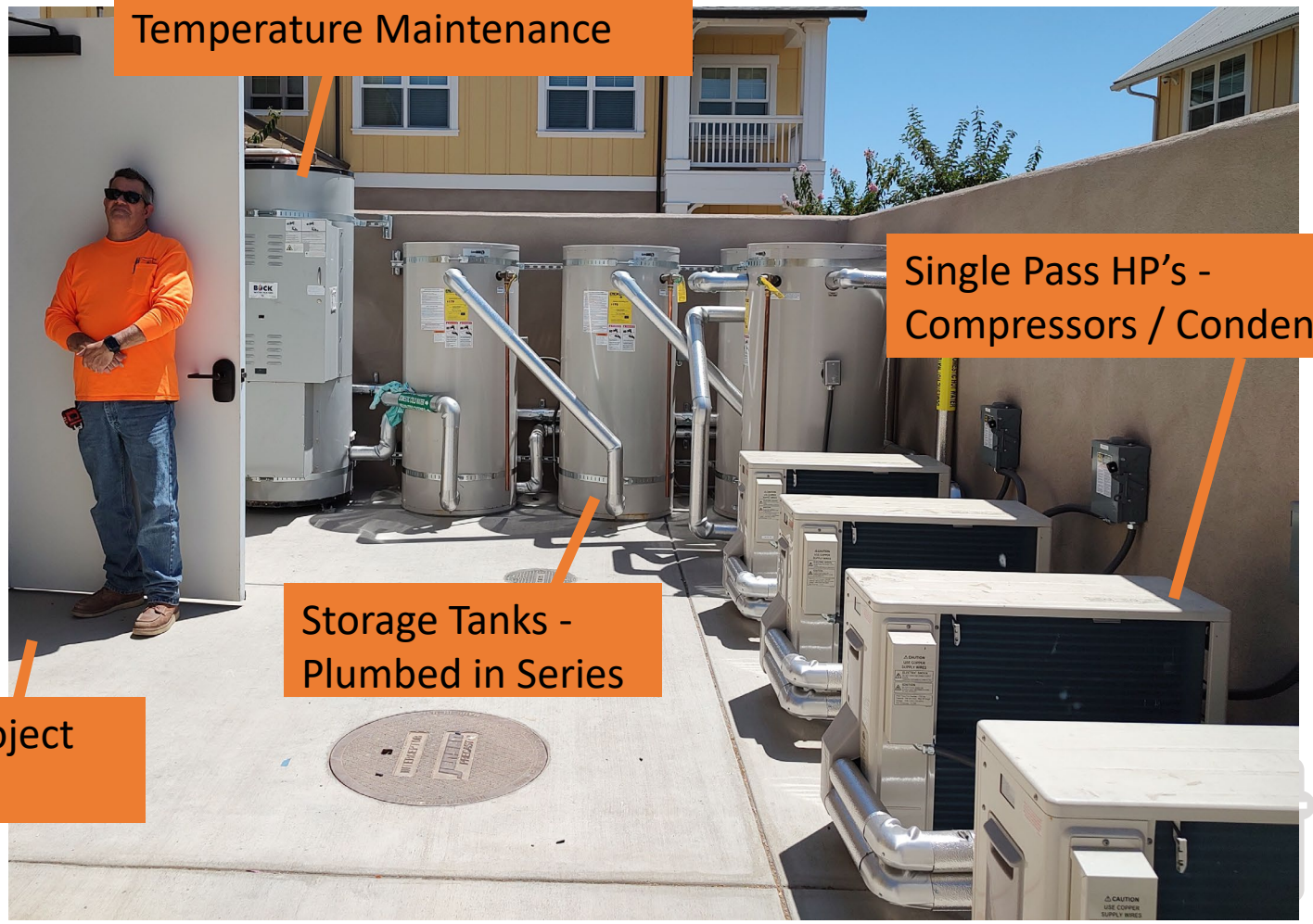
Central Domestic Hot Water (>8 units)

Heat Pump System with the following:

- Hot water return from recirculation loop shall connect to a recirculation loop tank
- Fuel source for the recirculation loop tank shall be electricity if auxiliary heating is needed
- For systems with single pass primary heat pump water heater, the primary thermal storage tanks shall be plumbed in series if multiple tanks are used
- Primary storage tank temp setpoint ≥135ºF
- Recirculation loop tank temp setpoint should be at least 10ºF lower than primary thermal storage tank
- Minimum HPWH compressor cut-off temp ≤ 40ºF

Central Heat Pump Systems – SanCO2 Systems





Project: Harry's House – Santa Barbara County

Photovoltaic (PV) –Applicable Bldg Type and System Size

Use the smaller of:

1. **kW_{PV} = (CFA x A)/1000**
   - CFA = conditioned floor area in square feet
   - A = PV capacity factor from Table 140.10-A

OR

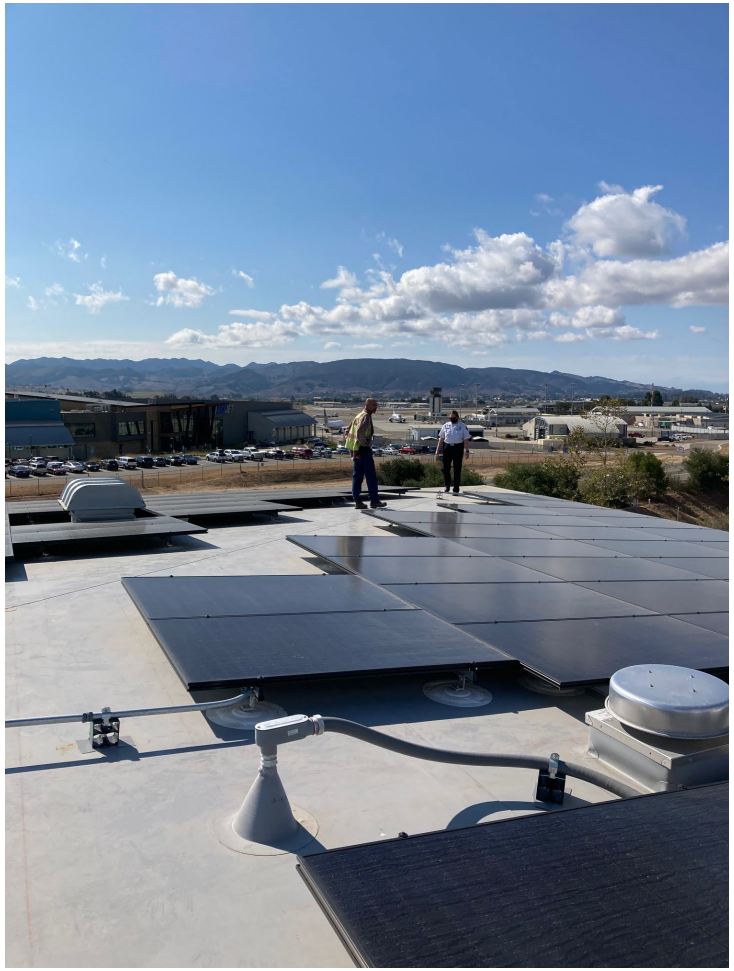
2. **Total SARA x 14 W/ft²**

Table 140.10-A – PV Capacity Factors

-	Factor A – Minimum PV Capacity (W/ft² of conditioned floor area)		
Climate Zone	**1, 3, 5, 16**	**2, 4, 6-14**	**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

Applies to new construction as **listed in Table 140.10-A** or mixed occupancy where one or more of these building types constitute at least 80% of the floor area of the building

Solar Access Roof Area (SARA)



- Area of a buildings' roof space capable of supporting PV system
- Area of all roof space on covered parking areas, carports and other newly constructed structures onsite that are compatible with supporting a PV system per CBC 1511.2

Exceptions:

- Any roof area that has <70% annual solar access
- Occupied roof areas per CBC 503.1.4
- Roof area not otherwise available due to compliance with other State Building Code requirements, and local codes if confirmed by the Executive Director

PV System Size (kW_{dc}):

$$kW_{PV} = \frac{CFA \times A}{1000}$$

EQUATION 140.10-A

CFA: Conditioned Floor Area

A: Climate Zone Factor

No PV required if:

- PV size < 4 kWdc;
- SARA < 80 sq ft contiguous or < 3% of the CFA
- Snow loading parameters

OR

the PV size = 14 W/sq ft x SARA

SARA is the Solar Accessible Roof Area (area receiving 70% solar insolation)

VTA Housing Ohlone Station, San Jose, CA (CZ 4)

Restaurant -- 2,000 sf

Retail – 3,500 sf

Office and Unleased – 7,000 sf

SARA = 4,500 sf

kW_{PV} = (**2000** x 0.44)+(**3500** x 2.91) +(**7000** x 3.13) /1000

kW_{PV} = 33 kW

OR

kW_{PV} = 14 W/sf x 4,500 sf /1000

kW_{PV} = 63 kW

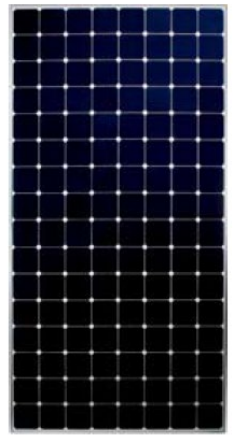
Example Estimating Quantity of Panels

Given a PV System Size (kWdc)

- Take the PV System Size (kWdc) calculated from EQ 170.2-C/D and multiply by 1000 to convert to watts.
- Look at different PV panel products and look for nominal power output (W, watts) and the panel dimensions.
- Divide PV System Size (watts) by a panel's nominal power (W, watts) to determine an estimated number of panels.

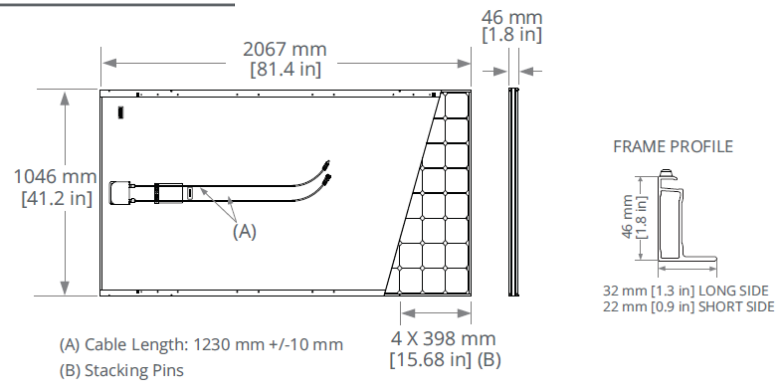
Sunpower x-series-commercial x21-470-com

	Electrical Data
	SPR-X21-470-COM SPR-
Nominal Power (Pnom)[5]	470 W
Power Tolerance	+5/−0%
Avg. Panel Efficiency[6]	21.7%
Rated Voltage (Vmpp)	77.6 V
Rated Current (Impp)	6.06 A
Open-Circuit Voltage (Voc)	91.5 V
Short-Circuit Current (Isc)	6.45 A



SPR-X21-470-COM

For estimating a layout, use the outer panel dimensions and add 0.5" as an average value for spacing between panels to allow for some of the more common mounting hardware.



PV System Size = 33 kW*1000 = 33000 W

No of Panels = PV System Size / Panel wattage

= 33000 W / 470 W

= 70.2, call it **71 Panels**

Battery Storage

All buildings **required** to have a **PV system** shall also have a **battery storage system**.

Reminder: Battery system must meet **both** rated **energy** capacity (kWh) and the rated **power** capacity (kW) Calculate the energy and power capacities for each occupancy type in mixed use buildings, and sum the values.

Rated Energy capacity :

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

D is the rated single charge-discharge cycle AC to AC efficiency of the battery

Rated Power capacity:

$kW = kW_{PVdc} \times C$

Table 140.10-B – Battery Storage Capacity Factors

-	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

Battery Storage

Exceptions:

- If installed PV system size < 15% of the size determined by Equation 140.10-A
- In buildings with system requirements with < 10 kWh rated capacity
- In climate zone 1, no battery storage system is required for offices, schools, and warehouses.

Note: For multi-tenant buildings the energy and power capacities of the battery storage system shall be based on the tenant spaces with more than 5,000 ft^2 of conditioned floor area.

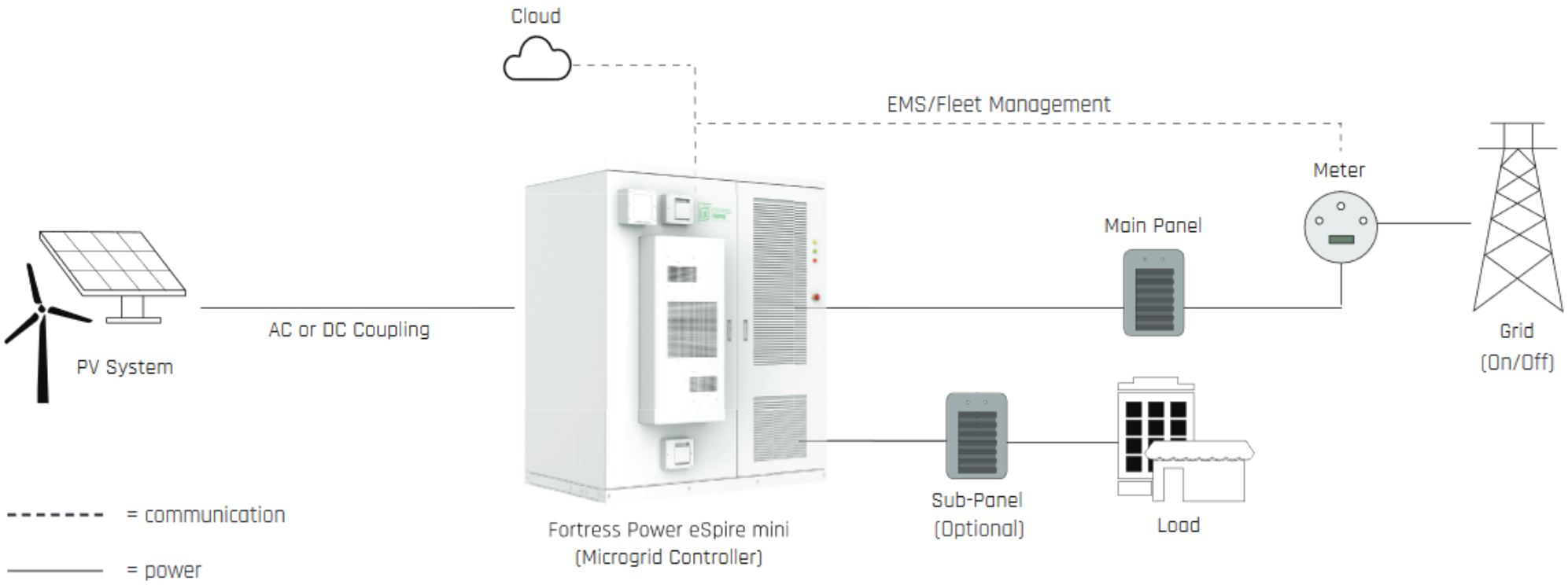
Example of a Commercial System

eSpire 280 Energy Storage System

Safe Technology & Multi-level Protection

The solution uses the best-in-class Tier 1 Lithium Iron Phosphate (LFP) chemistry forthe highest level of safety, thermal stability, and reliability; An integrated, multi-levelBattery Management System (BMS) monitors, optimizes, and balances the system.

Example of Multifamily / Small Commercial System



eSpireMini_022224

Integrated, Pre-configured Packaged
Battery Energy Storage System

Photovoltaic (PV) and Battery – NRCC-SAB-E

Sample form with instructions is available on the CEC's website. Use the Energy Code Ace Forms Tool website for completing the NRCC-SAB-E form for permit.

STATE OF CALIFORNIA
Solar And Battery CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE		NRCC-SAB-E
Project Name: MG Rancho Mission Viejo East and West	**Report Page:**	**(Page 4 of 6)**
	Date Prepared:	2024-07-25T13:19:56-04:00

J. PHOTOVOLTAIC (PV) AND BATTERY SYSTEMS

This table documents compliance with prescriptive photovoltaic and battery system requirements in 140.10/ 170.2(g and h). Unless the project meets one of the listed exceptions, or trades-off PV in an energy model using performance path, 140.10/ 170.2(g and h) requires installed photovoltaic and battery systems for newly constructed buildings. The installed PV systems must meet the minimum requirements in Joint Appendix 11.

Photovoltaic (PV) System

01	02	03	04	05	06	07	08
Occupancy	Conditioned Floor Area (ft^2)	Area of New Roof[1] (ft^2)	Roof Area < 70% Solar Access[2] (ft^2)	Plansheet or Document showing Solar Access Calculations	Occupied Roof Area[3] (ft^2)	Solar Access Roof Area (SARA) (ft^2)	Min Size of PV System Required (kWdc)
High-Rise Residential	225,531	57,682	21,073	MEP roof plans	2,000	34,609	484.53
						Total Min Size PV System Required for all Spaces (kWdc):	484.53
						Total Size PV System in Design (kWdc):	500

[1]FOOTNOTES: Includes the area of the 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 Title 24, Part 2 Section 1511.2.
[2]Solar access must be determined using CEC approved solar access calculation tools found at https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/solar-assessment-tools.
[3]As specified by CBC Section 503.1.4.

Battery Storage System

01	02	03	04	05
Space Type	Min Size of PV Applicable To Battery Sizing (kWdc)	Rated Single Charge-Discharge AC Efficiency of Battery System[1]	Min Battery Rated Energy Capacity Required (kWh)	Min Power Capacity of Battery Required (kWdc)
High-Rise Residential	484.53	0.92	520.31	125.97
		Total Min Energy (kWh) and Power (kW) Capacity Required	520.31	125.98
		Total Energy (kWh) and Power (kW) Capacity in Design	529	143

[1]FOOTNOTE: Rated single charge-discharge cycle AC to AC (round trip) efficiency of the battery storage system

Excerpt from the Ace Forms Tool interview:

Solar & Battery Scope

This form is used to demonstrate compliance with prescriptive PV and battery requirements in §140.10/§170.2 for nonresidential, multifamily and mixed-use buildings and prescriptive solar thermal requirements in §170.2(d)3C for multifamily and hotel/ motel occupancies.

Which of the following occupancy types are included in your project? (Select all that apply)

Gymnasium Building, High-Rise Residential, Office Building & 4 more

Which of the following choices best describes the scope of your roof project? §110.10

New construction

How many above grade stories are on this project?

Building 4-10 stories

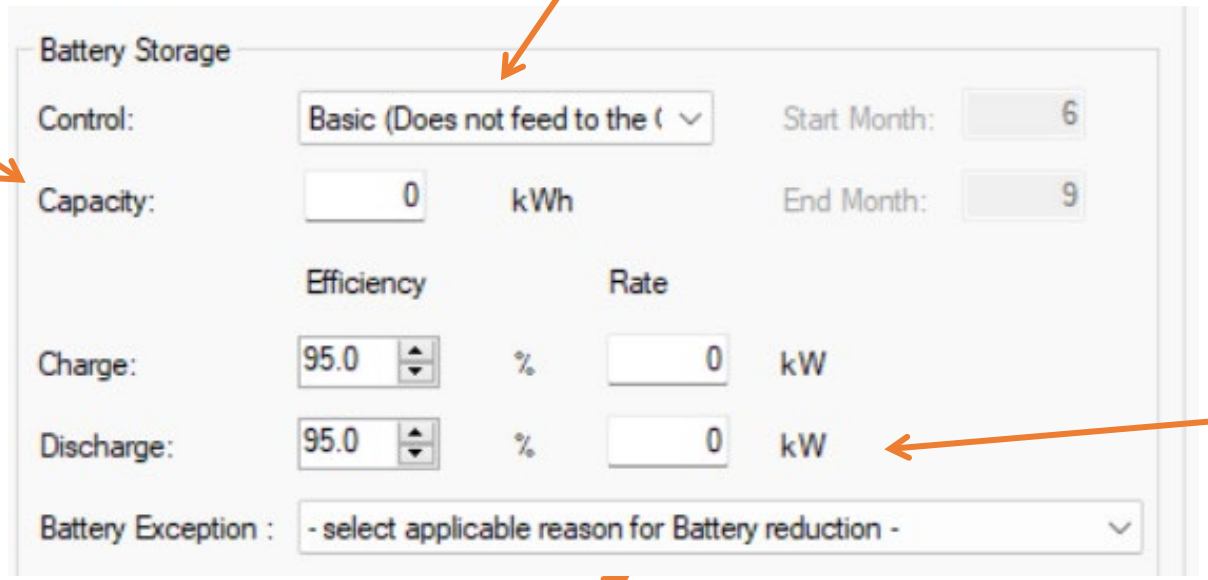
Performance Method –Example of EnergyPro v9 Input

Additional Credit can be used for reducing the "carbon" Source Metric

Control Options:

- **Basic** (Does not feed to the Grid)
- **Time of Use** [*need 'Start Month' and 'End Month'*]
- **Advances DR Controls** [i.e., *Advanced Demand Response Controls / JA12 Advanced Demand Flexibility Control*]

Energy Capacity (kWh) is obtained from manufacture.



Battery Charge and Discharge Efficiency is a 95% default. [*Equivalent to 90% round trip efficiency]*

Rate of Charge and Discharge is obtained from manufacture.

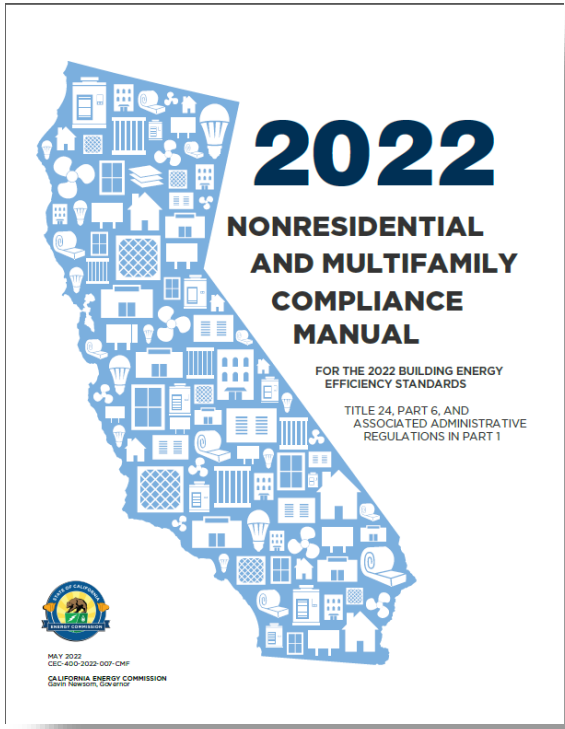
Note: Battery Exceptions apply to Non-Res occupancies and Multi-Family high-rise buildings (greater than 3 stories).

Additions and Alterations

Alterations

Wall Alterations

- When **25% or more of the building envelope wall area** is altered it needs to meet the air barrier design and material requirements for newly constructed building
- **See 3.2.4 for air barrier details and blower door testing**
- If the **air leakage rate exceeds 0.4 cfm/sq ft** a Visual Inspection and Diagnostic Evaluation must be completed in accordance with Nonresidential Appendix NA5.7 to find the sources of excessive leakage. The leaks shall then be sealed.



Tip:
The 2022 Nonresidential and Multifamily Compliance Manual has numerous **alteration scenarios with potential cost effective solutions and considerations, especially for roofing and HVAC roof top units**– See Section 3.6 starting at pg 3-84.

Alterations

Roofing Alterations

- When 50% or 2000 sf of existing roof is replaced or recovered, the new requirements under **Section 140.3(a)1A** are triggered
- **Table 141.0-B** Roof/Ceiling Insulation Trade-offs for Low-Sloped Aged Solar Reflectance has updated U-factors and a new climate zone organization
- For **low-sloped roofs**, the area of the roof recover or roof replacement shall be insulated to the level specified in **Table 141.0-C**.

End result of changes is higher levels of roof insulation

TABLE 141.0-C INSULATION REQUIREMENTS FOR ROOF ALTERATIONS

Climate Zone	Continuous Insulation R-value	U-factor
1-5, 9-16	R-23	0.037, with at least R-10 above deck
6-8	R-17	0.047, with at least R-10 above deck

Additions and Alterations

- **HVAC alterations –New or replacement space conditioning system or components**:
  - **Additional fan power allowances** are available in **Table 141.0-D** and can be added to the allowances in Tables 140.4-A and 140.4-B (exceptions apply)
- **Duct alterations** (considered 'new' ducts if replacing 75% of the duct system)
  - The duct system that is connected to the new or replaced space-conditioning system equipment shall be sealed and HERS tested **< 6%** leakage
  - Duct extensions for constant volume, single zone systems serving less than 5,000 sf, shall be sealed and HERS tested **< 15%**
- **Water Heater alterations**
  - Service water heating systems shall meet the requirements of 140.5(a)2 and 140.5(b), except for the solar water heating requirements
  - Follows the new requirements for Hotel/Motel, Non-Res, and large capacity boiler efficiency

Excerpt from Table 141.0-D

Airflow	Multi-Zone VAV Systems[1] ≤5,000 cfm	Multi-Zone VAV Systems[1] >5,000 and ≤10,000 cfm	Multi-Zone VAV Systems[1] >10,000 cfm	All Other Fan Systems ≤5,000 cfm	All Other Fan Systems >5,000 and ≤10,000 cfm	All Other Fan Systems >10,000 cfm
Supply Fan System Additional Allowance	0.135	0.114	0.105	0.139	0.12	0.107
Supply Fan System Additional Allowance In Unit with Adapter Curb	0.033	0.033	0.043	0.000	0.000	0.000
Exhaust/ Relief/ Return/ Transfer Fan System Additional Allowance	0.07	0.061	0.054	0.07	0.062	0.055

Reminder: Additions and Alterations can be shown to comply with the Energy Code via Performance (computer modeling) or Prescriptively (checklist).

Questions about Title 24?

3C-REN offers a *free* Code Coach Service

Online:
3c-ren.org/codes

Call:
805.781.1201

Energy Code Coaches are local experts who can help answer your Title 24 questions. Coaches have decades of experience in green building and energy efficiency improvements. They can provide citations and offer advice for your project in the tri-county region to help your plans and forms earn approval the first time.

Closing

- Continuing Education Units Available
  - Contact shuskey@co.slo.ca.us for AIA and ICC LUs
- Coming to Your Inbox Soon!
  - Slides, Recording, & Survey – Please Take It and Help Us Out!
- Upcoming Courses:
  - August 23rd - Building the Future: Electrification Strategies for Contractors and Architects
  - August 27th - Introduction to Passive House Trades
  - September 5th - Passive Design/Build™ Boot Camp – Free info session
  - September 12th - All-Electric Accessory Dwelling Units (ADUs)
  - Sep 30th – Oct 4th - Passive Design/Build Boot Camp with Emu Passive – People's Self Help Housing in San Luis Obispo
- Visit www.3c-ren.org/events for our full catalog of trainings.

Thank you!

For more info:
3c-ren.org

For questions:
info@3c-ren.org

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