Clean Coalition

Solar-driven Microgrids and Super Green Building

deliver unparalleled economic, environmental, and resilience benefits

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Mission

To accelerate the transition to renewable energy and a modern grid through technical, policy, and project development expertise.

Renewable Energy End-Game

100% renewable energy; 25% local, interconnected within the distribution grid and ensuring resilience without dependence on the transmission grid; and 75% remote, fully dependent on the transmission grid for serving loads.

GRI overiview

The Green Rebuild Initiative (GRI) aims to help ensure that the homes that get rebuilt in Pacific Palisades and Altadena (and beyond) will be done in a Super Green fashion. The target audiences are property owners, architects & designers, and builders. Super Green homes are 100% electric and feature enough solar to achieve Net Zero Energy (NZE) -- and are configured with energy storage to benefit from the unparalleled resilience delivered by Solar Microgrids.

GRI website

https://clean-coalition.org/programs/green-rebuild-initiative/

Types of microgrids

- A microgrid is a combination of energy resources, definitely including generation, that are coordinated to serve specified loads, including in an islanded fashion.
- A Solar Microgrid is a behind-the-meter (BTM) microgrid that solely relies on solar for energy generation when islanded. A Solar Microgrid relies on energy storage to time-shift solar and ensure energy availability at night etc.
- A Hybrid Solar Microgrid is a Solar Microgrid that includes additional sources of energy generation, beyond just solar.
- A Community Microgrid a microgrid that covers a target grid area and relies on existing distribution feeders (ie, power lines) to operate when islanded. Community Microgrids typically include both front-of-meter (FOM) and BTM resources, including Solar Microgrids, and require effective participation from utilities, which have mostly erected barriers to date.

Value-of-Resilience (VOR) details

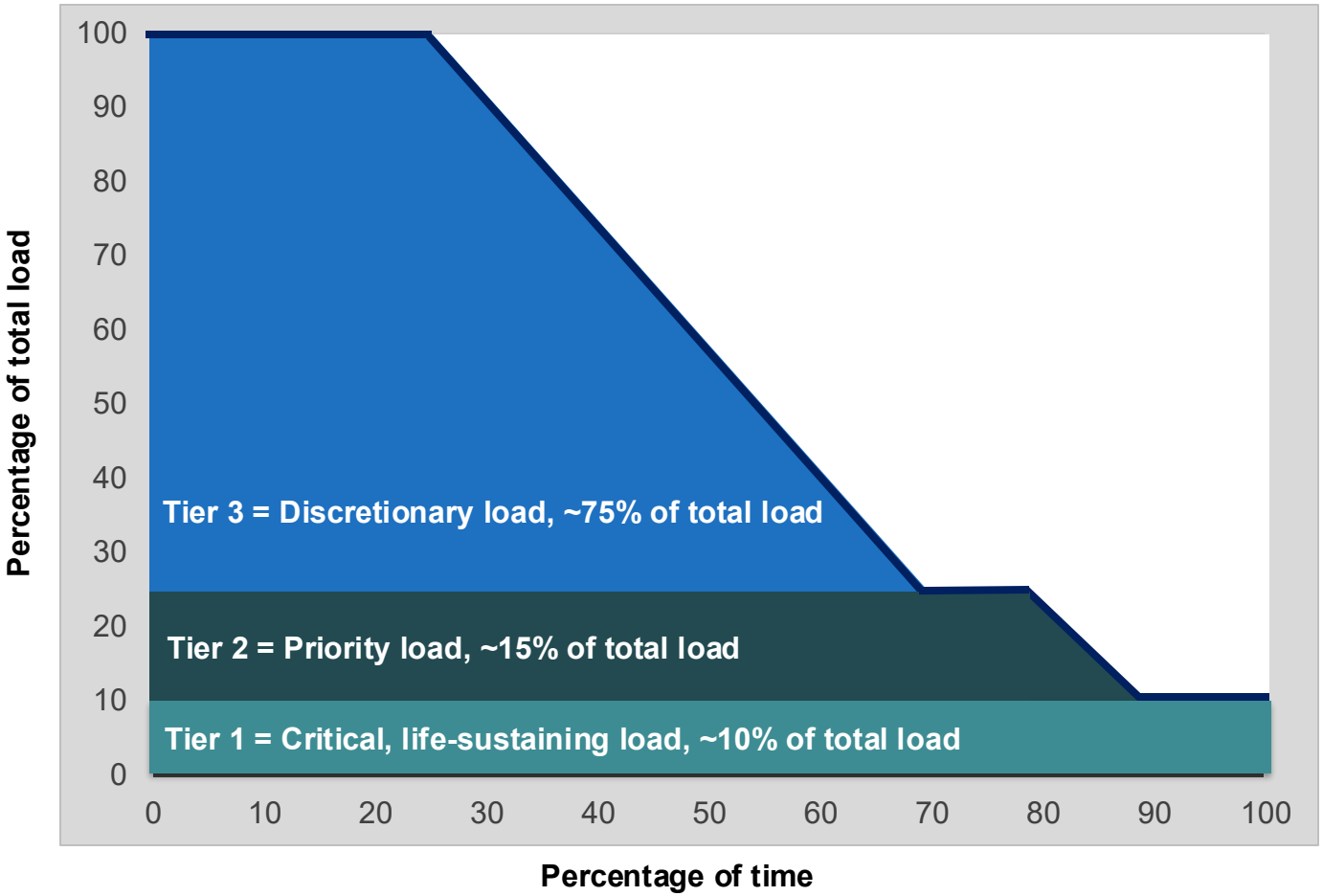
VOR123

VOR123 is the value-of-resilience (VOR) from Solar Microgrids methodology that the Clean Coalition has developed to normalize VOR across all types of facilities & geographies. The VOR normalization is founded in tiering loads into three categories: Tier 1 (critical), Tier 2 (priority), and Tier 3 (discretionary). Since each Tier has its own resilience requirement and VOR, this methodology is called VOR123.

VOR123 webinar

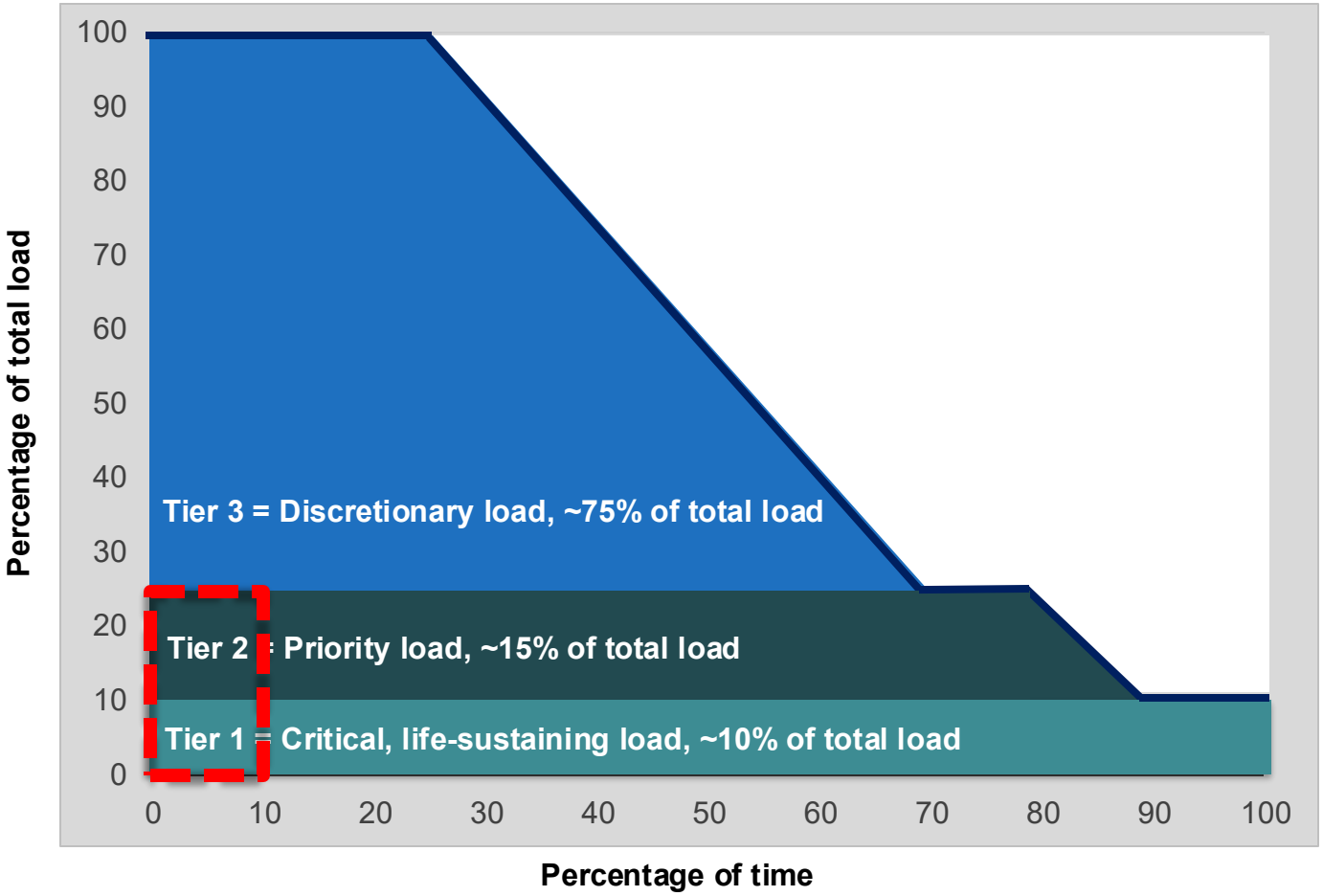
https://clean-coalition.org/news/webinar-valuing-resilience-solar-microgrids-thursday-5-nov-2020/

Typical load tier resilience from Solar Microgrids



Percentage of time online for Tier 1, 2, and 3 loads for a Solar Microgrid designed for the University of California Santa Barbara (UCSB) with enough solar to achieve net zero and 200 kWh of energy storage per 100 kW solar.

Diesel generators are designed for limited resilience

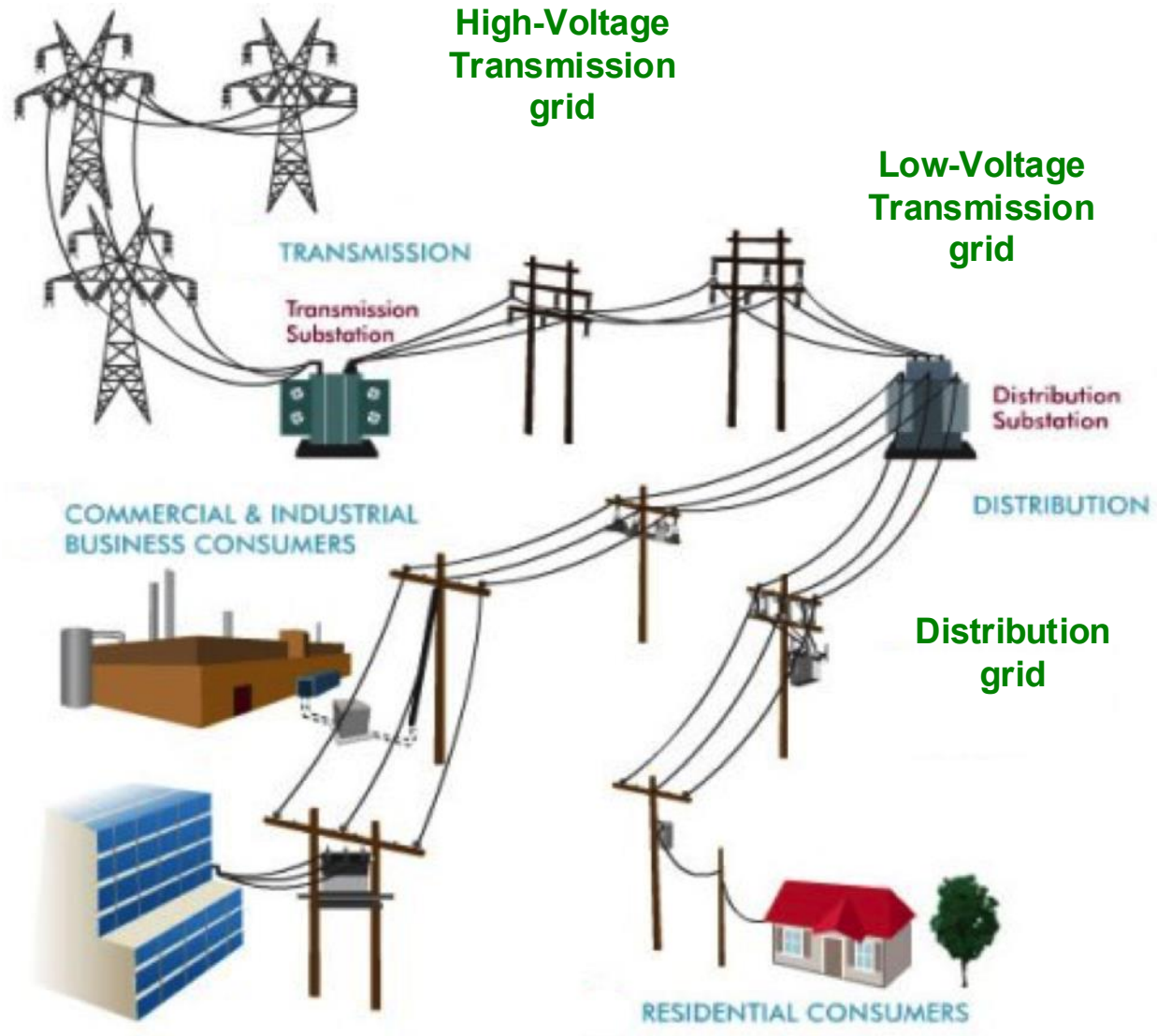


A typical diesel generator is configured to maintain 25% of the normal load for two days. If diesel fuel cannot be resupplied within two days, goodbye. This is hardly a solution for increasingly necessary long-term resilience. In California, Solar Microgrids provide a vastly superior trifecta of economic, environmental, and resilience benefits.

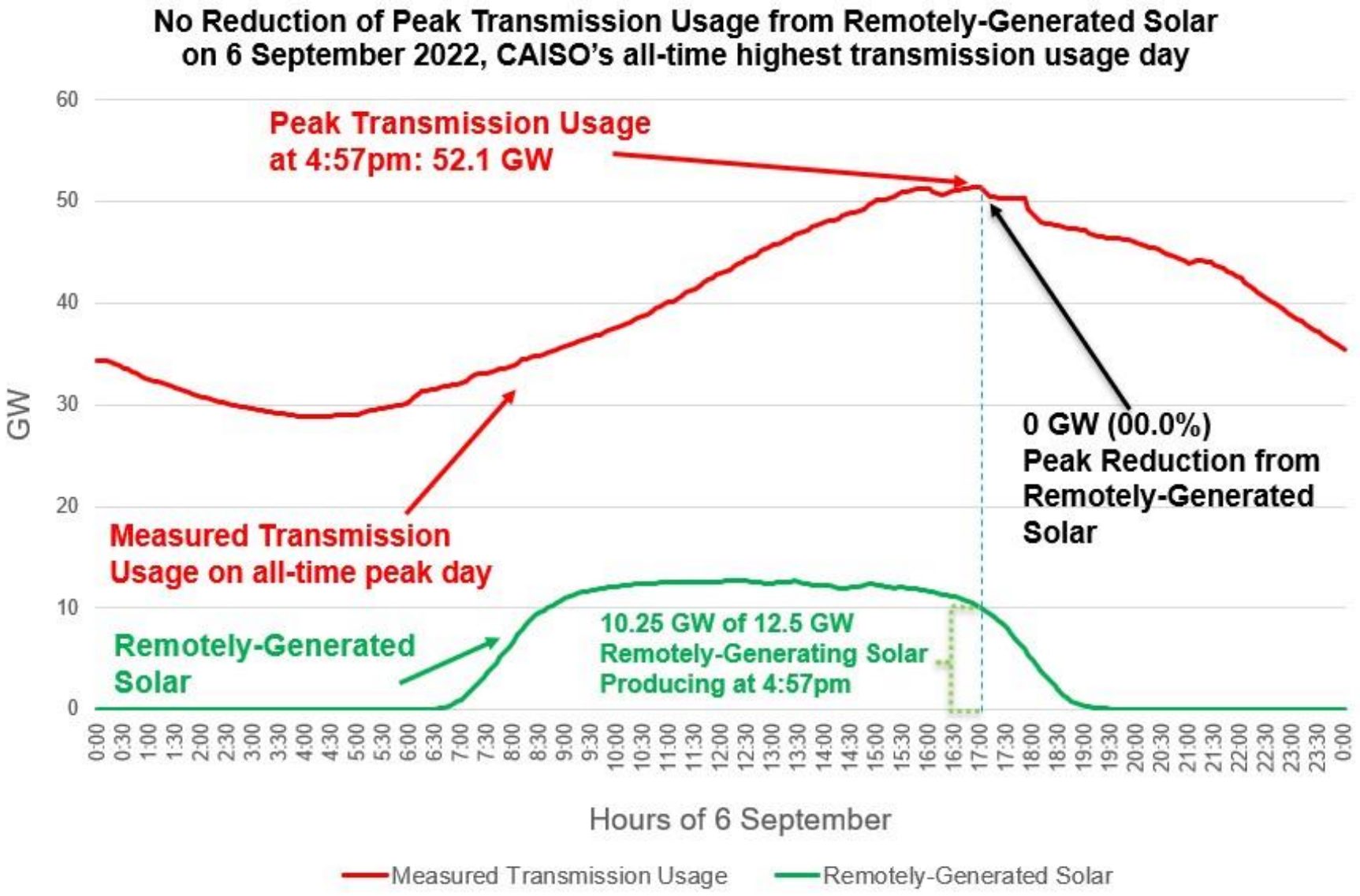
Local solar & storage optimize grid outcomes

Local solar & storage
optimize grid outcomes

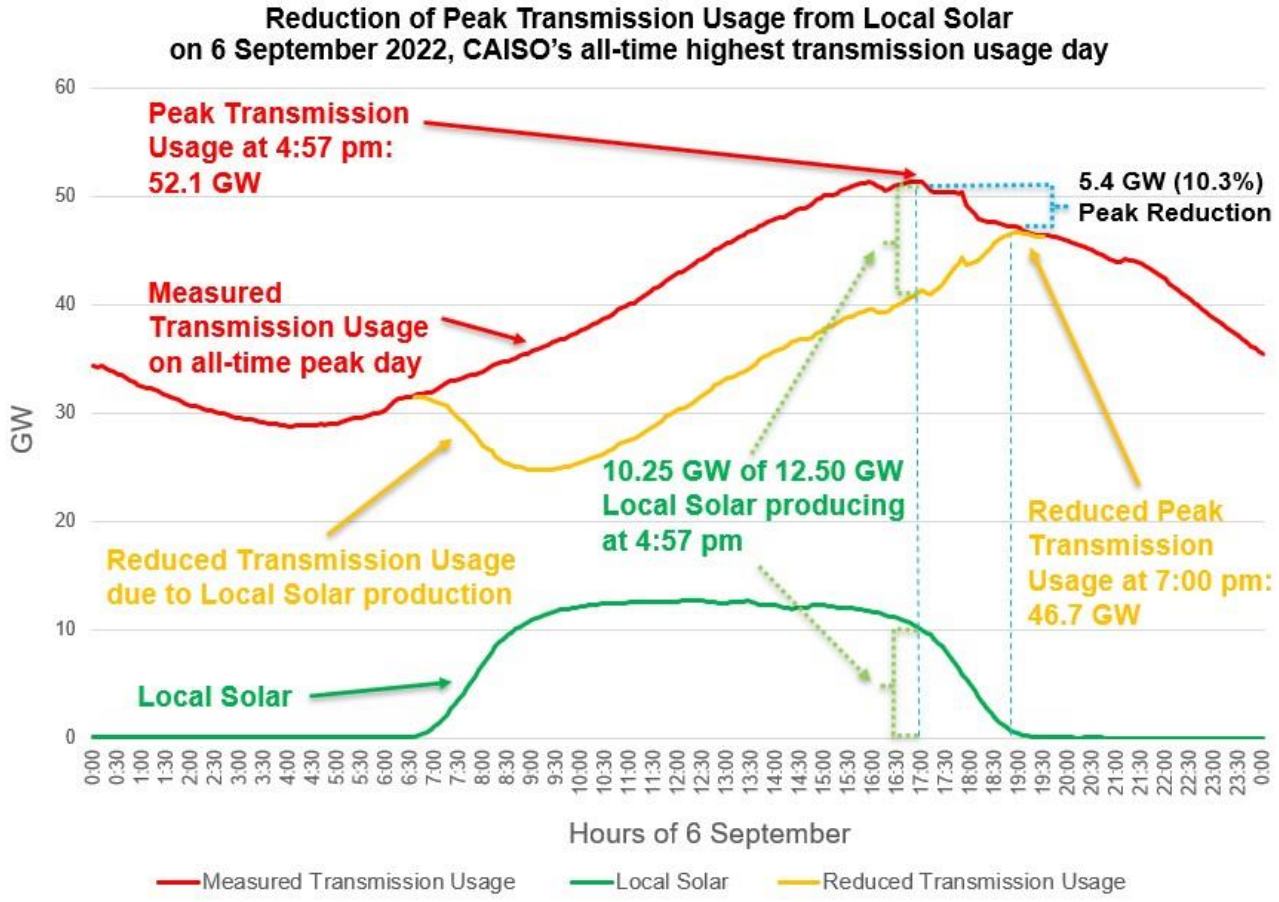
Local means within the distribution grid



Transmission stress & cost is a massive problem



Local Solar reduces transmission stress & costs



1. Local Solar reduces Peak Transmission Usage by close to 50% of the installed local solar capacity. The effect is amplified by energy storage.
2. Bringing down the peak with distributed generation and demand flexibility will reduce transmission investments, saving ratepayers hundreds of billions of dollars over the next two decades.
3. Reducing the Peak Transmission Usage by around 10% is enough to prevent most major outages.

Clean Coalition

Super Green home design

100% Electric, Net Zero Energy, and Solar Microgrid

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Optimizing the trifecta of Economic, Environmental, and Resilience benefits

Green Rebuild Initiative

Mission:

The Green Rebuild Initiative (GRI) aims to facilitate sustainable and resilient rebuilds through "Super Green" home designs that are all-electric, Net Zero Energy (NZE), and supported by Solar Microgrids for unparalleled resilience. The GRI also encourages homes to be designed for high energy efficiency and low embedded carbon, while being engineered to withstand extreme weather events and built with non-toxic materials.

Actions:

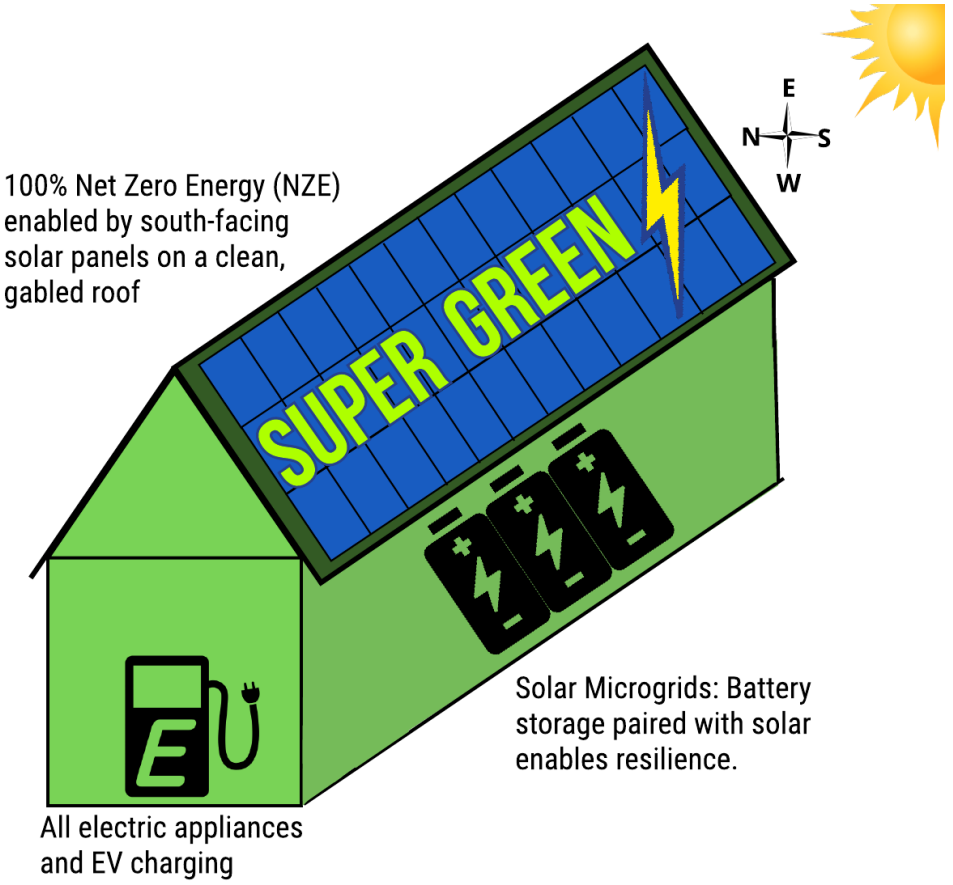
1. Educate property owners, architects, builders, policymakers, lenders, insurers, and everyone else about the superiority of Super Green homes.
2. Illuminate the economic benefits of Super Green designs, including the associated tax benefits and other incentives.
3. Provide easy access to specifications associated with Super Green designs.
4. Share showcase Super Green home designs.
5. Connect parties for Super Green outcomes, including property owners, architects, builders, and associated experts.

What is Super Green?

1. 100% Electric: No gas service to the home and ideally an all-EV household.

2. Net Zero Energy (NZE): Onsite solar energy production at least equals the annual energy consumption across the premise, including to cover home EV charging.

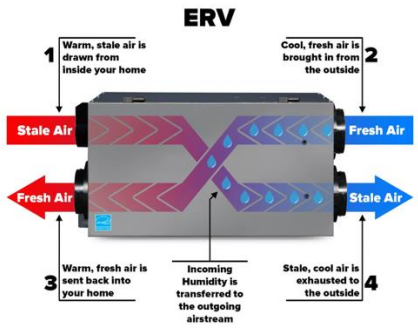
3. Solar Microgrid: Combines a battery to the solar for economic optimization and achieving unparalleled energy resilience.

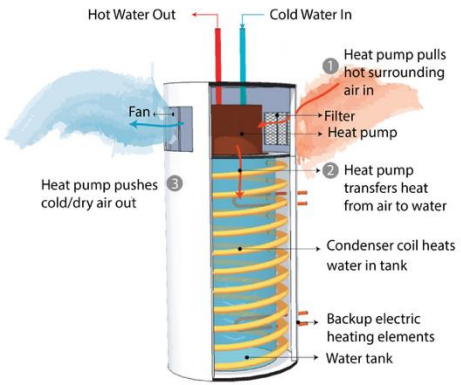


Super Green: 100% Electric

Specifications

- **Mechanical and Plumbing**
  - Heat Pump HVAC
  - Heat Pump Water Heater
  - ERV: Energy Recovery Ventilator
  - E-Fireplace: Napoleon Alluravision 60” [Optional]
  - Heat Pump Pool Water Heater [Optional]





- **Electrical**
  - LED Light Bulbs
  - Occupancy/Vacancy Sensors
  - Dimming Switches
  - Span Panel [Optional]

Super Green: 100% Electric

Appliances

- Induction Cooktop
- EnergyStar Refrigerator
- EnergyStar Dishwasher
- EnergyStar Washing Machine
- Energy Efficient Microwave
- Heat Pump Dryer
- EV Charging Outlet and/or Charger (Level 2 capable)

Induction Cooktops

100% Electric

Energy Efficient

Super Green: Net Zero Energy (NZE)

NZE requires the solar to produce at least as much energy as the home consumes over the course of a year. Solar needed to achieve NZE for homes with Title 24 levels of energy efficiency and two EVs (22,000 miles of home EV charging per year):

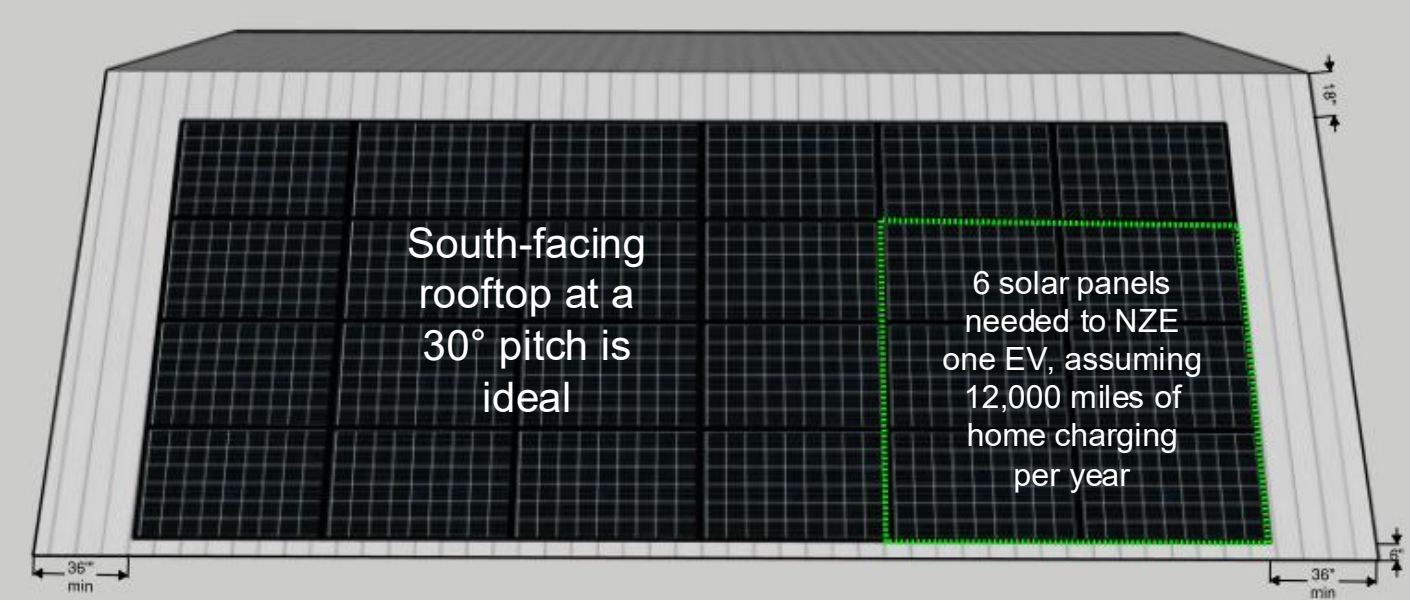
- 1,500sf home requires 9.8kW of solar (24 solar panels).
- 2,500sf home requires 14.8kW of solar (36 solar panels).

California Energy Code Title 24 (Part 6) falls far short of NZE:

- 1,500sf home only requires 2kW (5 solar panels)
- 2,500sf home only requires 3kW of solar (7 solar panels).

Super Green: Solar to achieve 1,500sf NZE home

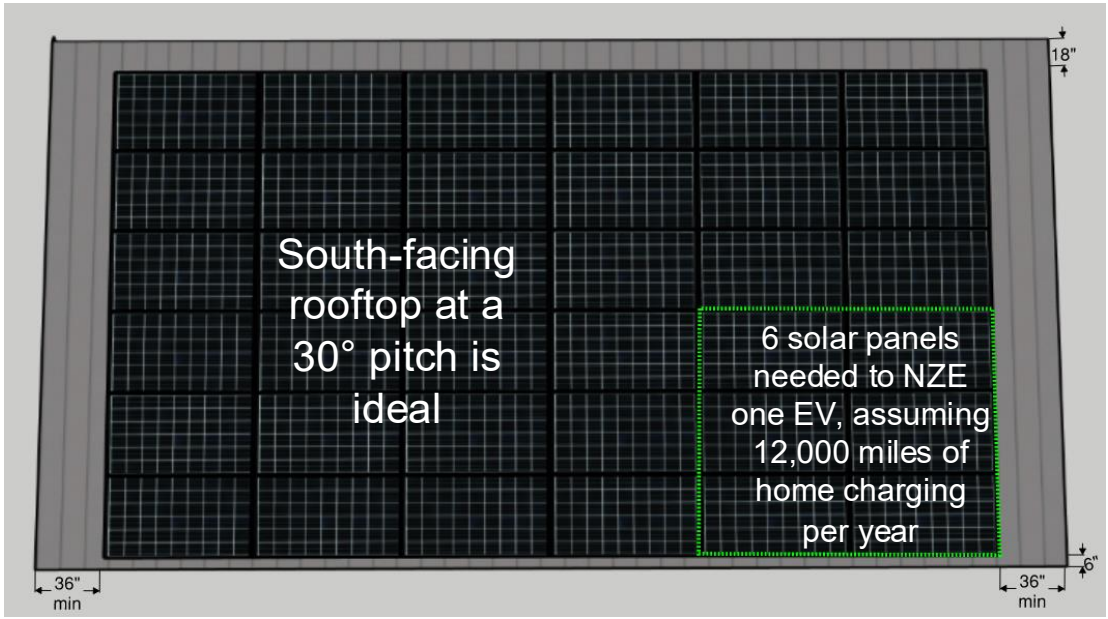
Total single roof area required to achieve NZE for a 1,500 sf house is 700 sf, to accommodate 507 sf of solar (9.8 kW) plus setbacks



- 14,600 kWh per year is the estimated energy consumption for a typical 4-person household in a 1,500sf home.
- A 9.8kW solar array (assuming 1,512kWh/kW-yr) is required to achieve Net Zero Energy (NZE), which includes charging two EVs
- Note: an EV driving 12,000 miles per year will require 3,600kWh of energy per year to charge, which can be offset by 6 solar panels. This model also assumes there is a second EV using 10,000kWh per year.
- Assumes QCELL 410W solar panels, each with dimensions of 6.2 ft x 3.4 ft (21.1 sf per panel).
- 24 solar panels required to achieve NZE, requiring 507 sf for the solar layout, and producing 14,808 kWh per year.
- Total roof area required is 700 sf, including setbacks of 3 feet on side edges, 1.5 feet from the ridge, and 0.5 feet from the bottom edge (the bottom setback is needed to ensure proper rain drainage into a gutter).

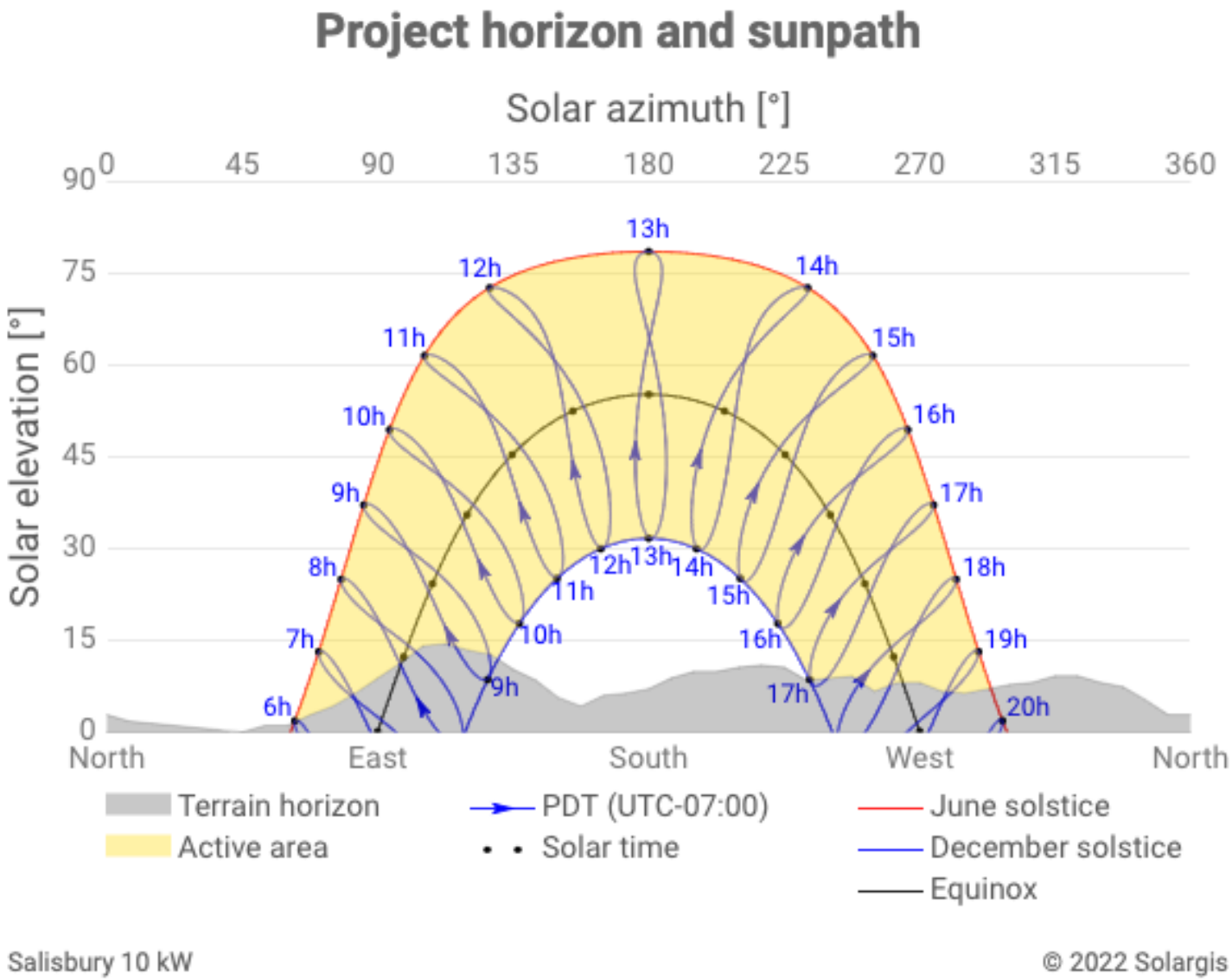
Super Green: Solar to achieve 2,500sf NZE home

Total single roof area required to achieve NZE for a 2,500 sf house is 1,000 sf, to accommodate 760 sf of solar (14.8 kW) plus setbacks



- 21,221 kWh per year is the estimated energy consumption for a typical 2,500sf 4-person household
- A 14.8kW solar array (assuming 1,512kWh/kW-yr) is required to achieve Net Zero Energy (NZE), which includes charging two EVs
- Note: an EV driving 12,000 miles per year will require 3,600kWh of energy per year to charge, which can be offset by 6 solar panels. This model also assumes there is a second EV using 10,000kWh per year.
- Assumes QCELL 410W solar panels, each with dimensions of 6.2 ft x 3.4 ft = 21.1 square feet
- 36 solar panel required to achieve NZE, requiring 760 sf for the solar layout, and producing 22,223 kWh per year.
- Total roof area required is 1,000 sf, including setbacks of 3 feet on side edges, 1.5 feet from the ridge, and 0.5 feet from the bottom edge (the bottom setback is needed to ensure proper rain drainage into a gutter).

Solar should be as close to south-facing as possible

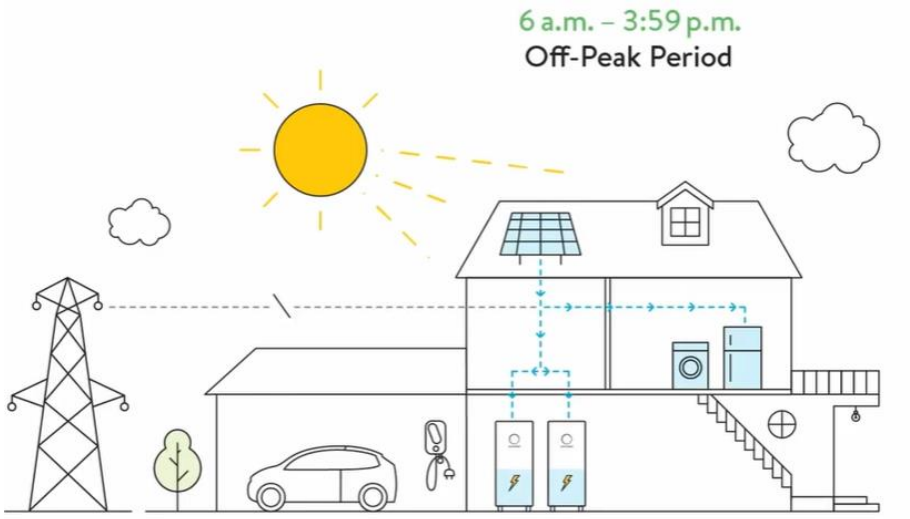


Super Green: Solar Microgrid

Off-Peak Period

Power from Sun

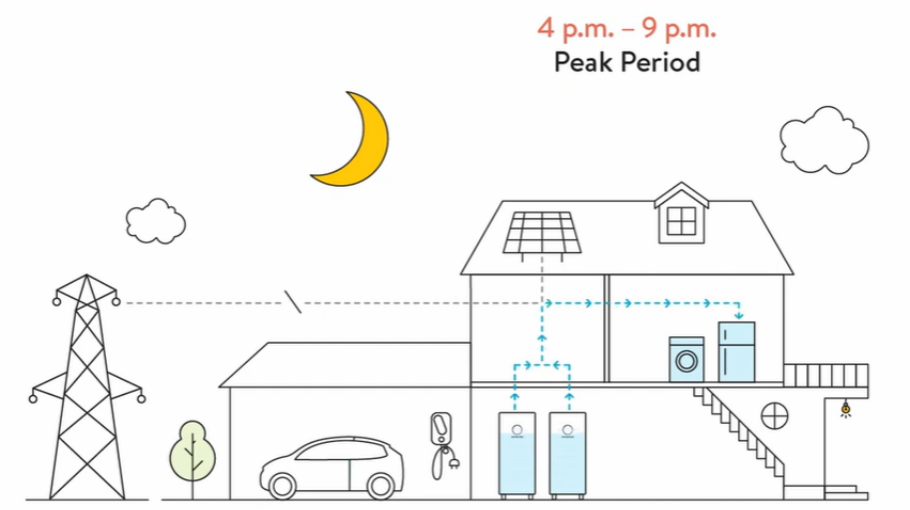
During the day the home draws power from its solar array and charges the home battery.



Peak Period

Power from Battery

Power is drawn from the home's battery, and Peak Utility-based costs are avoided



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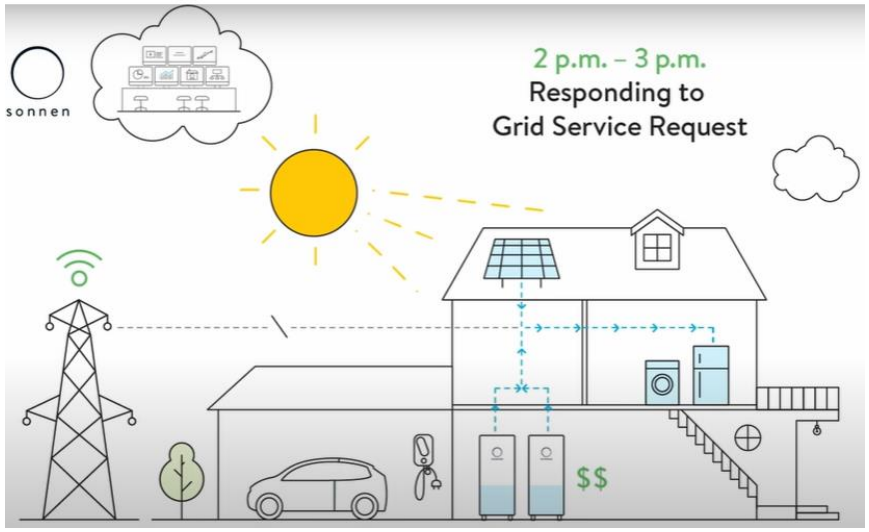
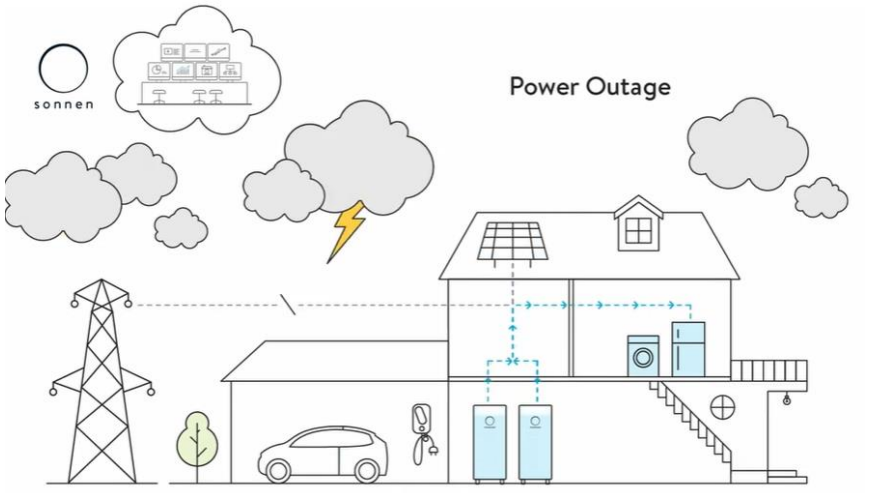
Super Green: Solar Microgrid



Grid Service Request

Earn Credits

Homeowner can earn credits from the utility company by providing excess power during a Grid Service Request. These credits can be used to offset future utility charges



Power Outage

Off-Grid Mode

During a planned and/or unexpected power outage, homeowners can shift consumption to ***Critical Loads*** and consume energy entirely from their solar + battery system. Critical Loads include only essential appliances and circuits, (Refrigerator, Microwave, WiFi, fire-life-safety devices and select outlets).

Whole-home Back Up Optional

Value-of-Resilience (VOR) details

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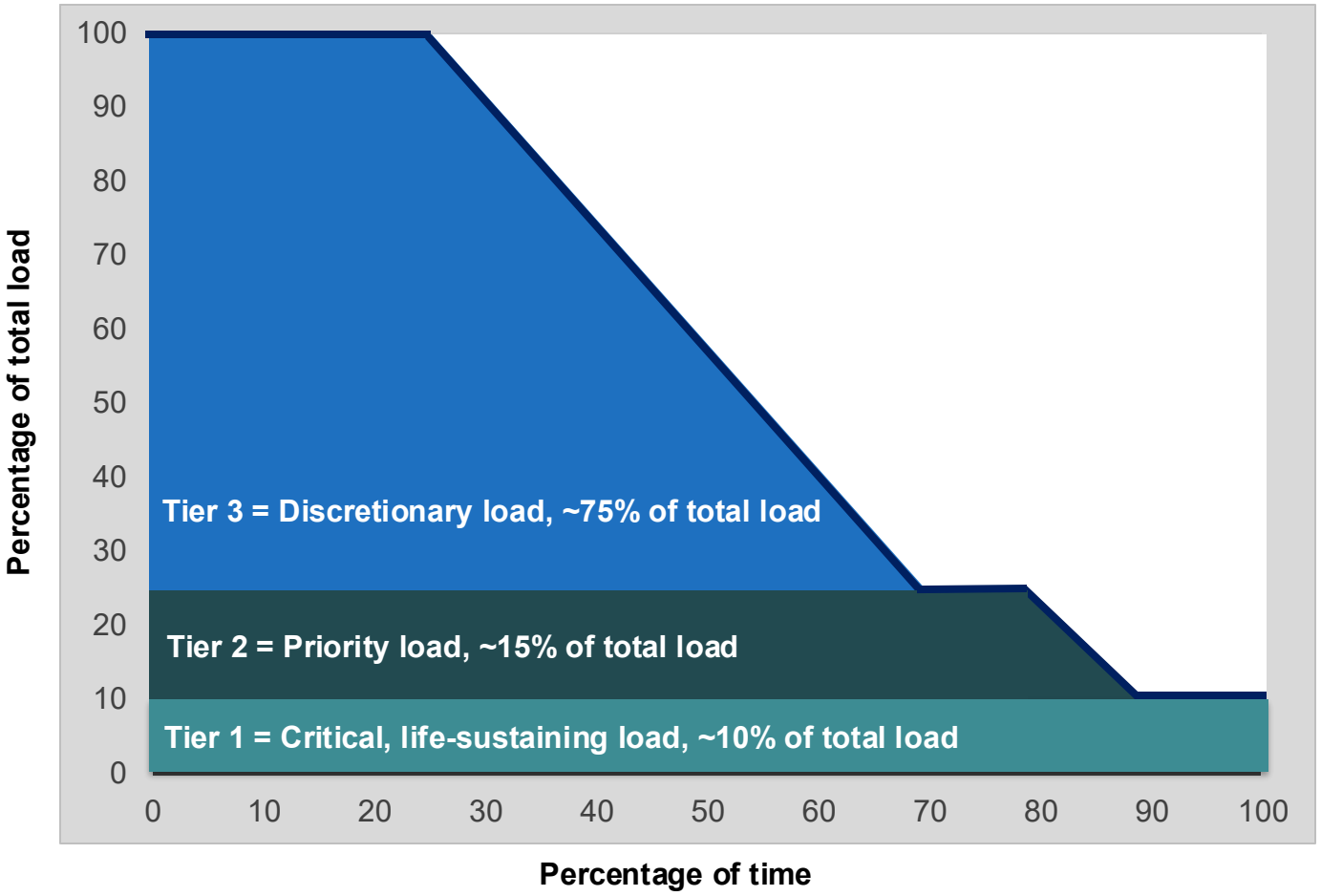

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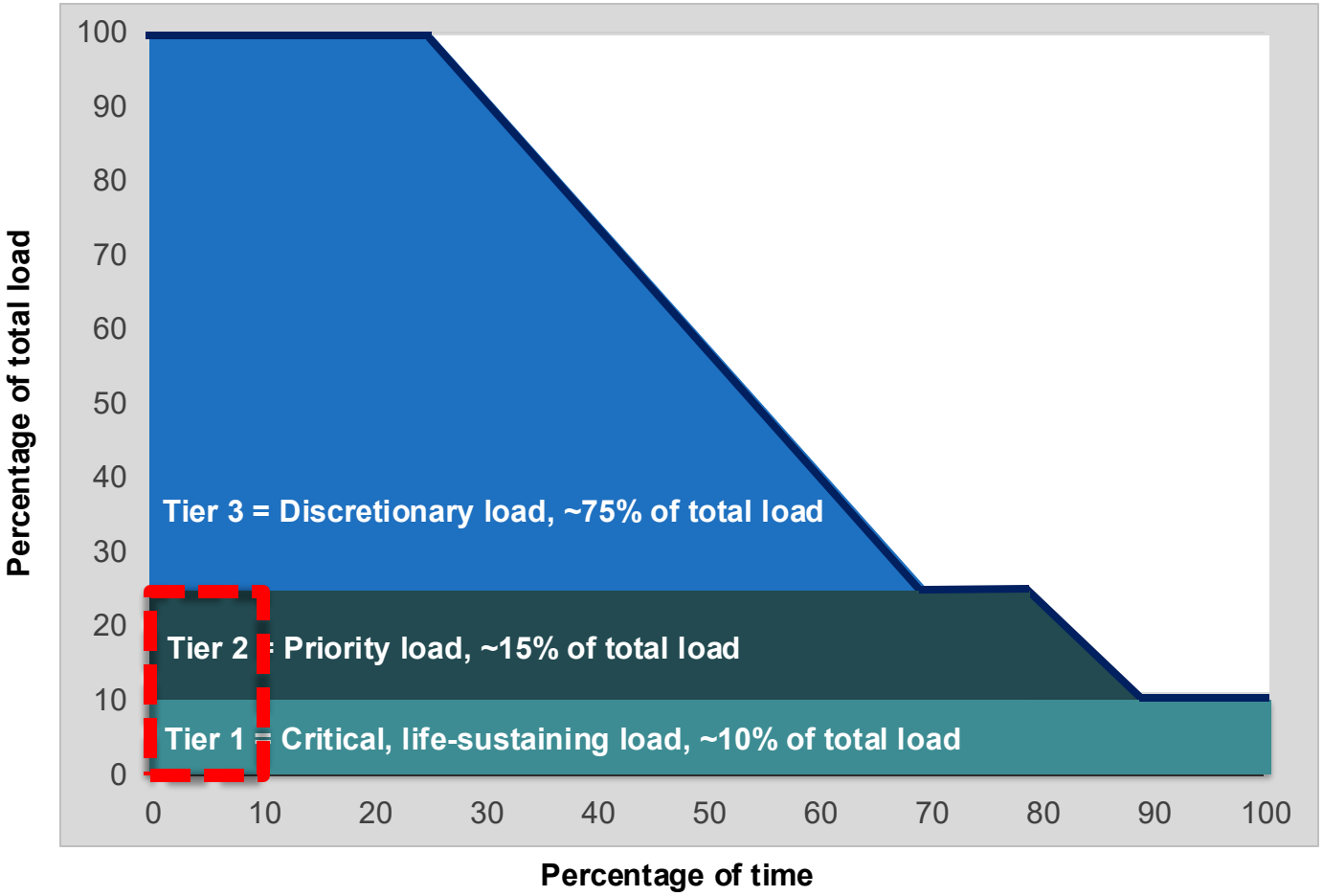

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Load Management is key to Solar Microgrids

SPAN Panels are king of residential Load Management

- Control circuits from anywhere

Real-time on/off control over every circuit in the home from the SPAN Home App + scheduling with Amazon Alexa.

- Learn from deep energy insights

360-degree view of your home's energy from a smartphone or tablet helps you save more.

- Save on energy bills

Quantify the impact of appliances on your energy bill, and make smarter decisions to save.

- Set a powerful foundation

Future-proof your home for upgrades such as EV, solar, battery storage, heat pumps, induction cooktops, and more.

https://www.span.io/

Super Green is a lucrative personal investment

- Achieving Super Green for a new 2,500 sq ft home adds approximately $50,000 to construction costs, compared to standard California requirements known as Title 24.
- About 30% of that cost can typically be recovered through tax credits, rebates, and other incentives.
- Even without any tax benefits or other incentives, the investment in SCE territory yields a 10% annual, tax-free, risk-free return through reduced energy bills.
- This return is comparable to a long-term certificate of deposit (CD) offering a 15% annual percentage rate (APR), which is taxable. Hence, lucrative for mortgage rates up to 15%.

Clean Coalition

Sierra Blanca Community & Solar Microgrids

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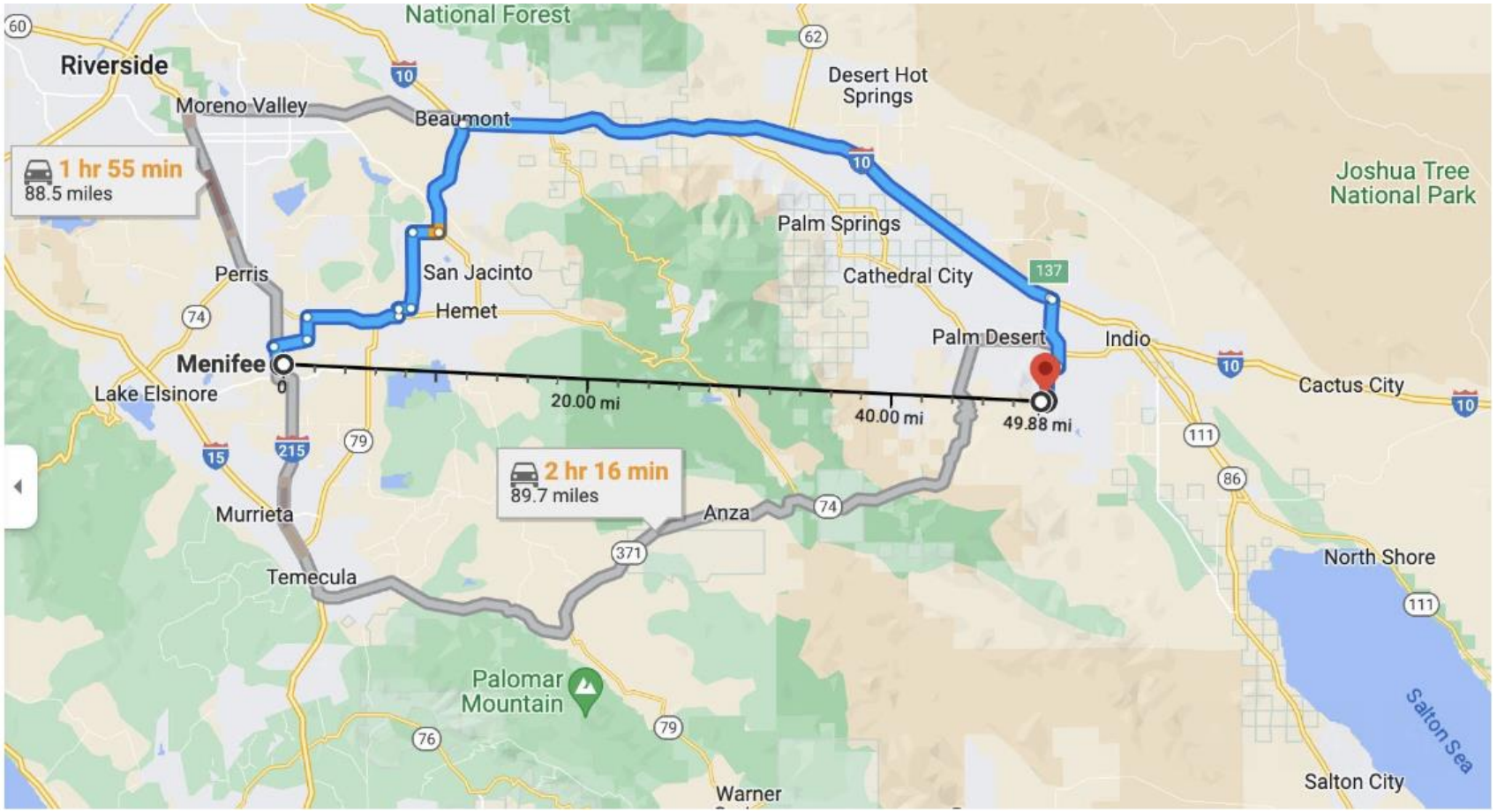
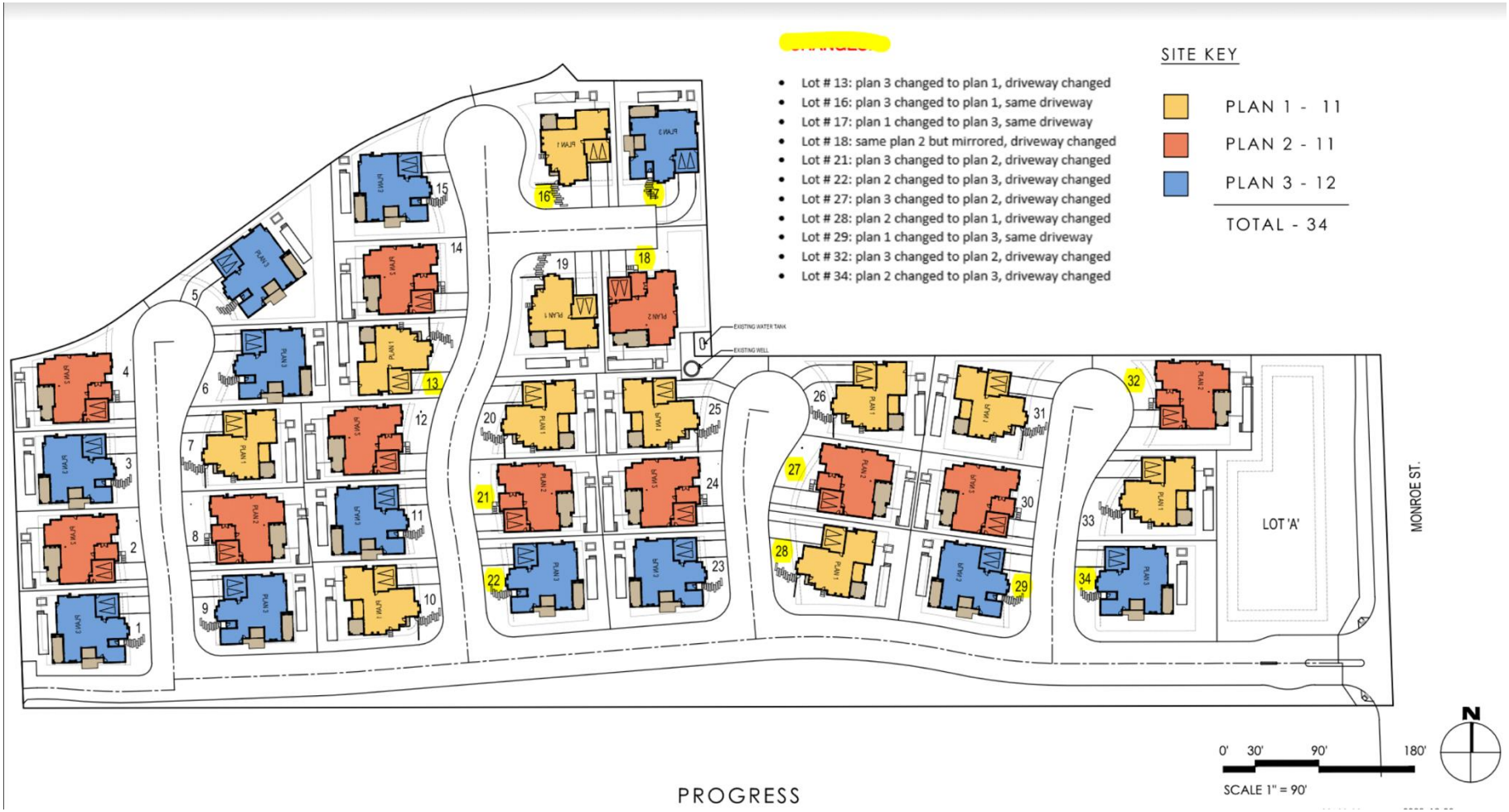
Menifee solar community provides local example



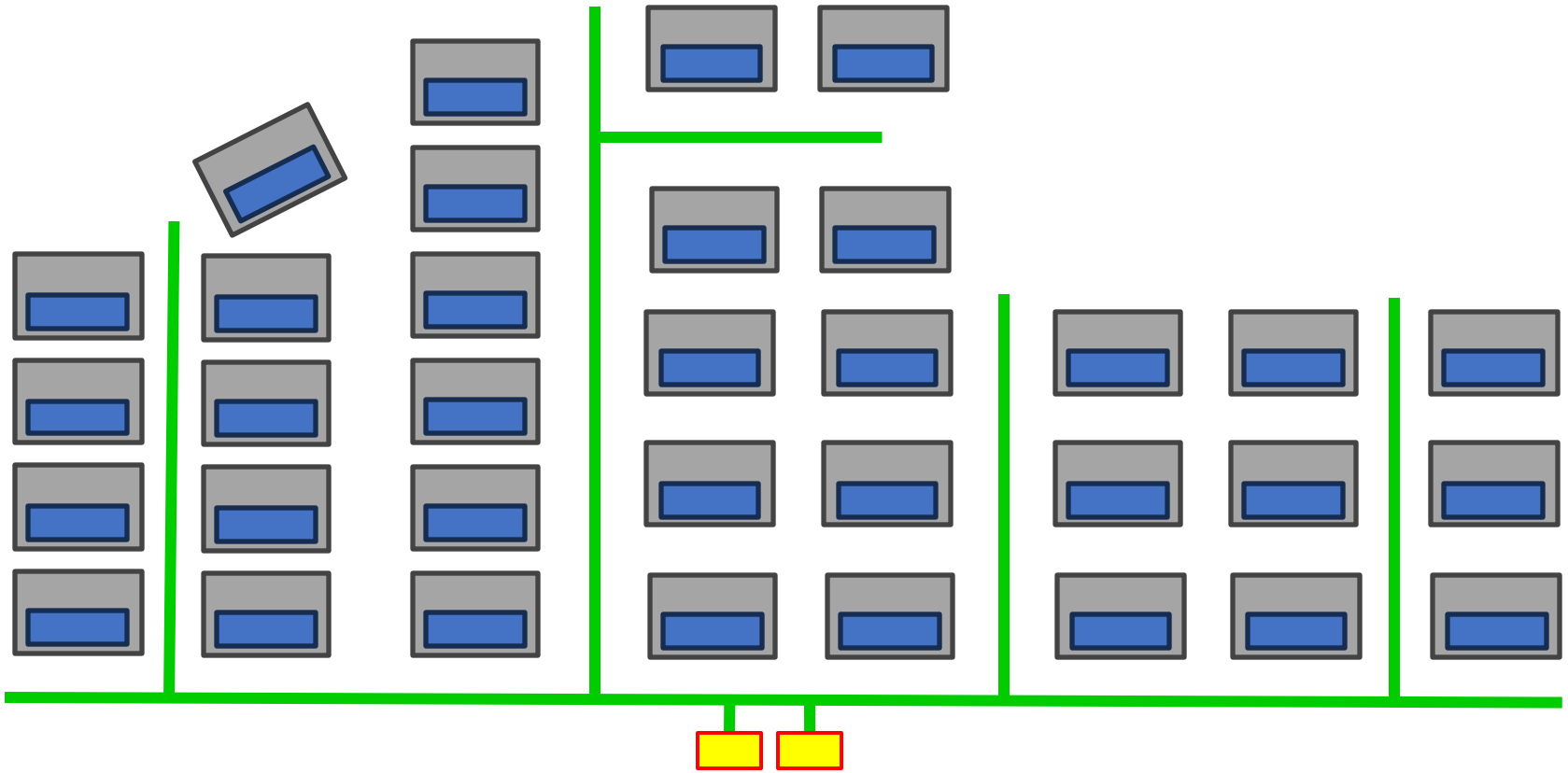
https://www.latimes.com/opinion/story/2023-07-09/la-home-electrification-new-construction-menifee-microgrid

https://www.cbsnews.com/losangeles/news/menifees-microgrid-community-offers-energy-self-sufficiency/?intcid=CNM-00-10abd1h

34-home Sierra Blanca community



Sierra Blanca energy system layout – Scenario A



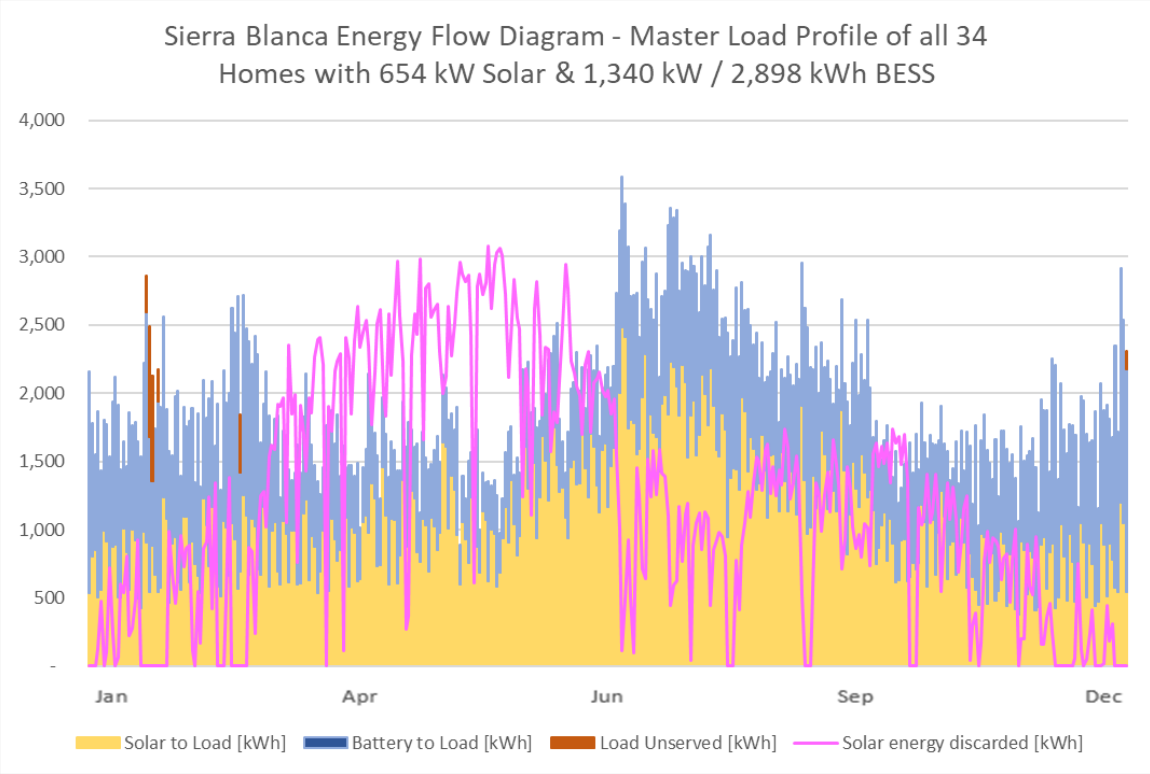
Legend

Average house with average Solar Microgrid:
- 19.25 kWdc solar
- 10 kWac / 26.4 kWh battery

20'x10' battery container hosting 500 kW & 1 MWh

Private electricity grid

Scenario A: 654 kW solar and 1,340 kW & 2,898 kWh BESS across the community



Sierra Blanca - Scenario B (All 34 Homes) Energy Flow Diagram Summary						
	Total Annual Load (kWh)	Annual Solar Generation (kWh)	Total Solar to Load (kWh)	Total Battery to Load (kWh)	Total Solar Energy Discarded (kWh)	Total Load Unserved (kWh)
Energy	706,321	1,177,457	395,108	308,566	441,460	2,647
Percentage of Total Annual Load	100%	167%	56%	44%	63%	0.37%
Percentage of Annual Solar Generation	60%	100%	34%	26%	37%	0.22%

Berkeley Efficient & Resilient Mixed-Use Showcase (BERMUS)

Key BERMUS features

- All-electric, 8-story, commercial and permanently affordable housing community.
- 65 units of 100% affordable housing with ground floor commercial offices and retail spaces.
- Affordable home ownership via condominiums that provide homeownership benefits from original tenancy, with all being disadvantaged and low-income.
- Net Zero Energy (NZE) building with a solar canopy covering the entire roof area, including a large rooftop patio and roof-mounted mechanical equipment for HVAC etc.
- GridOptimal with the Solar Microgrid providing all energy during the 4-9pm grid-constrained period daily.
- Solar Microgrid resilience ensuring indefinite resilience for the critical loads during grid outages of any duration, with significant resilience to all other loads based on solar energy availability and battery state-of-charge. Meets the full performance requirements of the CEC-recommended VOR123 value-of-resilience (VOR) methodology.

Backup

Goleta Load Pocket Community Microgrid

Goleta Load Pocket (GLP)

The GLP is the perfect opportunity for a comprehensive Community Microgrid

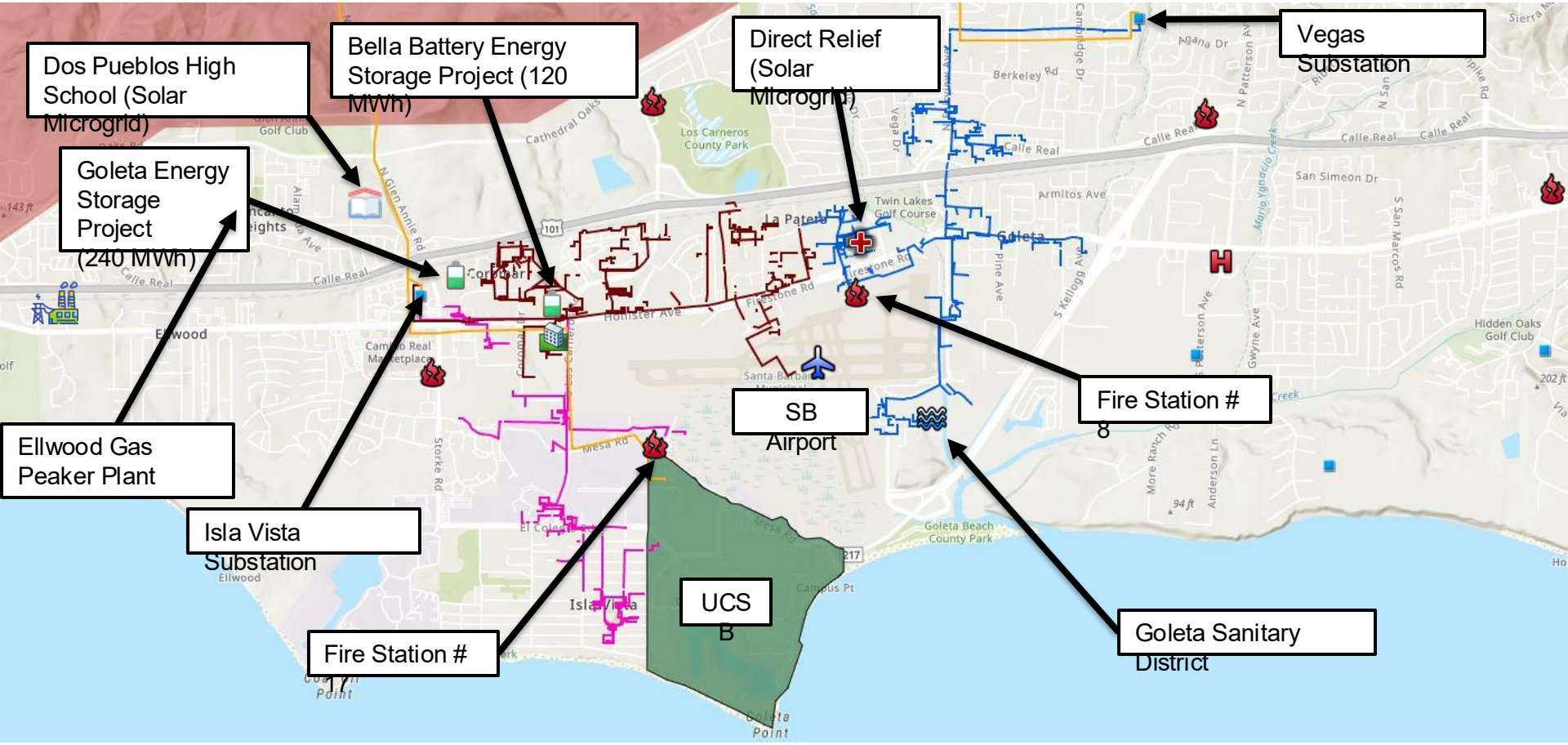
- GLP spans 70 miles of California coastline, from Point Conception to Lake Casitas, encompassing the cities of Goleta, Santa Barbara (including Montecito), and Carpinteria.
- GLP is highly transmission-vulnerable and disaster-prone (fire, landslide, earthquake).
- **200 megawatts (MW) of solar and 400 megawatt-hours (MWh) of energy storage** will provide 100% protection to GLP against a complete transmission outage ("N-2 event").
  - 200 MW of solar is equivalent to about 5 times the amount of solar currently deployed in the GLP and represents about 25% of the energy mix.
  - Multi-GWs of solar siting opportunity exists on commercial-scale built-environments like parking lots, parking structures, and rooftops; and 200 MW represents about 7% of the technical siting potential.
  - Other resources like energy efficiency, demand response, and offshore wind can significantly reduce solar+storage requirements.

Core load area of the GLP

Legend

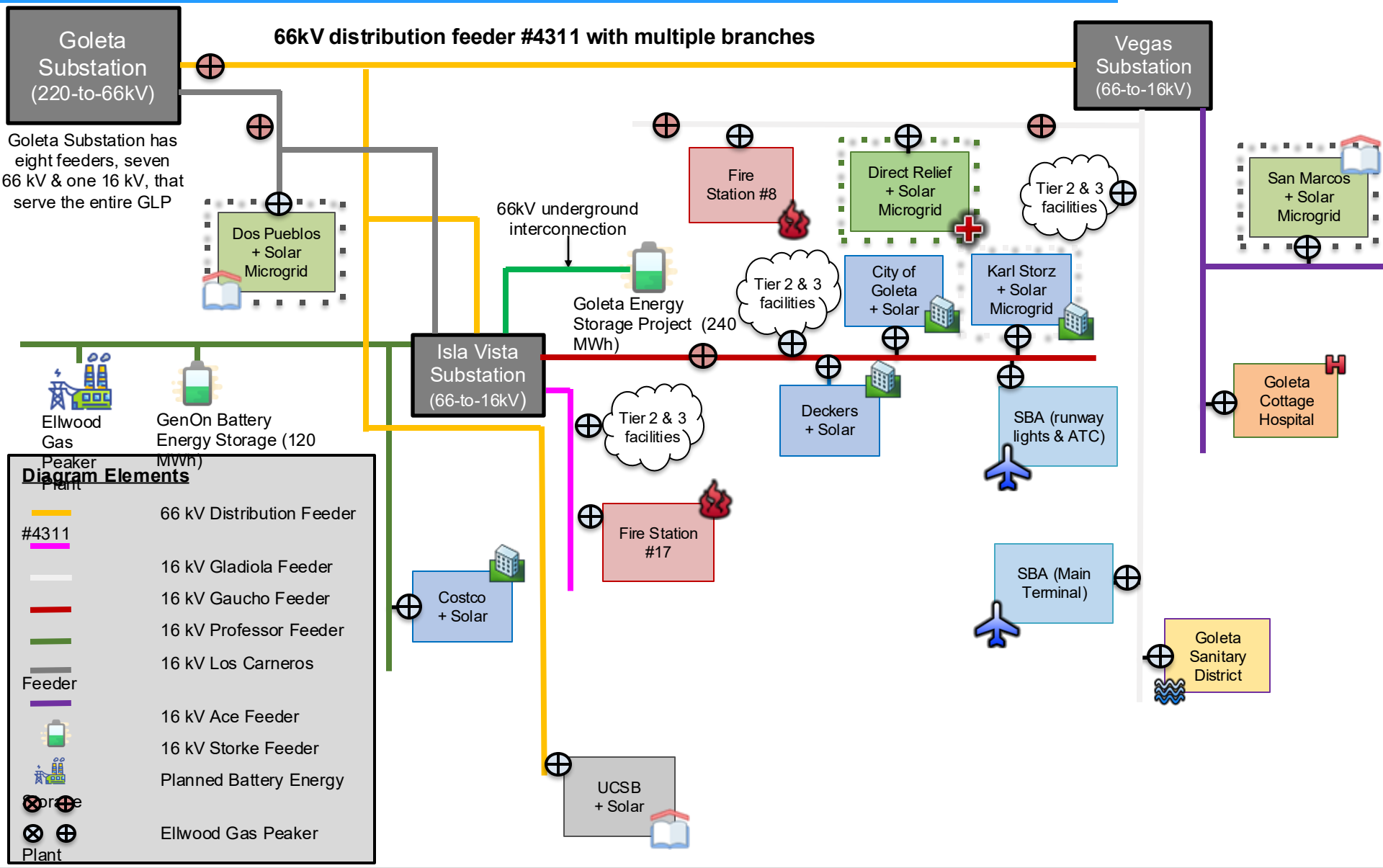
- 220 kV Transmission
- Santa Barbara Airport
- Substations
- Tier 3 Fire Threat
- Tier 2 Fire Threat
- UCSB
- 16kV Gladiola Feeder
- 16kV Gaucho Feeder
- 16kV Professor Feeder
- Feeder #4157
- Feeder #4169
- Feeder #3556
- Feeder #4227
- Feeder #4311
- Feeder #3565
- Feeder #3559

First targeted chunk of the GLP Community Microgrid



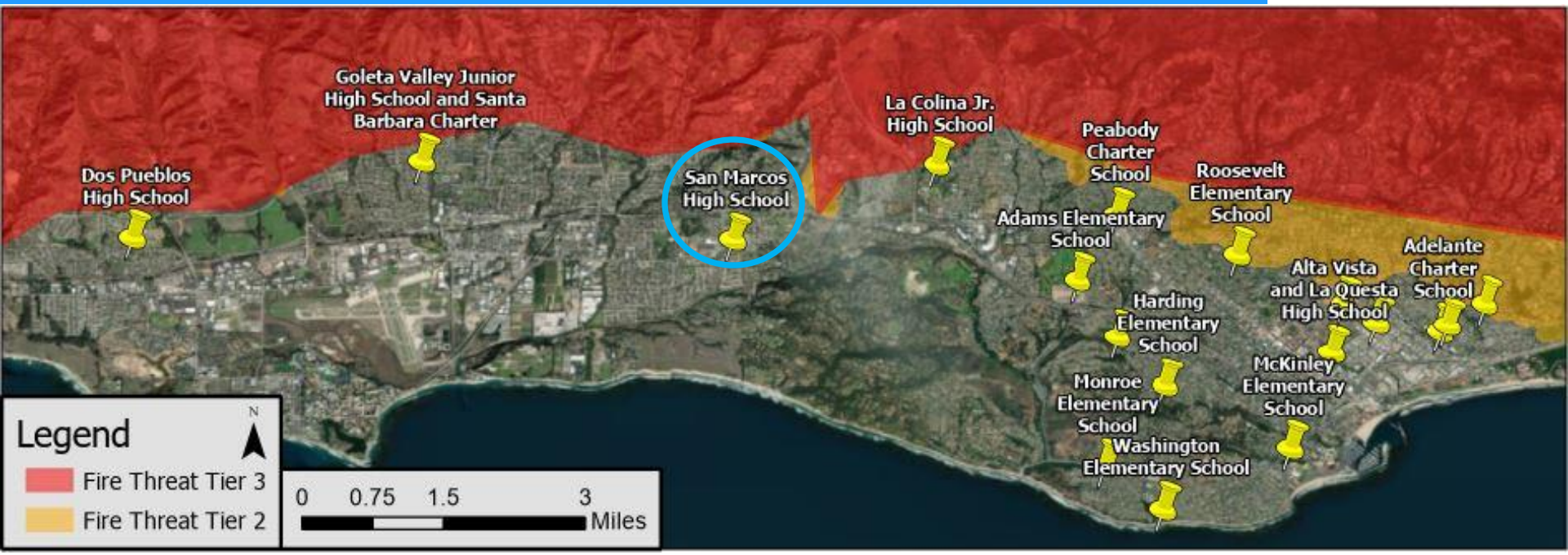
First targeted chunk of the GLP Community Microgrid

Clean Coalition



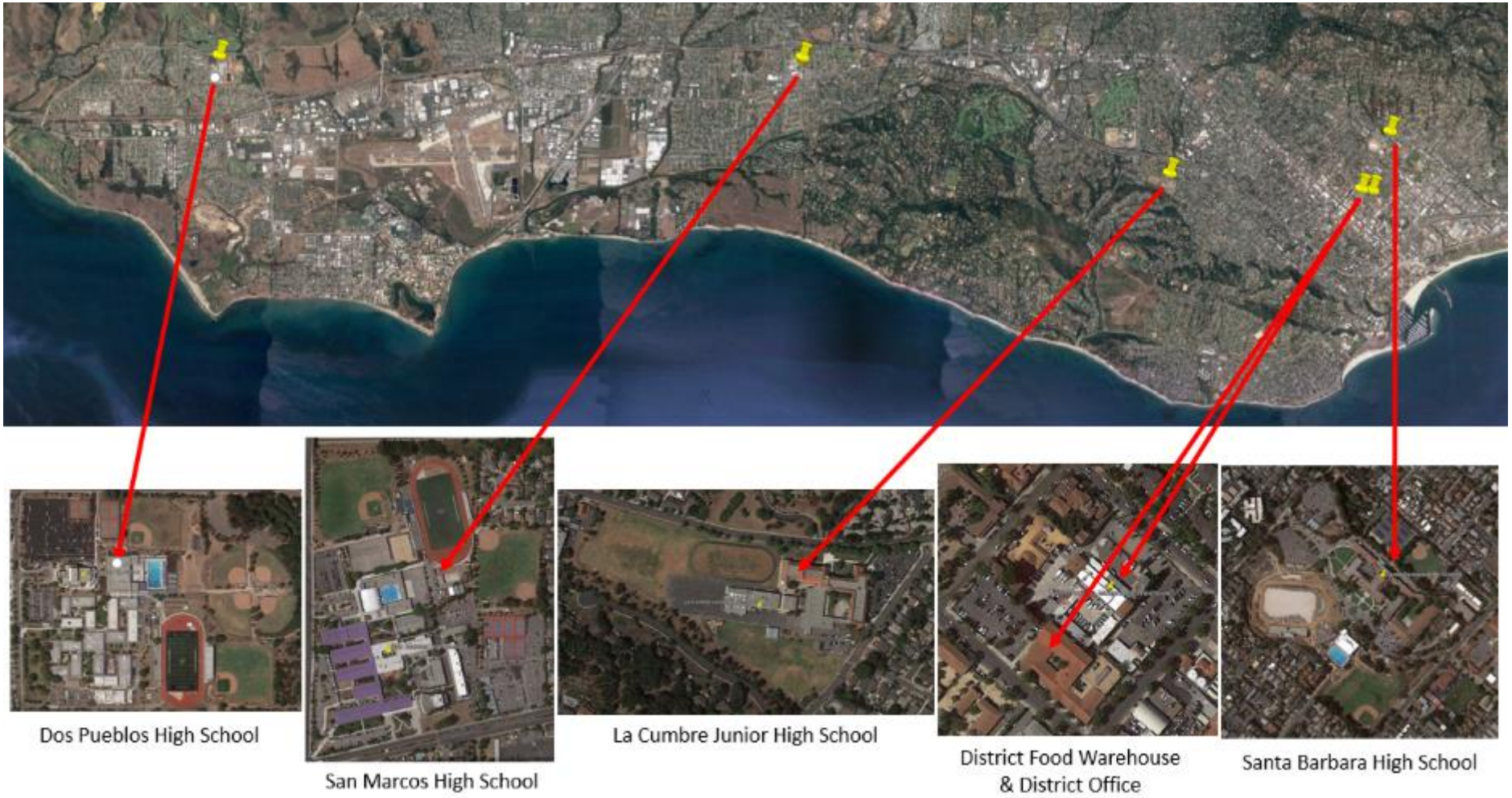
Santa Barbara Unified School District (SBUSD)
Solar Microgrids case study

Santa Barbara Unified School District (SBUSD)

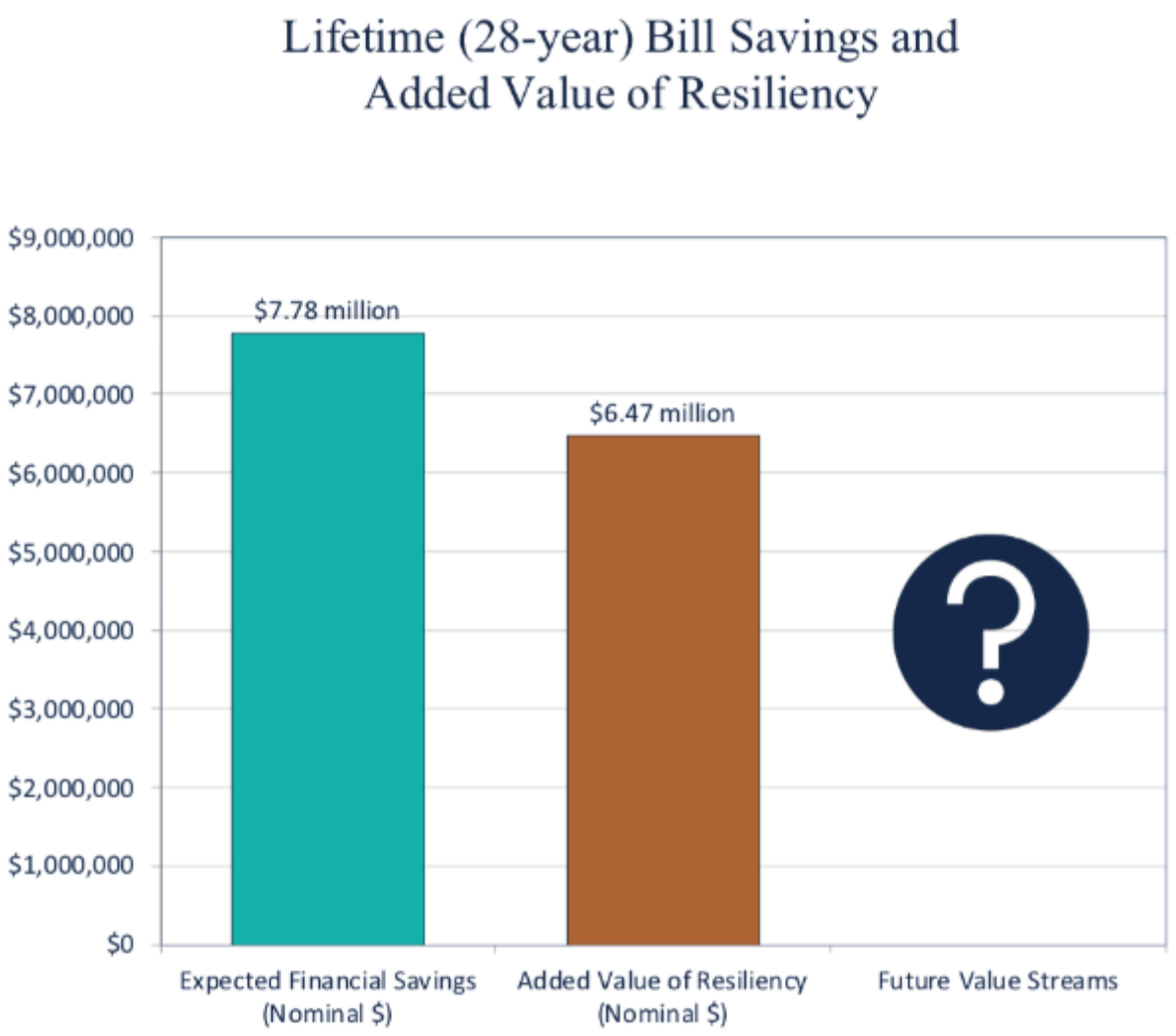


- The entire Santa Barbara region is surrounded by extreme fire risk (earthquake & landslide risk too) and is extremely vulnerable to electricity grid outages.
- The SBUSD is a major school district that increasingly recognizes the value-of-resilience (VOR) and has embraced the Clean Coalition's vision to implement Solar Microgrids at a number of its key schools and other critical facilities.
- SMHS is in the middle of the extensive SBUSD service area.

Six SBUSD Solar Microgrid sites

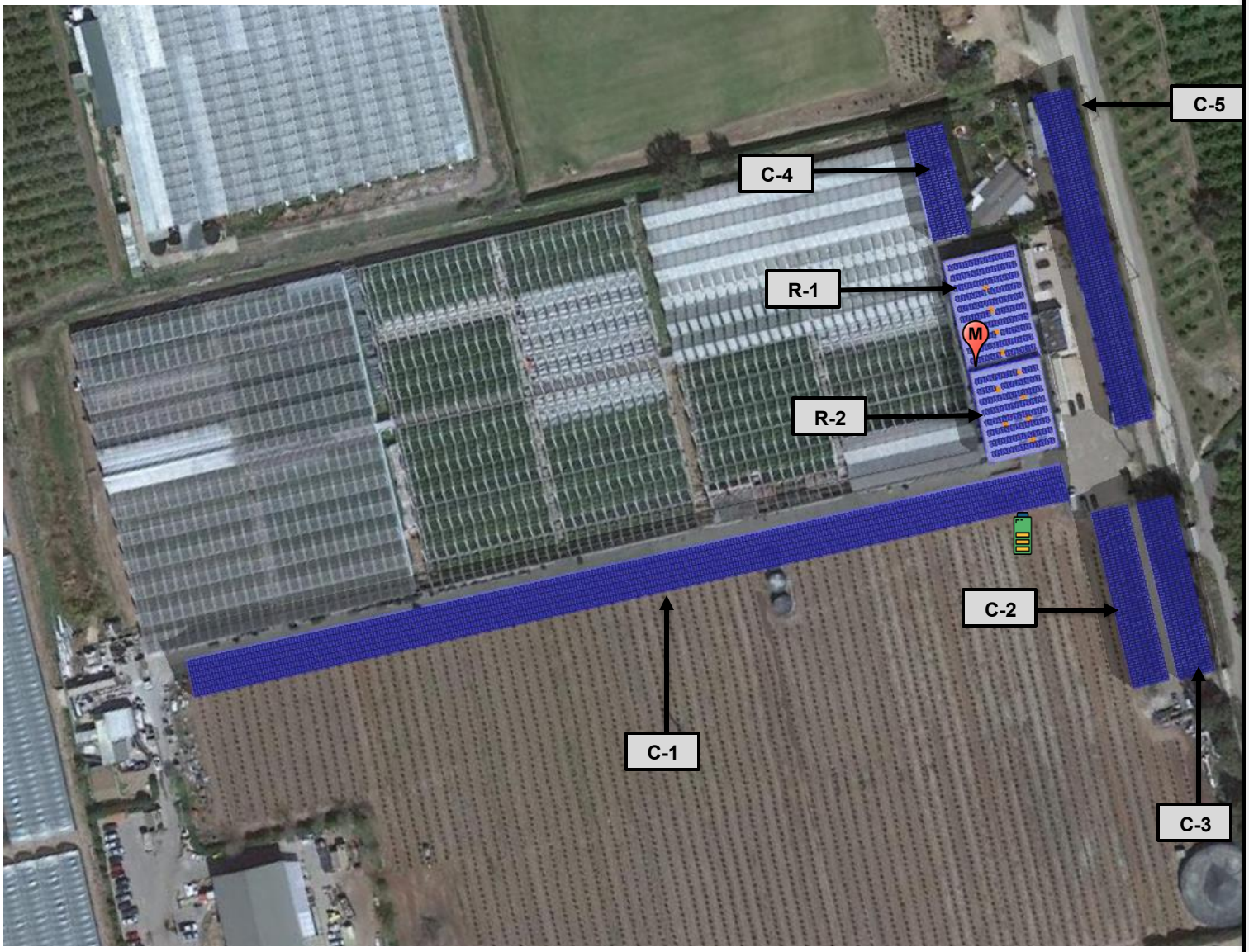


Guaranteed SBUSD bill savings and free VOR



Large farm case study in Carpinteria, CA

1.5 MWdc of solar for GH2 meter



Brand Farms

Greenhouse #2 Meter
Solar Microgrid Site
Layout

M Service Meter
#259000-062804

3 MW / 6 MWh
BESS
Potential Location

Potential Solar Siting Locations:

- C-1 710 kW Solar Canopy
- C-2 142 kW Solar Canopy
- C-3 142 kW Solar Canopy
- C-4 89 kW Solar Canopy
- C-5 269 kW Solar Canopy
- R-1 84 kW Rooftop Solar
- R-2 66 kW Rooftop Solar

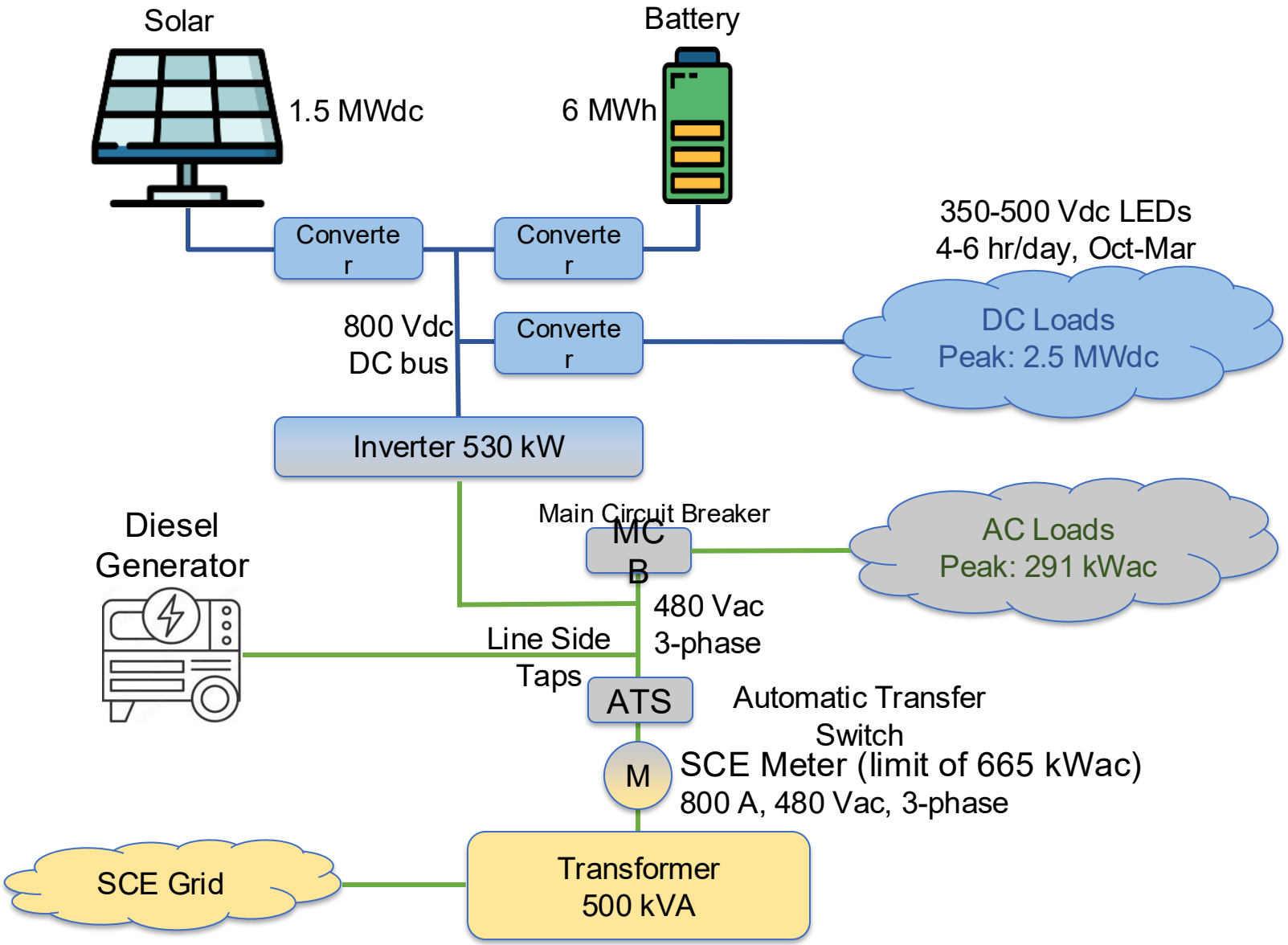
Total Solar Siting Potential: 1,500 kW

- **Annual Generation:** 2,492,565

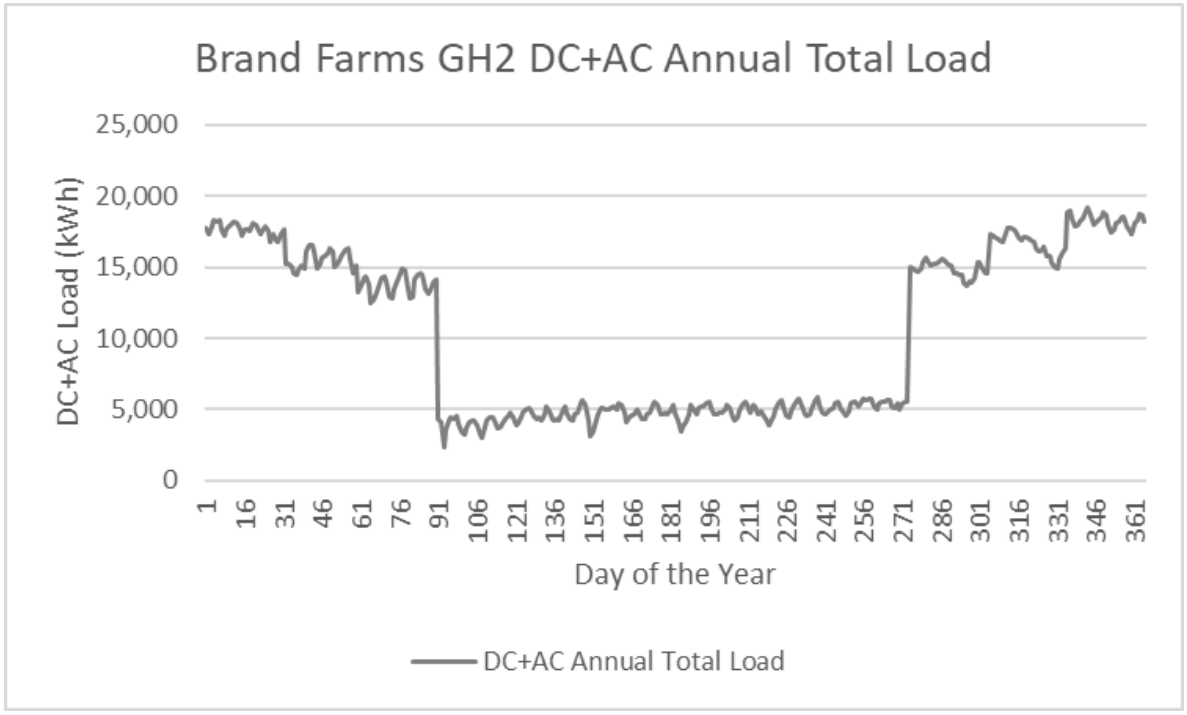
Total Annual Loads:

- Master Load Profile: 3,804,085 kWh

DC-coupled Solar Microgrid to serve 2.5 MWdc of added DC loads to Greenhouse2 meter



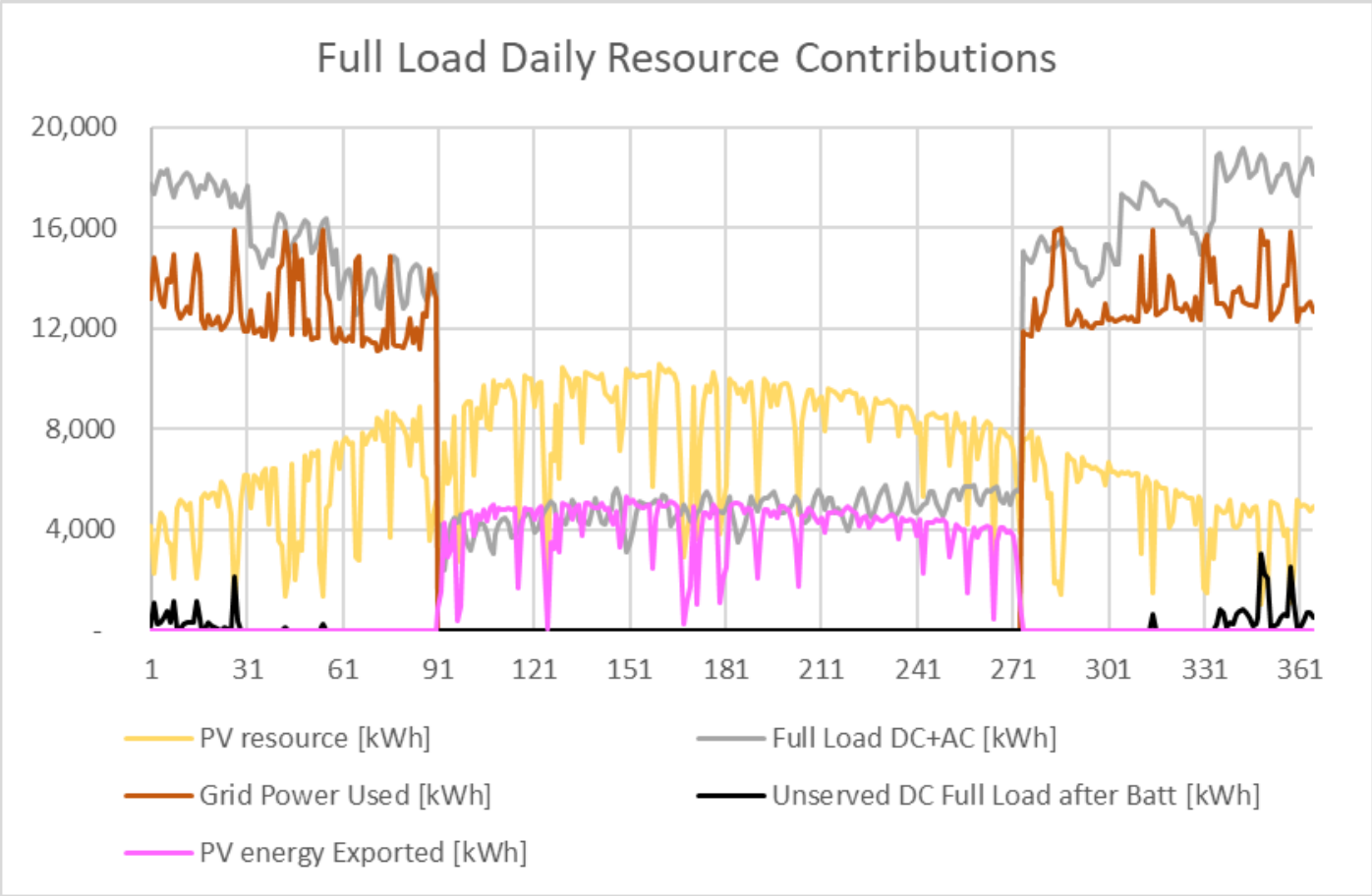
Greenhouse2 economics assuming all future AC & DC loads can be served by the grid



Brand Farms Greenhouse 2 (DC + AC Loads) Business-As-Usual Electricity Bill Cost Based on TOU-8-D and 3CE Rates								
Meter	Scenario Types	Business-As-Usual Blended Utility Rate Over Time at a 5% Utility Price Increase (¢/kWh)			25 Year Electricity Bill Cost			
		Year 1	Year 10	Year 25	Year 1 Total Electricity Bill Cost	Year 10 Electricity Bill Cost	Year 25 Electricity Bill Cost	Total Cumulative 25 Year Electricity Bill Cost
Greenhouse 2 (DC + AC)	No Solar or Storage	$0.15	$0.23	$0.47	$1,038,158	$1,610,524	$3,348,163	$49,548,269

Greenhouse2 Energy Flow after addition of $10 million Solar Microgrid and 2.5 MWdc of DC loads

Energy Flow Diagram
1.5 MW solar and 3 MW / 6 MWh energy storage



Orcas Community Microgrid (OCM)

Grand OCM plan for the entire San Juan Islands

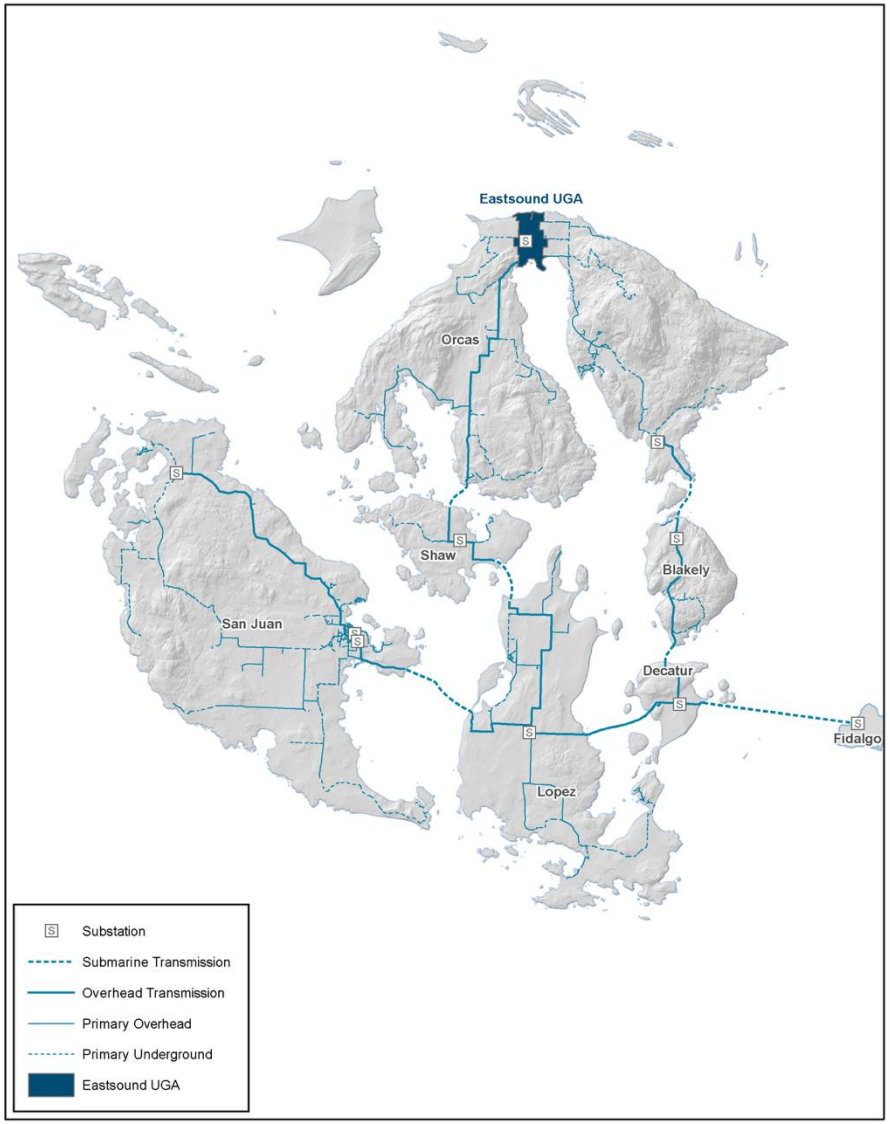


Figure 1: OPALCO's service territory covers San Juan County and includes 20 islands. Eastsound is shaded towards the top of Orcas Island and represents the initial Orcas Community Microgrid location. Over time, the Community Microgrid will expand to cover all of Orcas and then eventually the entire OPALCO service territory.

Eastsound Tier 1 & 2 facilities map

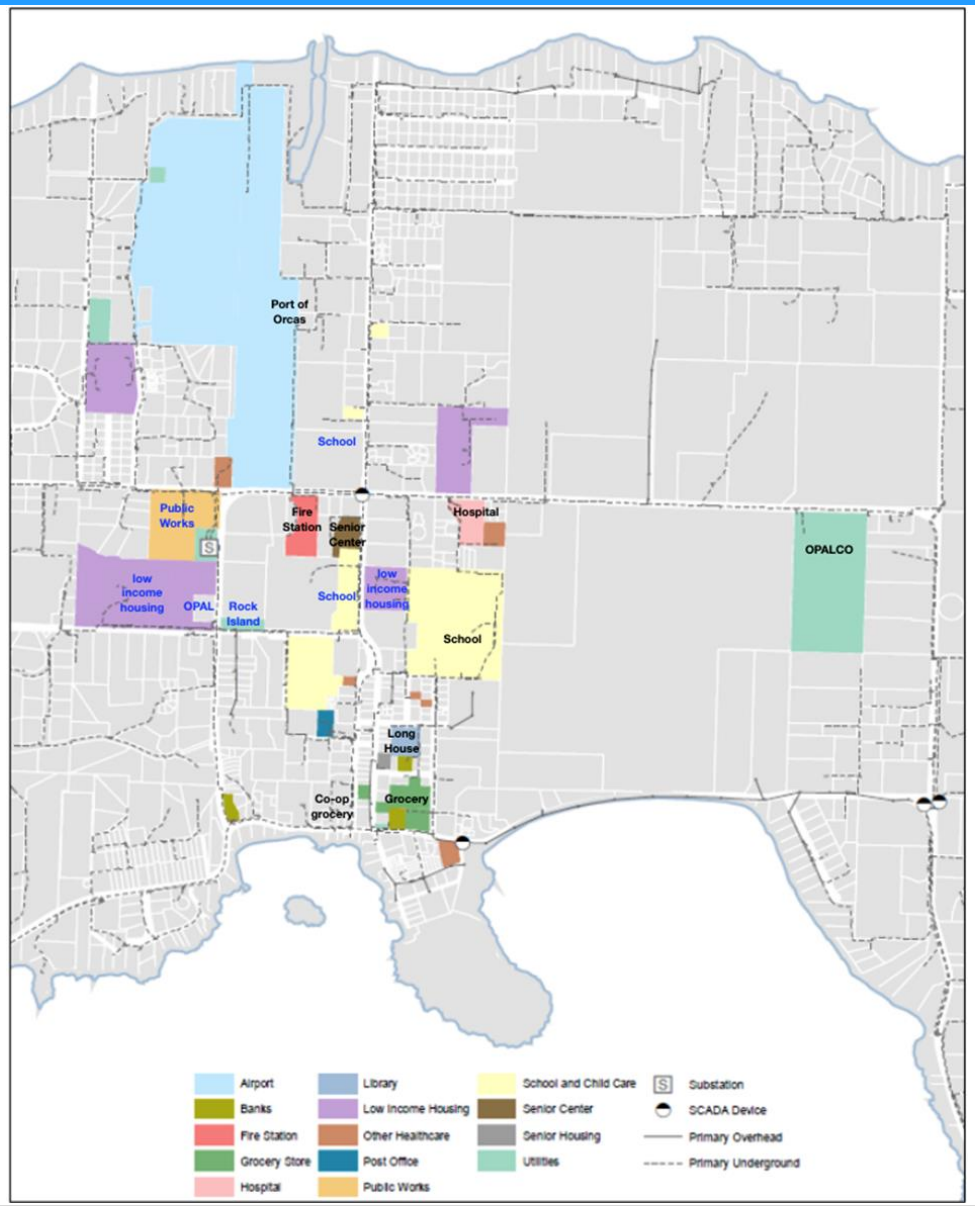


Figure 2: Eastsound facilities that are being provisioned with priority Community Microgrid resilience in the initial Orcas Community Microgrid design are shaded. Tier 1 Critical Community Facilities (CCFs) are shaded and labeled with black text, while Tier 2 CCFs are shaded in blue text. Figures 3 and 4 further depict the initial Orcas Community Microgrid in block diagram form.

OCM map for Orcas Island