



We will be starting soon!

Thanks for joining us



Batteries: Options and Implementation for a Building's Energy Storage System



Jennifer Rennick, AIA, CEA – In Balance Green Consulting

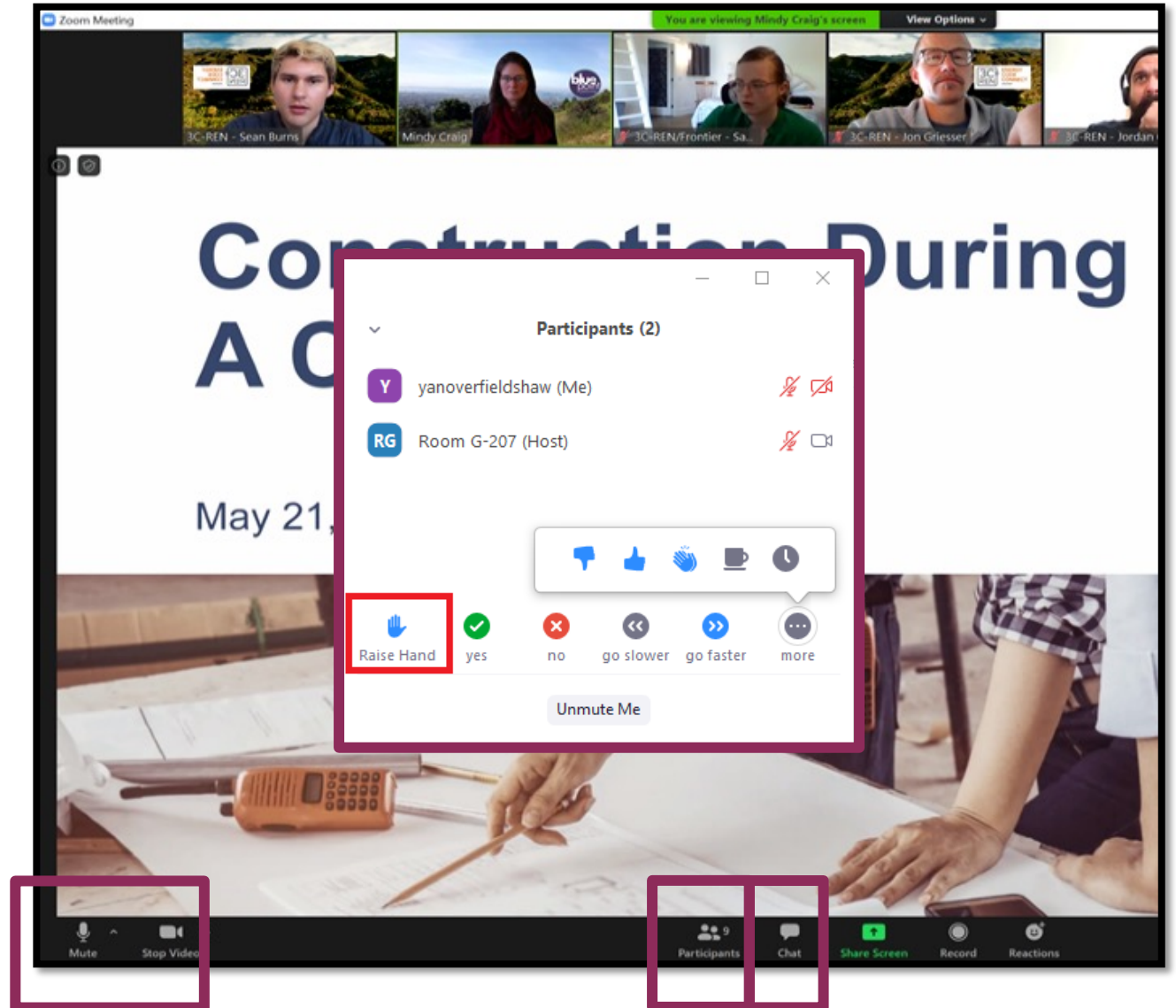
Grant Murphy, CEA – In Balance Green Consulting

January 24, 2024



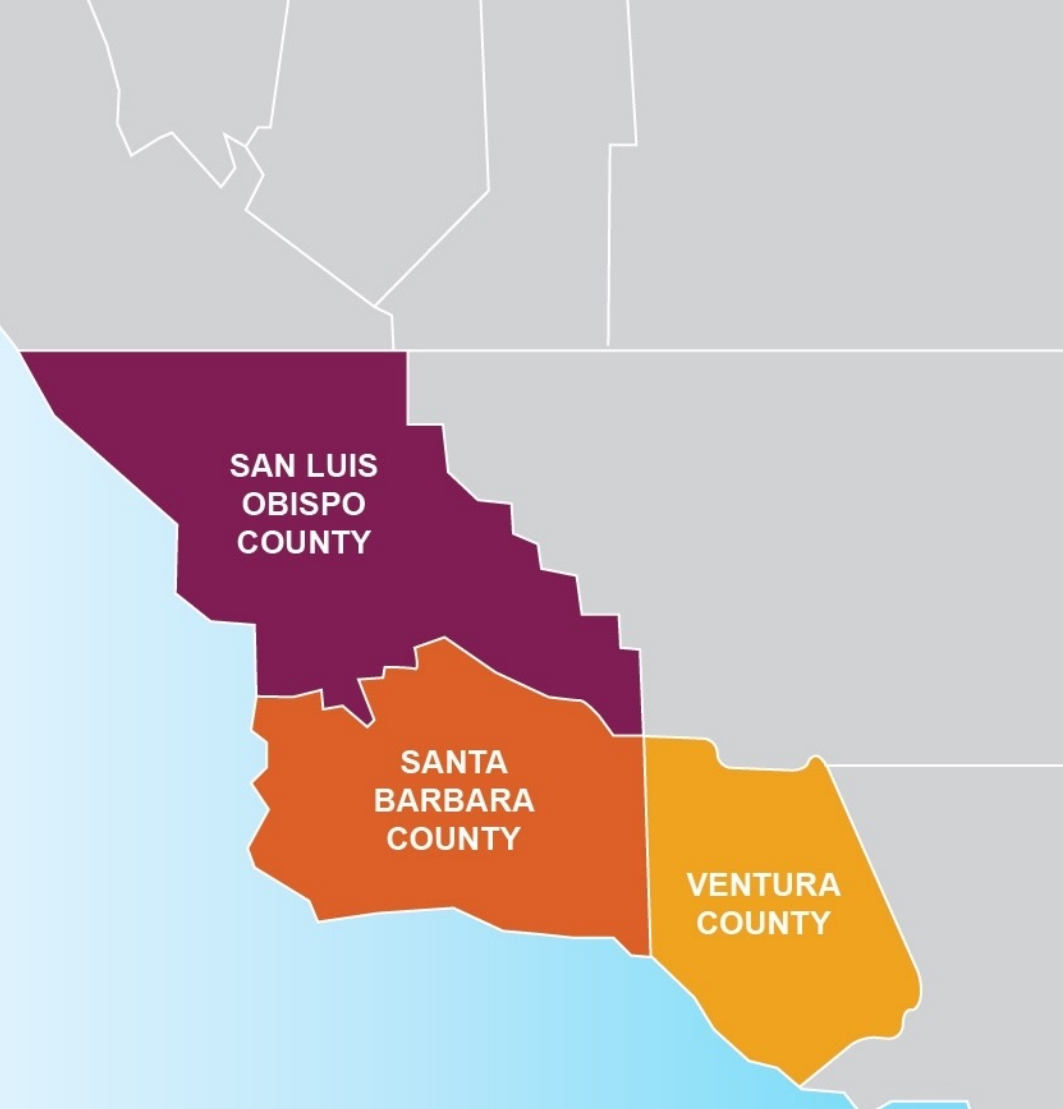
Zoom Orientation

- 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





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





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

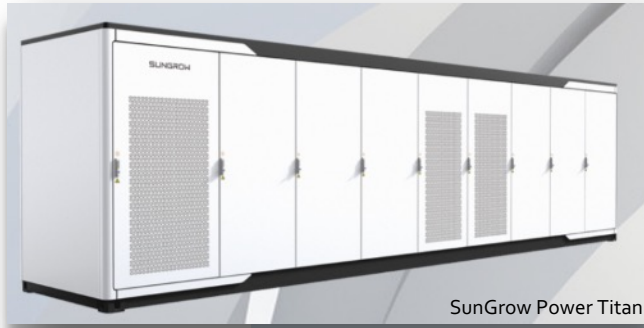


Today's Learning Objectives

- Understand different battery types and their applications for buildings
- Understand practical integration of batteries into project design and construction
- Know the process for sizing batteries and when they are required
- Review cost implications for battery use when paired with on-site renewable energy



Battery – Energy Storage Systems (ESS)



SunGrow Power Titan



<https://primuspower.com/en/energy-storage/>

Batteries for Grid Scale Applications Must Last Decades and Deliver Long Duration Energy Discharge On-Demand

Utility Scale –Grid Stabilization



Commercial and Industrial



Multifamily and Hospitality



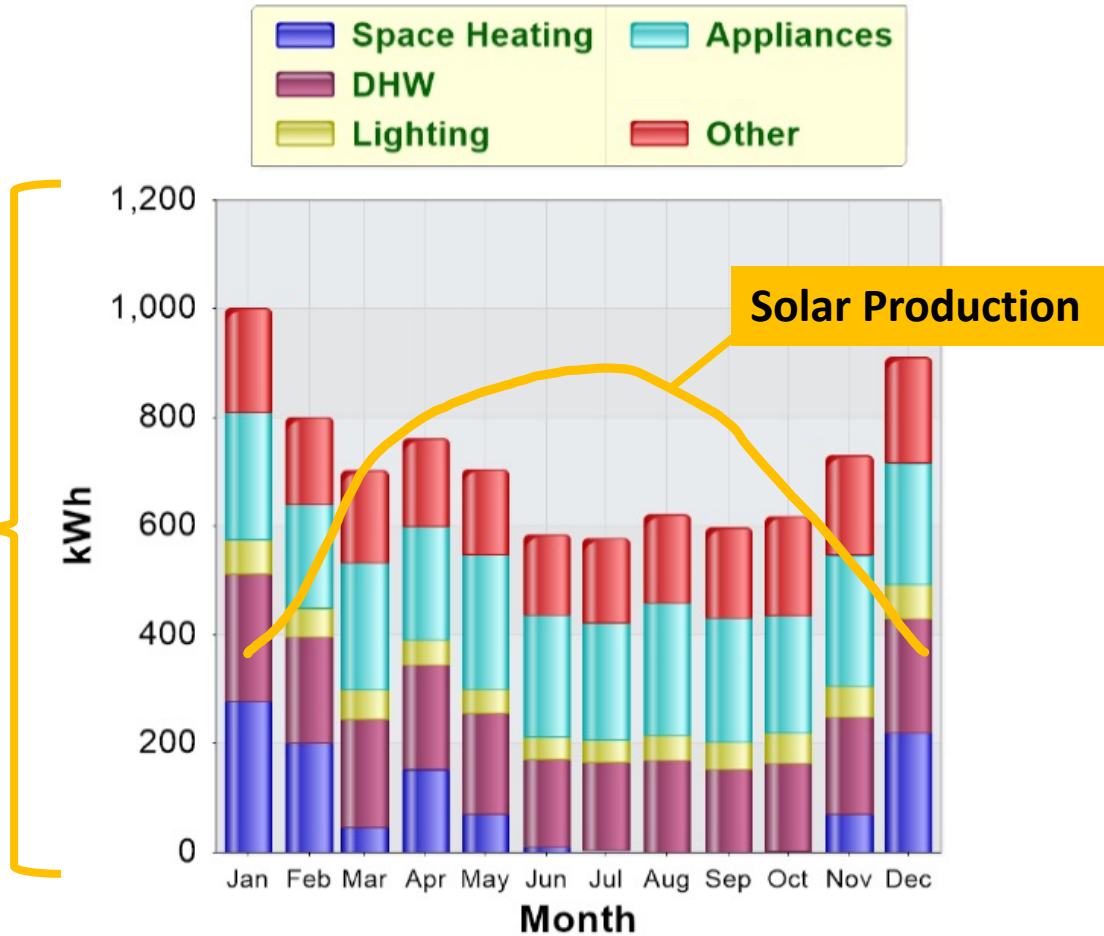
Private Homes



The Electric Grid was the Battery for Solar PV...

Single Family Energy Modeling Example

Predicted Electricity Energy-Use in Kilo-Watt Hours (kWh) per Month



Grid-Tied solar systems were designed to use the 'Grid' as a seasonal battery.

During a given year the building's solar production would deliver as many kWh as the household used.



...now, the Grid Needs a Battery

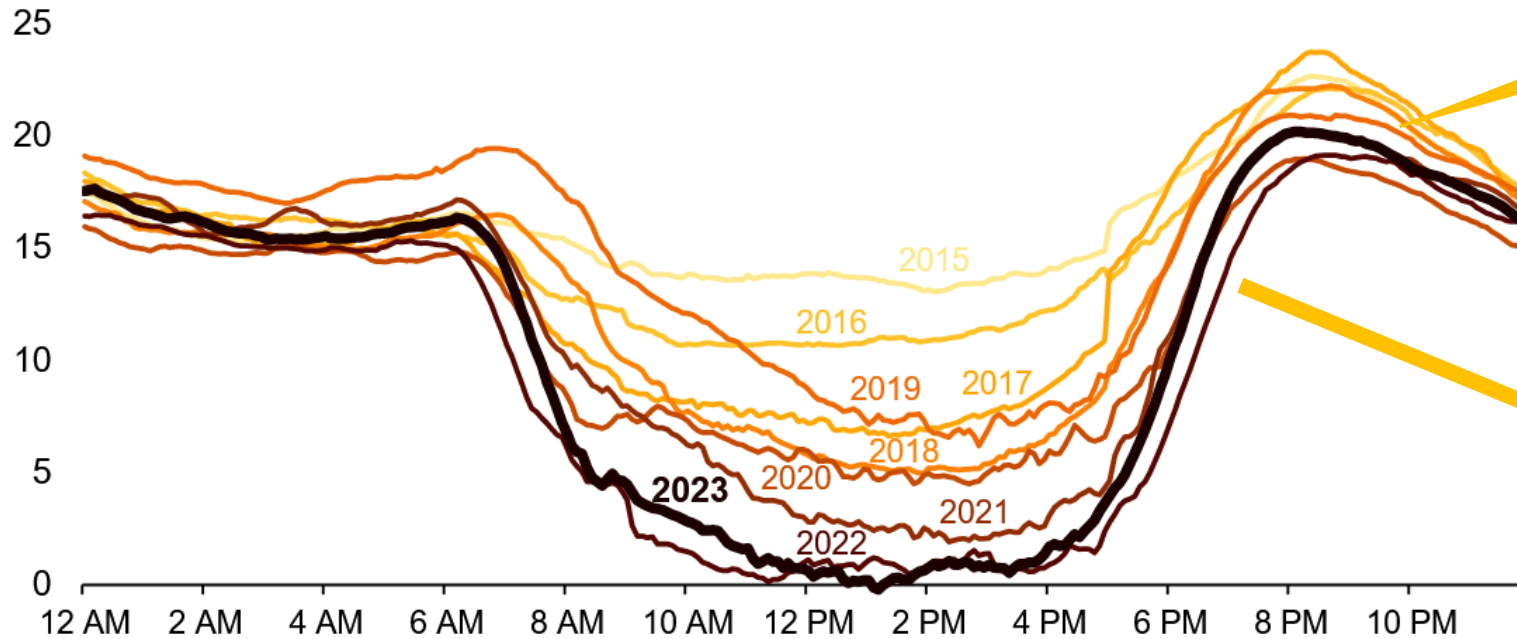
A look at the daily swing of net energy demand

JUNE 21, 2023

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

California's duck curve is getting deeper

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



ESS will help California flatten the bottom of the duck curve and provide stored energy in the evenings when most needed.

As solar energy production drops off, household energy use steeply ramps up.

Data source: California Independent System Operator (CAISO)

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



Building Battery Use

Resiliency and Load Shifting (Single Fam and all Occupancies)

- Load Shifting –Use battery when electric rates are highest cost
- Resiliency –Use battery when electric power goes out
- Grid Stability: Virtual Power Plant (VPP) Battery Programs through the Electric Utility
- Self Utilization –Store excess on-site Solar Energy for later use

Code Requirement (High-Rise Multifamily and Non-Res)

- Multifamily 4 Stories or Greater
- Commercial Occupancies
- Only Required if a PV System is Triggered
 - Grid Tied
 - Minimum Size Threshold – Exemptions

Home Battery Systems – Large Market

Some popular examples, but there are many others coming to market every day:



SUNPOWER®



LG Energy Solution
ESS Battery Division



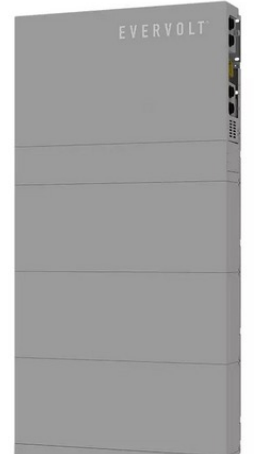
FRANKLINWH



solarEdge



ENPHASE



Panasonic EVERVOLT®



electric power



sonnen



GOALZERO



GENERAC



LITHION

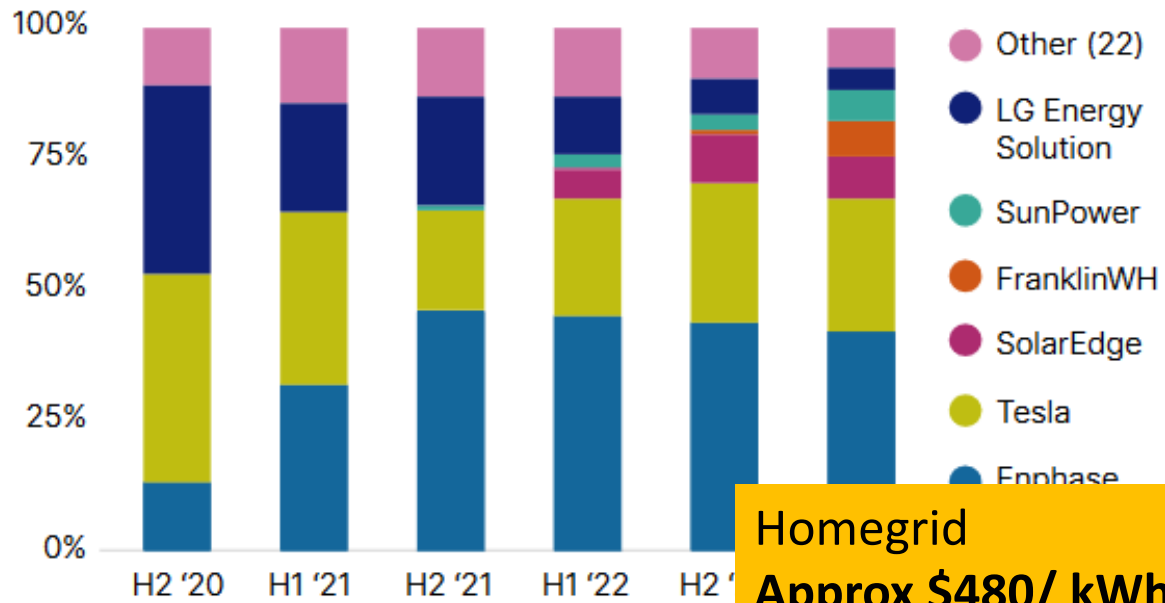


TESLA

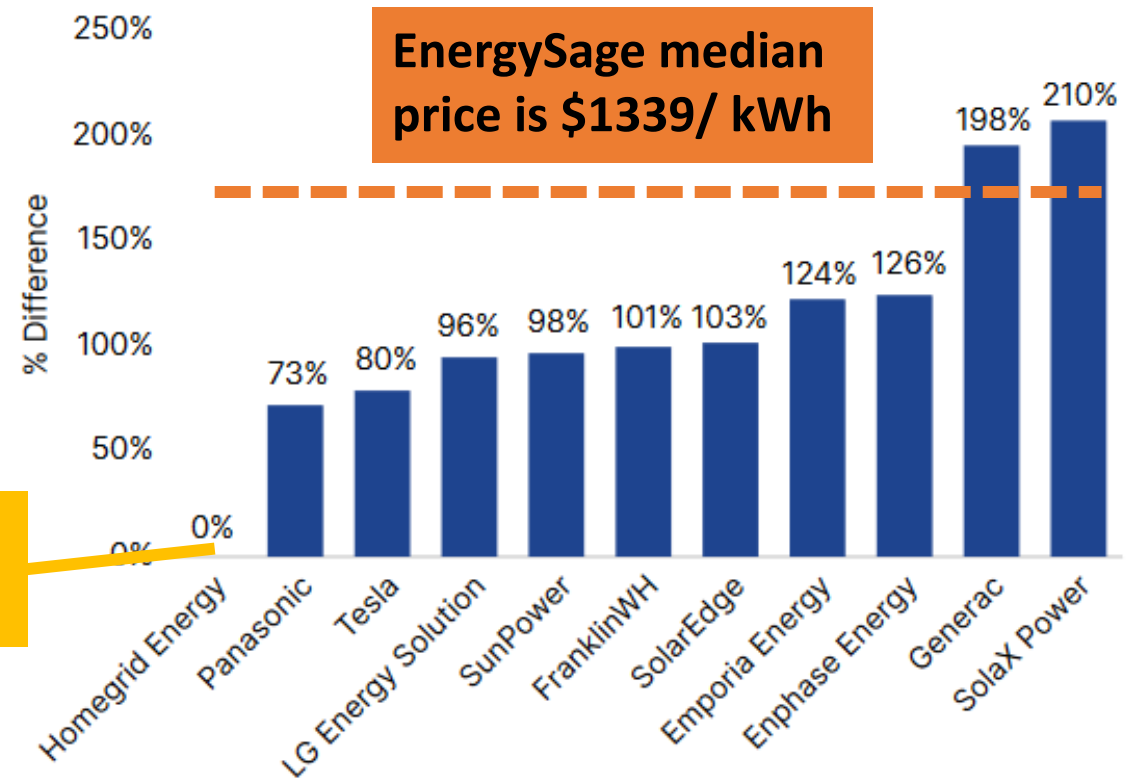
Market Share – Excerpt from EnergySage Data Set

www.energysage.com

STORAGE MARKETPLACE SHARE BY HALF YEAR



PERCENT DIFFERENCE FROM LEAST EXPENSIVE OPTION



Historical Context

Examples of Home Batteries of the Resent 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

Current Context

Current Safety Concerns of Lithium Batteries:

Combustible Li-Ion Batteries:

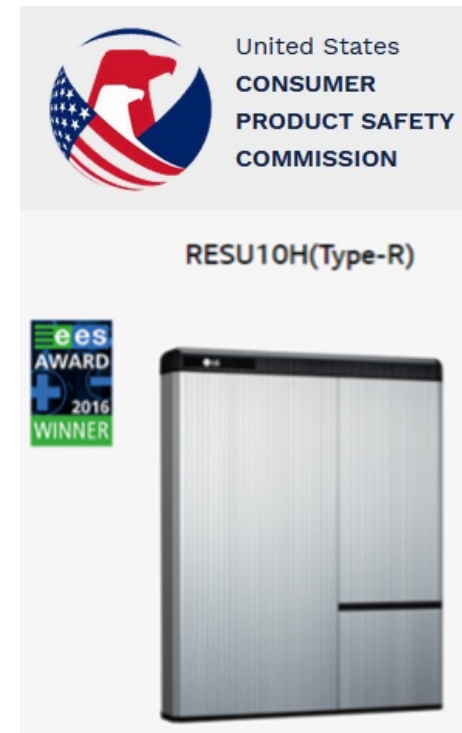
LCO – Lithium Cobalt Oxide

NCA – Nickel Cobalt Aluminum

NMC – Nickel Manganese Cobalt



YouTube · 7NEWS Australia · Sep 30, 2023

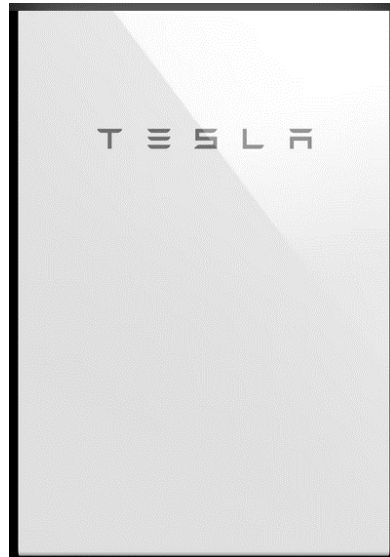


- LG Chem stationary home battery is implicated in house fires
- LG Chem recalls 10,000 batteries in 2020 and 2021
- LG Energy Solutions emerges with new home battery and new chemistry options

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



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

INPUT

Batteries, battery packs & production scrap

Consumer electronics

Collection & receipt

Storage & preparation

Recycling

Refining

OUTPUT

Anode (Copper foil)

Cathode (Precursor & Cathode active material)

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

SOLUTION

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.

[Recycle with us](#)

REDWOOD
MATERIALS

redwoodmaterials.com

On the Horizon in the USA...

Sodium-ion

SIB – Na⁺

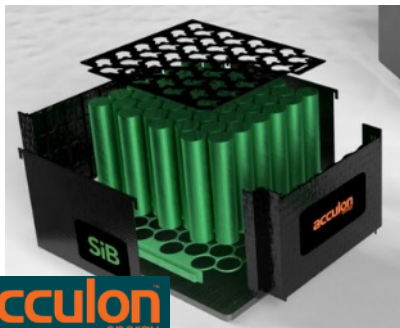
Lower-Power Density

Potentially, Very Low Cost

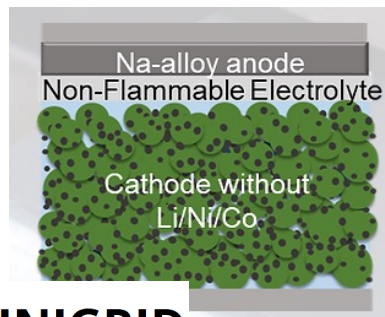
Non-Combustible

Na is Abundant

Better Environmentally



acculon
energy



 **UNIGRID**

Zinc-ion

ZIB– Zn²⁺

Lower-Power Density

Potentially, Very Low Cost

Non-Combustible

Zn is Abundant in North America

Better Environmentally

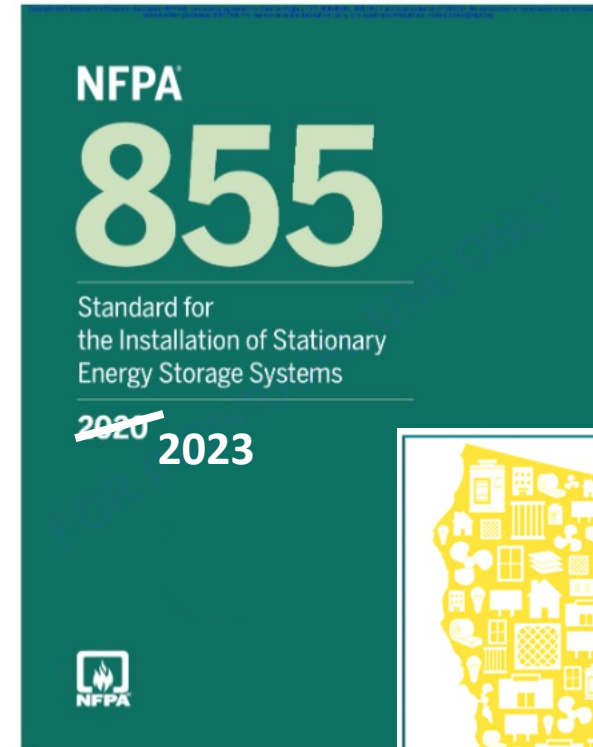
Li and Co Free



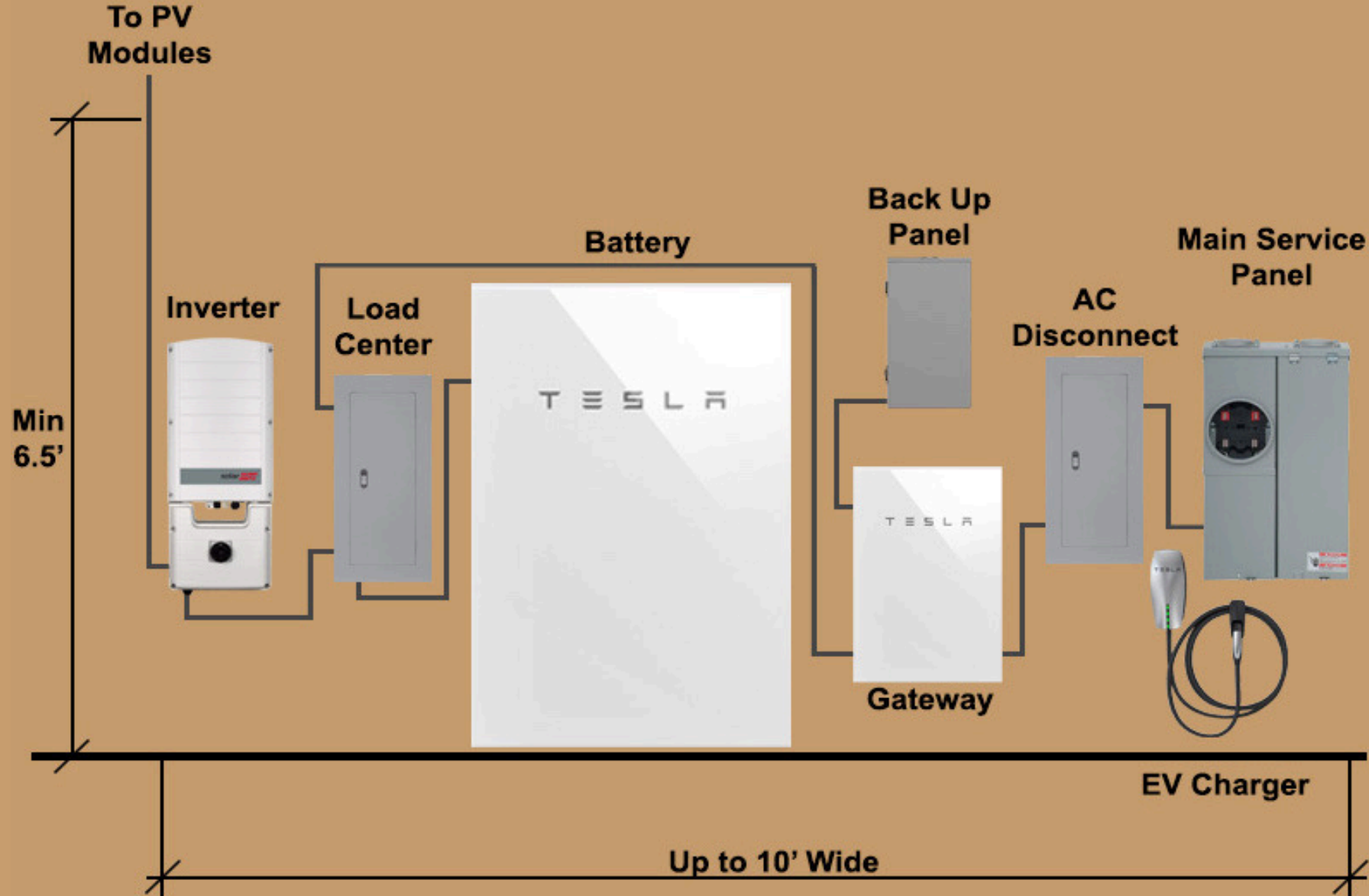
SALIENT
ENERGY

Design Considerations for Battery Installations

- Functionality – Supporting Equipment and Space Needs
- Fire Safety –NFPA 855
- Energy Code –Title 24 Part 6:
 - Desired –Single Family, or
 - Required –Non-Res



Common Equipment for a Solar + Battery System



General Design Considerations

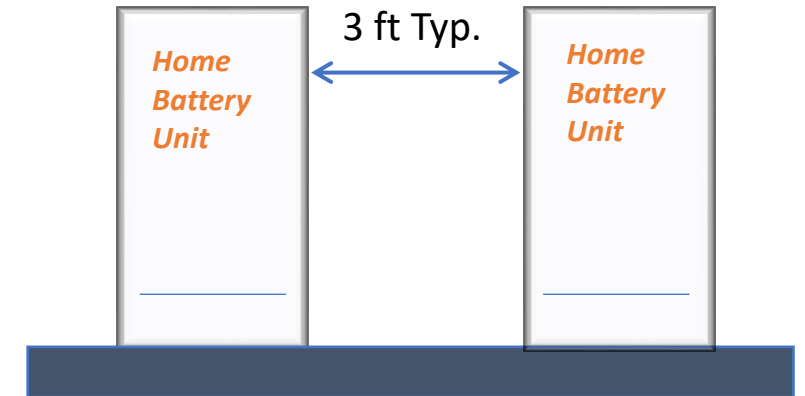
- Outdoor and indoor installations are possible
- Protect from impact damage
- Protect from temperature extremes
- Protect from adverse weather
- Maintain 3 ft distance from paths of travel, doors and windows
- Follow manufacture's installation requirements



Fire Safety – NFPA 855

Highlights from Chapter 15 – One and Two Family Units and Townhouses:

- Individual ESS units max 20 kWh stored energy
- Separate individual units by 3 ft
- Aggregate capacity shall not exceed:
 - 40 kWh within utility closets or storage spaces
 - 80 kWh in garages and/or detached accessory structures
 - 80 on exterior walls or in outdoor installations
- Utility closets/spaces and/or garage shall have 5/8" Type X gypsum board ceilings and walls
- Interconnected smoke alarms shall be installed through out the dwelling and attached garage (or when appropriate an interconnected heat alarm)
- Maintain 3 ft clearance from all windows and doors

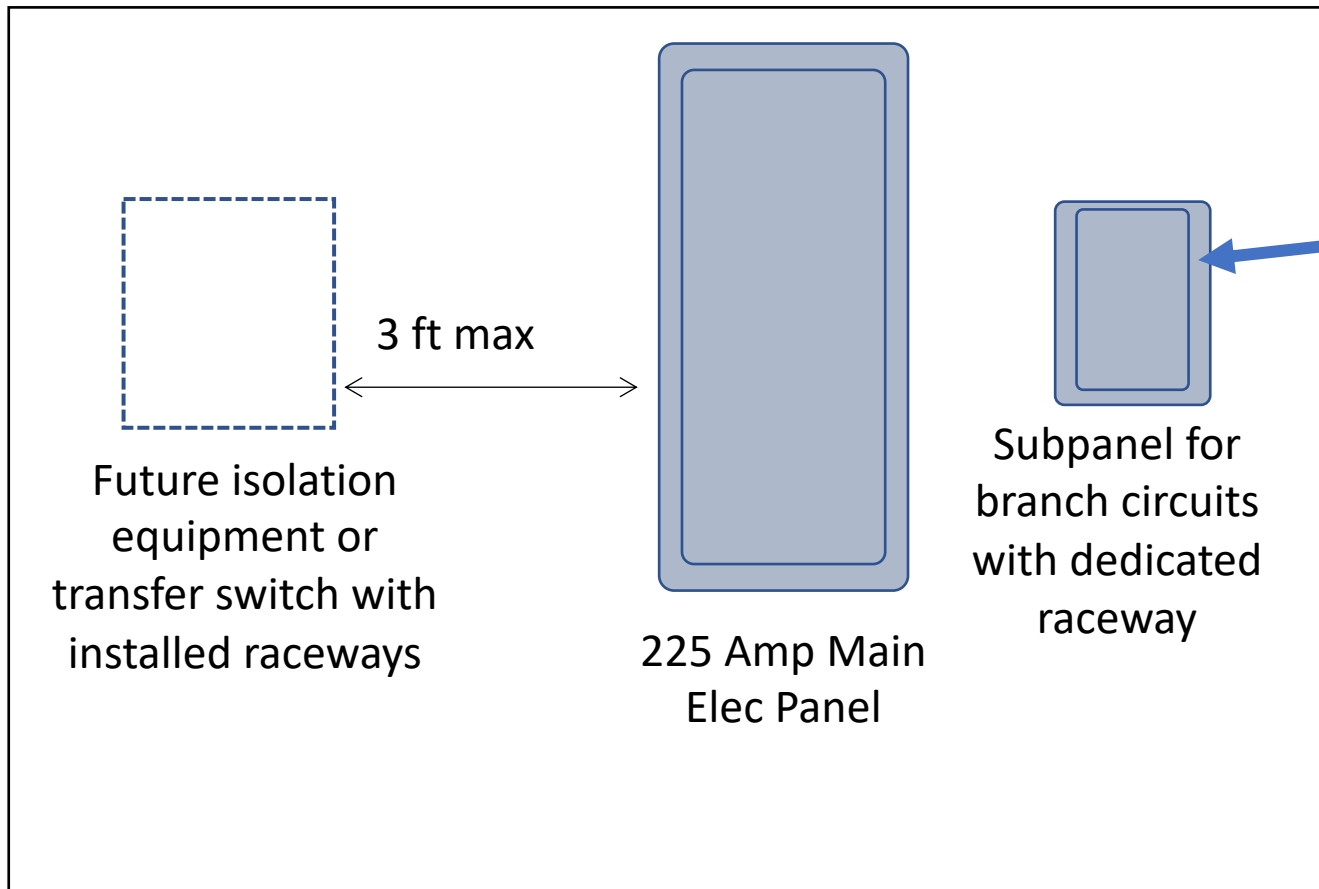


Batteries maybe installed closer if it can be shown to the AHJ that the battery manufacture has complied with proper fire testing and has specified the minimum distance.



2022 Energy Code – Single Family

- Only applicable to **New Construction**
- **Mandatory Measure: “Battery Ready”**



‘Critical Loads’ Subpanel – A minimum of 4 branch circuits shall be identified feeding:

- Refrigerator
- Lighting circuit near the primary egress
- Sleeping room receptacle outlet
- Owner choice

2022 Energy Code – Highrise and Non-Res

Applicable Occupancy Types:

High-Rise Residential
Grocery
Retail
Restaurant
School
Warehouse
Auditorium, Convention Center, Theater
Hotel-Motel
Office, Financial, or Unleased
Clinic/Medical Office Building

Applies to new construction as listed or mixed occupancy where one or more of these building types constitute at least 80% of the floor area of the building.



Solar System size will depend on Occupancy Type, Conditioned Floor Area, etc. The Battery System size will depend on PV System Size.

Photovoltaic (PV) –Applicable Bldg Type and System Size

Use the smaller of:

1. $kW_{PV} = (CFA \times A)/1000$

- 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

Climate Zone	Factor A – Minimum PV Capacity (W/ft ² of conditioned floor area)		
	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



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)



Ohlone Station, San Jose, CA (CZ 4)

Restaurant -- 2,000 sf

SARA = 4,500 sf

Retail – 3,500 sf

Office – 7,000 sf

$$kW_{PV} = (2000 \times 0.44) + (3500 \times 2.91) + (7000 \times 3.13) / 1000$$

$$kW_{PV} = 33 \text{ kW}$$

OR

$$kW_{PV} = 14 \text{ W/sf} \times 4,500 \text{ sf} / 1000$$

$$kW_{PV} = 63 \text{ kW}$$

Battery Storage Size –kWh and kW

Energy Capacity :

$$\text{kWh} = \text{kW}_{\text{PVdc}} \times B / D^{0.5}$$

Where, **D** is the rated single charge-discharge cycle AC to AC efficiency of the battery, aka “AC round-trip efficiency”

Power Capacity:

$$\text{kW} = \text{kW}_{\text{PVdc}} \times C$$

The primary function of the battery storage system is daily cycling for the purpose of load shifting, maximized solar self-utilization, and grid-harmonization.

Table 140.10-B – Battery Storage Capacity Factors

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

Battery Exemption Highlights:

- Calculated energy capacity is less than 10 kWh
- Single tenant spaces/buildings < 5,000 sq.ft CFA
- Climate Zone 1, offices, schools, and warehouse



Battery Size – Based on PV System Size

Restaurant -- 2,000 sf
Retail – 3,500 sf
Office – 7,000 sf

Take **Exemption**: Need only calculate for separate tenant space 5000 sf or more

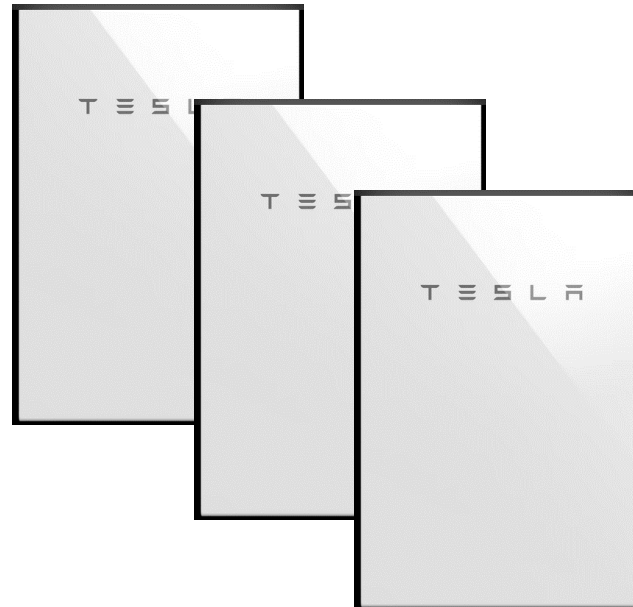
$$\text{kW}_{\text{PVdc}} = (7000 \times 3.13) / 1000$$
$$= 21.9 \text{ kW}$$

Energy Capacity:

$$\text{kWh} = \text{kW}_{\text{PVdc}} \times B / D^{0.5}$$
$$= 21.9 \times 1.68 / .89^{0.5}$$
$$= 39.14 \text{ kWh}$$

Power Capacity:

$$\text{kW} = \text{kW}_{\text{PVdc}} \times C$$
$$= 21.9 \times .42$$
$$= 9.20 \text{ kW}$$



Consider (3) Power Walls

Powerwall Specs

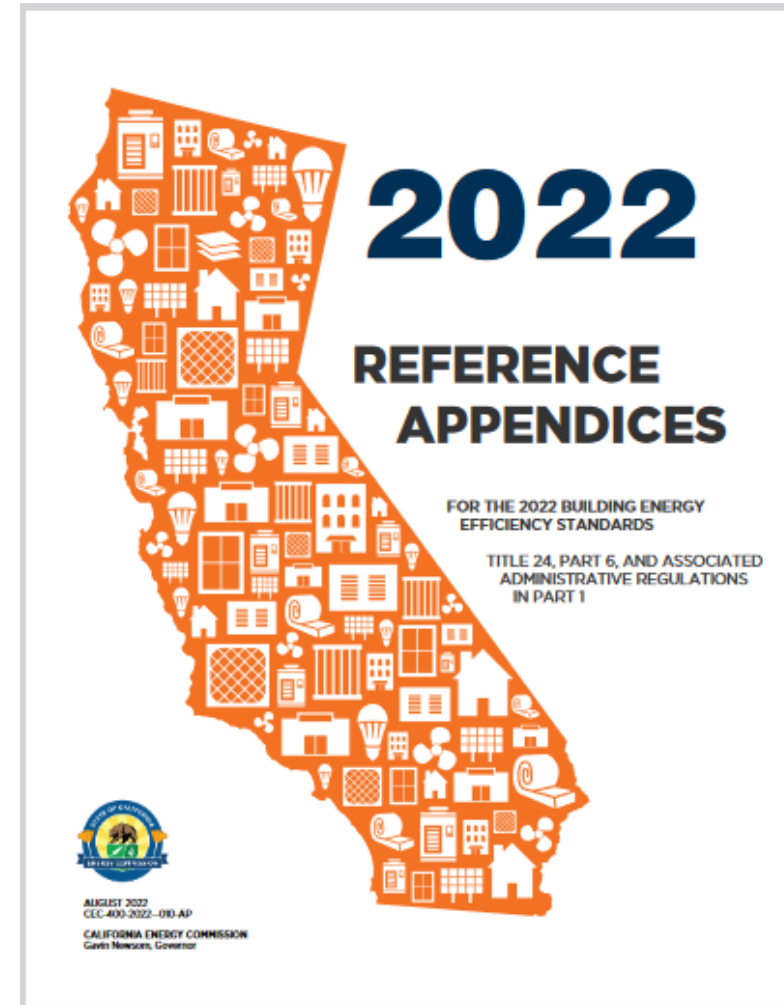
Powerwall 2	Powerwall+
Powerwall 3	
Energy Capacity 13.5 kWh*	Size and Weight L x W x D 45.3 in x 29.6 in x 5.75 in 251.3 lbs
On-Grid Power 5 kW continuous	Installation Floor or wall mounted Indoor or outdoor Up to 10 Powerwalls -4°F to 122°F Water and dust resistance
Backup Power 7 kW peak 106A LRA motor start Seamless backup transition	Warranty 10 years
Scalable Up to 10 units	

*See [Powerwall Technical Specifications](#) for more details.

Battery Storage System Controls

Highlight a Few Control Requirements and Credits:

- See Appendix JA12 – Qualification Requirements for Battery Storage System
- Battery capable of being remotely programmed
- Battery can be programmed for time-of-use (TOU) metering and/or Advanced Demand Control
- In power outage, ESS can be used for back-up power and after power is restored, the battery must revert immediately to the previously programmed control strategy



Battery Resources: Sizing, Cost, Savings

Industry Websites

- Tools for battery sizing based on typical household energy use
- Provide average appliance kWh and time-use estimates
- EnergySage connects homeowners to vetted contractors

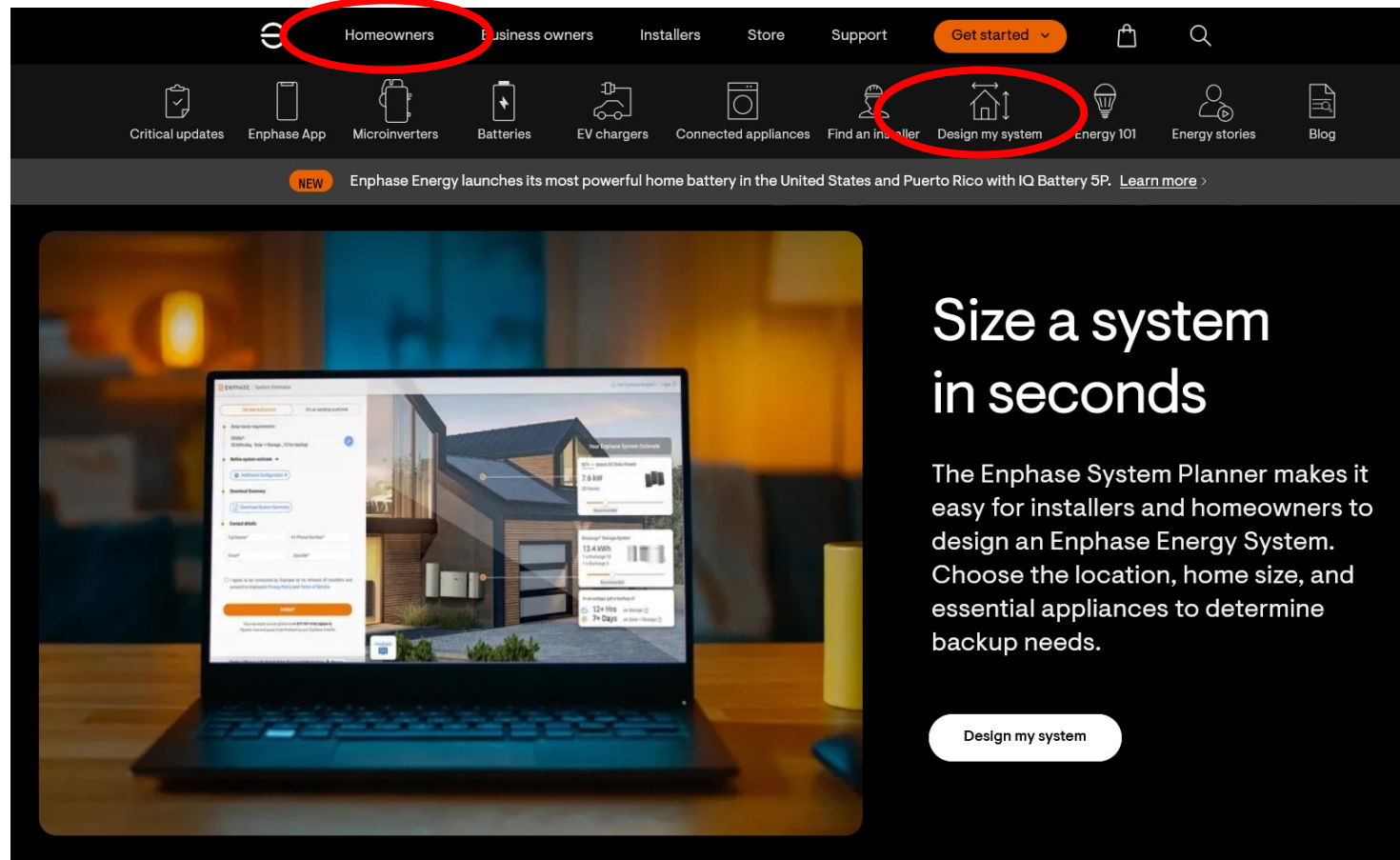
Utility Company Websites

- Links to Battery and Self-Utilization Incentives
- PG&E links to a 'Solar Calculator' tool that includes battery storage

Size a Battery for your Home

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

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

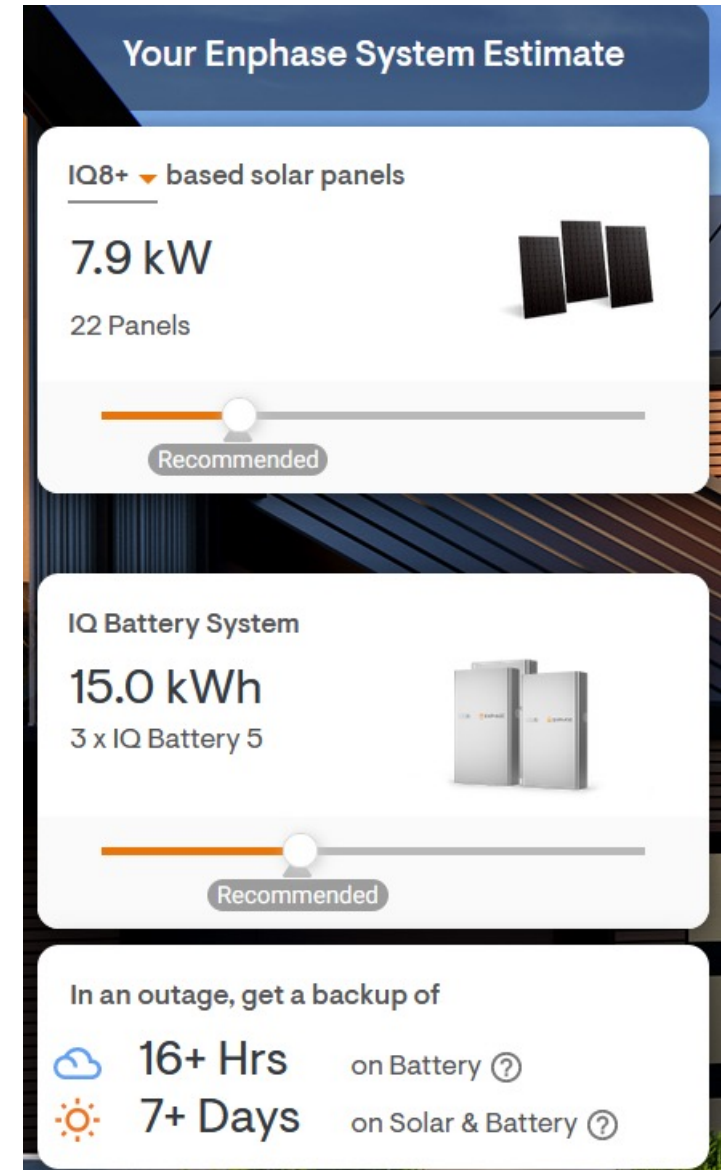


The screenshot shows the Enphase website's navigation menu. The 'Homeowners' link is circled in red. Below it, the 'Design my system' link is also circled in red. A laptop in the foreground displays the Enphase System Planner interface, which includes a 3D rendering of a house and various system configuration 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](#)

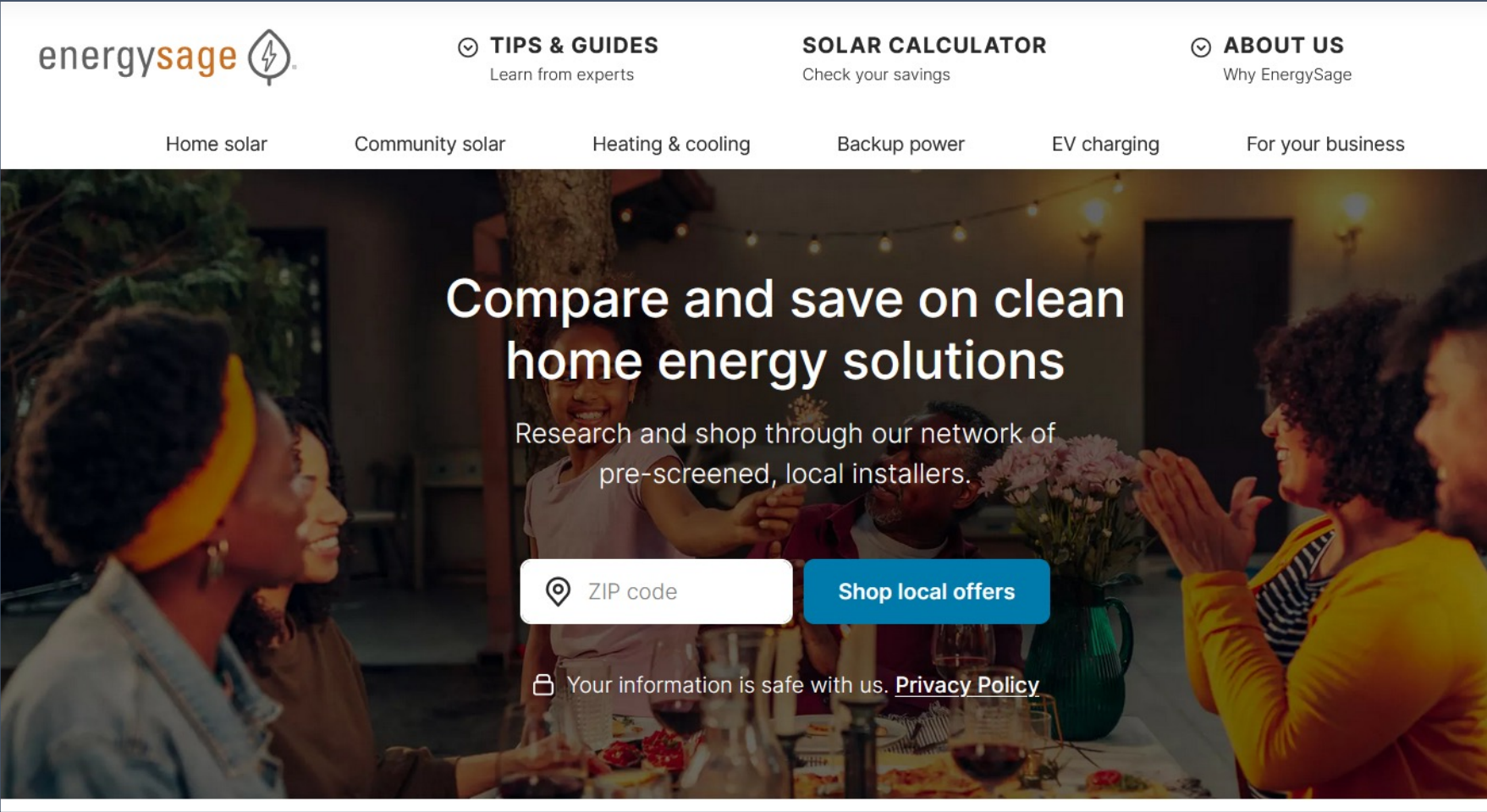


Your Enphase System Estimate

- 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 ?

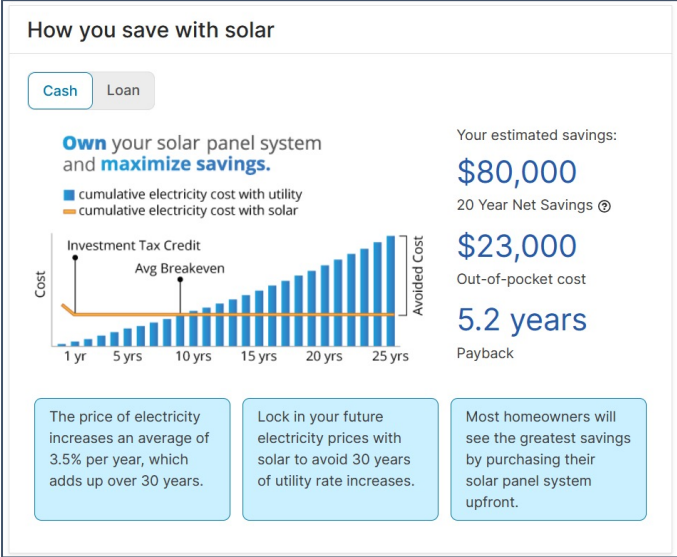
EnergySage: Information Hub, Pre-screen Installers

https://www.energysage.com/



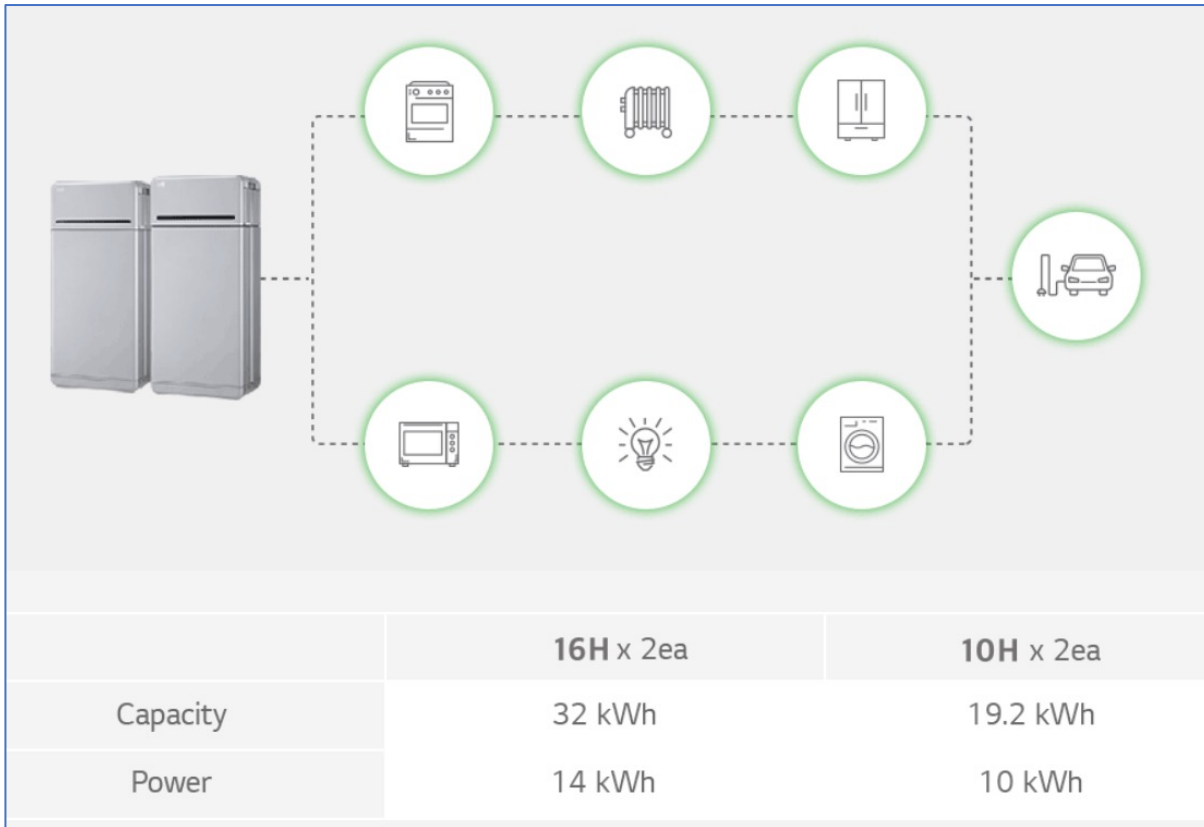
The image shows the top portion of the EnergySage website. At the top left is the EnergySage logo. To its right are four navigation links: 'TIPS & GUIDES' (Learn from experts), 'SOLAR CALCULATOR' (Check your savings), and 'ABOUT US' (Why EnergySage). Below these are six category links: 'Home solar',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

Sample Results from the 'Solar Calculator'



Manufacturers often show estimates for their products' use:

This is useful information for a basic understanding of the capacity and duration of use for a battery system.



One Yeti PRO 4000 gives you 4,000 watt hours of backup power! That's enough to keep the essentials running for a whole day.

Power these devices simultaneously for a day with one Yeti PRO 4000.



Full Size Refrigerator

Run time: 24 Hours

(Uses about 67 W/hr):



WiFi Router

Run time: 24 Hours

(Uses about 25 W/hr):



60" TV

Run time: 4 Hours

(Uses About 80 W/hr):



Microwave

Run time: 15 Mins

(Uses 1000 W/hr):



4 LightBulbs

Run Time: 4 Hours

(Uses about 44 W/hr):



Phone

Charges 2

(Uses about 12 Wh per):



Laptop

Charges 2

(Uses about 51 Wh per):



Coffee Maker

1 Pot

(250 w/hr per):

Virtual Power Plant (VPP) – multiple brands and utility companies are partnering for program participation.

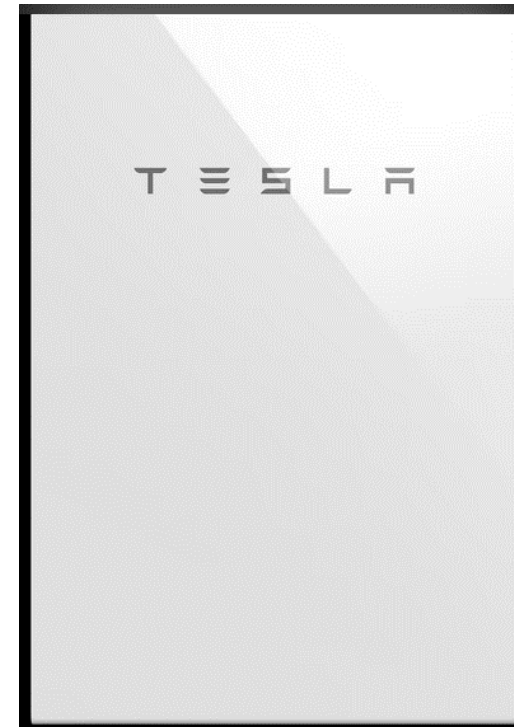
More information and program application be accessed through the manufacture often through the battery app.

Tesla Power Wall Example:

Eligibility

Tesla Powerwall owners with or without solar are eligible to participate in PG&E's ELRP pilot if they:

- Receive electric services from PG&E or are Community Choice Aggregation (CCA) customers located within the PG&E service territory.
- Have a residential service account.
- Are not enrolled in a conflicting PG&E or non-utility demand response program or another Virtual Power Plant.
- Have a valid Rule 21 interconnection agreement.



Battery Storage Rebates for Qualifying Utility Customers

Need to be in a Tier 2 or Tier 3 Fire Zones, and Enhanced Powerline Safety Settings districts – follow links to appropriate maps from PG&E website.

The screenshot shows the PG&E website interface. At the top, there is a search bar and navigation links for Account, Outages & Safety, Save Energy & Money, Business Resources, and Clean Energy. Below the navigation, there are radio buttons for "Address" and "City / County / Tribe". A dropdown menu is open for "Enhanced Powerline Safety Settings (EPSS)". The main map area displays a geographic region with two types of fire-risk areas: "High Fire-Risk Area" (represented by blue dots) and "Near High Fire-Risk Area" (represented by orange dots). The map includes labels for various locations such as Cambria, Morro Bay, San Luis Obispo, and Nipomo. At the bottom left, there is a copyright notice: "© 2024 PG&E ACCESSIBILITY PRIVACY TERMS AND CONDITIONS DO NOT SELL MY PERSONAL INFORMATION" and "California State Parks, Esri, TomTom, Garmin, SafeGraph, FAO, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USFWS". At the bottom right, it says "Powered by Esri".

The screenshot shows the CPUC High Fire Threat District (HFTD) map. The map displays various fire threat zones in shades of orange and red across California. An "About" popup window is open, providing details about the HFTD. The popup text reads: "The CPUC High-Fire-Threat District (HFTD) Map is comprised of two map sources and includes three fire-threat areas:". It lists three tiers: "Tier 3 consists of areas on the CPUC Fire-Threat Map where there is an extreme risk from wildfires associated with overhead utility power lines or overhead utility power-line facilities also supporting communication facilities.", "Tier 2 consists of areas on the CPUC Fire-Threat Map where there is an elevated risk from wildfires associated with overhead utility power lines or overhead utility power-line facilities also supporting communication facilities.", and "Zone 1 consists of Tier 1 High-Hazard Zones (HHZs) from the United States Forest Service (USFS) and California Department of Forestry and Fire Protection (CAL FIRE) joint map of Tree Mortality HHZs. Tier 1 HHZs are in direct proximity to communities, roads, and utility lines, and are a direct threat to public safety." It concludes with: "Together, Tier 3, Tier 2 and Zone 1 constitutes the HFTD. When the three fire-threat areas overlap, Tier 3 supersedes Tier 2 which supersedes Zone 1." and "To download GIS files, please click [HFTD](#)." The map interface includes a search bar, navigation icons, and a scale bar. At the bottom right, it says "CGIAR, USGS | California State Parks, Esri, TomTom, Garmin, SafeGraph, FAO, METI/NASA, USGS, Bureau of ...".



Sizing and Cost Savings – Solar Calculator ‘WattPlan’

<https://guide.pge.com>

PG&E RESOURCES

Explore resources for PG&E Customers

Everything you need to reduce costs and maximize savings

RESET ALL



Solar Calculator

Make an informed decision about rooftop solar for your home. Calculate your solar savings potential with a personalized assessment with PG&E's Solar Calculator.

GENERATE SOLAR POWER | TOOLS AND CALCULATORS

[Start Estimate >](#)



Disadvantaged Communities – Single-Family Solar Homes (DAC-SASH) program

Learn more about available programs for income qualified customers in disadvantage communities

GENERATE SOLAR POWER | PROGRAMS, REBATES

[Get Started >](#)



'WattPlan' - Information Gathering

https://pge.wattplan.com

Will you make any energy efficiency improvements?

We will perform a bundled estimate that factors in these associated costs and energy savings and then right-sizes a solar system for you.

No improvements Annual energy reduction: 0%	Easy improvements Examples: <ul style="list-style-type: none">• Install LED lights• Adjust thermostat temperature Annual energy reduction: 5%
Moderate improvements Examples: <ul style="list-style-type: none">• Purchase energy efficient appliances• Install insulation Annual energy reduction: 10% Estimated cost of improvements: \$ 2000	Advanced improvements Examples: <ul style="list-style-type: none">• Whole house upgrade Annual energy reduction: 10%

Energy improvements can be accounted for in the financial calculations

I entered monthly energy-use

Tell us about your energy usage

 Select average electric bill Quick estimate	 Enter monthly electric usage Detailed estimate	 Upload data Most accurate estimate
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For best results, we recommend that you upload your electric interval data using Green Button Download my Data.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1057	851	759	815	761	630	643	677	651	675	784	966
kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh

← Back Next →

Solar and Battery Details

My new plan

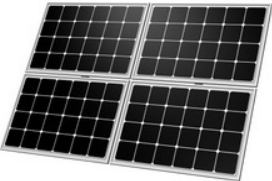
Electricity comes from utility & solar

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 [?]

0.5 27

Power, Max Continuous: 5.0 kW [?]

1 10

Unit Price: \$1,000 per kWh [?]

100 2000

System Price: \$13,500 [?]

Example of Additional Inputs and Assumption

Estimate assumptions	
Current annual electric bill	\$4192, Time-of-Use (Peak Pricing 4-9 p.m. every day)
Installed solar unit price	\$3 per W-DC
Storage system cost	\$1000.0 per kWh

Summary	
Key financial results	
First year electric bill savings	\$3,202
Breakeven year	7
Key assumptions	
Payment type	Cash
Solar system price	\$15,960
Storage system price	\$13,500
Utility rate increase	2% per year
Incentives available	
	\$4,788 Federal Residential Solar Credit
	\$4,050 Federal Battery Storage Credit
Next steps	
	Follow these steps to learn how to get started with installing solar today.

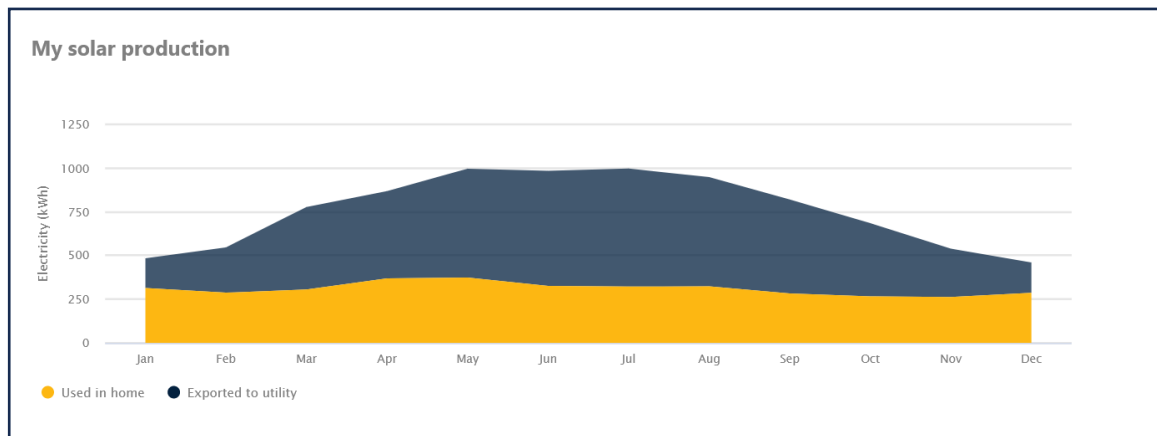
Includes 'next steps' for making a solar and/or battery system a reality



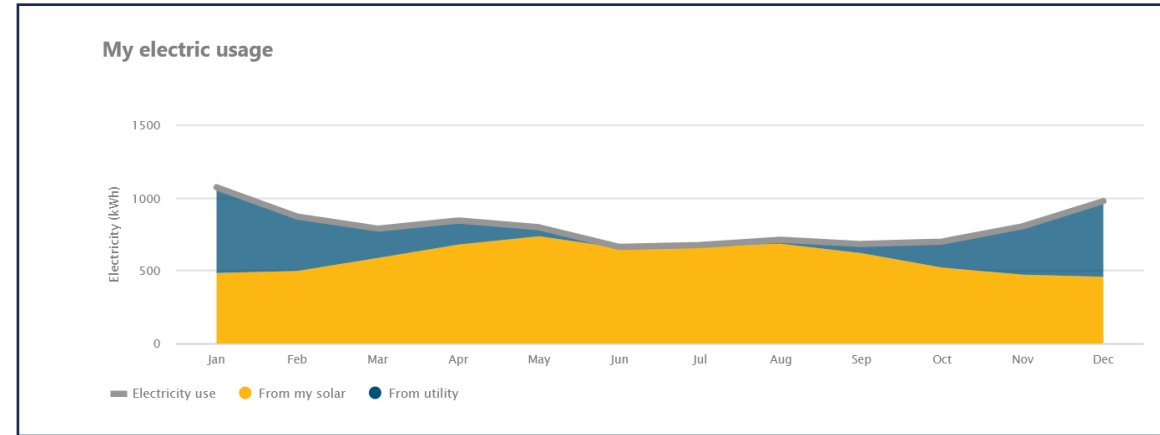
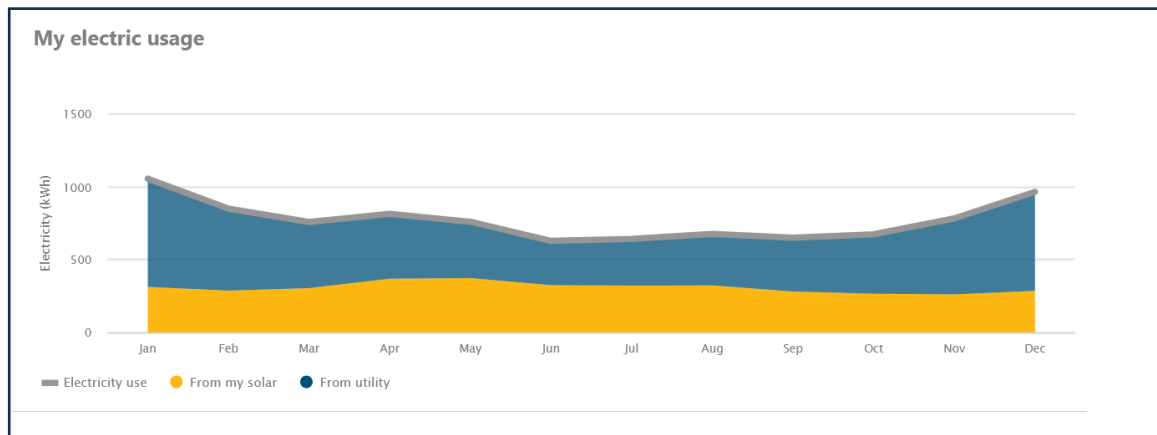
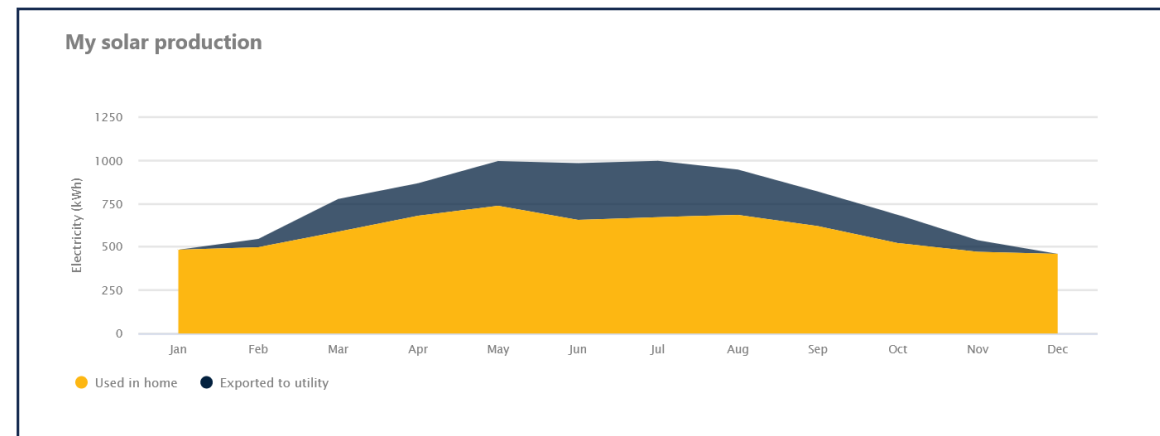
Graphic Results from 'WattPlan'

<https://pge.wattplan.com>

Solar without a Battery System



Solar with a Battery System



Same solar output and energy use, but the battery allows more of the produced energy to be used by 'My' household and not exported to the 'Grid.'

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

No Backup power	41% Solar energy used on site, not exported
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Key financials

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

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

Yes Backup power	78% Solar energy used on site, not exported
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Key financials

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

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/codes

Call:
805.781.1201

ENERGY CODE CONNECT

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 to help your plans and forms earn approval the first time.



Closing

- Continuing Education Units Available
 - Contact itzel.torres@ventura.org for AIA and ICC LUs
- Coming to Your Inbox Soon!
 - Slides, Recording, & Survey – Please Take It and Help Us Out!
- Upcoming Courses:
 - January 18 - [Using Life Cycle Assessment & Embodied Carbon Calculators to Make Design and Product Choices](#)
 - January 24 - [Batteries: Options and implementation for a building's energy storage system](#)
 - January 30 - [Intro to Residential HVAC Systems](#)
 - January 31 - [Energy Code Compliance: Using HERS Measures \(Part 1\)](#)
- 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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