



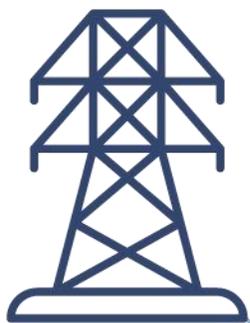
TRI-COUNTY  
REGIONAL ENERGY NETWORK

SAN LUIS OBISPO • SANTA BARBARA • VENTURA

# Renewable Energy, Energy Storage and Resiliency

*Jennifer Rennick, AIA, CEA, ASES Fellow, In Balance Green Consulting*  
*Andy Pease, AIA, LEED AP BD+C, In Balance Green Consulting*  
January 14, 2026





UTILITIES



# Tri-County Regional Energy Network

3C-REN is a collaboration between the tri-counties

Our programs reduce energy use for a more sustainable, equitable and economically vibrant Central Coast

Our free services are funded via the CPUC, bringing ratepayer dollars back to the region



# Our Services

## Incentives



### HOME ENERGY SAVINGS

[3c-ren.org/for-residents](https://3c-ren.org/for-residents)  
[3c-ren.org/multifamily](https://3c-ren.org/multifamily)



### COMMERCIAL ENERGY SAVINGS

[3c-ren.org/commercial](https://3c-ren.org/commercial)

Contractors can enroll at  
[3c-ren.org/contractors](https://3c-ren.org/contractors)

## Training



### BUILDING PERFORMANCE TRAINING

[3c-ren.org/events](https://3c-ren.org/events)  
[3c-ren.org/building](https://3c-ren.org/building)



### ENERGY CODE CONNECT

[3c-ren.org/code](https://3c-ren.org/code)

View past trainings at  
[3c-ren.org/on-demand](https://3c-ren.org/on-demand)

## Technical Assistance



### AGRICULTURE ENERGY SOLUTIONS

[3c-ren.org/agriculture](https://3c-ren.org/agriculture)



### ENERGY ASSURANCE SERVICES

[3c-ren.org/assurance](https://3c-ren.org/assurance)





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# 3C-REN INCENTIVES ARE BACK!

Incentives are available to lower the cost of energy-saving projects like HVAC, water heaters and insulation for single family and multifamily homes, and small-med businesses.

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# Learning Objectives

As energy codes and interest in electrification come together, the winning combination of renewable energy and energy storage work together to reduce pollution, improve affordability and, importantly, resiliency in emergencies that may lead to power outages. We'll review the background and drivers of distributed energy generation and storage and review different approaches to meet a project team's goals.

- Understand the drivers for increasing distributed PV's and battery storage for individual projects and neighborhoods
- Differentiate between terms including distributed energy storage, 'microgrids', islanding, grid-tied, demand response and behind-the-meter / in-front-of-the-meter
- Review key design features of batteries to inform system selection and sizing
- Understand factors impacting upfront and long-term system costs, including time of use and options for managing renewable energy and battery use.

## Learning Units

- 1.0 AIA HSW LUs approved for this course
- 1.0 ZNCD Continuing Education units for CAB



# Agenda

1. Terms and Energy Use in Context
2. Grid to Building Scale Solutions
3. Regulations and Best Practices: Solar Panels
4. Regulations and Best Practices: Chemical Batteries
5. Managing Client Expectations: Residential Examples
6. Resources





# Terms and Energy Use in Context

# Terms

**DER** –Distributed Energy Resources, typically small scale, such as rooftop solar, battery storage, combined heat and power (CHP) systems, wind, fuel cells, etc. The energy can feed a specific location or back to the ‘grid.’

**Microgrid** –Energy system that can operate independently of the grid, and operate while connected to the greater utility grid. The microgrid has its own monitoring system and controls, infrastructure, and includes energy production and storage capabilities. Microgrids can be an individual building or multi-building facility scale, or whole neighborhood or town scale.

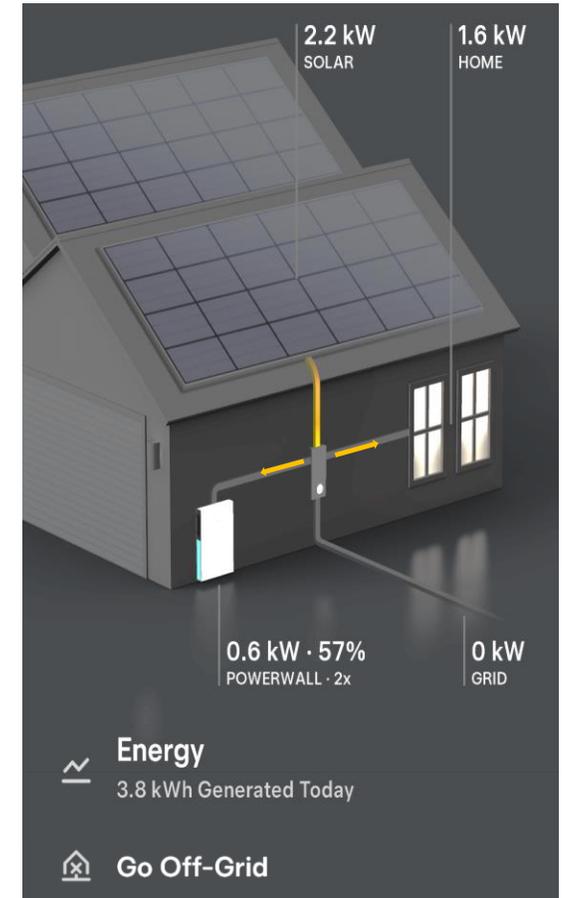
**Note:** *Microgrids* can use DERs. *DER* can include a specific microgrid(s).

**Islanding** –a term used to describe a microgrid that is operating independently from the greater utility grid.

**VPP** –Virtual Power Plant, refers to distributed, small battery storage systems that have utility demand response controls.

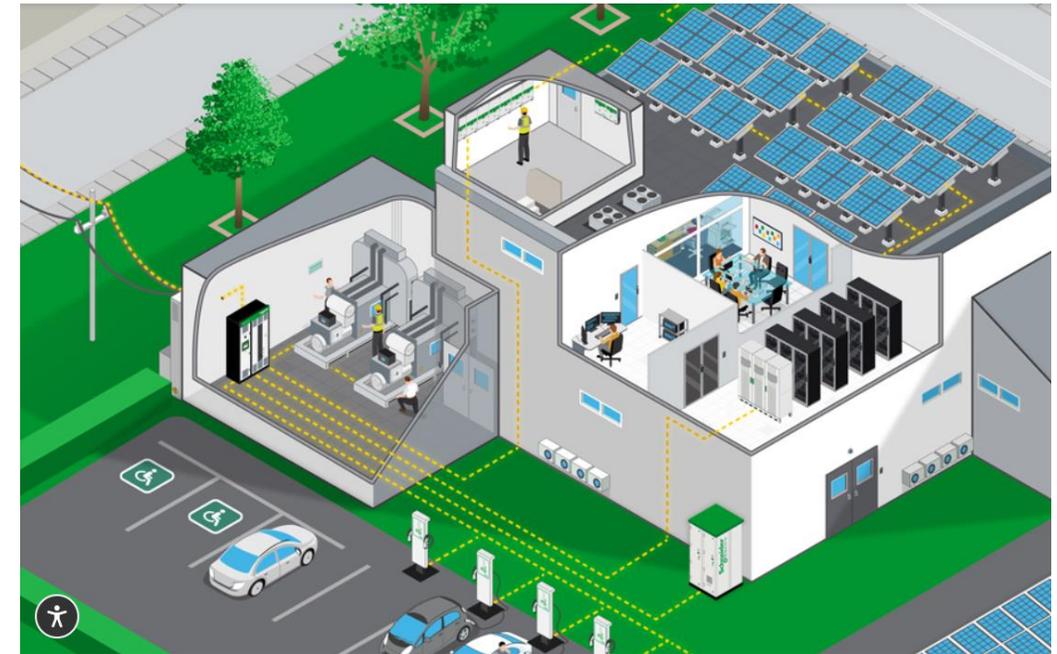
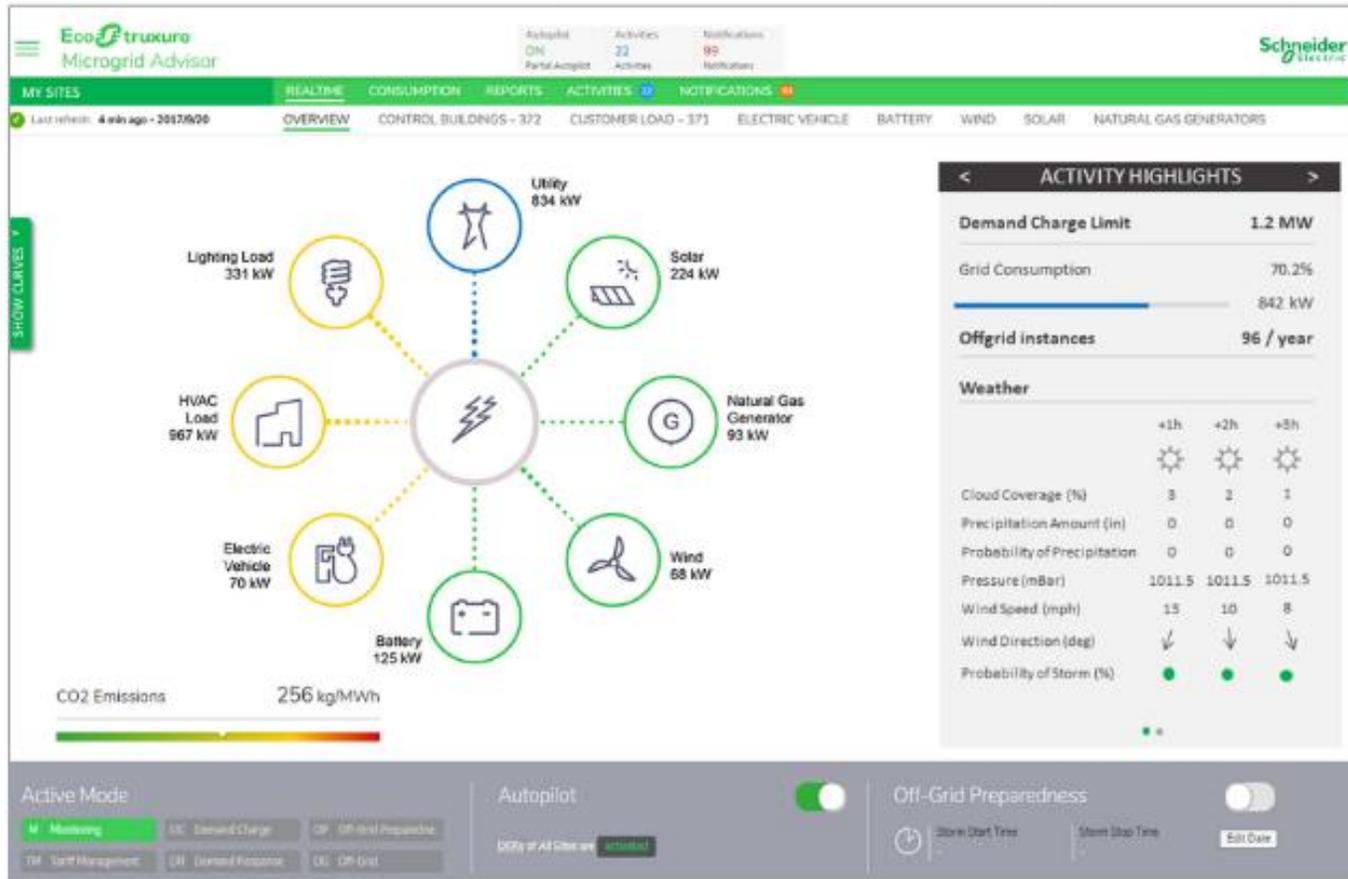
**PPA** – Power Purchase Agreement. Third party owns and maintains the solar or solar-and-battery system for a predetermined cost for the energy produced by the system.

**E-a-a-S** –Energy-as-a-Service. Third party owns and maintains the microgrid and associated equipment for a predetermined cost for the energy produced by the DERs.



# Microgrids and Energy-as-a-Service

Access real-time DER system operation



[www.schneider-electric.us/microgrid](http://www.schneider-electric.us/microgrid)



# Solar Energy and Building Energy Efficiency

- Established in 1974, National Renewable Energy Laboratory (NREL) began operating in 1977 as the Solar Energy Research Institute.
- President Carter signs the Solar Photovoltaic Energy Research, Development, and Demonstration Act of 1978 with a goal of getting solar cells to \$1/watt by 1987.
- California Buildings Standards Commission created the CA Energy Code in 1978
  - To reduce CA energy consumption
  - Development of California Energy Efficiency Standards



Using NREL's state-of-the-art facilities, a scientist scribes an organic photovoltaic module to make into a sample to test in a solar simulator. Photo by Dennis Schroeder, NREL

Image Source: [www.nrel.gov](http://www.nrel.gov)



# California Building-Sector Strategy

## Part One: Energy Efficiency

- Energy conservation, i.e. better insulation, windows, etc.
- Climate responsive strategies: passive solar and thermal mass, shading, night venting and economizers, etc.
- Higher efficiency equipment and appliances

## Part Two: Better Electricity Generation

- On-site solar PV systems
- Grid Scale: Solar, Wind, Hydro, etc.

## Part Three: Energy Storage

- On-site chemical batteries and demand response
- Grid scale batteries, pumped energy, long duration storage, etc.



Stern House  
Bruce Severance

- Orientation for passive solar and PV
- Designed for Zero Net Energy (ZNE) and occupant comfort
- Used phase change material (PCM)

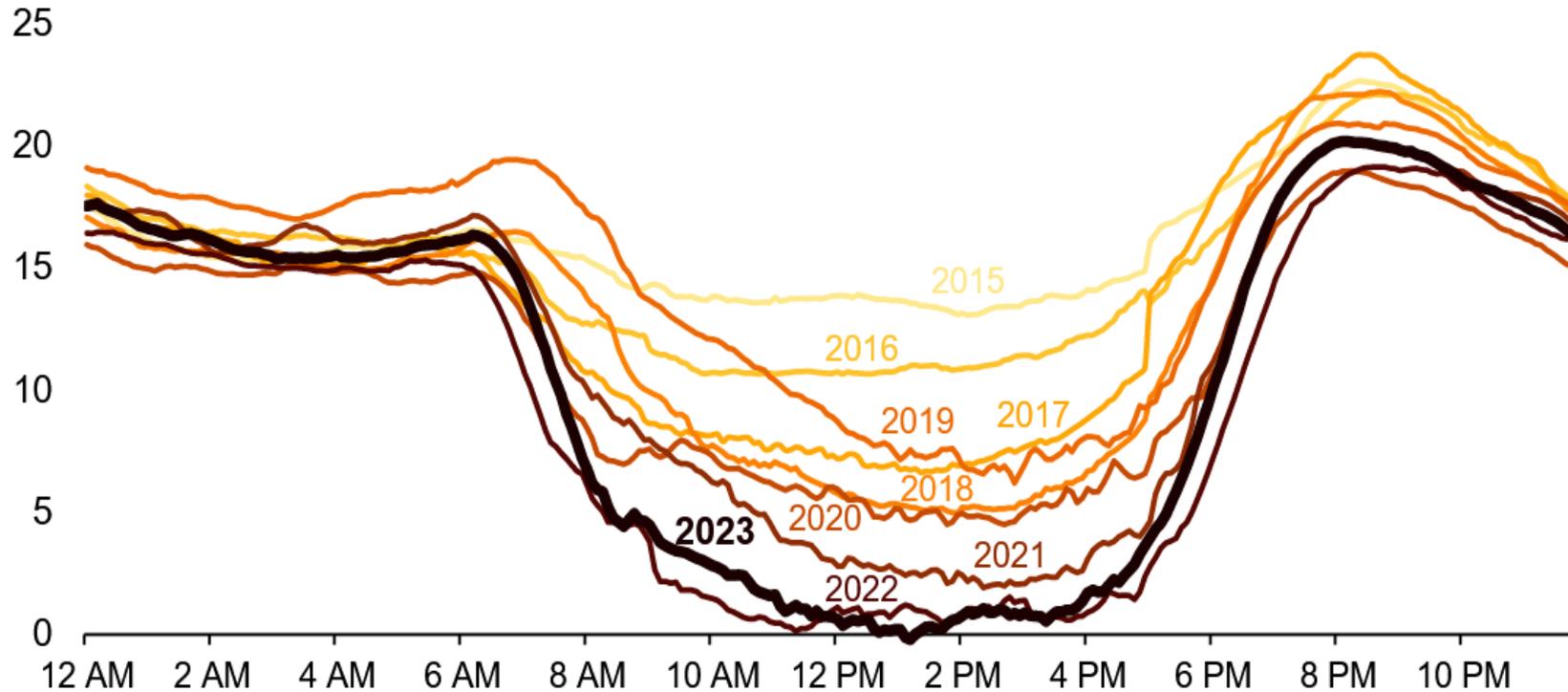


# The 'Duck Curve' – Daily Net Energy Load

JUNE 21, 2023

As solar capacity grows, duck curves are getting deeper in California

CAISO lowest net load day each spring (March–May, 2015–2023), gigawatts



Data source: California Independent System Operator (CAISO)



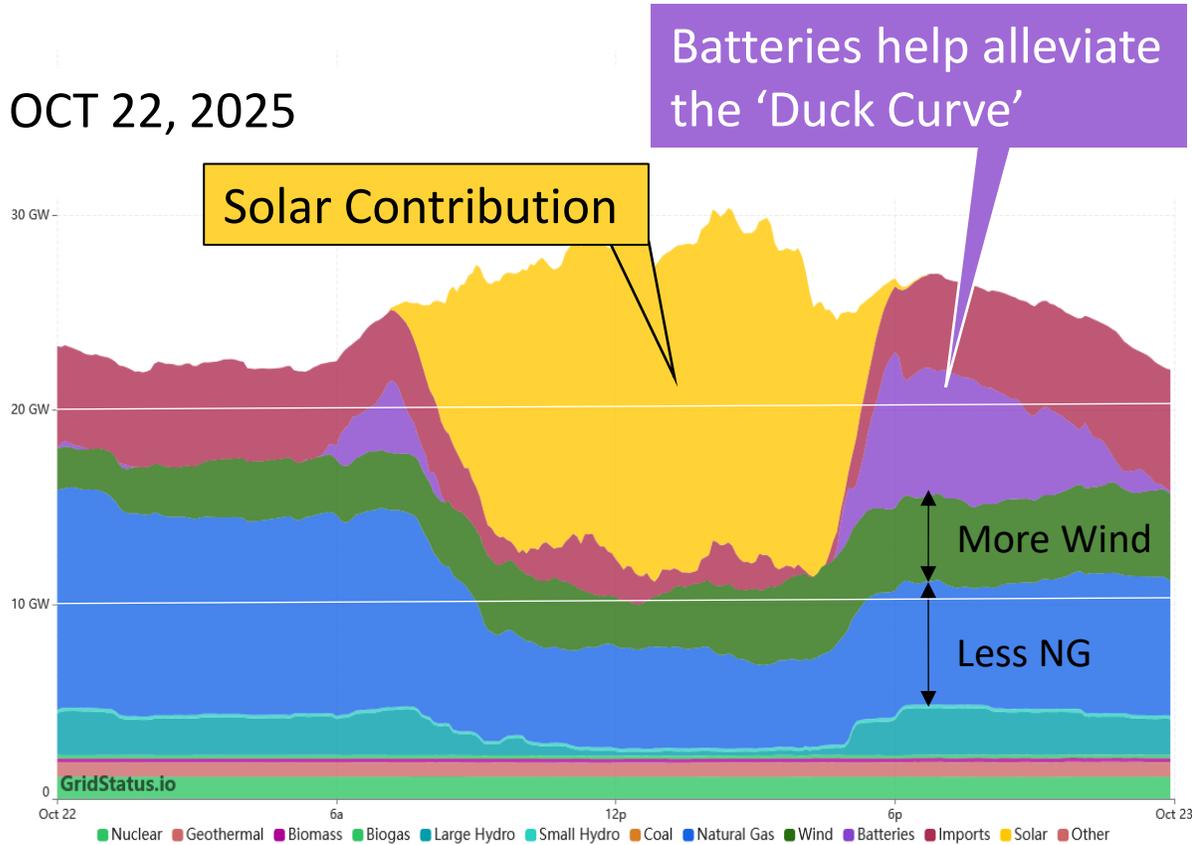
As solar energy production drops off in the afternoon, California's energy need continues to ramp up.



<https://www.eia.gov/todayinenergy>

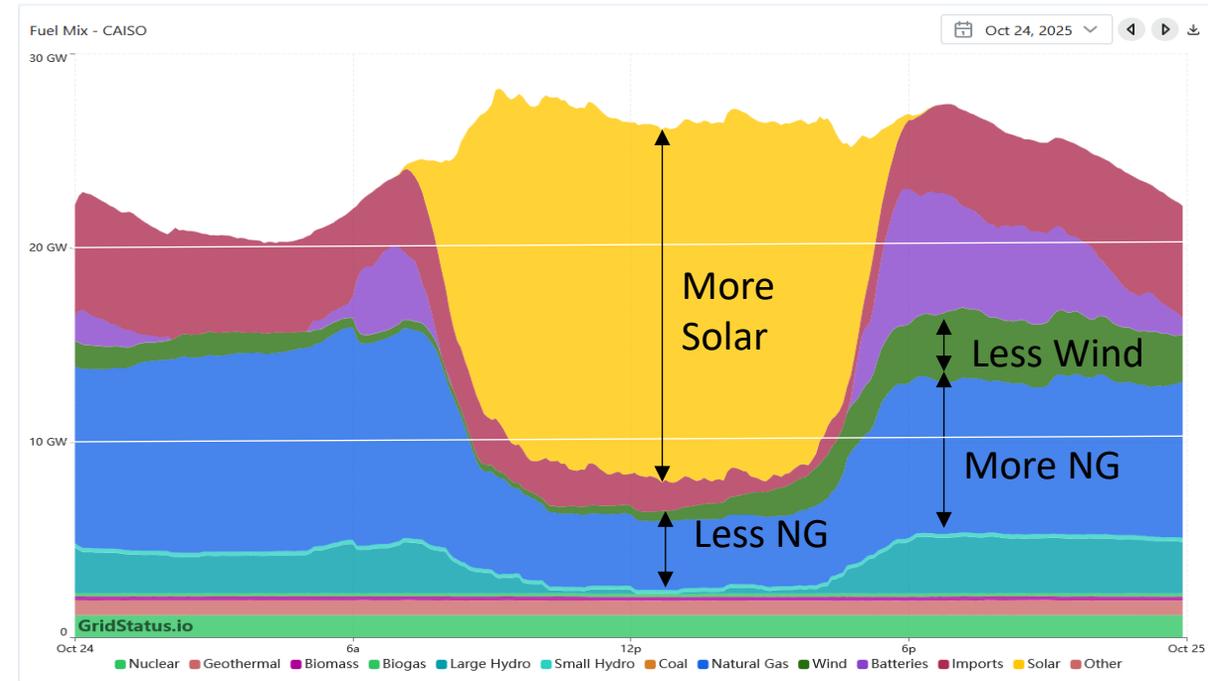
# CAISO – Recent 2025 Fuel Mix Snap-Shot – Two Day Comparison

OCT 22, 2025



OCT 24, 2025

<https://www.gridstatus.io>



Large Hydro

Natural Gas

Wind

Batteries

Imports

Solar

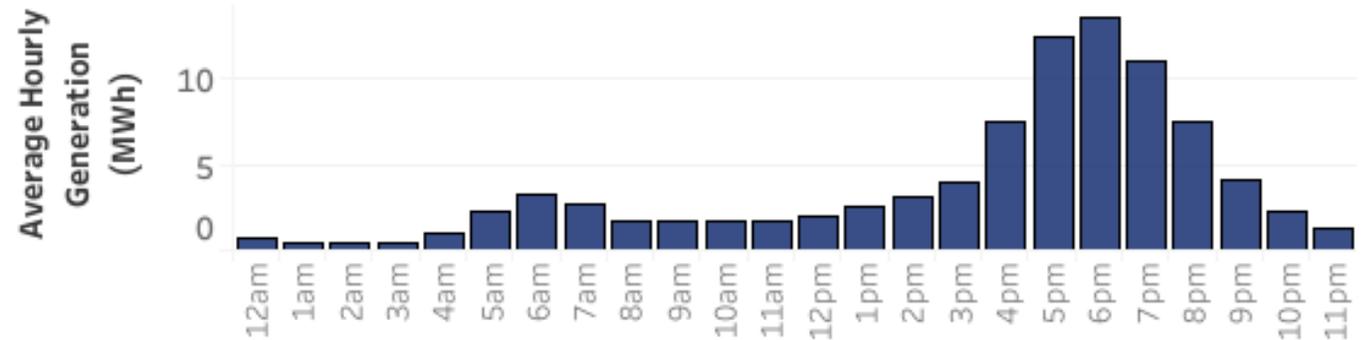


# Smaller NG Peaker Plants Built to Target Peak Demand



**McGrath Peaker – Oxnard, CA**  
Peaker, Natural Gas

## Hourly Generation Profile



**PSE** Bringing science  
to energy policy

<https://www.psehealthyenergy.org/work/california-power-map/>

### Plant Size:

Capacity (MW)	49
Generation (MWh)	27,516
Capacity factor	6.4%



# NG Plants Retired – Solar & Battery Storage Implemented





# Grid to Building Scale Solutions

# California Continues to Add Solar and Batteries to the Grid

- By Mar 2024, California energy was 69% from non-fossil fuel sources
- Nonhydroelectric renewables (mostly wind and solar) provided approx. 38% of the total mix



<https://www.mortenson.com/projects/edwards-sanborn-solar-plus-storage>



# Commercial Scale Microgrid –Solar and Storage



Mission Produce's Oxnard, CA Avocado Packing Facility

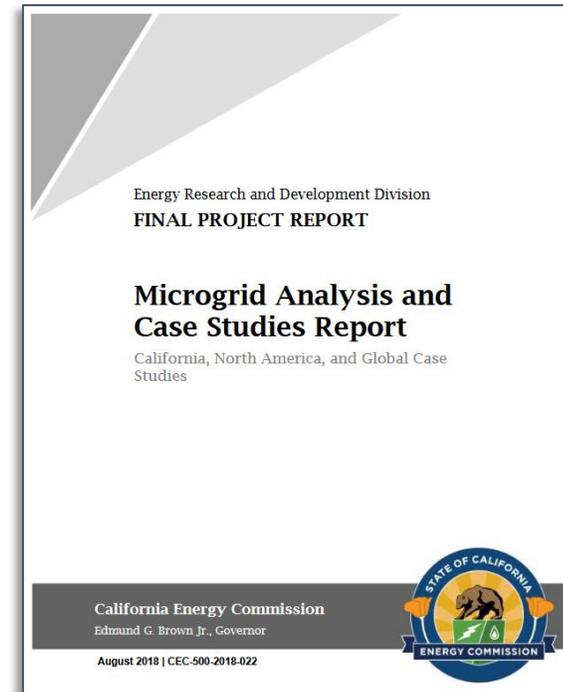
<https://m.andnowuknow.com/bloom/mission-produce-completes-its-2015-seasons-california-and-peru/christofer-oberst/47312>

## Technical Characteristics

- 1 MW solar PV
- 0.5 MW / 2.0 MWh advanced vanadium redox flow batteries, UET Uni.System
- Cloud-based demand management software platform, Powerit Solutions Spara Hub

## Costs

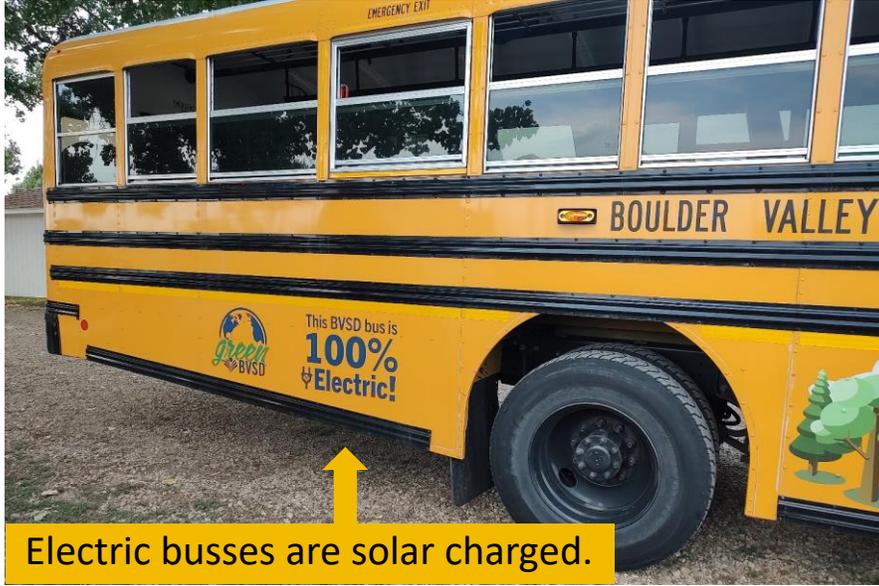
The estimated total cost of the 0.5 MW / 2 MWh flow batteries is approximately \$1 million. This does not include solar PV and other costs. UET's vanadium redox flow batteries are roughly at parity with 4-hour Li-ion batteries, which typically cost \$430-\$535/kWh (not counting extended warranties). However, flow batteries are less mature than Li-ion batteries, and expect to see a greater decrease in prices over time.



# Community Scale Solutions



Agrivoltaics: Solar Farm and Working Farm in Boulder, Colorado



Electric busses are solar charged.



Designed to have enough head room for people, animals and equipment.

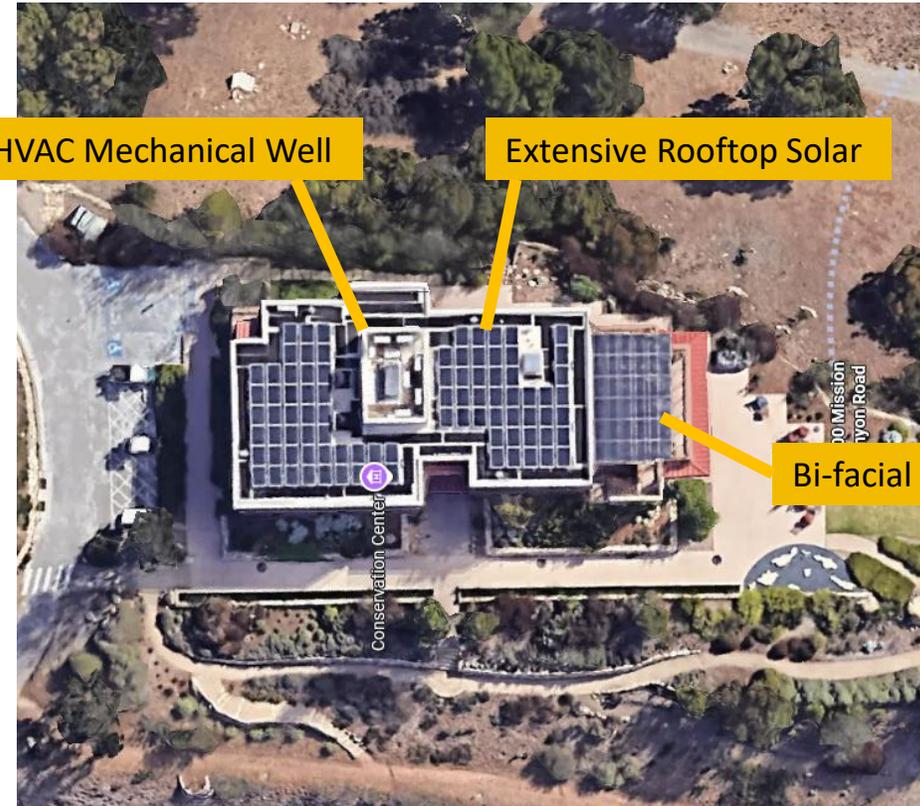


# Solar Energy in Community Spaces

Santa Barbara Botanical Gardens Conservation Center



Bi-facial Solar Panels –  
Covered Outdoor Seating



# Municipal Projects –Microgrids, Battery Storage and More



City of Santa Barbara  
**SUSTAINABILITY  
& RESILIENCE**



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[Home](#) > [City Clean Energy Projects](#) > Granada Garage Solar Project

<https://sustainability.santabarbaraca.gov/projects/city-clean-energy-projects/>

MENU



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**SUSTAINABILITY  
& RESILIENCE**

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“...In addition to providing a backup power benefit, this system will also allow the facility to "load shift," charging the battery with grid power when electricity is abundant and cheapest in the middle of the day, and discharging the battery during peak evening times when electricity is in short demand and most expensive.”



425-kW system combines solar photovoltaic and battery energy storage at the Grenada Garage. The microgrid will generate power for the garage, offices, 911 Call Center and offset electricity costs at the nearby Central Library.

<https://www.microgridknowledge.com/community-microgrids/article/33010977/santa-barbara-microgrid>

# Solar Energy in Santa Barbara Multifamily Projects

All-Electric Affordable Multi-family Projects in North County Santa Barbara



## Rooftop Equipment:

HVAC, DHW, Solar Panels, Vent Stacks, electric Conduit, etc.

## Electrical Equipment:

Solar Inverts, Electric Panels, Switch Gear, Electric Meters, etc



# Resiliency: Site Includes Battery, Back-up Generator and Solar

Santa Barbara County Office of Emergency Operations



Parking Canopy – while under construction

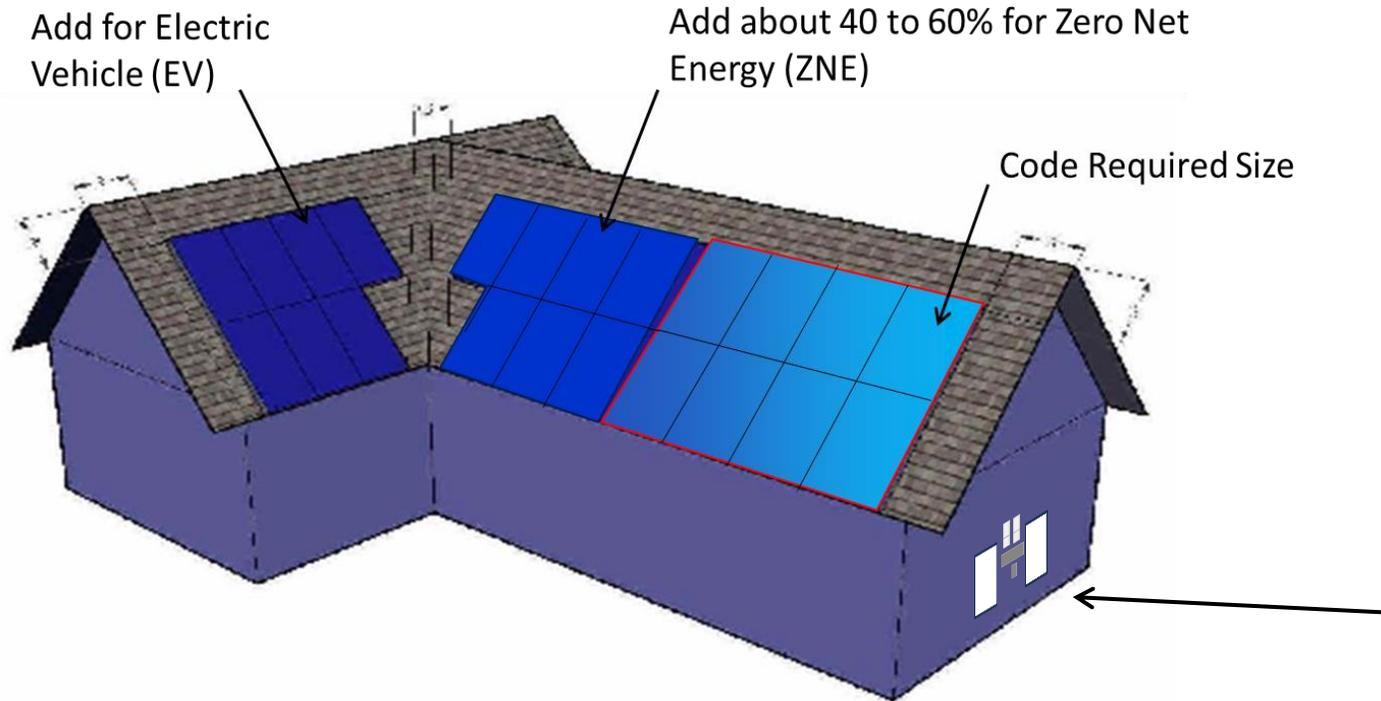


All-Electric ZNE Fire Dispatch Center

Architect: RRM



# Zero Net Energy (ZNE) –the energy a home uses in one year is equal to the energy produced on-site for that year



Under the new electric pricing system (NEM 3), a solar PV system with battery storage can be more cost effective than a PV System alone for a ZNE home.

Battery Storage System can add Resiliency and Energy Independence; Example: 2 Tesla Power Walls @ 13.5 kWh each = 27 kWh total capacity

*For Example: New Construction 2000 SF home in Atascadero (climate zone 4) a 2.38 kW system would be required. Santa Barbara and Ventura coastal areas would be slightly less.*

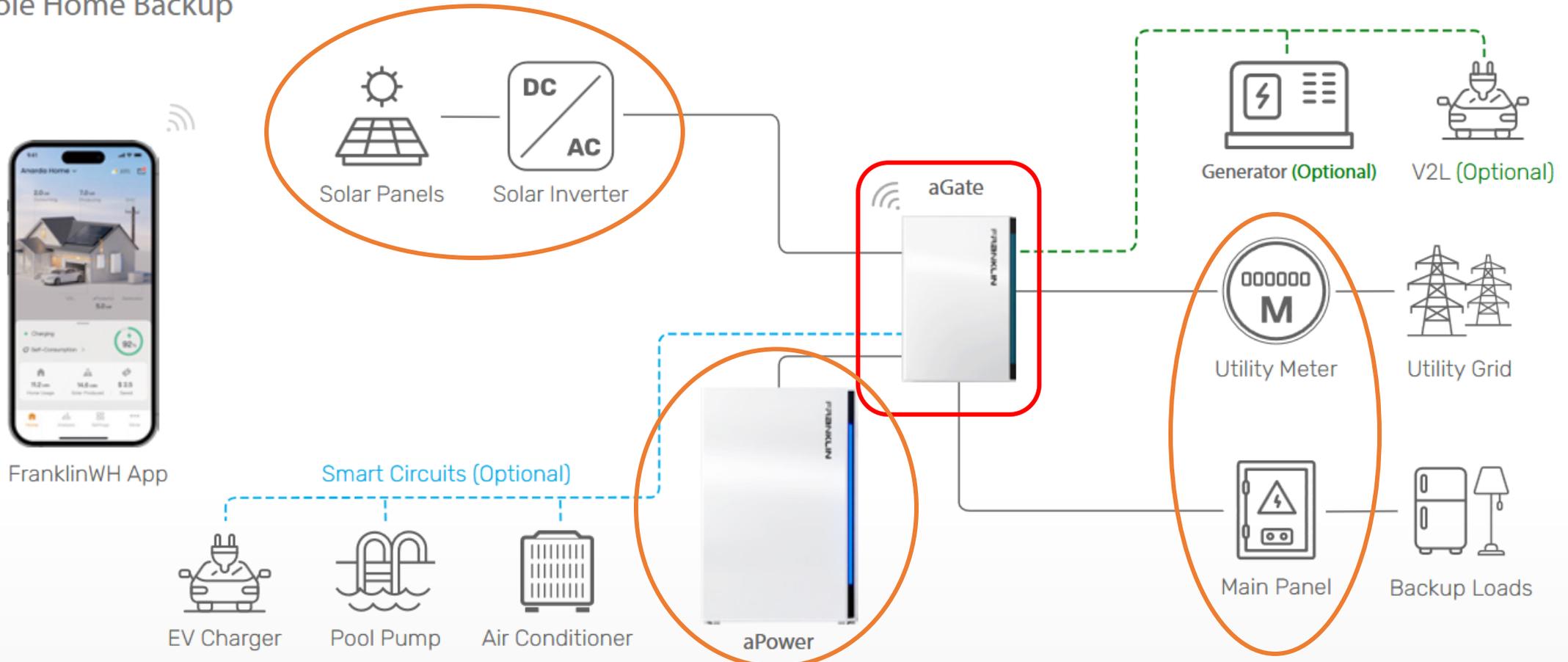


# Residential Solar and Battery - Conceptual Diagram

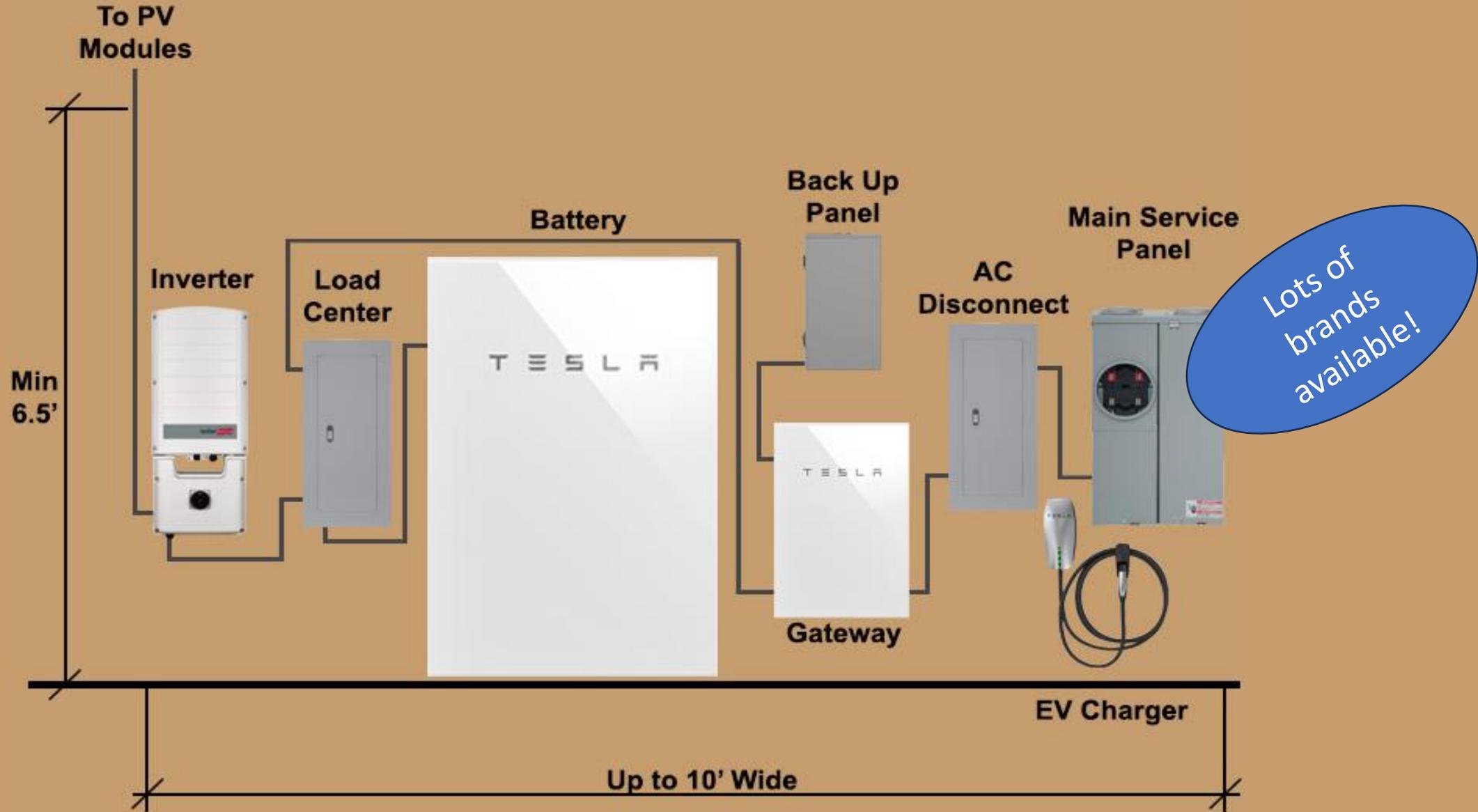
## Franklin Home Power Solution

[www.franklinwh.com](http://www.franklinwh.com)

### Whole Home Backup



# Common Equipment for a Solar + Battery System

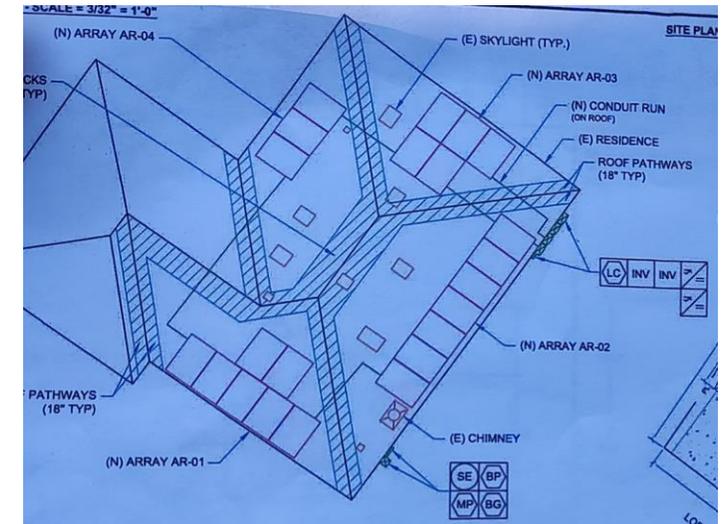


# Example of Exterior Installation

Inverters  
(from PV Panels)



Home Load Center  
and Disconnect  
(Houses the Solar  
Panel Array/Inverter  
Breakers -20amp  
each)



Tesla PowerWall  
13.5 kWh Capacity and  
11.3 kW max continuous  
Power Supply.  
(Approx. 33" x 46")  
Can be ground or wall  
mounted.



# Example of Exterior Installation

225 Amp Main  
Elec Panel

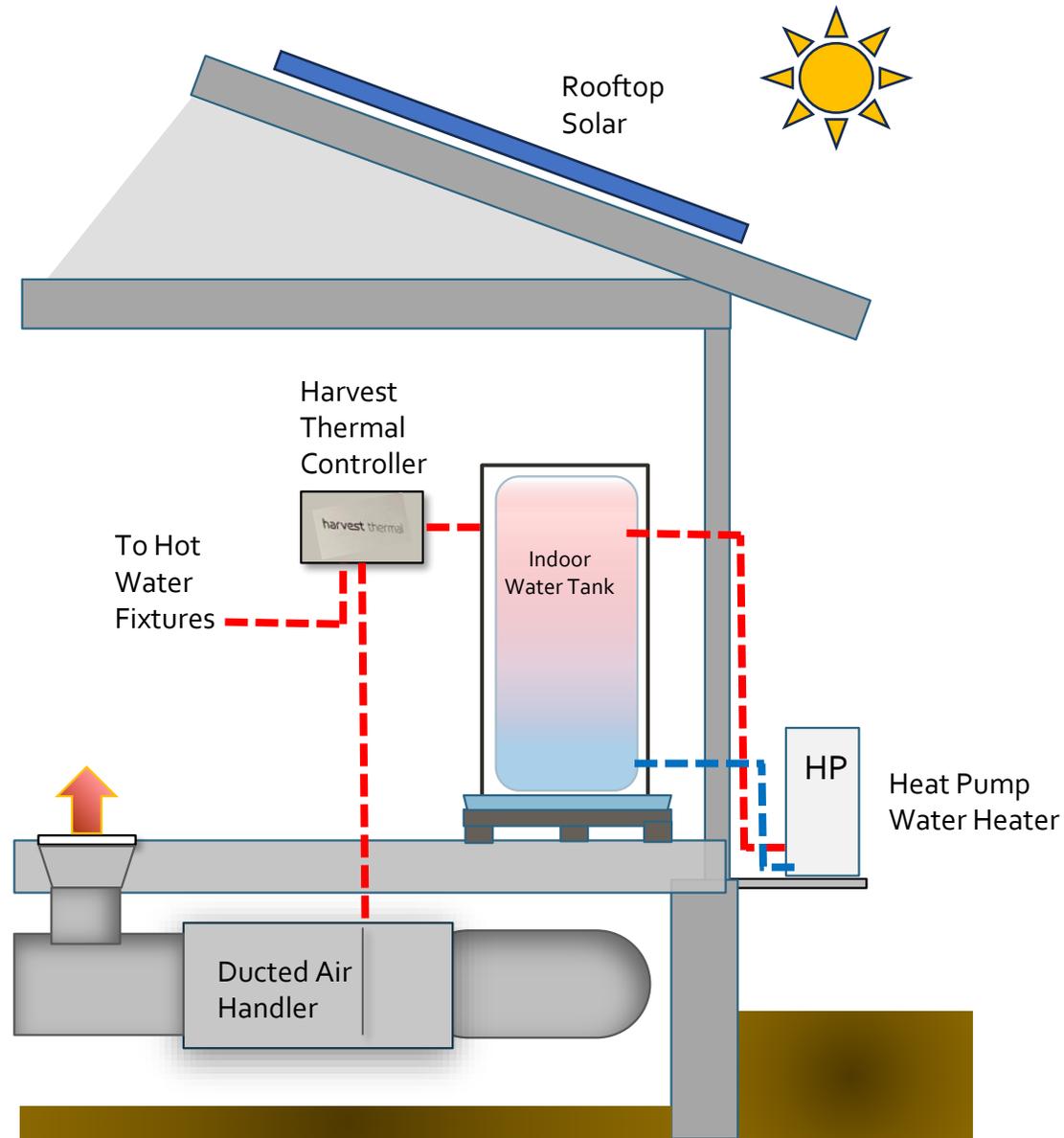


Tesla Gateway  
(Approx. 16" x 26")  
Transfer/Isolation  
Equipment  
Purpose is to isolate  
the building from the  
electrical grid during  
a power outage.

Subpanel  
"Back-up Loads"  
with 4 branch  
circuits minimum –  
can have more, can  
be the whole house.



# Residential Scale: Solar and Thermal Energy Storage

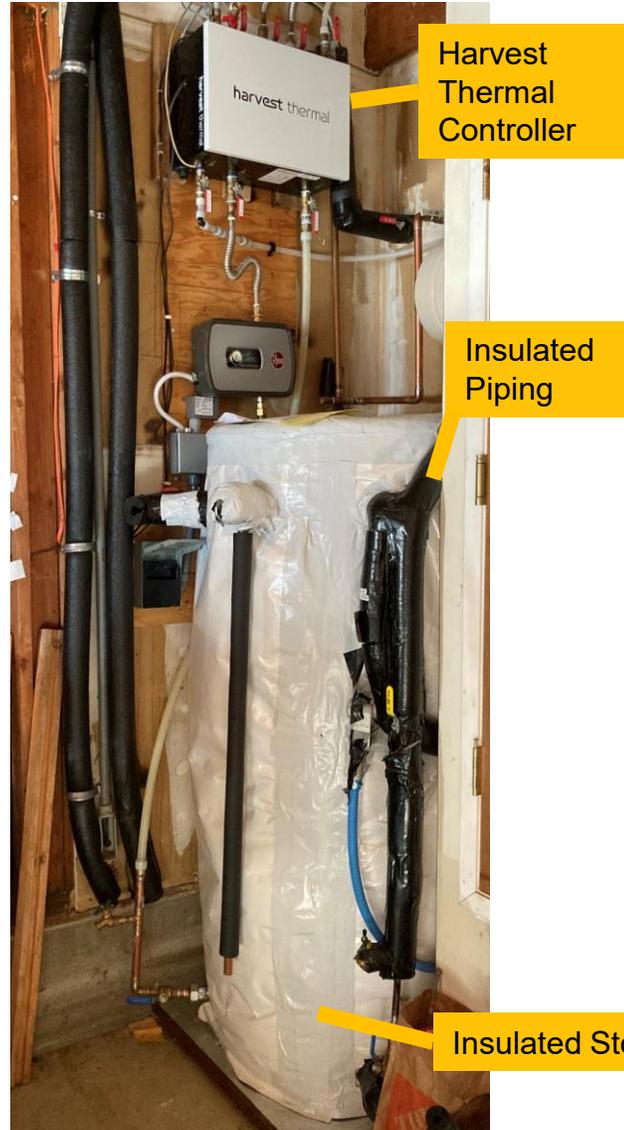


- Solar electric energy can be used strategically to operate the heat pump water heater.
- The hot water becomes thermal storage that can be utilized when solar is not available, i.e. evening through morning.
- The Harvest Thermal / SanCO2 system is used for both domestic hot water and space heating

# Harvest Thermal System in Action



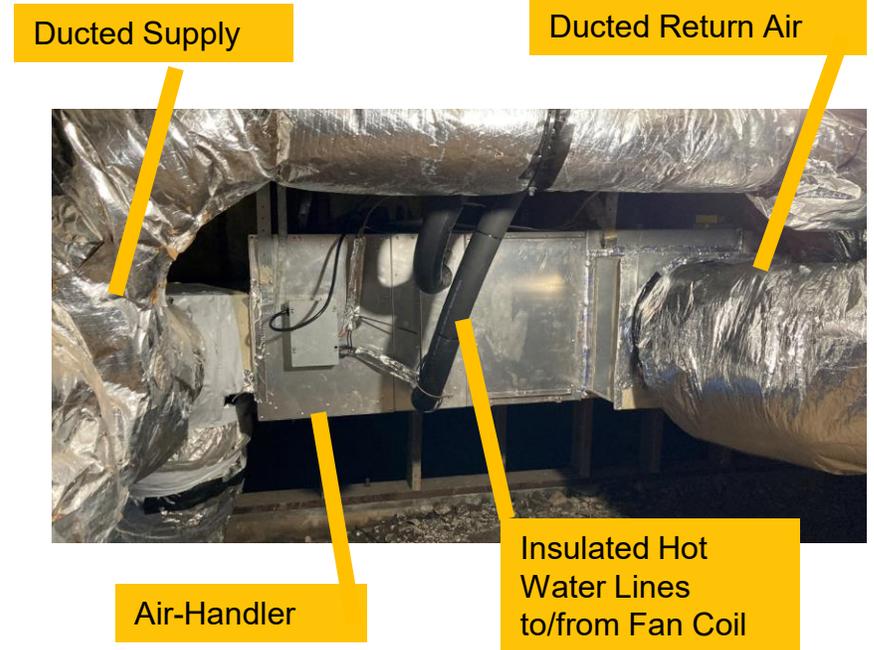
Heat Pump Water Heater



Harvest Thermal Controller

Insulated Piping

Insulated Storage Tank



Ducted Supply

Ducted Return Air

Air-Handler

Insulated Hot Water Lines to/from Fan Coil



# Regulations and Best Practices: Solar Systems

# Solar and Battery – Highrise and Non-Res

## Applicable Occupancy Types:

High-Rise Residential

Grocery, Retail

Restaurants

School

Library

Warehouse

Religious Worship

Sports and Recreation

Events and Exhibits

Hotel-Motel

Office and Financial Institution

Unleased Tenant Space

Medical Office Building/Clinic



Under the 2025 Code some occupancy types were added and some will have increased Solar PV and Battery requirements. Restaurants, for example, had a dramatic increase.



# Solar Panels and Fire Fighter Roof Access

- Energy Code (Title 24, Part 6) Dictates when PV Systems are Required and what Size
- Fire Code (Title 24, Part 9 and/or Part 2.5) Dictates Fire Safety and Access
- Roof Access must be capable of supporting fire fighters and roof fire ventilation
- Walkways to be located with least amount of obstruction and trip hazards
- PV system conduit, wiring and raceways shall be located as possible to a ridge, hip, valley or outside wall



# Roof Installations – Non-Res and R-3



- Title 24, Part 9 Section 1205
- Walkway widths vary by occupancy:
  - R-3 or similar: 3 ft wide walkways
  - Other Occupancies: 6 ft wide perimeter walkway and 4 ft wide interior walk ways
- 4 ft clearance around smoke hatches, roof access, and skylights, etc.
- PV Panels cannot be located below an egress or in an egress pathway



# Roof Installations – Residential

- Title 24, Part 2.5 Section R324
- Walkway widths:
  - 3 ft wide walkways in general
  - Ridges: with 33% PV roof coverage, 18” width on each side of ridge
  - Ridges: with greater than 33% PV roof coverage, 36” width on each side of ridge
  - For homes with qualifying fire sprinklers, PV roof coverage changes to 66%
- PV Panels cannot be located below an egress or in an egress pathway





# Regulations and Best Practices: Chemical Batteries

# Historical Context

## Examples of Home Batteries of the Recent Past:

### Lead Acid

Typical of “Old-school” Off-Grid Systems

Low-Power Density

Some Maintenance Required

Recyclable



KiloVault XLC 2V 1000

Lead Acid is still an available option, although not as popular as other chemistries.

Li-Ion ‘Drop-In’ replacements available

### Yeti – Goal Zero



#### September 2019

With a rise in demand for reliable, smart home backup systems, Goal Zero creates the first solution for customizing and expanding home energy storage capacities. Using industry-leading technology, the innovative Yeti Link connects a Yeti Lithium battery to Yeti Tank lead-acid batteries

[www.goalzero.com](http://www.goalzero.com)

# Current Context

## Current Safety Concerns of Lithium Batteries:

### Combustible Li-Ion Batteries:

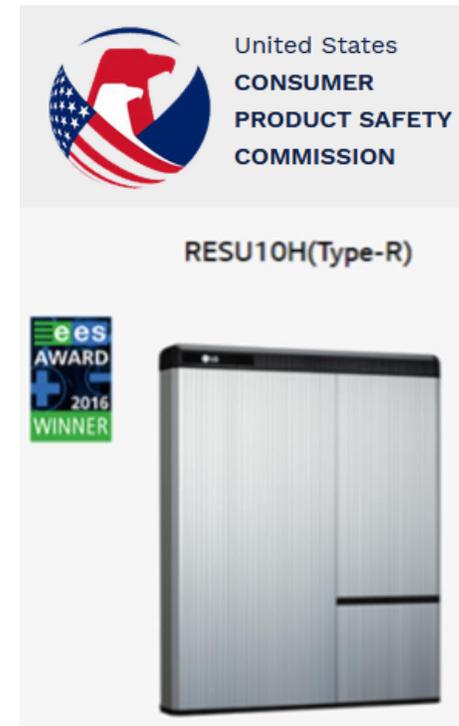
LCO – Lithium Cobalt Oxide

NCA – Nickel Cobalt Aluminum

NMC – Nickel Manganese Cobalt



YouTube · 7NEWS Australia · Sep 30, 2023



- LG Chem stationary home battery is implicated in house fires
- LG Chem recalls 10,000 batteries in 2020 and 2021
- LG Energy Solutions emerges with new home battery and new chemistry options

# Chemistry Matters

- Battery production is dependent on mined minerals
- Many minerals such as Lithium, Cobalt, Nickel, and Copper are mined outside of the US and often concentrated in few locations
- Finding alternative battery chemistries will be a key to the electric clean energy transition
- And ‘mining’ minerals from used batteries, i.e. recycling, will be imperative

The image is a composite graphic. At the top, a portion of the periodic table is shown, highlighting transition metals like Titanium (Ti), Vanadium (V), Chromium (Cr), Manganese (Mn), Iron (Fe), and others. Below this is a flowchart titled 'INPUT' and 'OUTPUT'. The 'INPUT' side shows 'Batteries, battery packs & production scrap' and 'Consumer electronics'. The process steps are 'Collection & receipt', 'Storage & preparation', 'Recycling', and 'Refining'. The 'OUTPUT' side shows 'Anode (Copper foil)' and 'Cathode (Precursor & Cathode active material)'. Below the flowchart is a photograph of a man in a white lab coat and safety glasses working with a battery pack. To the right of the photo is a text box with the heading 'SOLUTION' and the text: 'If recycled, your lithium-ion batteries and rechargeable devices can decrease global reliance on mining and lower the cost and environmental impact of our products.' Below the text is a button that says 'Recycle with us'. At the bottom left of the photo is the 'REDWOOD MATERIALS' logo.

NOV 16, 2023  
Toyota to source cathode active material and anode copper foil from Redwood  
[Read post](#)

**REDWOOD**  
MATERIALS

<https://www.redwoodmaterials.com/>

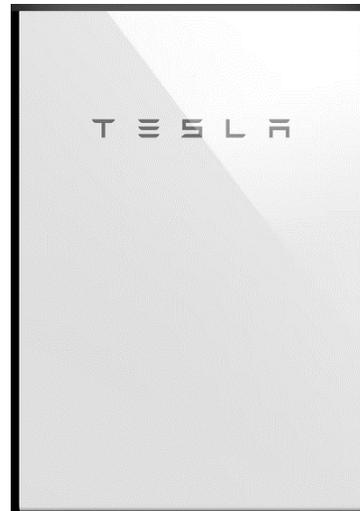
# Common Battery Chemistry

## Lithium-Ion

Typically: NMC – Li, Ni, Mg, & Co

Thermal Runaway Possible

High-Power Density



## Lithium Iron Phosphate

LFP – Li, Fe, PO4

Non-combustible

High-Power Density

Cobalt (Co) Free



## Lithium Titanate Oxide

LTO – Li & Ti

Non-combustible

Lower-Power Density

Cobalt (Co) Free



# On the Horizon in the USA...

## Sodium-ion

SIB – Na<sup>+</sup>

Lower-Power Density

Potentially, Very Low Cost

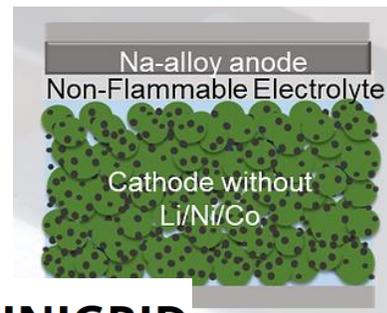
Non-Combustible

Na is Abundant

Better Environmentally



**acculon**  
energy



 **UNIGRID**

## Zinc-ion

ZIB– Zn<sup>2+</sup>

Lower-Power Density

Potentially, Very Low Cost

Non-Combustible

Zn is Abundant in North America

Better Environmentally

Li and Co Free



**SALIENT**  
ENERGY

# Battery Chemistries Dictate the Allowable Battery Size

Title 24, Part 9 Section 1207

**TABLE 1207.1.1 ENERGY STORAGE SYSTEM (ESS) THRESHOLD QUANTITIES**

TECHNOLOGY	ENERGY CAPACITY <sup>a</sup>
Capacitor ESS	3 kWh
Flow batteries <sup>b</sup>	20 kWh
Lead-acid batteries, all types	70 kWh <sup>c</sup>
Lithium-ion batteries	20 kWh
Nickel metal hydride (Ni-MH)	70 kWh
Nickel-cadmium batteries (Ni-Cd)	70 kWh
Other battery technologies	10 kWh
Other electrochemical ESS technologies	3 kWh

For SI: 1 kilowatt hour = 3.6 megajoules.

- a. Energy capacity is the total energy capable of being stored (nameplate rating), not the usable energy rating. For units rated in amp-hours, kWh shall equal rated voltage times amp-hour rating divided by 1,000.
- b. Shall include vanadium, zinc-bromine, polysulfide-bromide and other flowing electrolyte-type technologies.
- c. Fifty gallons of lead-acid battery electrolyte shall be considered equivalent to 70 kWh.

- The Code limits the size of individual ESS units.
- Larger sizes or mixed battery types are allowed with a Hazard Mitigation Analysis.



# Table is Expanded with New Battery Chemistries

2025 Code update

TABLE 1207.1.3—ENERGY STORAGE SYSTEM (ESS) THRESHOLD QUANTITIES

TECHNOLOGY	ENERGY CAPACITY <sup>a</sup>
Capacitor ESS	3 kWh
Flow batteries <sup>b</sup>	20 kWh
Lead-acid batteries, all types	70 kWh <sup>c</sup>
Lithium-ion batteries	20 kWh
Nickel-cadmium (Ni-Cd), nickel metal hydride (Ni-MH) and nickel zinc (Ni-Zn) batteries	70 kWh
Nonelectrochemical ESS <sup>d</sup>	70 kWh
Other battery technologies	10 kWh
Other electrochemical ESS technologies	3 kWh
Sodium nickel chloride batteries	70 kWh
Zinc manganese dioxide batteries (Zn-MnO <sub>2</sub> )	70 kWh

For SI: 1 kilowatt hour = 3.6 megajoules.

- Energy capacity is the total energy capable of being stored (nameplate rating), not the usable energy rating. For units rated in amp-hours, kWh shall equal rated voltage times amp-hour rating divided by 1,000.
- Shall include vanadium, zinc-bromine, polysulfide-bromide and other flowing electrolyte-type technologies.
- Fifty gallons of lead-acid battery electrolyte shall be considered equivalent to 70 kWh.
- Covers nonelectrochemical technologies such as flywheel and thermal ESS.



# Large Scale Battery Energy Storage

- Hazard Mitigation Plan Required
- Large Scale Outdoor –Weatherproof Self-Contained Units with Fire Suppression
- Structural Pad and Site Drainage
- Clearances from Other Structures –Above, Back, Front, and Side to Side
- Access Doors open Front and Back
- Vehicular and other Impact Protection
- Specific Additional Requirements for Roof Top and Open Parking Garage Installations



<https://www.poshenergy.com/articles>



# Example of Exterior Installation



“Doors Open”



<https://www.poshenergy.com>

Stanford University EV Bus Fleet Solar with Battery Storage



# Non-Res and R-3 Battery ESS Permitting

## 1207.1.3 Construction documents.

The following information shall be provided with the permit application:

1. Location and layout diagram of the room or area in which the ESS is to be installed.
2. Details on the hourly fire-resistance ratings of assemblies enclosing the ESS.
3. The quantities and types of ESS to be installed.
4. Manufacturer's specifications, ratings and listings of each ESS.
5. Description of energy (battery) management systems and their operation.
6. Location and content of required signage.
7. Details on fire suppression, smoke or fire detection, thermal management, ventilation, exhaust and deflagration venting systems, if provided.
8. Support arrangement associated with the installation, including any required seismic restraint.
9. A commissioning plan complying with Section 1207.2.1.
10. A decommissioning plan complying with Section 1207.2.3.

Code Excerpt

Title 24, Part 9 Chapter 12

Required:

- Construction Documents
- Commissioning Plan



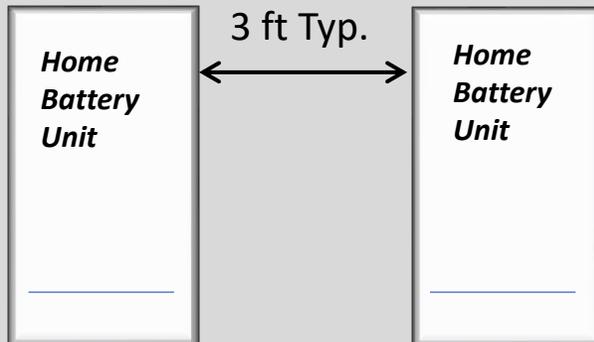
# Small Scale (< 20 kWh): General Design Considerations



- Outdoor and Indoor
- Ground Mount or Wall Mount
- Protect from Impact Damage
- Protect from Temperature Extremes
- Protect from Adverse Weather
- Maintain 5ft (or 3 ft for Residential Code) from
  - Paths of Travel
  - Doors
  - Windows

# Residential Battery Energy Indoor Storage Location

Residential Batteries vary between 5 and 13.5 kWh typ.



Batteries may be installed closer than 3 ft, if it can be shown to the AHJ that the battery manufacturer has complied with proper fire testing and has specified the minimum distance.

Title 24, Part 2.5 Chapter 3 Building Planning, Section ~~R328~~ R330

- Individual ESS units max 20 kWh
- Listed and Labeled for Residential use
- Aggregate capacity shall not exceed:
  - 80 kWh on exterior walls or in outdoor installations
  - 80 kWh in garages and/or detached accessory structures
  - 40 kWh within utility closets or storage spaces
- Utility closets/spaces and/or garage shall have 5/8" Type X gypsum board ceilings and walls
- Interconnected smoke alarms shall be installed throughout the dwelling and attached garage (or when appropriate an interconnected heat alarm)



# 2024 Supplemental and 2025 Code Update

~~TABLE R328.5~~ Table R330.5  
**MAXIMUM AGGREGATE RATINGS OF ESS**

LOCATION	MAXIMUM AGGREGATE RATINGS (kWh)	INSTALLATION REQUIREMENTS
<i>Within utility closets, basements, and storage or utility spaces located within dwellings</i>	40	
<i>In attached garages</i>	80	
<i>On or within 3 feet of exterior walls of dwellings and attached garages</i>	100	
<i>On or within 3 feet of exterior walls of dwellings and attached garages</i>	200	<i>Exterior walls and eaves are constructed with non-combustible surfaces<sup>a</sup></i>

<i>In detached garages and detached accessory structures</i>	200	
<i>In detached garages and detached accessory structures</i>	600	<i>Detached garage or detached accessory structure is a minimum 10 feet away from property lines and dwellings</i>
<i>Outdoors on the ground</i>	200	<i>ESS is a minimum 3 feet away from property lines and dwellings</i>
<i>Outdoors on the ground</i>	600	<i>ESS is a minimum 10 feet away from property lines and dwellings</i>

For SI: 1 foot = 304.8 mm.

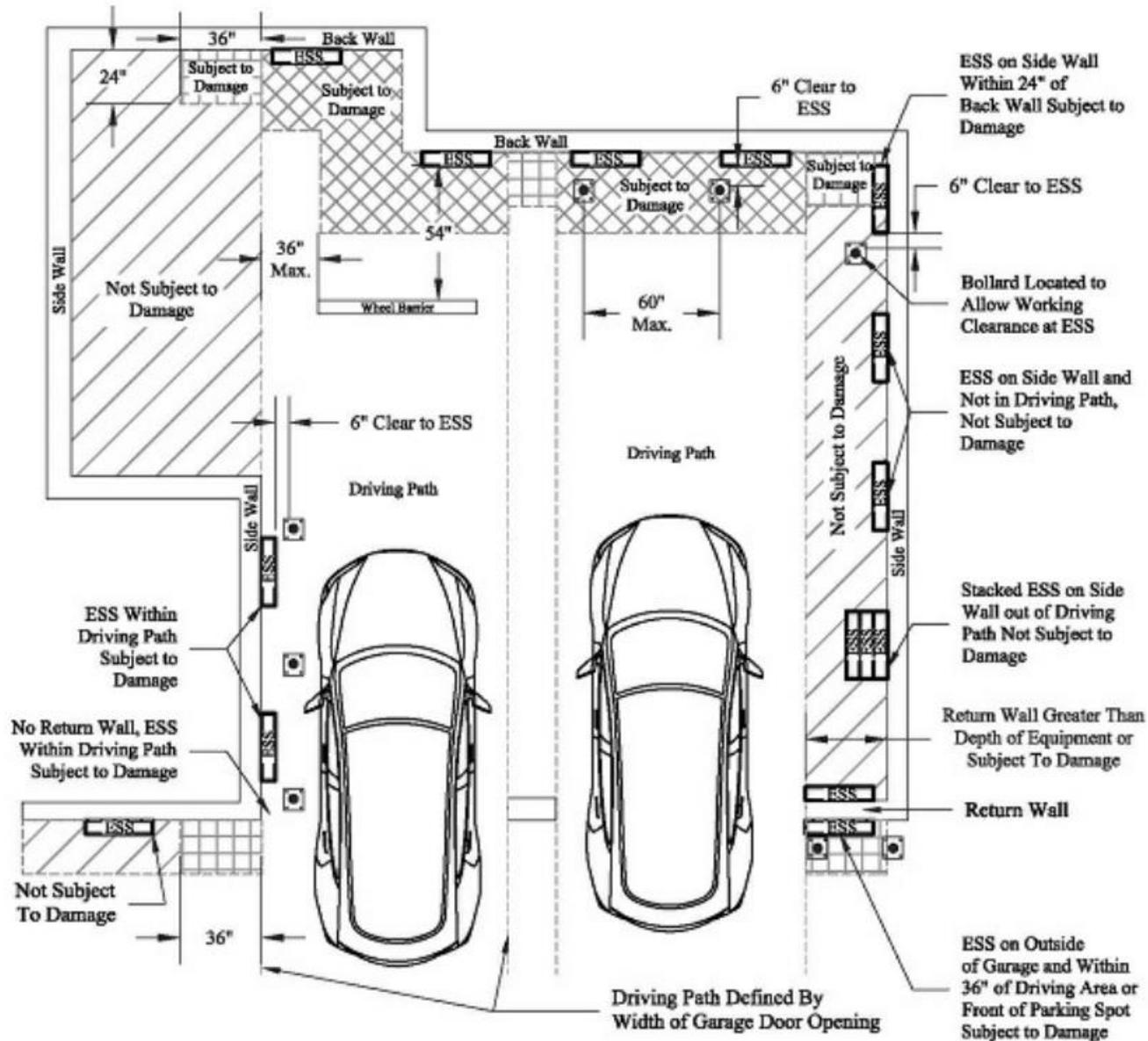
a. Noncombustible wall surface shall extend in accordance with all the following:

1. A minimum of 5 feet horizontally from the edge of the ESS.
2. A minimum of 1 foot vertically below the bottom edge of the ESS.
3. A minimum of 8 feet vertically above the ESS, or to a non-combustible eave, whichever is less.

The code official is authorized to approve reductions of installation requirements based on large-scale fire testing complying with Section 1207.1.5 of the California Fire Code.



# 2024 Supplemental and 2025 Code Update



Refer to Section R330.8.1 Garages under the 2025 Code (Title 24, Part 2.5)

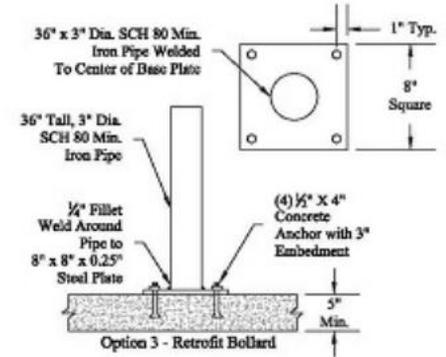
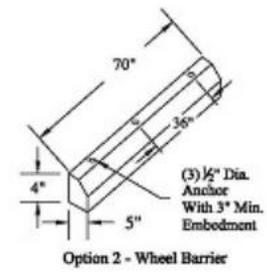
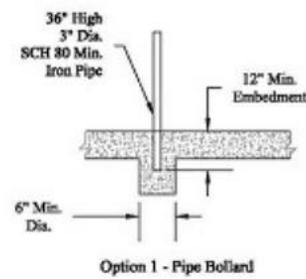


FIGURE R328.8.1  
ESS VEHICLE IMPACT PROTECTION





# Managing Client Expectations: Residential Examples

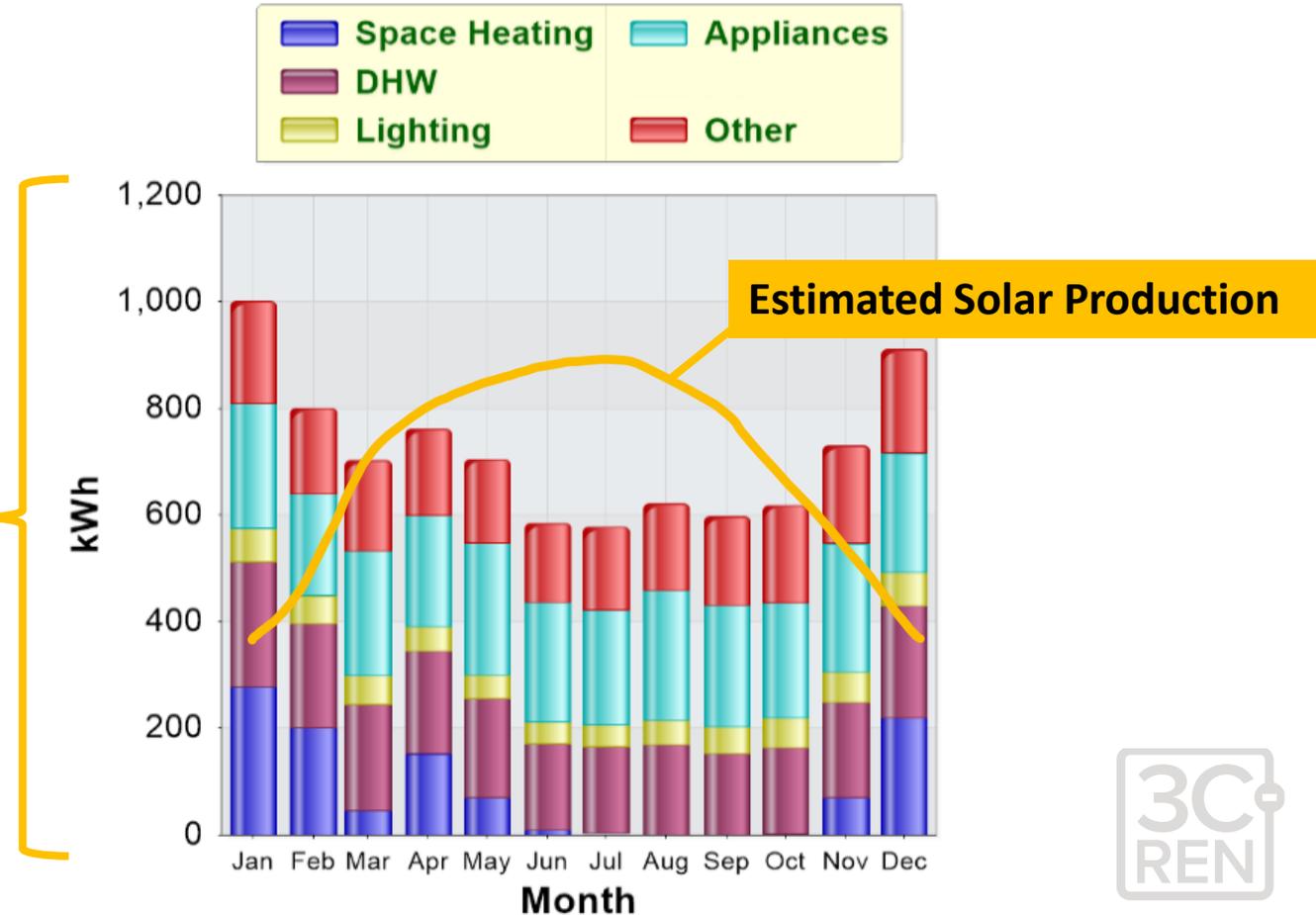
# Designing a Home for Zero Net Energy (ZNE)

**ZNE** –For a given year, the home’s solar production would deliver as many kWh as the household used.

One BIG (or small) electric bill at the True-up once a year.

Or a PPA or other financial model

Predicted electricity energy-use in kilowatt hours (kWh) per each month



# Residential Solar System Example – Inverter Allows for Instantaneous Reading of Energy Use



Electric Disconnect

Rooftop Solar 2005



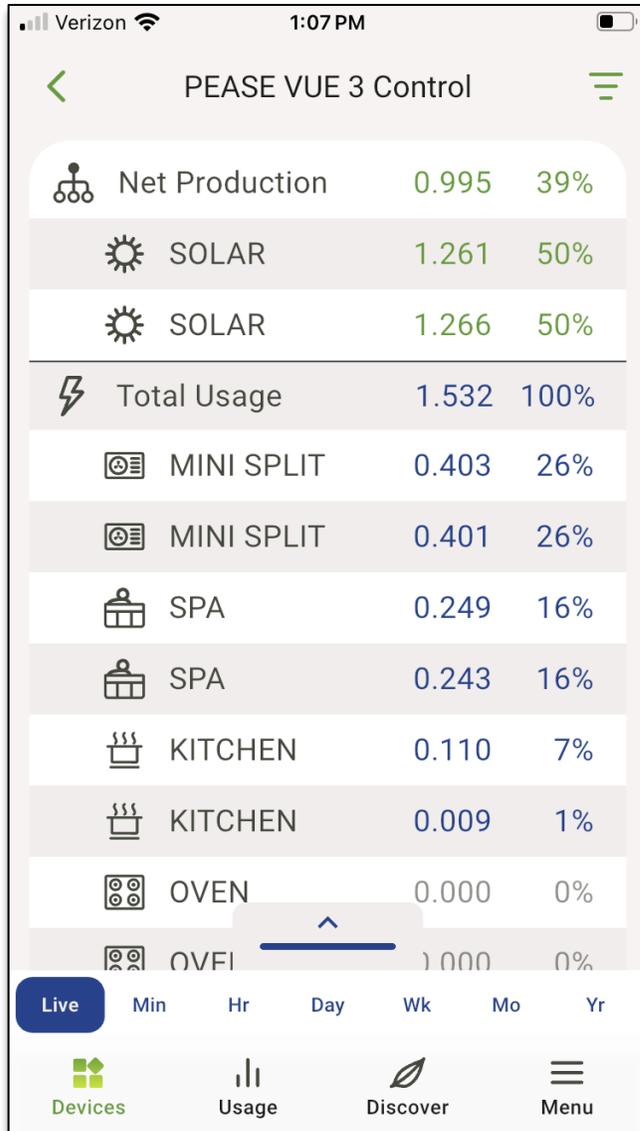
DC/AC Single-Phase Grid Inverter



PV Expansion 2023



# Energy Usage Patterns and Lessons Learned... ?



Rooftop Solar

Roofing

Pet Moss



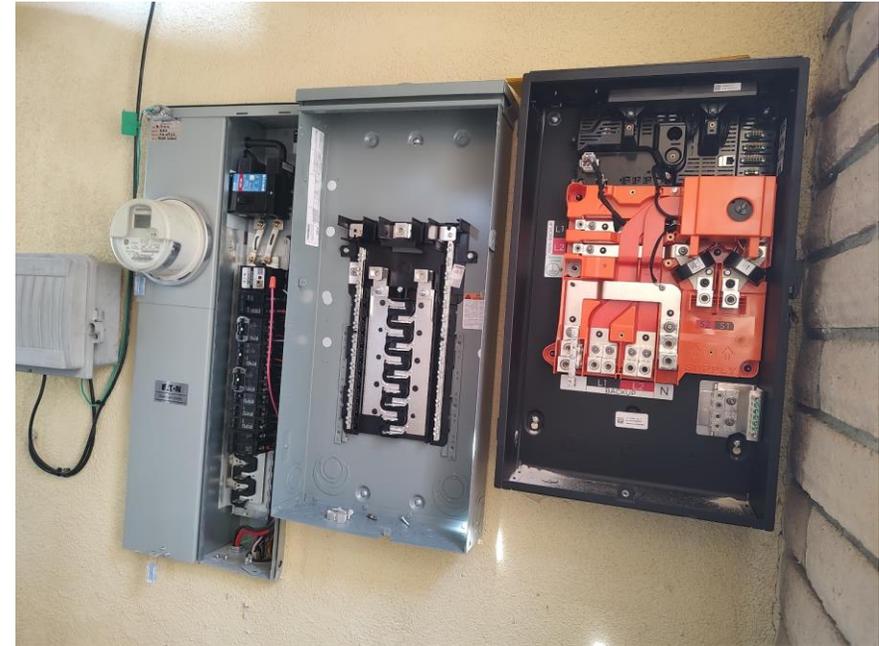
# Existing Homes: Solar PV and Battery Systems



Electrical  
Panels  
and  
Inverters

Solar Panels  
and Hardware

Batteries



New electrical panel, sub-panel and controller.

Considerations:

New roof or re-roofing / repairs needed?

Panel upgrade needed –additional costs?

Solar access / shading on roof?



# Occupant Habits: Energy Usage, Solar PV and Battery Systems

Installed Roof Top Solar

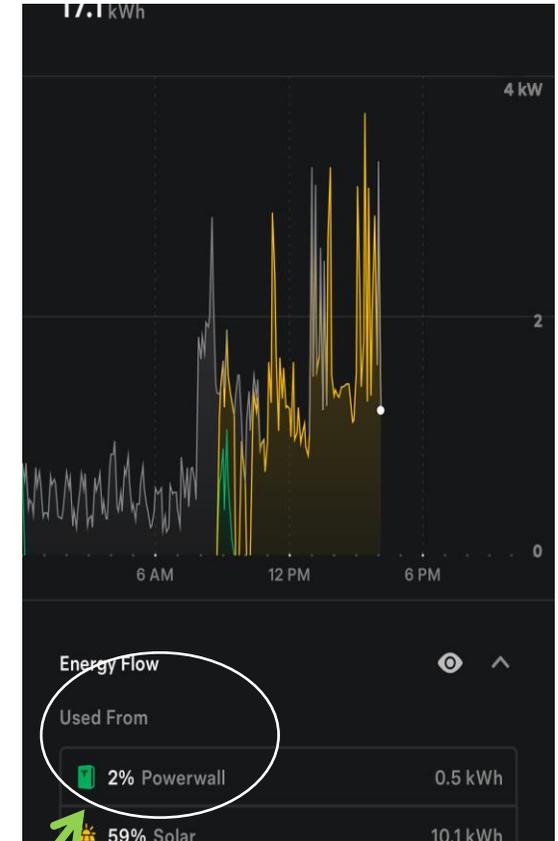


Depending on one's driving mileage, electric cars can add significant loads.



Electric Washer/Dryer

"Laundry Day" – Solar only met 59% of the need that day – battery recharge has "priority" on solar energy.





# Resources



# Large Scale BESS Permitting and Fire Safety Standards



The screenshot shows the top navigation bar of the California GO-Biz website. It includes the state logo, the text 'CALIFORNIA BUSINESS AND ECONOMIC DEVELOPMENT', and menu items for 'Industries', 'Resources', 'About', 'Newsroom', and 'Search'. The main content area has a blue background with the heading 'GO-Biz Clean Energy Permitting Initiative'. Below the heading is a paragraph of text and a 'Contact Us' button. A second section below has the heading 'Public Feedback for the Playbook and Toolkit' and another paragraph of text.

CA

Contact Us Translate Settings

**CALIFORNIA**  
BUSINESS AND ECONOMIC DEVELOPMENT

Industries Resources About Newsroom Search

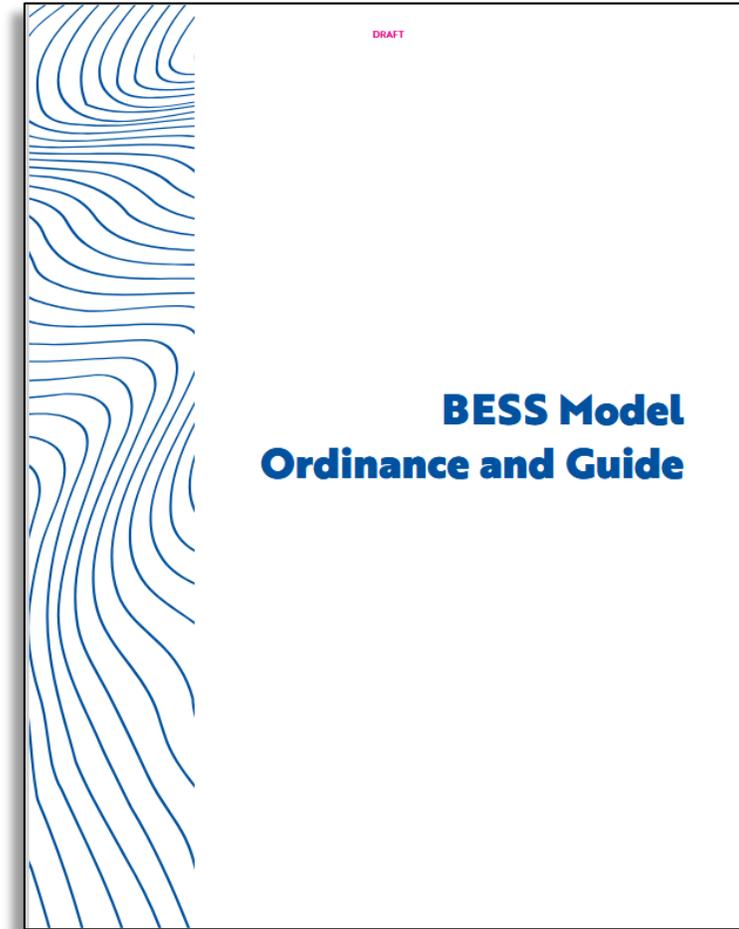
## GO-Biz Clean Energy Permitting Initiative

Improved permitting processes is one element that can help reduce barriers to deployment of renewable projects. In late 2024, GO-Biz kicked off the clean energy permitting initiative to assess challenges and barriers faced by local jurisdictions for permitting large scale energy projects and develop a toolkit of resources for process improvements. The final report and toolkit will include best practices and other resources that will help to increase transparency and alignment of local jurisdiction permitting processes to reduce barriers for the deployment of energy projects.

Contact Us

### Public Feedback for the Playbook and Toolkit

GO-Biz looks forward to hearing your comments on the resources that will be included in the final Clean Energy Permitting Playbook and Toolkit. The team spent several months surveying, interviewing, and conducting focus groups to understand challenges and pain points of the local permitting process for large-scale clean energy projects as well as opportunities for improvement. Based on input and feedback from



<https://business.ca.gov/industries/climate-and-clean-energy/go-biz-renewable-energy-permitting-initiative/>



# County of Santa Barbara – Energy Assurance Plan

  A project of the County of Santa Barbara's One Climate Initiative 

**Energy Assurance Plan**     About    Goals    **Strategies**    Energy Map    Energy & Climate Change    Energy Systems

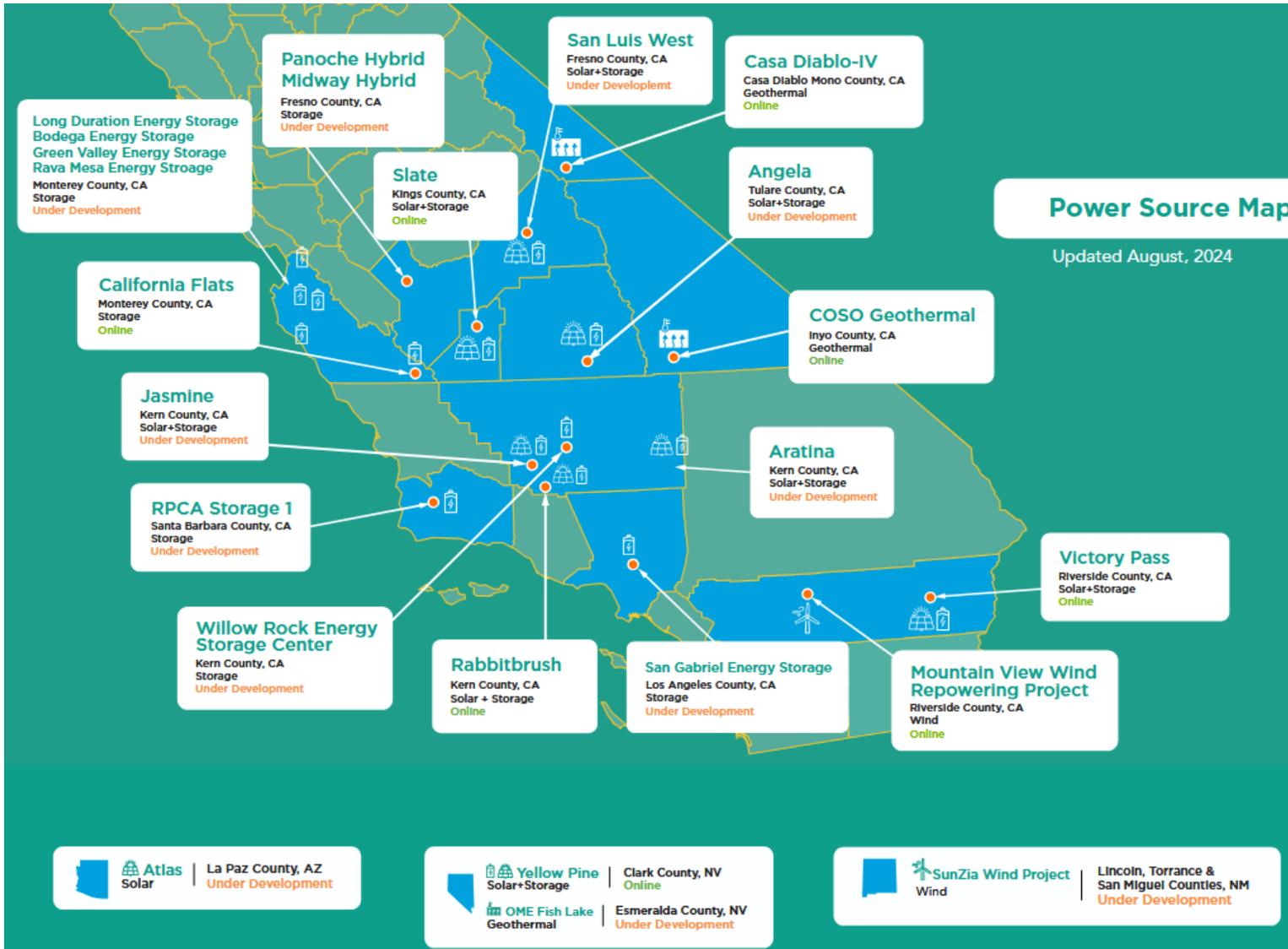
## Strategies for Achieving Energy Assurance

Direct Relief's Santa Barbara-based headquarters includes a solar and battery microgrid to provide critical services even during a prolonged power outage. *Photo credit: Donnie Hedden, Direct Relief*



<https://eap.countyofsb.org/strategies>

# Local Electricity Provider –Central Coast Community Energy



<https://3cenergy.org>



# PG&E Resources: Clean Energy Tab –Solar, EV Charging, Batteries, and a *Your Home Electrification Project Guide*

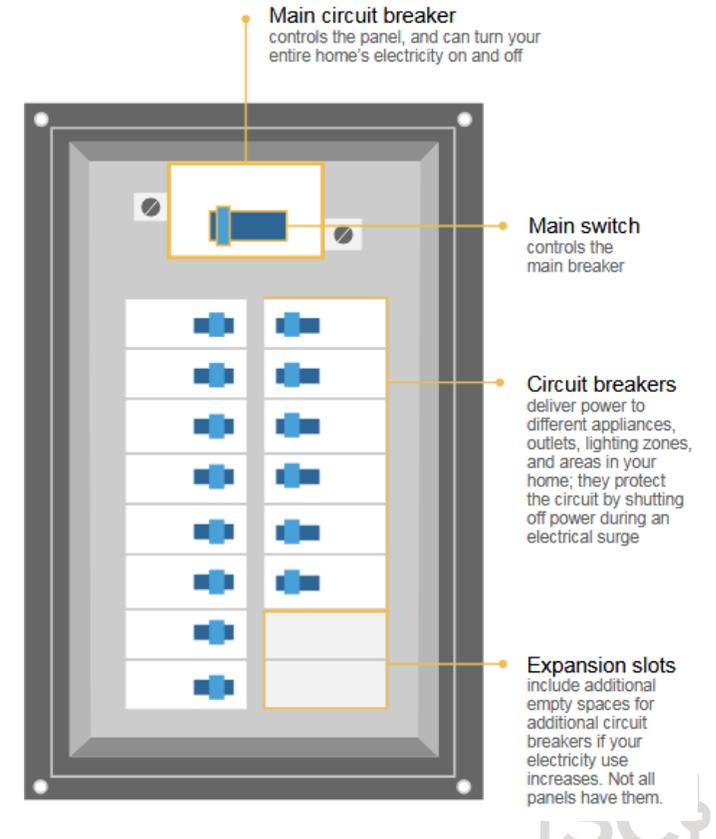
INTRODUCTION	PANEL 101	ESTIMATE	SAVE MONEY	RESOURCES
--------------	-----------	----------	------------	-----------

## Electric load comparison for a sample project

A single-family homeowner in California plans to electrify their 2,400 square foot home with 4 occupants. See how they can complete the project by strategically using load management technology and lower-wattage appliances to fit their 100-amp / 24,000 watts panel capacity.

A licensed electrician can help you assess your panel capacity and plan your project. Avoiding a panel upgrade could save you \$2,000 - \$6,000.

	No Electrification	Standard Electrification (Exceeding panel capacity)	Strategic Electrification (Using smart devices and lower-wattage appliances)
<b>Appliances included and wattage<sup>1</sup></b>	Base energy use <sup>2</sup>	Base energy use	7,800
	Electric clothes washer	Electric clothes washer	1,800
	Gas dryer	Electric dryer	2,520
	Gas stove	Induction stove	13,992
	Gas water heater	Heat pump water heater (240V)	2,520
	Ducted gas furnace	Heat pump (ducted heating & AC)	2,362
	Air conditioner	EV charger	7,680
	<b>Smart technologies used to balance electric loads</b>	None	None
<b>Watts estimation for home's daily energy use<sup>3</sup></b>	13,824	42,346	30,358
<b>Total panel watts</b>	10,330	29,352	21,293
<b>Total panel amps</b>	43	122	89
<b>Minimum panel size required</b>	50 amps	125 amps	100 amps
<b>Is a panel upgrade required?</b>	No	Yes	No



<https://www.pge.com/assets/pge/docs/clean-energy/building-electrification/home-electrification-avoid-electrical-panel-upgrade.pdf>



<sup>1</sup> Sample appliance wattages. This information can be found on appliance nameplates.  
<sup>2</sup> Since most homes won't run appliances all at once, this is an estimation of actual electricity needs for this home.  
<sup>3</sup> Amps = Watts/Volts, Volts = Watts/Amps, Watts = Volts x Amps

# Resources for SCE

<https://solarmarketplace.sce.com/>



HOME ELECTRIFICATION MARKETPLACE

888-515-0326

Sign In

## Rooftop Solar & Home Battery Solutions

Take charge of how you power your home.

 Enter an address to start your journey

Get Started →



# Rough Idea of Costs and Savings

**SOUTHERN CALIFORNIA EDISON** | HOME ELECTRIFICATION MARKETPLACE | 888-515-0326 | [Sign In](#)

### Tell Us About Your Project

Location:  [🔍](#)

Average Energy Bill:  **\$250/Month**

Est. System Size: **5.6 kW**

Financing Preference:

Add home battery to your solar project?  Yes

Home Batteries Needed:  **1**  **10 kWh Capacity**

Recommended: 1

[Get Customized Offers](#)

### Your Solar & Battery Estimates

	Before Solar	After Solar (20-year loan term)
Monthly Payment	\$250	\$237
Bill Reduction	0%	5%
Lifetime Energy Cost	\$96,450	\$78,371
Lifetime Savings	\$0	\$18,078
Average Electricity Rate	45.1¢ /kWh	36.7¢ /kWh
Available Incentives	\$0	\$4,872

Map | **Satellite**



Google | Map data ©2025 | Terms

#### Complete Battery Solution

- Instant Start
- Grid Integrated
- No Maintenance



**16 Hours**

Your Backup Power During Outages

[Learn More](#)

**Cost**

**\$89 /Month**  
Net Cost (Including Savings)

**\$18,000**  
Battery Price

**Benefits**

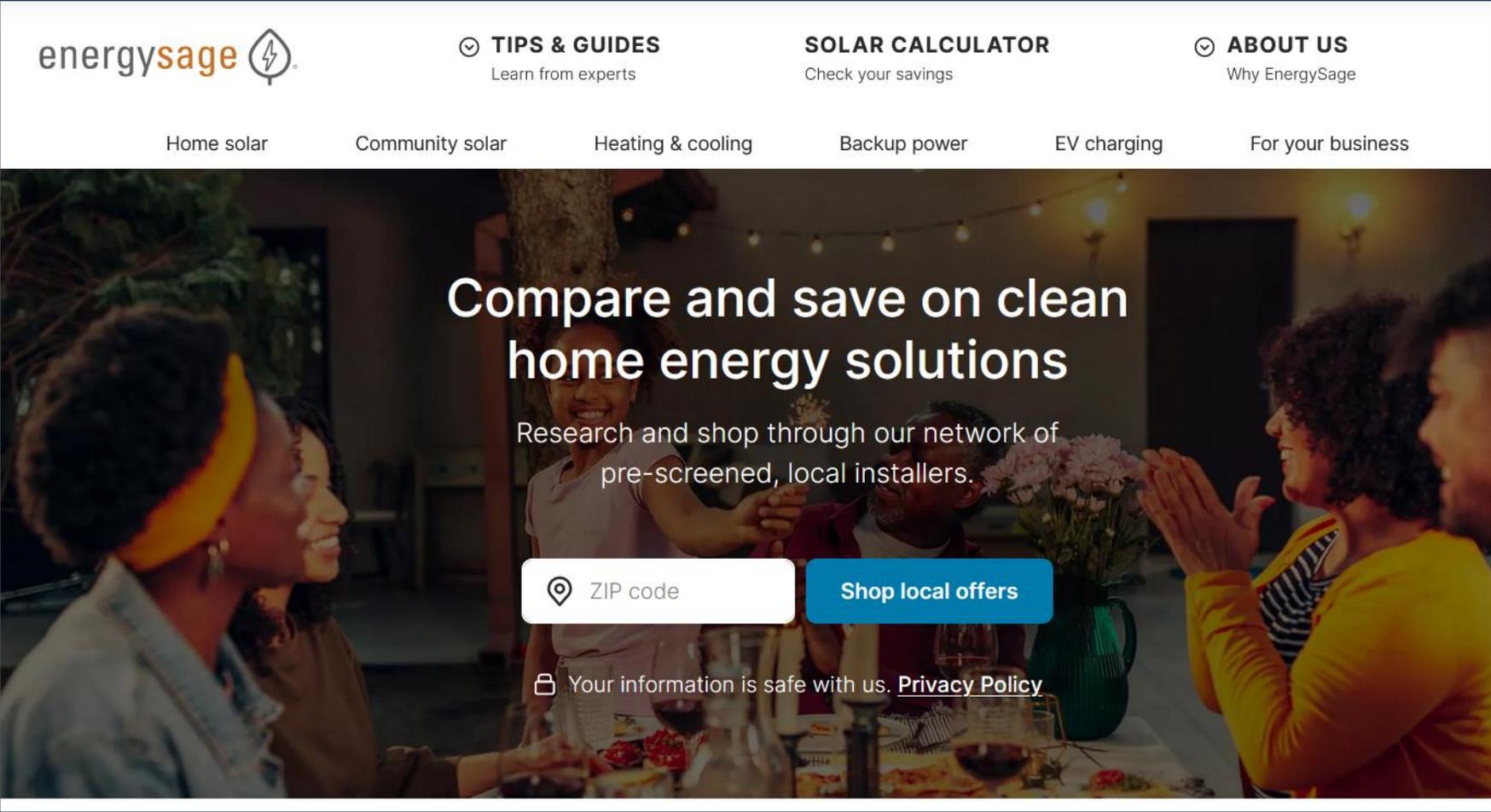
**+\$6,353**  
Incentives

**\$572/year**  
Load-Shifting Savings

<https://solarmarketplace.sce.com/>

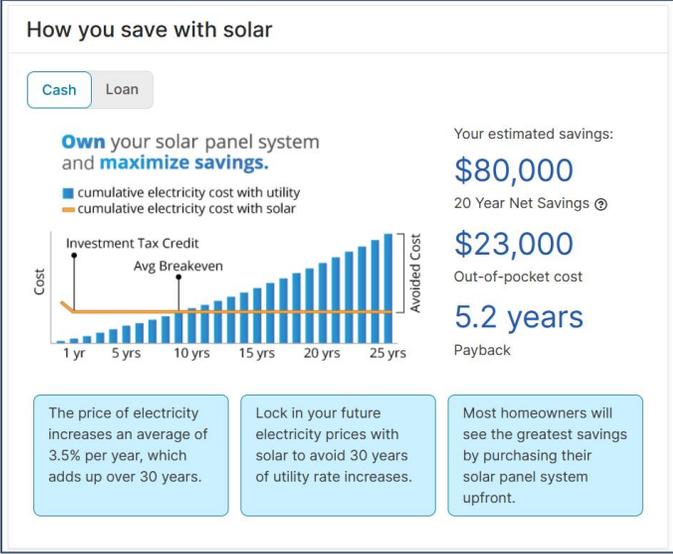
# EnergySage: Information Hub, Pre-screen Installers

<https://www.energysage.com/>



The image shows the top portion of the EnergySage website. At the top left is the EnergySage logo. To its right are four navigation links: 'TIPS & GUIDES' (Learn from experts), 'SOLAR CALCULATOR' (Check your savings), and 'ABOUT US' (Why EnergySage). Below these are six category links: 'Home solar', 'Community solar', 'Heating & cooling', 'Backup power', 'EV charging', and 'For your business'. The main content area features a large background image of a group of people dining at an outdoor restaurant. Overlaid on this image is the text 'Compare and save on clean home energy solutions' and 'Research and shop through our network of pre-screened, local installers.' Below this text is a search bar with a location pin icon and the text 'ZIP code', and a blue button labeled 'Shop local offers'. At the bottom of the main content area is a lock icon and the text 'Your information is safe with us. Privacy Policy'.

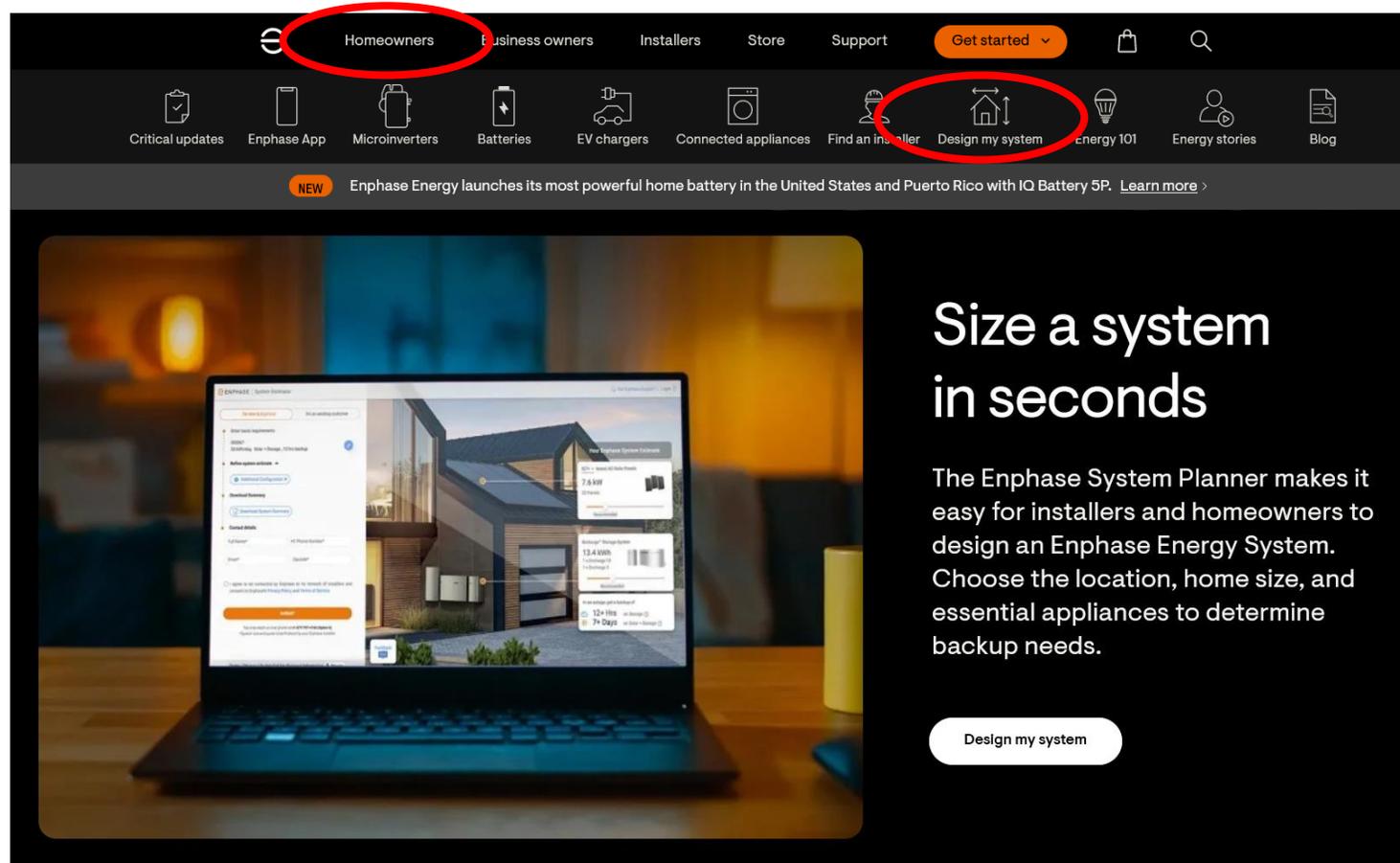
## Sample Results from the 'Solar Calculator'



# Size a Battery for your Home

Enphase Website Example: <https://enphase.com/homeowners>

Click *Homeowners*, and then *Design my system*

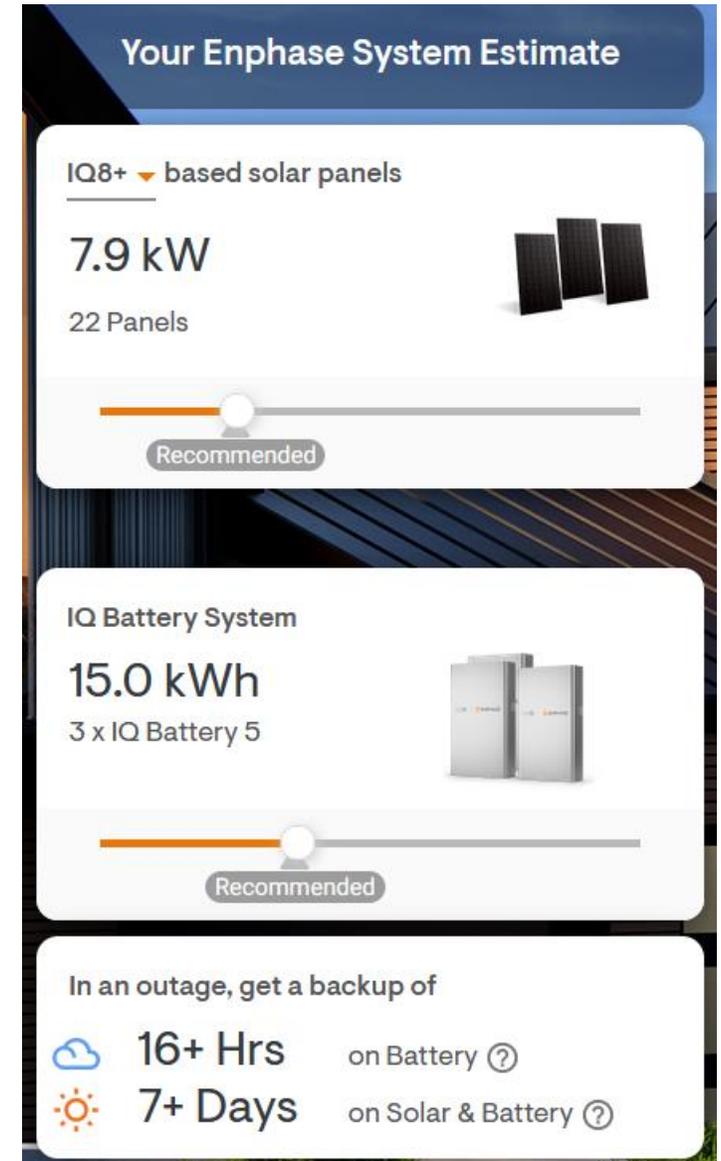


The screenshot shows the Enphase website's navigation menu. The 'Homeowners' link is circled in red. Below it, the 'Design my system' link is also circled in red. A laptop in the foreground displays the Enphase System Planner interface, which includes a house image and various system configuration options.

## Size a system in seconds

The Enphase System Planner makes it easy for installers and homeowners to design an Enphase Energy System. Choose the location, home size, and essential appliances to determine backup needs.

[Design my system](#)



**Your Enphase System Estimate**

- IQ8+ based solar panels**  
7.9 kW  
22 Panels  
Recommended
- IQ Battery System**  
15.0 kWh  
3 x IQ Battery 5  
Recommended
- In an outage, get a backup of**
  - 16+ Hrs on Battery ?
  - 7+ Days on Solar & Battery ?

# Sizing and Cost Savings – Solar Calculator ‘WattPlan’

[www.wattplan.com](http://www.wattplan.com)



WattPlan®

English - EN

Feedback

Survey

## Plan your electricity usage in different scenarios

Explore adding solar and battery storage to your home or switching to an electric vehicle by choosing "Try Solar" or "Try an Electric Vehicle". If you already own an electric vehicle or just want to compare electric rates choose "Charge your EV" or "Optimize your Rate".



 Try Solar



Try an Electric Vehicle



Optimize your Rate



Charge your EV

Available for use by most California, Oregon and Washington residents

### How it works



#### Review personal estimate

Find out your savings potential based on your current electricity use paired with driving habits, rooftop solar potential and available tax credits, rebates and incentives.



#### Compare options

View options side-by-side to understand how different scenarios impact your costs in the near-term and long-term.



#### Make an informed decision

If rooftop solar, battery storage, an electric vehicle or a new electric rate seems like a good investment for you, we're here to help you get started.



# Solar and Battery Details

## My new plan

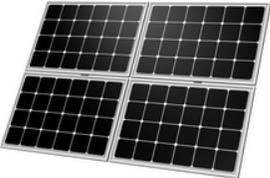
Electricity comes from utility & solar

**5.3 kW**

System size (DC)

**14**

Number of panels



**5.320 kW**

System size (DC)

**4.549 kW**

System size (AC)

**9,099 kWh**

System annual electricity production

## My new plan

Solar is stored for use in the evening when energy costs are highest

**13.5 kWh**

Battery capacity

**5.0 kW**

Power, max continuous



Select an option ↔

User can fine tune the battery parameters and costs

## Storage

Storage can increase the amount of usage you can cover with generation from your solar system.

Include storage?

Energy capacity: 13.5 kWh <sup>?</sup>

0.5  27

Power, Max Continuous: 5.0 kW <sup>?</sup>

1  10

Unit Price: \$1,000 per kWh <sup>?</sup>

100  2000

System Price: \$13,500 <sup>?</sup>

# Benefit of Battery Storage

If you can afford the upfront costs of the battery (assumed \$13,500 installed):

- Save additional \$9,307 over 20 yrs
- Additional year to 'Breakeven'
- Very low utility bill (est. \$82/mo)
- Power some critical loads during a power outage

Depending on battery and control system could participate in a virtual power plant (VPP) incentive program.

## Solar only

<b>No</b> Backup power	<b>41%</b> Solar energy used on site, not exported
---------------------------	--

### Key financials

System cost	<b>\$15,960</b>
Total incentives	<b>\$4,788</b>
Net savings or (costs) over the next 20 years	<b>\$33,184</b>
Breakeven	<b>Year 6</b>
Current average monthly bill	<b>\$349</b>
Average monthly bill after solar	<b>\$178</b>

### Key features

- Solar system will export excess power to receive bill credits
- Solar generation shuts down during power outages unless special inverter is used

## Solar and storage

<b>Yes</b> Backup power	<b>78%</b> Solar energy used on site, not exported
----------------------------	--

### Key financials

System cost	<b>\$29,460</b>
Total incentives	<b>\$8,838</b>
Net savings or (costs) over the next 20 years	<b>\$42,491</b>
Breakeven	<b>Year 7</b>
Current average monthly bill	<b>\$349</b>
Average monthly bill after solar + storage	<b>\$82</b>

### Key features

- Power critical appliances - or even your whole home - for a limited duration during power outages
- Use solar energy when the sun is shining, store excess solar power for use during evening peak hours, when electricity is most expensive

# Questions about Title 24?

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



Online:

[3c-ren.org/code](https://3c-ren.org/code)

Call:

805.781.1201

Energy Code Coaches are local experts who can help answer your Title 24 Part 6 or Part 11 questions.

They can provide code citations and offer advice for your res or non-res projects.



# Thanks for coming!

## Continuing Education Units Available

- Contact [chloe.swick@ventura.org](mailto:chloe.swick@ventura.org) for AIA LUs & ZNCD CEUs

## Slides: Coming to your inbox soon!

## Upcoming Courses:

- **Navigating the Energy Code** (1/22)
- **2025 Energy Code in Practice: Single Family Residential** (2/4)
- **Builder's Perspective: Heat Pump Water Heaters** (2/18)
- **Ask the Experts: Judy Rachel** (3/12)
- **Contractor Power Hour with Electrify My Home** (3/20)