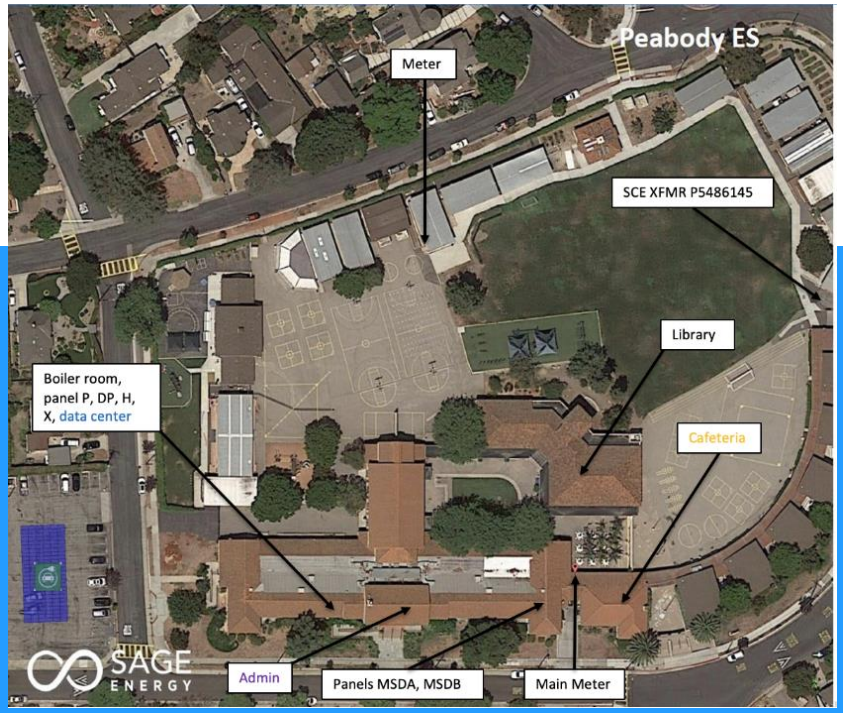
Clean Coalition

Peabody Solar Microgrid

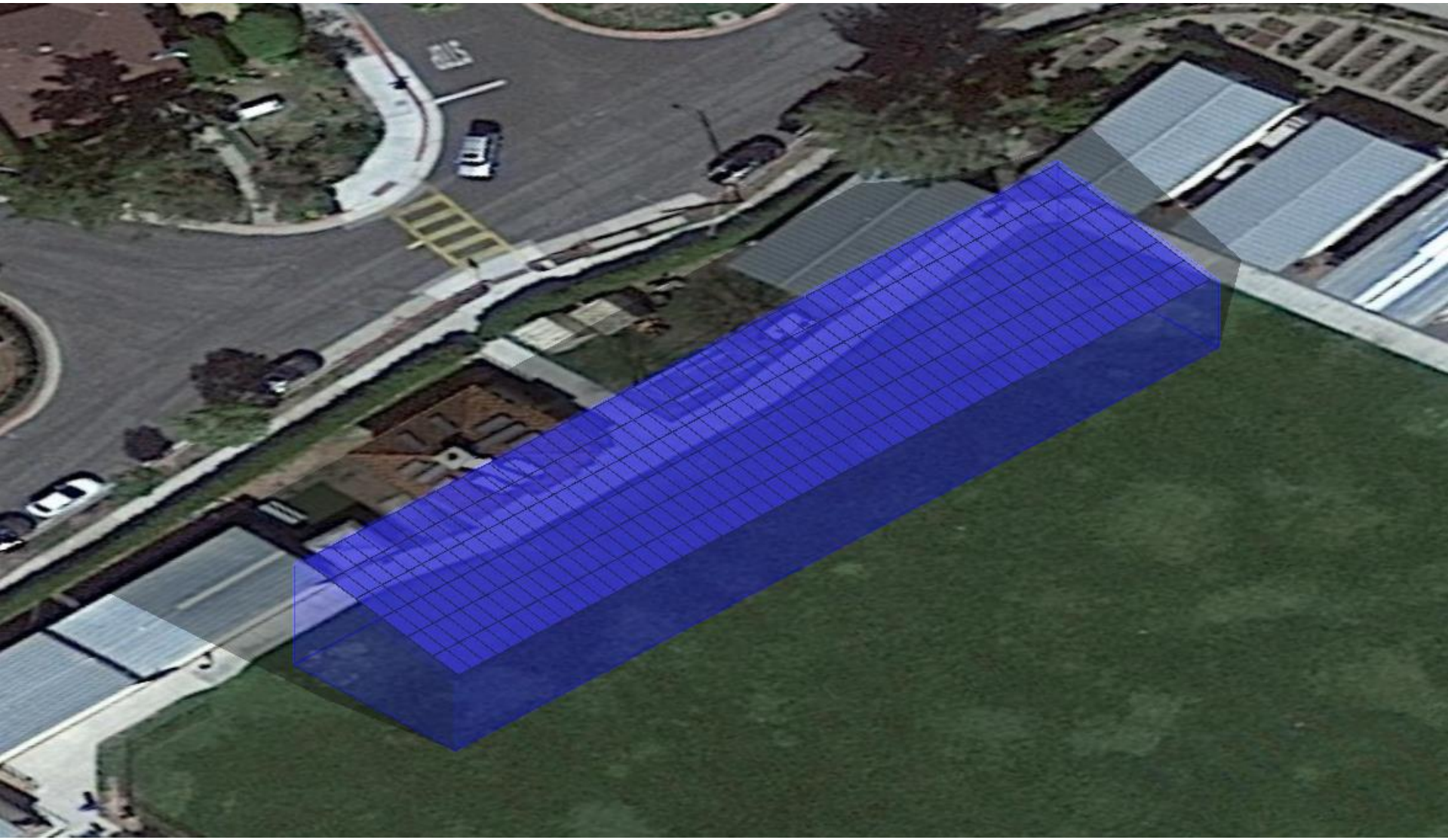


Craig Lewis
Executive Director
650-796-2353 mobile
craig@clean-coalition.org

Roosevelt is a proxy for Peabody solar canopy

Peabody Charter - 137 kW solar canopy (102% NZE)

Peabody Charter - 137 kW solar canopy (102% NZE)



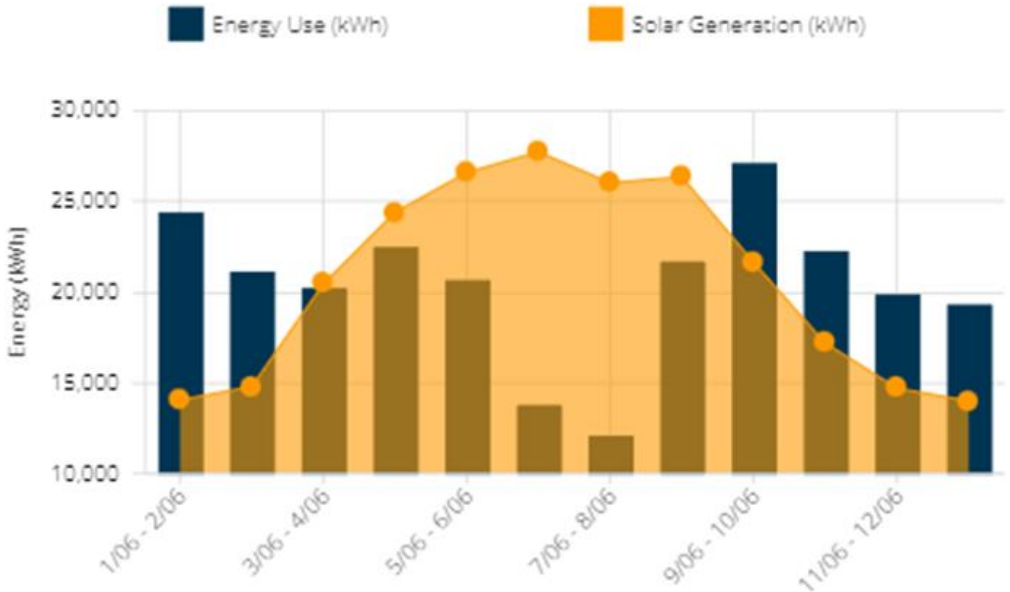
Peabody Charter – Current total annual load and billing (Pre-solar)

Peabody Charter - Current Load and Billing Analysis Based on SBCE 100% Green TOU-GS-2-E Rate Schedule							
Load Profile Type	**Total Annual load (kWh)**	**Peak Demand (kW)**	**Effective Blended Rate ¢/kWh**	**Total Annual Bill**	**Energy Charges**	**Demand Charges**	**NBC's & Fixed Charges**
Baseline Load Profile	244,114	173	31.4	$76,612	$45,257	$23,494	$7,861

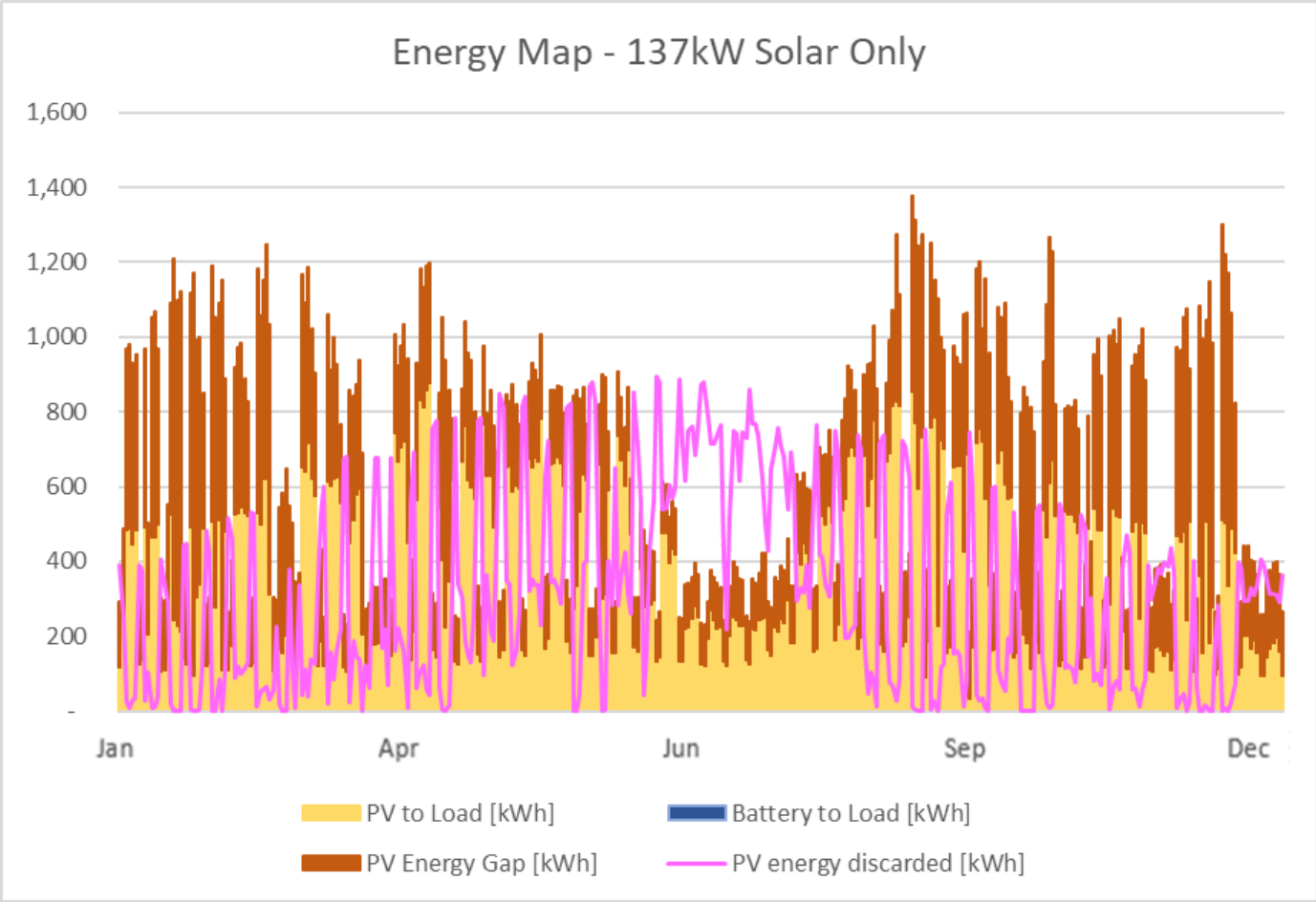
Solar only

Peabody Charter – 137 kW solar only billing analysis

Peabody Charter - Future Solar Only Billing Analysis Based on SBCE 100% Green TOU-GS-2-E Rate Schedule							
Load Profile Type	**Annual Load from Master Load Profile (kWh)**	**Peak Demand (kW)**	**Effective Blended Rate ¢/kWh**	**Total Annual Bill**	**Energy Charges**	**Demand Charges**	**NBC's & Fixed Charges**
Baseline Load Profile	244,114	173	8.77	$21,406	$0	$16,882	$4,524

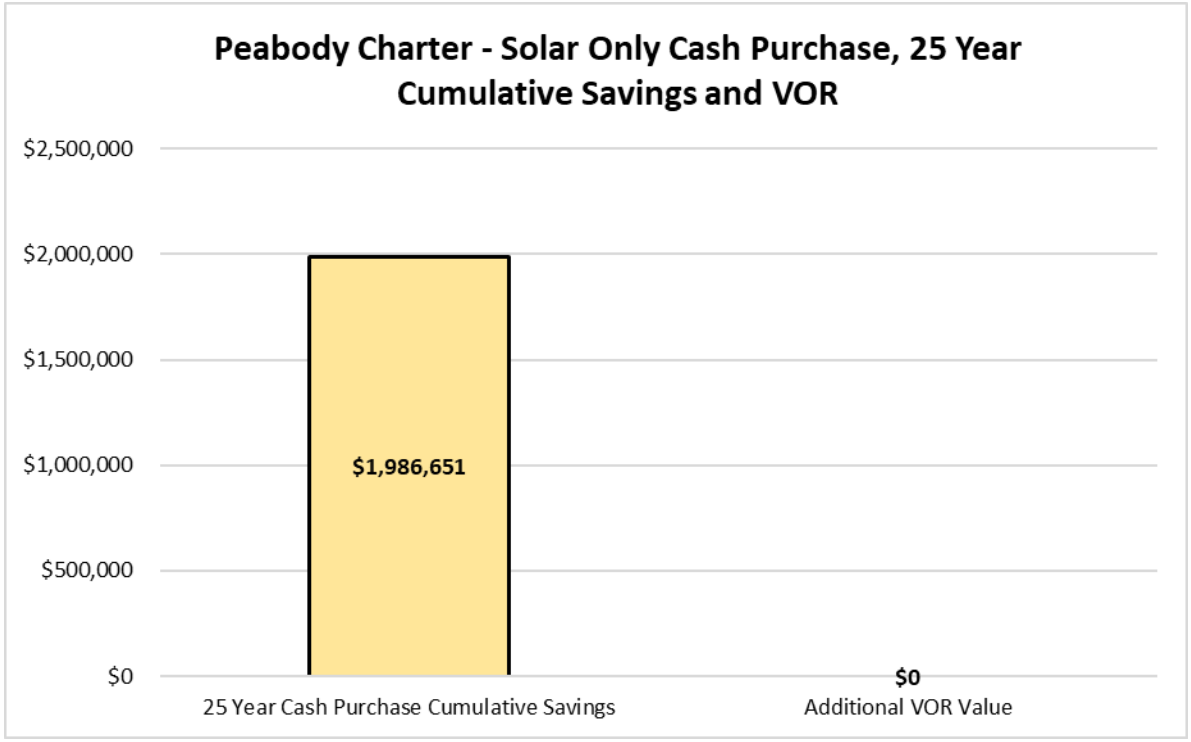


Peabody Charter - Energy map using 137 kW solar



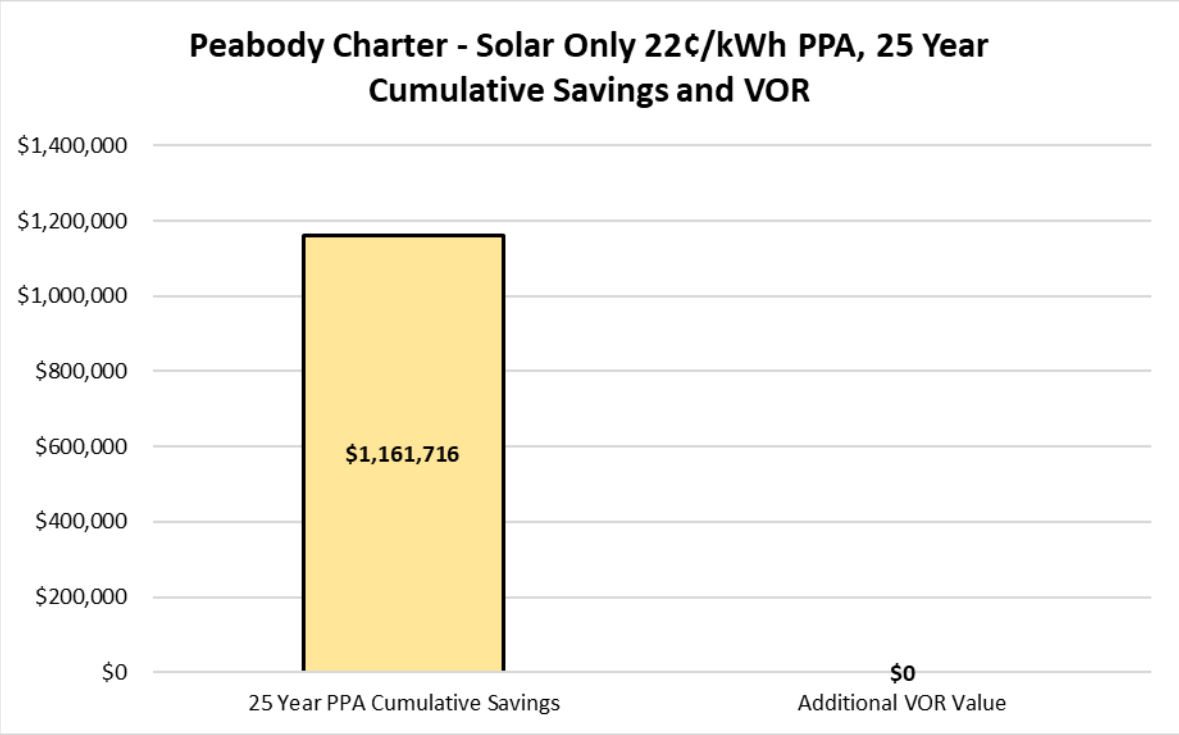
Peabody Charter – 137 kW solar only 25 year cash purchase economics

Peabody Charter - Solar Only 25 Year Cash Purchase Economic Details								
Facility	Annual Electricity Bill Cost (Pre-Solar)	Solar Only Cash Purchase - 25 Year Costs and Savings						Value of Resilience
		Capital Expenditure (Capex)	Operational Expenditure (Opex)	Incentives	Net Total Project Cost	Cumulative Utility Bill Savings	Net Cumulative Savings	25 Year Value
Peabody Charter	$76,612	($444,600)	($146,266)	$133,380	($457,486)	$2,444,137	**$1,986,651**	$0



Peabody Charter – 137 kW solar only 25 year PPA economics

Peabody Charter - Solar Only 25 Year PPA Economic Details							
Facility	Annual Electricity Bill Cost (Pre-Solar)	Solar Only 22¢/kWh PPA - 25 Year Costs and Savings					Value of Resilience
		Average Annual PPA Payment	25 Year Total PPA Payments	Cumulative Utility Bill Savings	Net Cumulative Savings	Year 1 Savings	25 Year Value
Peabody Charter	$76,612	($51,297)	($1,282,421)	$2,444,137	**$1,161,716**	$635	$0



Solar Microgrid

Peabody Charter - Energy map using 137 kW solar and 100 kW / 186 kWh energy storage

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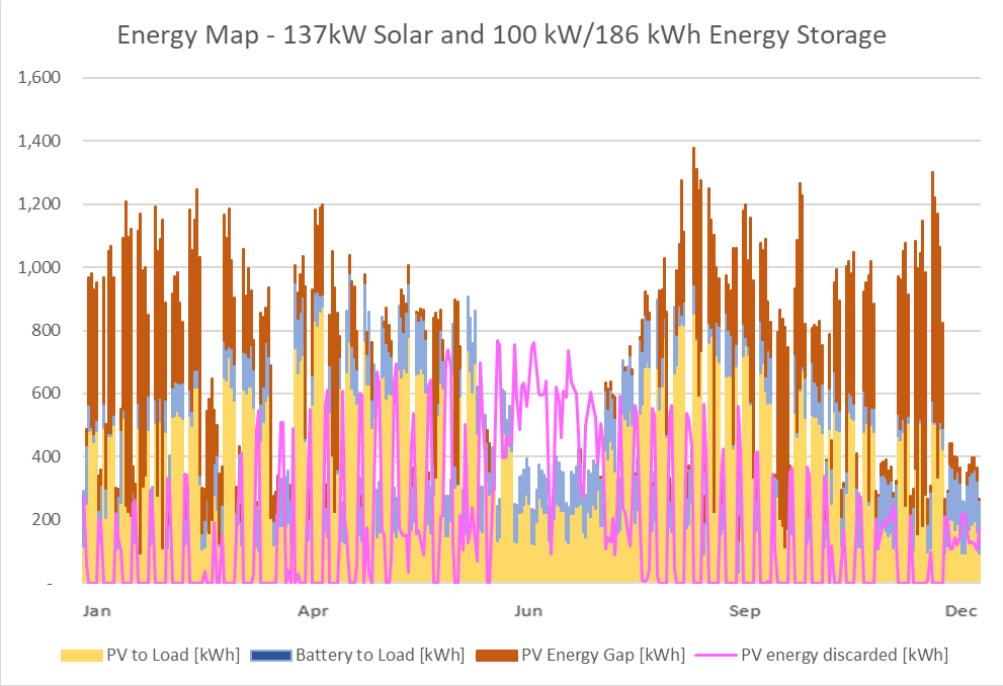
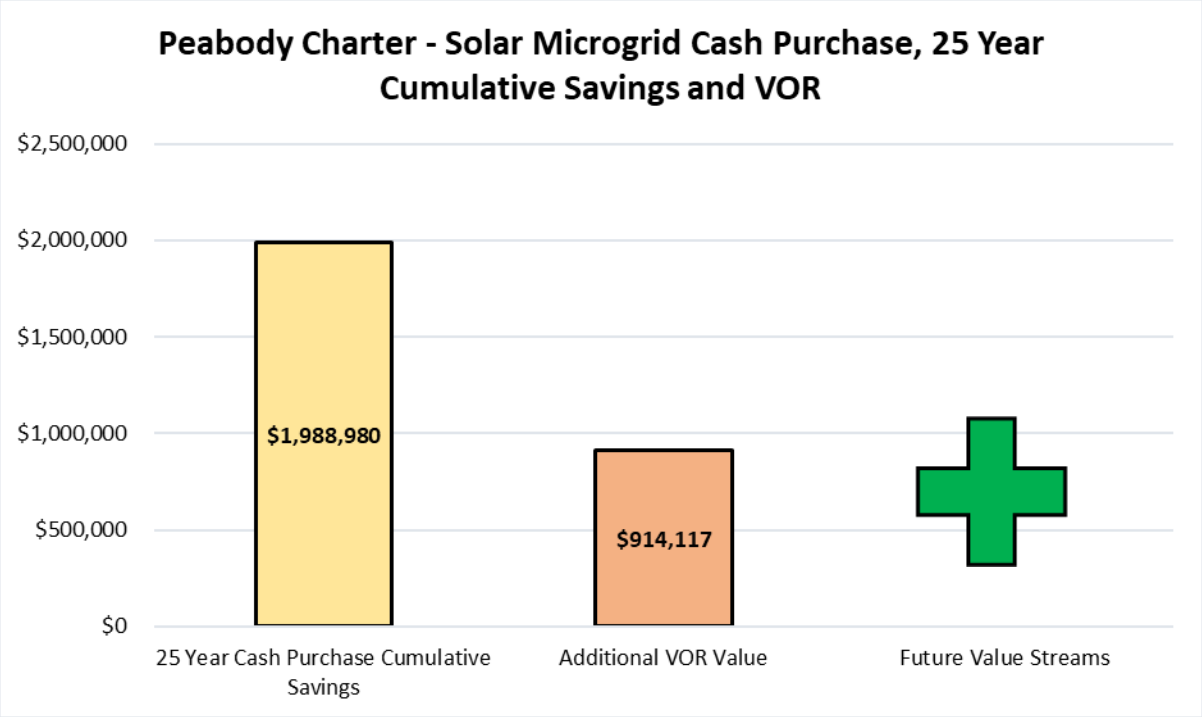
Peabody Charter - Battery Energy Storage Sizing, System Cost, and Resilience						
	Recommended Battery System Size		Battery System Cost		Indefinite Resilience	
Baseline Load Profile Peak Demand (kW)	Standard Option Battery Power Capacity (kW)	Standard Option Battery Energy Capacity (kWh)	Total Battery Energy Storage System Cost	Battery Energy Storage System Cost per kWh	Total Percentage of Load Kept Online Indefinitely (Year 1)	Total Percentage of Load Kept Online Indefinitely (Year 15 - before replacement)
173	100	186	$279,000	$1,500	17.0%	13.0%



Peabody Charter – Solar Microgrid 25 year cash purchase economics

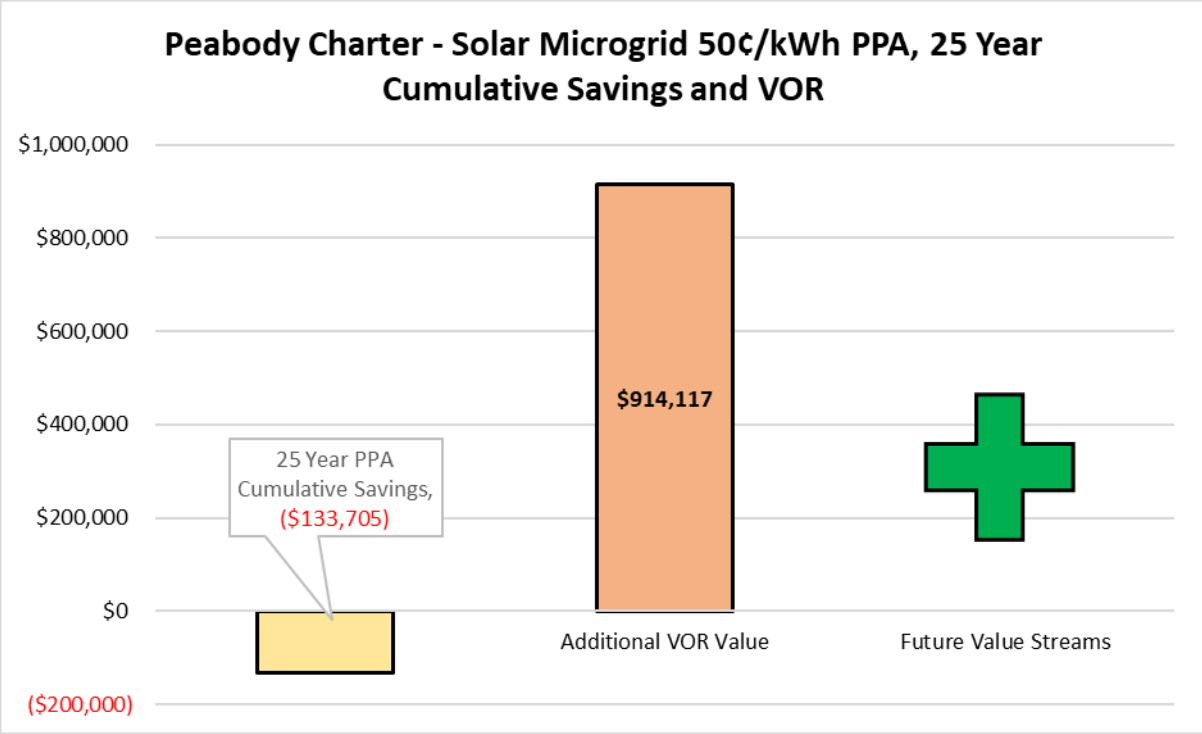
Clean Coalition

Peabody Charter - Solar Microgrid 25 Year Cash Purchase Economic Details								
Facility	Annual Electricity Bill Cost (Pre-Solar Microgrid)	Solar Microgrid Cash Purchase - 25 Year Costs and Savings						Value of Resilience
		Capital Expenditure (Capex)	Operational Expenditure (Opex)	Incentives	Net Total Project Cost	Cumulative Utility Bill Savings	Net Cumulative Savings	25 Year Value
Peabody Charter	$76,612	($723,600)	($285,388)	$217,080	($791,908)	$2,780,888	**$1,988,980**	$914,117



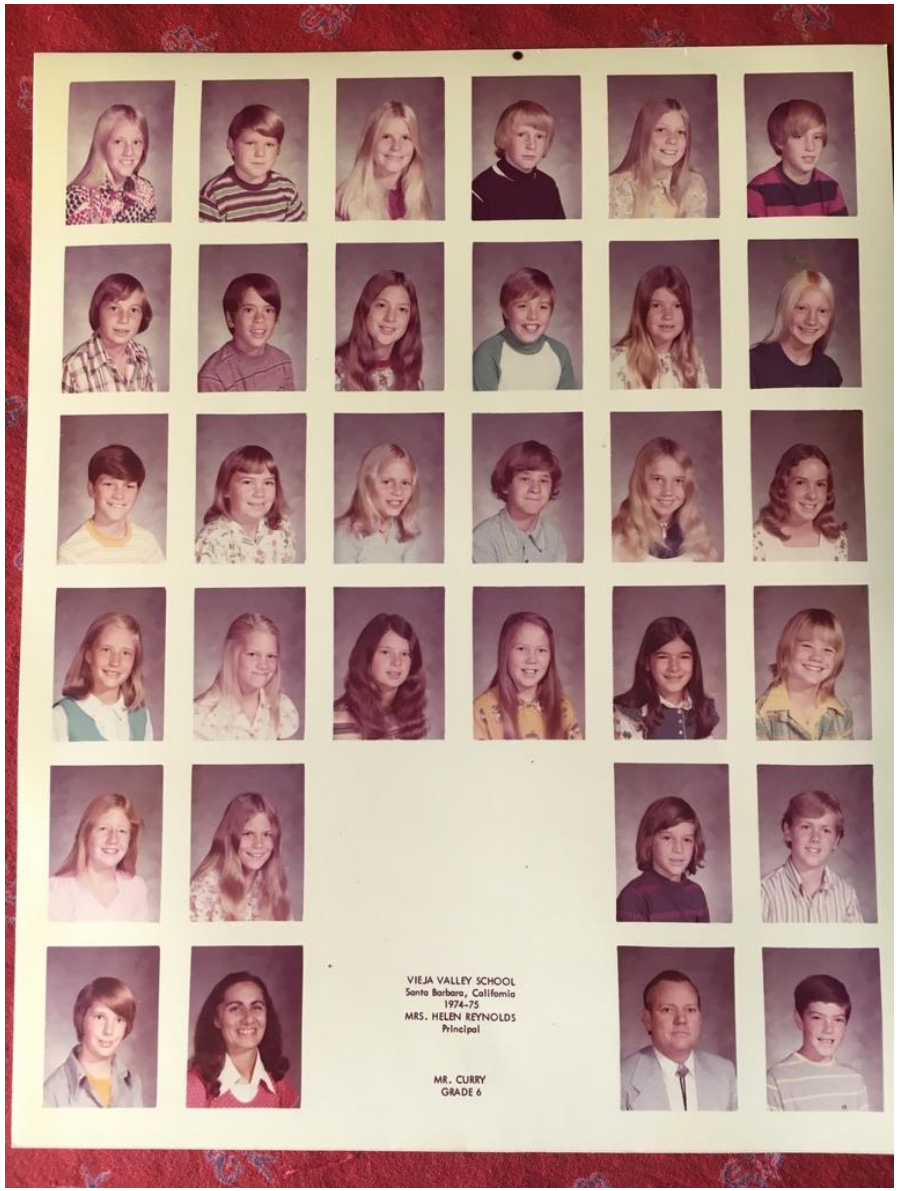
Peabody Charter – Solar Microgrid 25 year PPA economics

Peabody Charter - Solar Microgrid 25 Year PPA Economic Details							
Facility	Annual Electricity Bill Cost (Pre-Solar Microgrid)	Solar Microgrid 50¢/kWh PPA - 25 Year Costs and Savings					Value of Resilience
		Average Annual PPA Payment	25 Year Total PPA Payments	Cumulative Utility Bill Savings	Net Cumulative Savings	Year 1 Savings	25 Year Value
Peabody Charter	$76,612	($116,584)	($2,914,593)	$2,780,888	**($133,705)**	**($60,132)**	$914,117



Backup slides

6th Grade is the best!!!



Ms Craviotto is the best!!! (4th Grade teacher)

Clean Coalition

Mission

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

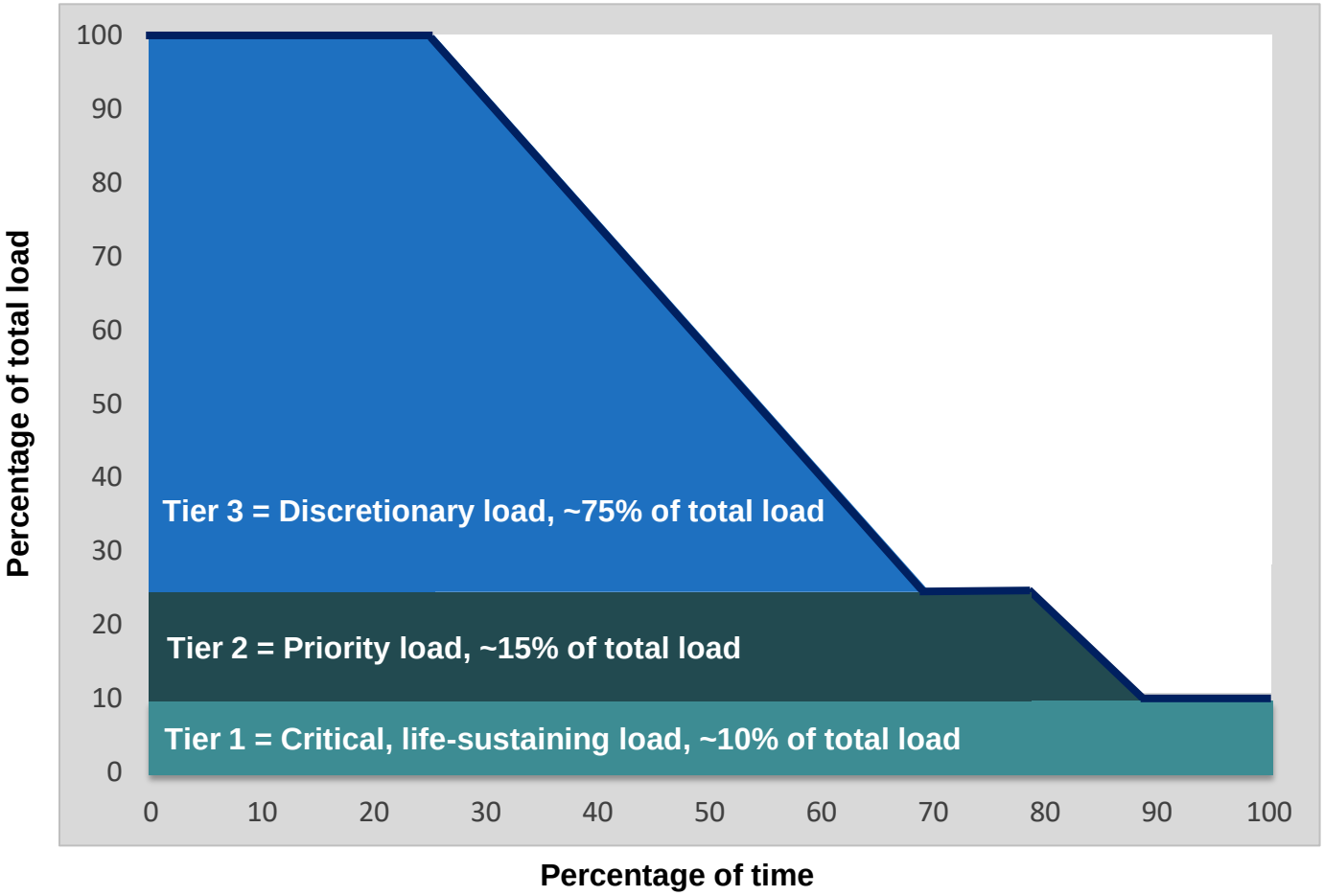
Renewable Energy End-Game

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.

Microgrids in the Clean Coalition's world

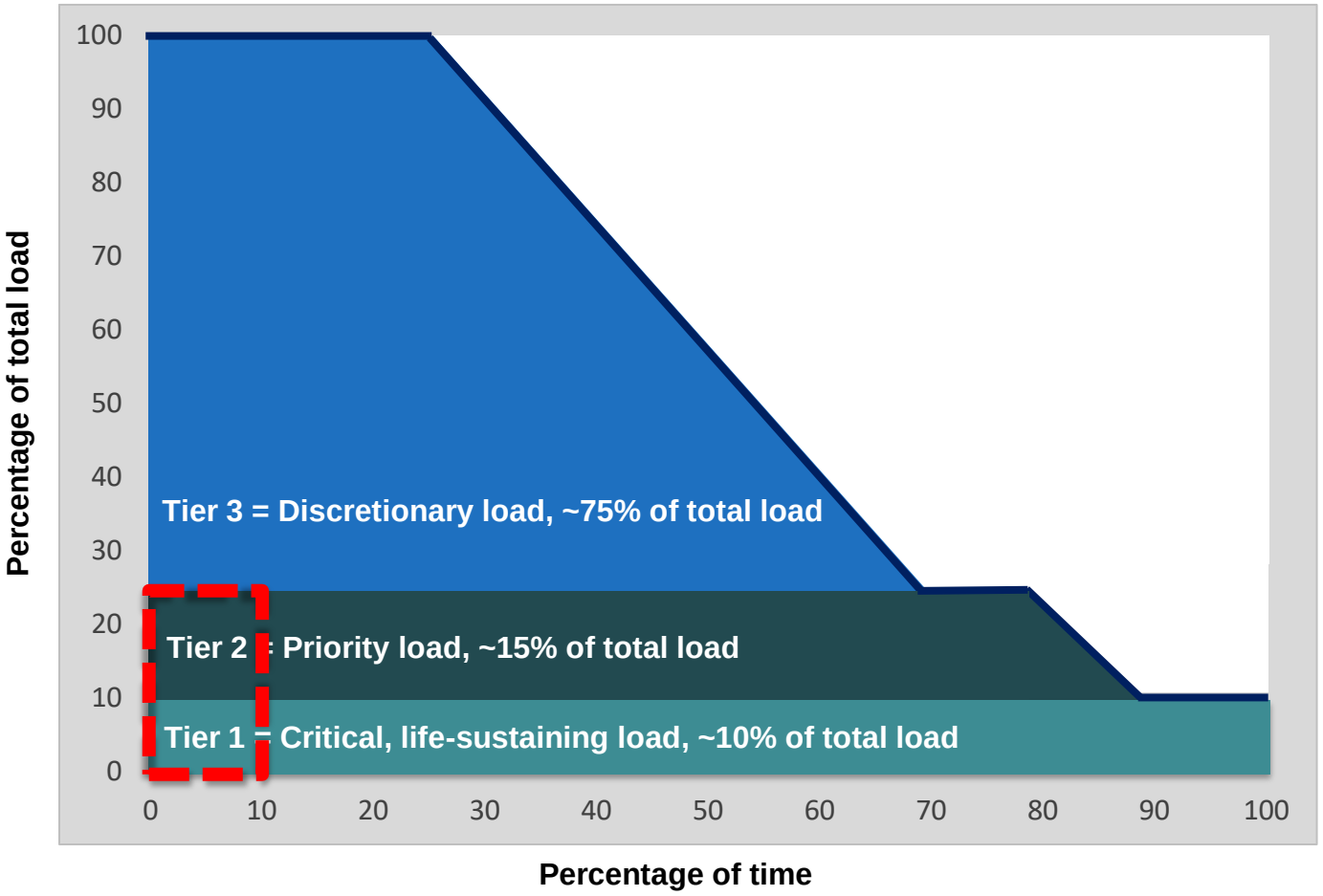
- A microgrid is a combination of energy resources, definitely including generation, that are coordinated to serve specified loads, including in an islanded fashion.
- A Solar Microgrid is a behind-the-meter (BTM) microgrid that solely relies on solar for energy generation when islanded.
- A Hybrid Solar 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.

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

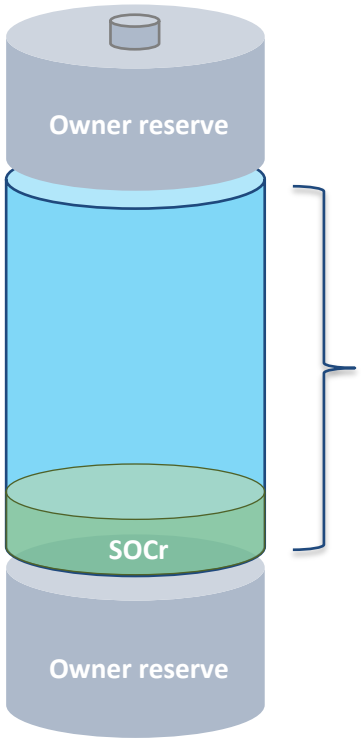


A typical diesel generator is configured to maintain 25% of the normal load for two days. If diesel fuel cannot be resupplied within two days, goodbye. This is hardly a solution for increasingly necessary long-term resilience. In California, Solar Microgrids provide a vastly superior trifecta of economic,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

Batteries optimized for economics & resilience

Top owner reserve is often in place to absorb battery energy storage system (BESS) degradation over time, while still delivering the contracted daily cycling energy capacity.

SOCr = the minimum state-of-charge (SOC) that is reserved for provisioning resilience. The SOCr can be dynamic and/or resized to between 0% and 100% of the contracted BESS energy capacity. A lower SOCr facilitates BESS operations that optimize daily economic performance, while a higher SOCr facilitates the provisioning of greater resilience.



Contracted BESS energy capacity (kWh) that must be available for daily cycling over the contract duration for achieving specified economic & resilience performance.

Bottom owner reserve is often required to meet BESS warranty requirements that are imposed by BESS vendors.

Community Microgrids are the grid of the future

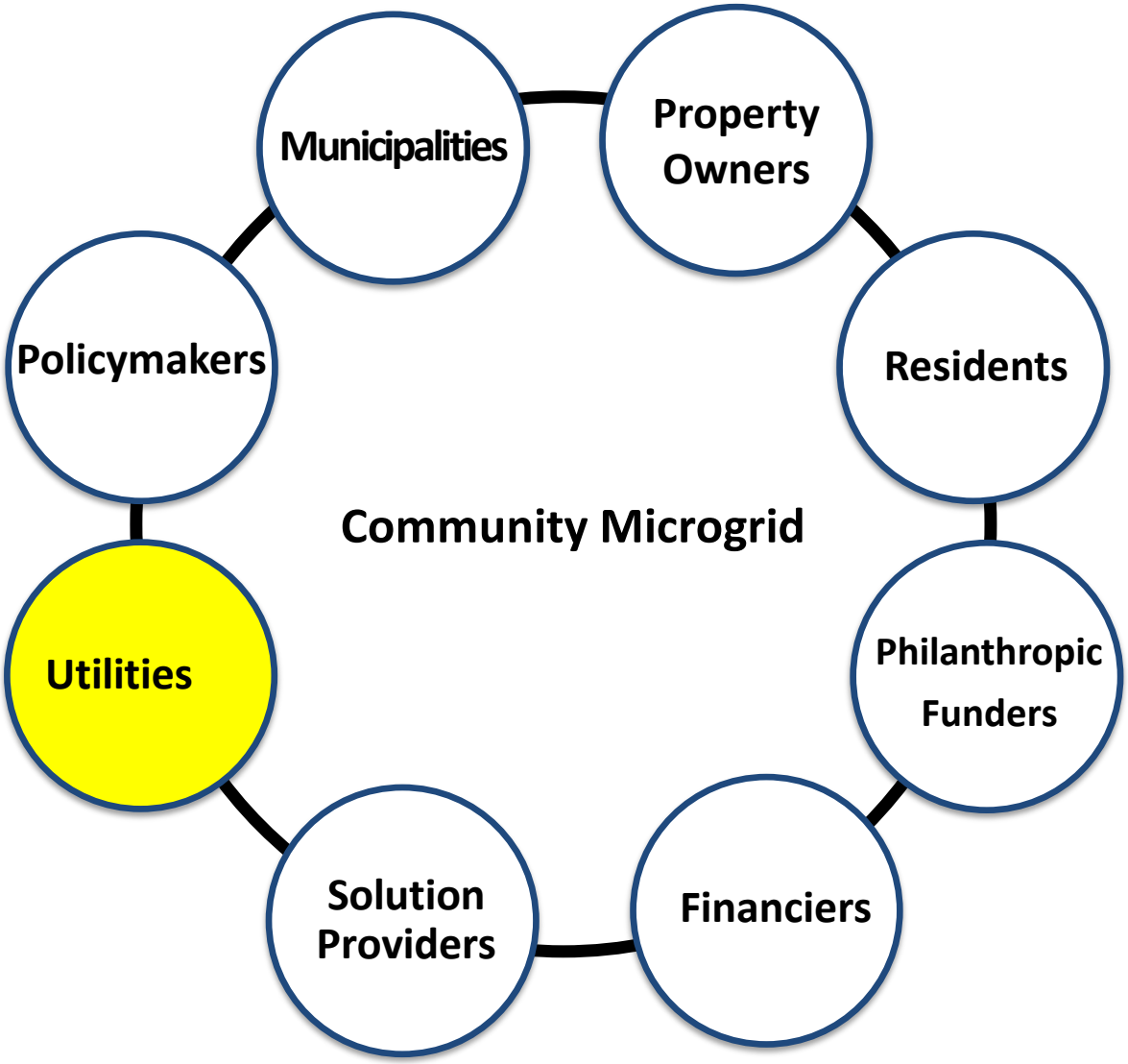
Clean Coalition

A Community Microgrid is a new approach for designing and operating the electric grid, stacked with local renewables and staged for resilience.

Key features:

- A targeted and coordinated distribution grid area served by one or more substations – ultimately including a transmission-distribution substation that sets the stage for Distribution System Operator (DSO) performance.
- Ability to utilize existing distribution grid infrastructure to serve the Community Microgrid during broader grid outages.
- High penetrations of local renewables and other distributed energy resources (DER) such as energy storage and demand response.
- Staged capability for indefinite renewables-driven backup power for critical community facilities across the grid area – achieved by 25% local renewables mix.
- A solution that can be readily extended throughout a utility service territory – and replicated into any utility service territory around the world.

Community Microgrid key stakeholders

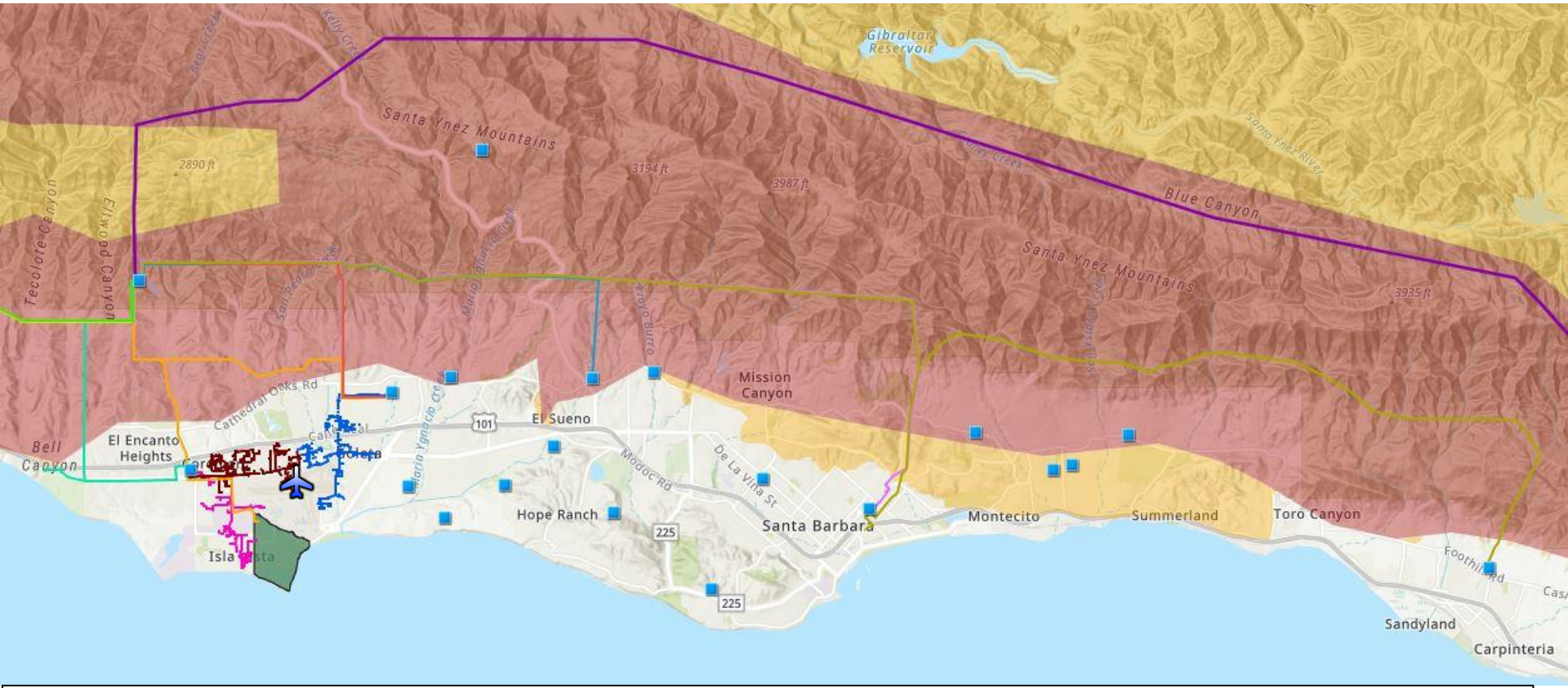


Goleta Load Pocket (GLP)

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.

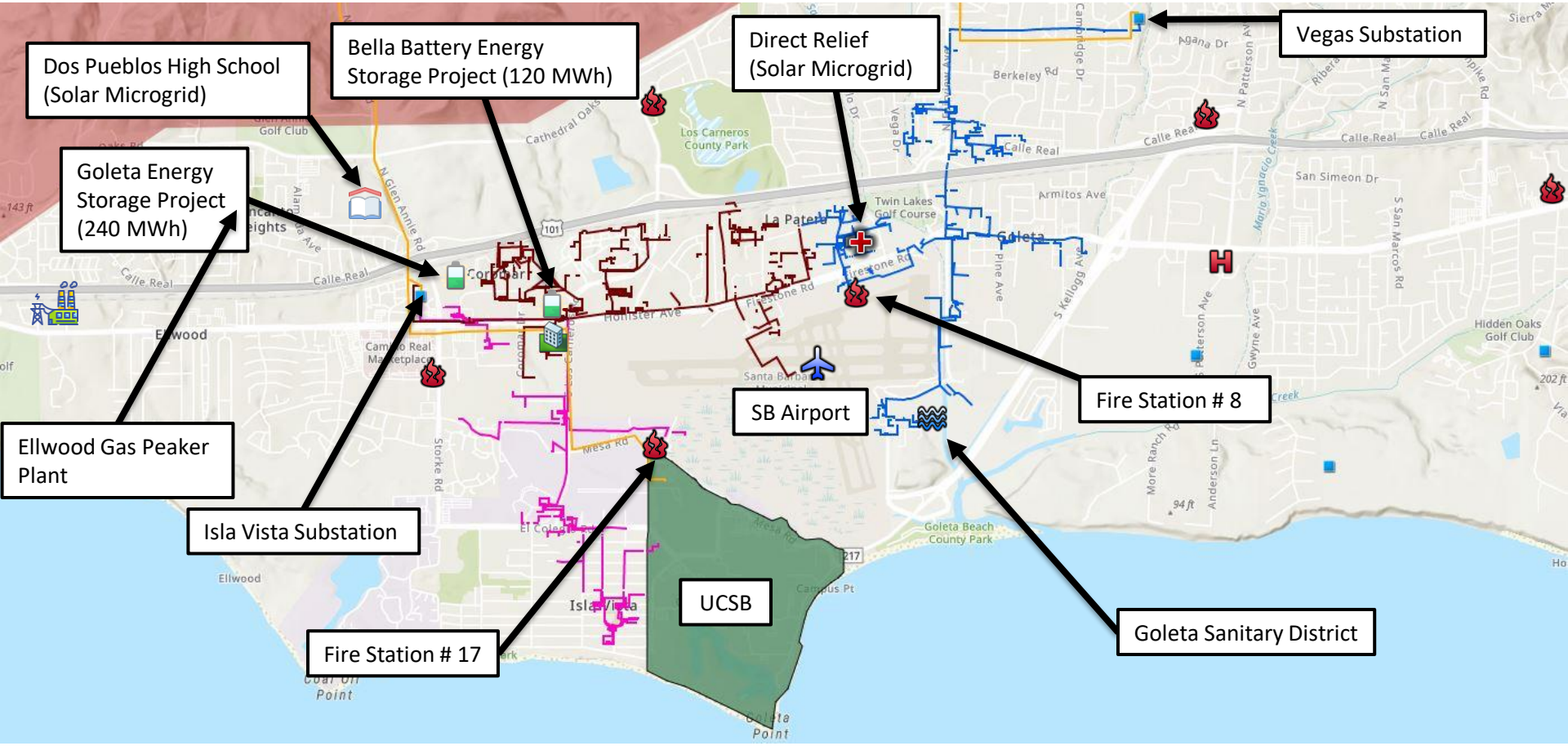
Core load area of the GLP



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 #3556
- Feeder #4311
- Feeder #3559
- Feeder #4169
- Feeder #4227
- Feeder #3565

Target 66kV feeder serves critical GLP loads

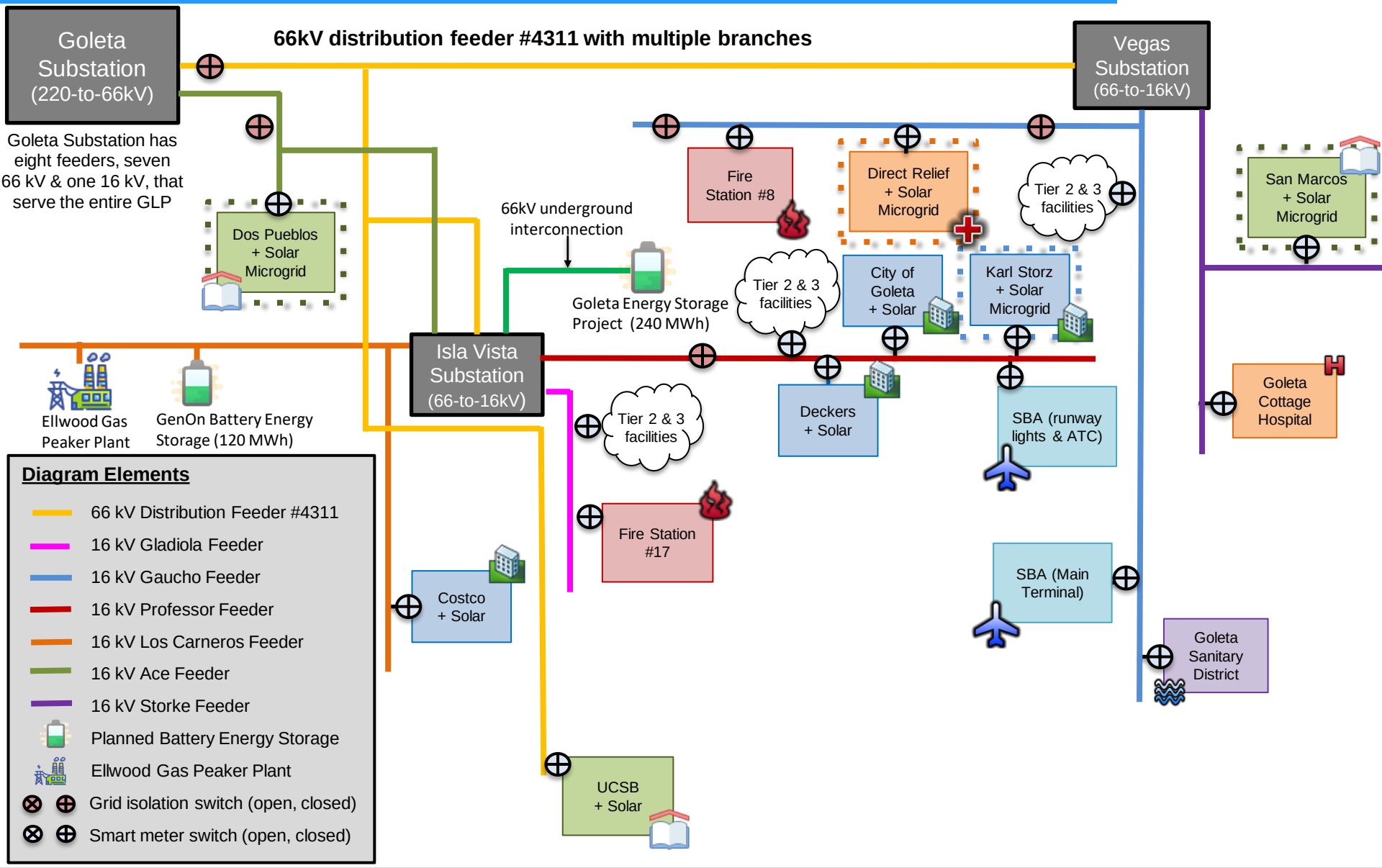


Legend

- 66 kV Feeder #4311
- Substations
- Tier 3 Fire Threat
- 16kV Gladiola Feeder
- 16kV Gaucho Feeder
- 16kV Professor Feeder
- Santa Barbara Airport
- University of California Santa Barbara
- Dos Pueblos High School
- Fire Stations
- Goleta Sanitary District
- Goleta Valley Cottage Hospital
- Direct Relief
- Deckers
- Planned Battery Energy Storage

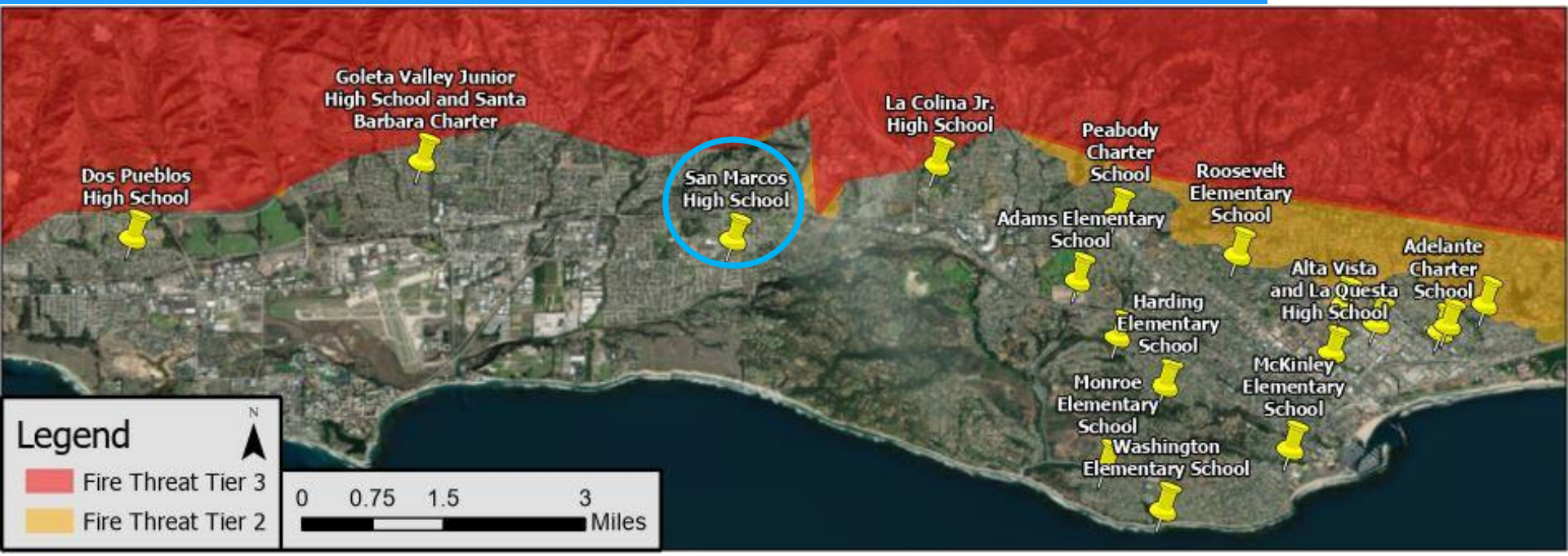
Target 66kV feeder grid area block diagram

Clean Coalition



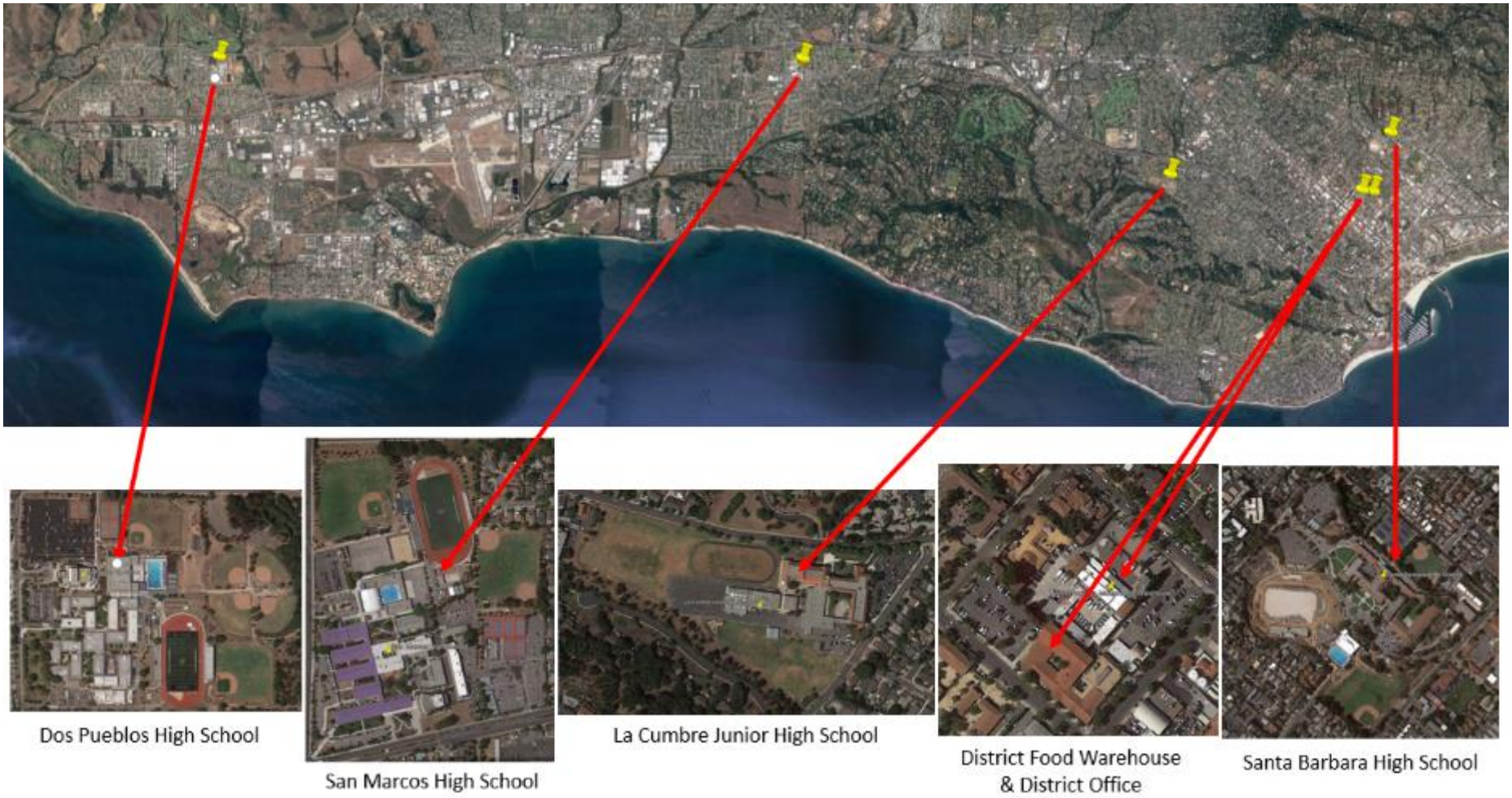
Santa Barbara Unified School District (SBUSD) case study

Santa Barbara Unified School District (SBUSD)

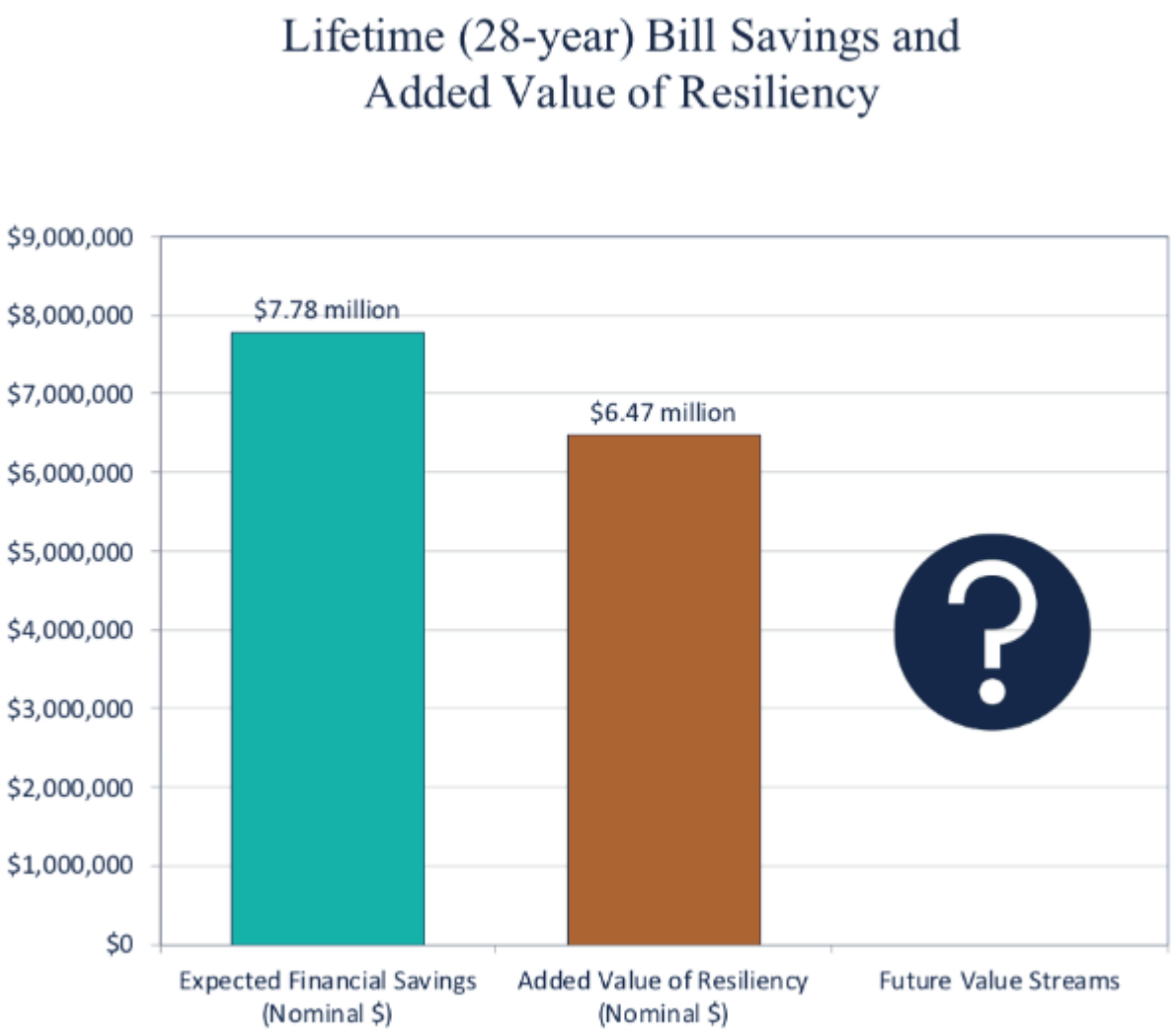


- The entire Santa Barbara region is surrounded by extreme fire risk (earthquake & landslide risk too) and is extremely vulnerable to electricity grid outages.
- The SBUSD is a major school district that increasingly recognizes the value-of-resilience (VOR) and has embraced the Clean Coalition's vision 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

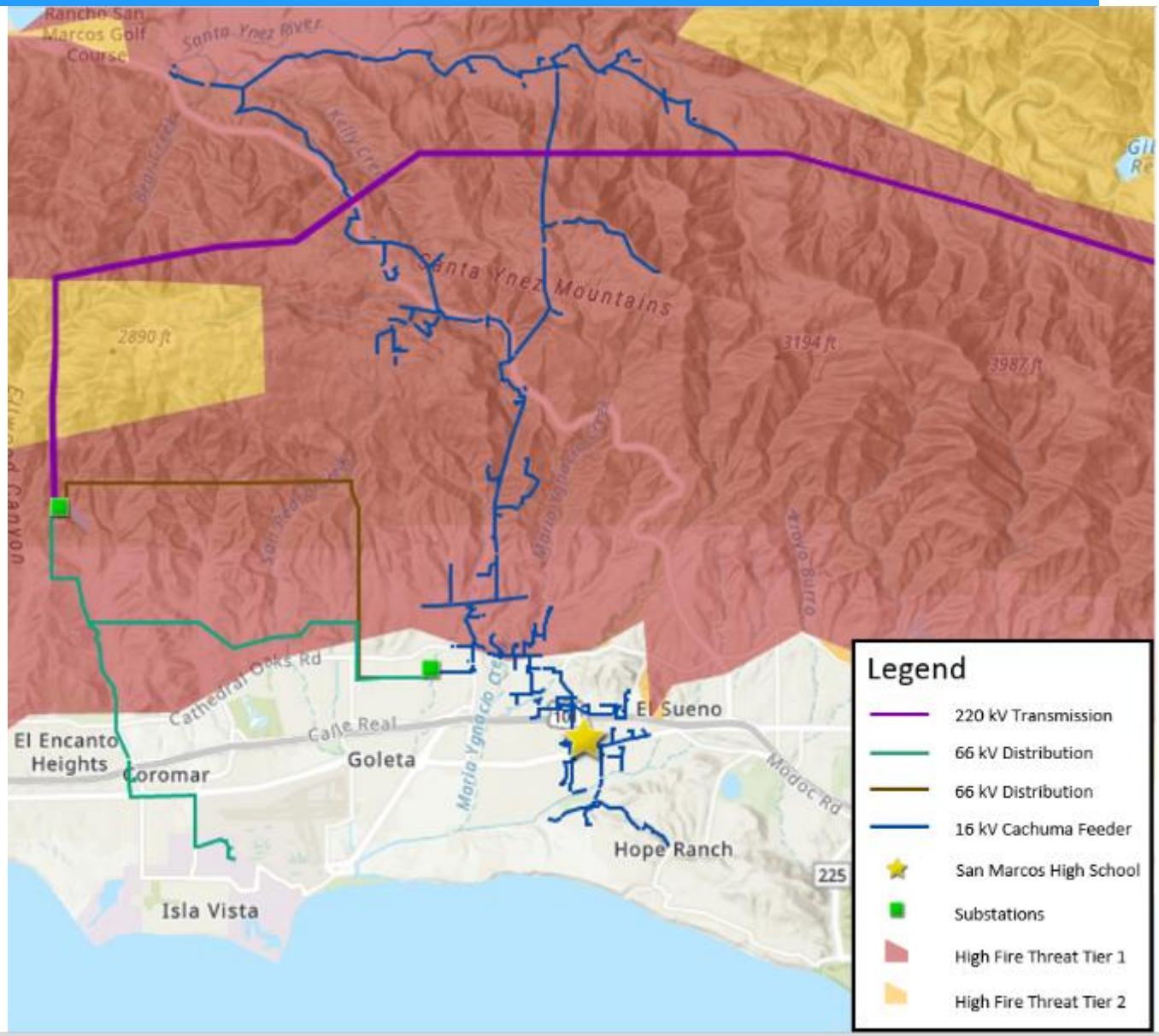


Guaranteed SBUSD bill savings and free VOR



San Marcos High School (SMHS) Solar Microgrid case study

SMHS is vulnerable to distribution outages too



San Marcos High School (SMHS) campus view

- SMHS is a large public high school serving 2,000+ students in grades 9 through 12.
- Red Cross designated facility.
- School features include:
  - Array of classroom buildings
  - Large pool
  - Gymnasium
  - Football stadium
  - Multiple baseball fields
  - Cafeteria
  - Outdoor Greek theater
  - Auditorium
  - Numerous tennis & basketball courts
- Craig Lewis in the Class of 1981.

SMHS Solar Microgrid overview

The SMHS Solar Microgrid is intended to enable the school to operate independently during grid outages of any duration with **indefinite resilience for the most critical loads** and **resilience for all loads for significant percentages of time**.

- **Solar**
  - 725 kWp
  - Solar is entirely in the form of solar parking canopies
  - Net Zero Energy (NZE) is exceeded at 101%
- **Battery Energy Storage System (BESS)**
  - 700 kWh energy capacity
  - 350 kW power capacity
- **Critical (Tier 1) loads**
  - Food service refrigerators & freezers, maintained indefinitely
  - 4.36 kW of average load
  - 3.44% of total average load
- **Priority (Tier 2) loads**
  - Gym lights and Main Distribution Frame, maintained at least 80% of the time
  - 4.32 kW of average load
  - 3.41% of total average load

SMHS Solar Microgrid site layout

Clean Coalition

San Marcos HS

4750 Hollister Ave, Santa Barbara CA 93110

Solar PV

Annual PV Production Target: 1,164,000 kWh

Battery Energy Storage Resiliency

Average State of Charge Reserve (SOCr): 28.50 kWh
Tier 1 Average Load: 4.36 kW
Tier 2 Average Load: 4.32 kW

EV Charging Infrastructure

Stalls	ADA Stalls	Non-ADA Stalls	Existing EVSEs	5-Year Install
514	22	492	0	37

Notes

1. This site is a designated community resilience center and Red Cross emergency shelter.
2. No lighting in main lot (some perimeter).
3. Main parking lot to be redesigned and existing portables relocated prior to solar construction. Will need to add ADA stalls under solar canopy and POT as part of main parking lot reconfiguration.
4. Will need to cover existing ADA stalls in NW Lot with the south ends of canopies C-5 and C-6 and two existing light poles will need to be removed.
5. Long homerun through campus from canopies C-5 and C-6, approximately 1,450'. Short homerun of approximately 150' crossing drainage swale from main parking lot to POI.
6. Small parking area under C-4 may be challenging to cover/upgrade ADA compliance.
7. Good BESS location adjacent to main service enclosure.
8. Suggest participation in future SCE EV Charge program. Due to location of EV charging areas, SCE likely to drop a new dedicated service feed.

Santa Barbara Unified School District
District-Wide Solar PV Energy and Resiliency RFP
PV, BESS, and EV Charge Site Plan
5/18/2020

Interview Q&A

Interview questions

from

Ms Shaefer 6th Grade Students

for

Craig Lewis

Interview Q&A (26 questions total)

1) What have the issues been in the past that prevented Peabody getting solar? (Manuel)
2) What would the cost estimate be for installing a PV system at Peabody? (Ryland)
3) How much BESS battery power does Peabody need? (Ana)
4) How much does the BESS battery system add to the cost? (Adamary)
5) What type of financing do you recommend for schools? (Trey)
6) Why did SB Unified go with a Power Purchase Agreement? (Mason)
7) Would Peabody get a tax incentive from the state for solar? (Maxx)

Interview Q&A (26 questions total)

8) How much space will solar panels at Peabody take up? (Trey)
9) Do you recommend installing freestanding solar arrays instead of putting solar on roofs for schools? (Javier)
10) Would it be possible to put it on the blacktop playground instead of doing it in the NE corner to provide shade for PE classes? (Sydney)
11) Are we going to need multiple locations to meet our energy needs? (Christopher)
12) How many solar panels do we need to put at Peabody? (Angel)
13) Do solar arrays on lawns kill the grass? (Chris)
14) If it is on the playground, can solar panels be damaged by balls or sports equipment? (Adrian)

Interview Q&A (26 questions total)

15)Is it better to put panels on lawns or over black top? (Dylan)
16)What are the safety precautions for the poles if they are on playgrounds?(Sol)
17)What are we allowed to put underneath the solar arrays if they are on playgrounds? (Joselyn)
18)What are the issues with putting solar in the parking lot? (Andy)
19)How much more would it cost to put it in the parking lot? (Gianna)
20)What is the process for putting solar arrays at schools once it has been approved by the board? (Chris)
21)How long does it take to install? (Sydney)

Interview Q&A (26 questions total)

22) What do other schools say after installing the solar panels? Is there anything they thought was a problem? What did they like about having them? (Adrian)

23) What makes a solar company good to work with? (Moises)

24) Why did the SB unified go with Engie as a company? (Sol)

25) What companies are good to work with schools? (Kim)

26) Is there anything else we should know about solar? (Gianna)

Consider a career in Sustainability

"We came all this way to to explore the Moon, and what we discovered is the Earth."

- Bill Anders, Apollo Astronaut, 1968 Earthrise photo

You all can continue to be Solar Leaders!!!

- Share your solar knowledge with others.
- Promote solar for anyone you know with a connection to:
  - A house
  - An office
  - Roles in government, including:
    - School districts
    - Cities
    - Counties
    - State
    - Federal
- Educate people that solar can go on all types of built environments, including rooftops, parking lots, water reservoirs, and even over roads and waterways.
- I remember when my nephew was about your age and asked his Mom & Dad whether they had considered solar for their house. And presto, they got solar a few months later!!!