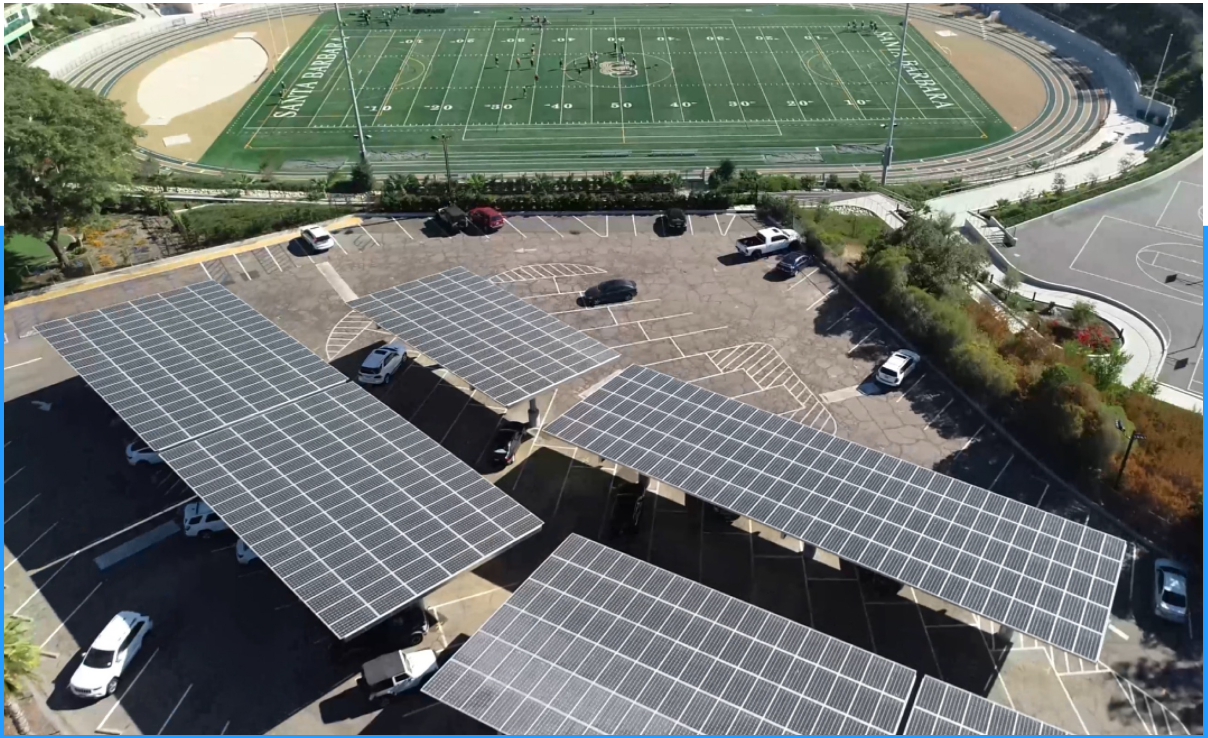
Renewables-driven Microgrids are key to the Energy Future



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Clean Coalition (nonprofit)

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.

Renewables-driven Microgrids deliver a trifecta of benefits

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1. Economic

   Savings via grid efficiency and lower costs

2. Environmental

   Sustainability via high renewable energy

3. Resilience

   Safety via enduring energy availability

Various configurations of Solar and/or Storage

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- Solar-only provides solar energy and delivers economic & environmental benefits. The solar will turn off during grid outages and there are no resilience benefits from solar-only.
- Storage-only allows energy to be time-shifted and provides economic and **limited resilience** benefits. Because storage-only simply time-shifts grid energy, solar-only deployments deliver no substantial environmental benefits. The resilience benefits will only last as long as the amount of energy that was stored at the time of a grid outage allows – then it's lights out.
- Solar+Storage combines solar & storage to deliver economic, environmental, and **limited resilience** benefits.
- Solar Microgrid combines to deliver economic, environmental, and **indefinite resilience** benefits. The solar provides an ongoing energy source, which is required for ongoing resilience.

Various types of Solar Microgrids

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- 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.

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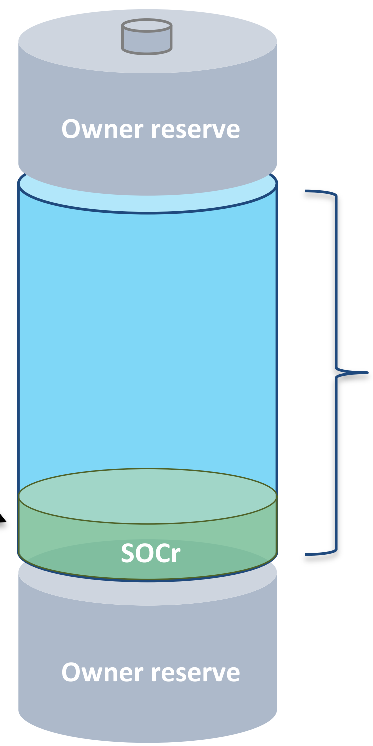
Storage, Resilience, Value-of-Resilience (VOR), and Load Management

Storage is 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.

Typical load tier resilience from Solar Microgrids

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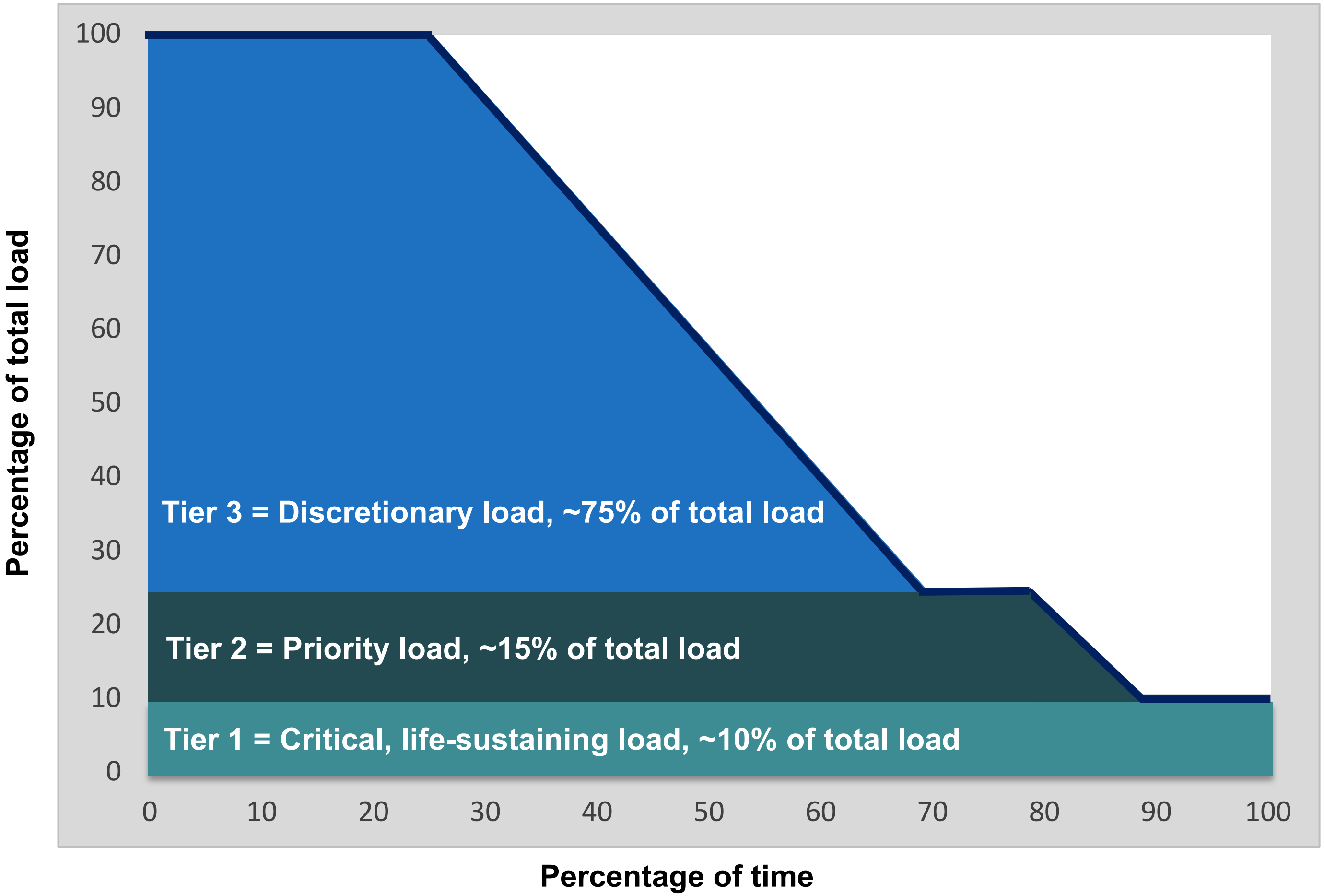

Percentage of time online for Tier 1, 2, and 3 loads for a Solar Microgrid designed for the University of California Santa Barbara (UCSB) with enough solar to achieve net zero and 200 kWh of energy storage per 100 kW solar.

Diesel generators are designed for limited resilience

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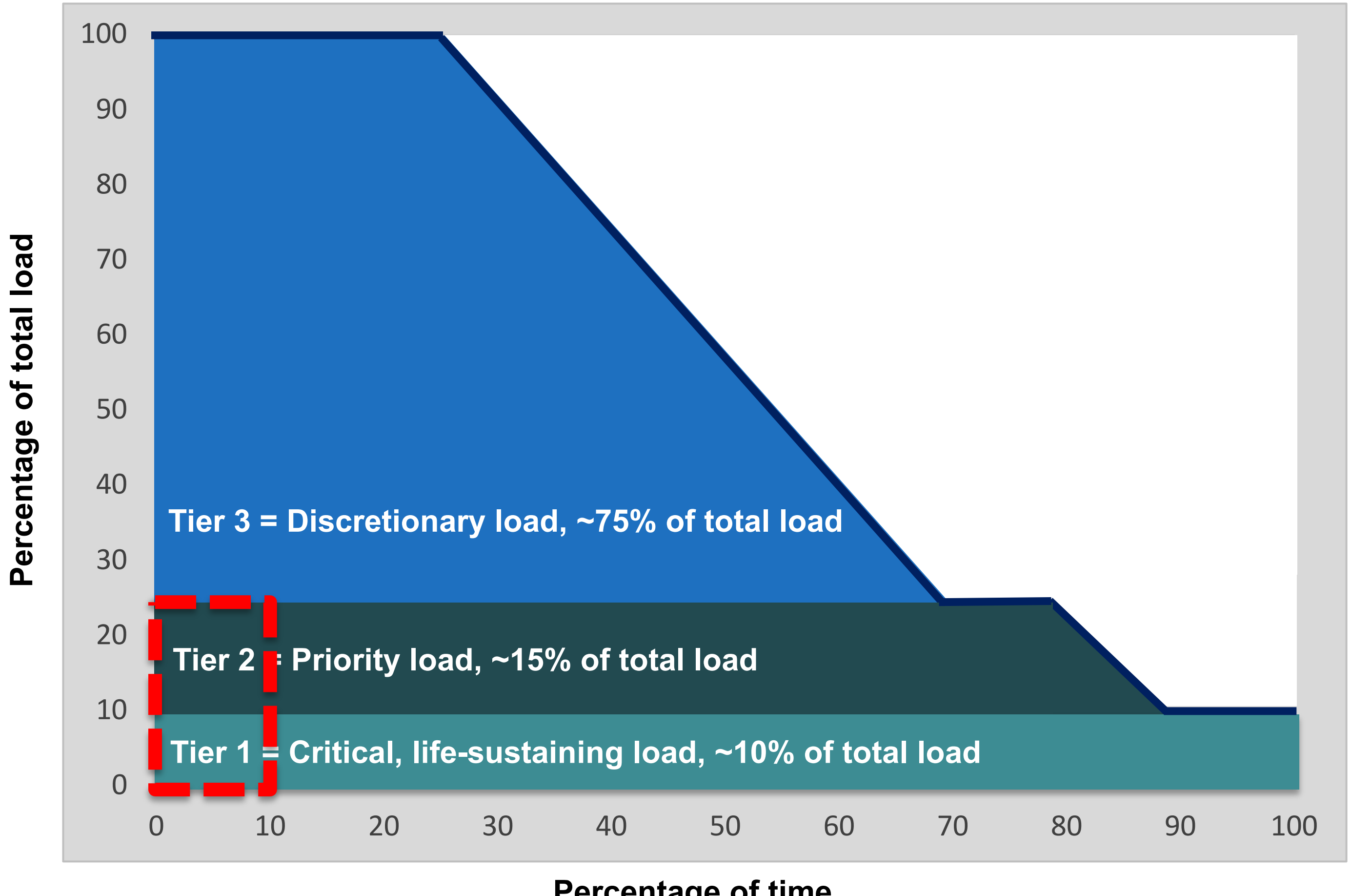

A typical diesel generator is configured to maintain 25% of the normal load for two days. If diesel fuel cannot be resupplied within two days, goodbye. This is hardly a solution for increasingly necessary long-term resilience. In California, Solar Microgrids provide a vastly superior trifecta of economic,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

Value-of-Resilience (VOR) depends on tier of load

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- Everyone understands there is significant value to resilience provided by indefinite renewables-driven backup power, especially for the most critical loads
  - But, this value-of-resilience (VOR) has yet to be quantified in a straightforward methodology.
  - Hence, VOR is often given no value, leaving a dangerously short-sighted economic gap.
- The Clean Coalition aims to establish a standardized value-of-resilience (VOR) for critical, priority, and discretionary loads that will help everyone understand that premiums are appropriate for indefinite renewables-driven backup power to critical loads and almost constant backup power to priority loads, which yields a configuration that delivers backup power to all loads a lot of the time
- The Clean Coalition's VOR approach standardizes resilience values for three tiers of loads:
  - Tier 1 are mission-critical & life-sustaining loads and warrant 100% resilience. Tier 1 loads usually represent about 10% of the total load with a 3x energy value.
  - Tier 2 are priority loads that should be maintained as long as doing so does not threaten the ability to maintain Tier 1 loads. Tier 2 loads usually represent about 15% of the total load and get a 1.5x energy value.
  - Tier 3 are discretionary loads comprising the remaining loads, usually about 75%. Tier 3 loads possess no extra value and are only maintained when Tier 1 & 2 are secure.

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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/

Load Management is fundamental to VOR123

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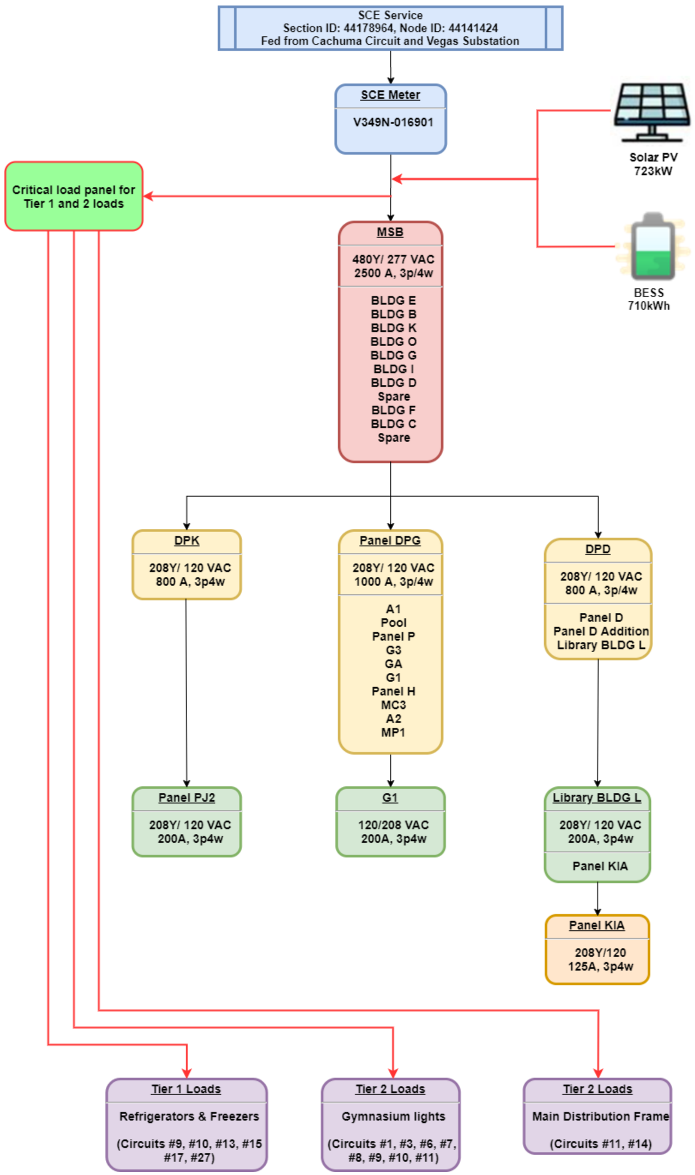
Although there are multiple potential Load Management configurations, the minimal functionality anticipated to be cost-effectively implemented is referred to as **the Critical Load Panel (CLP) approach**.

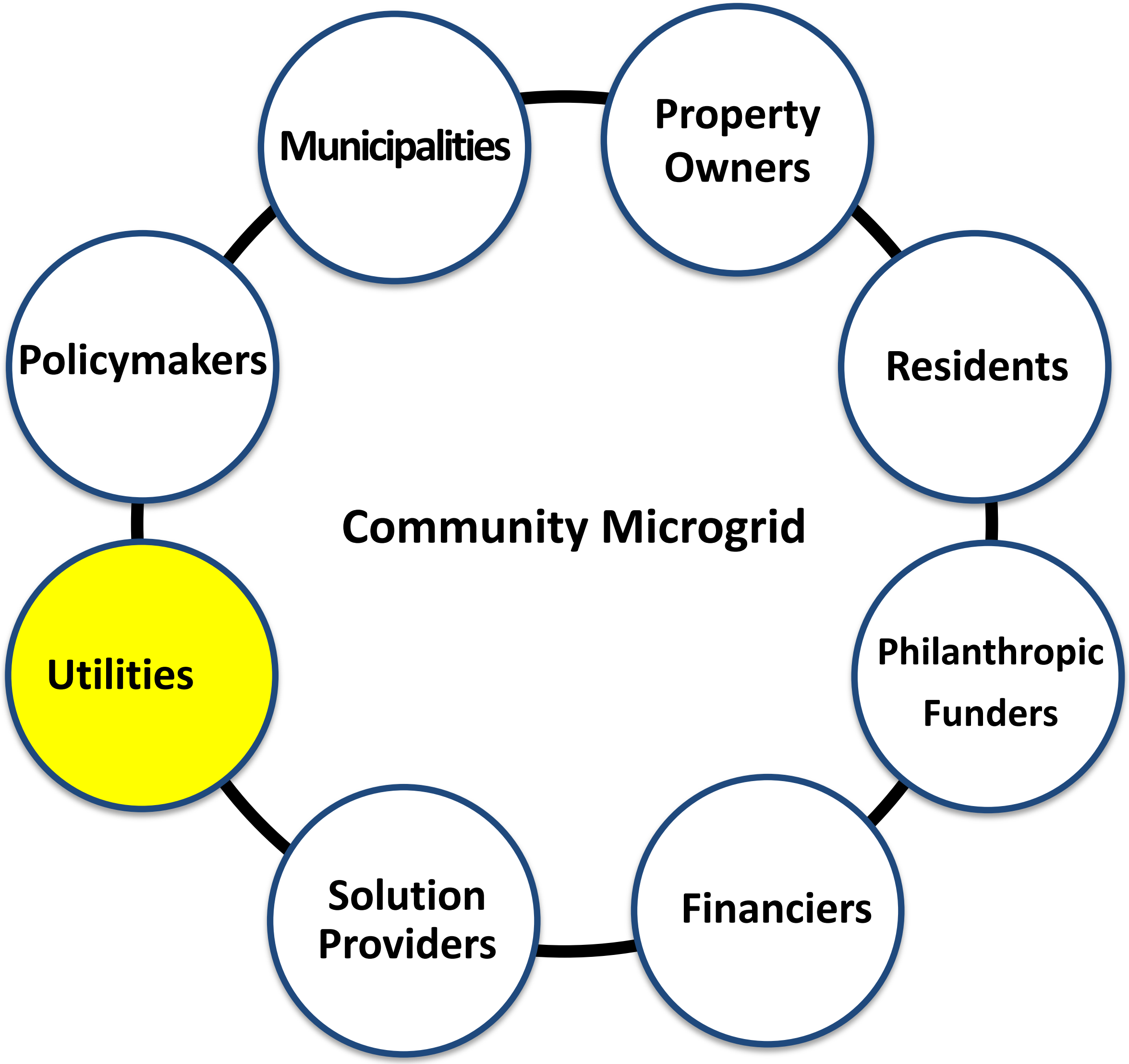
The CLP name reflects the requirement for a smart critical load panel that maintains Tier 1 loads indefinitely and toggles Tier 2 loads. In the CLP approach, Tier 3 loads will be toggled as a group by toggling power to the Main Service Board (MSB). Figure 9 illustrates the CLP approach for SMHS, with Tier 1 and Tier 2 loads being served by new dedicated wire runs that connect to a new smart critical load panel.



Getting things done = aligning stakeholders

Getting things done = aligning stakeholders

Community Microgrid stakeholders



Remember that all stakeholders are human

1. Humans like things to be simple
   - Make sure that objectives & analyses are effectively presented.
2. Most humans are capitalists
   - Economics are fundamental to all stakeholder decisions.
   - With utilities, follow the money.
   - With policymakers, hold them accountable.
3. Success requires multi-pronged action combined with courageous & relentless pursuit
   - Perform comprehensive analyses.
   - Tell the story effectively – which usually means colorfully.
   - Repeat the messaging courageously and ad nauseum.

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Think Vertical for maximizing winter solar

Solar sizing and generation per 1,000 sf by orientation type

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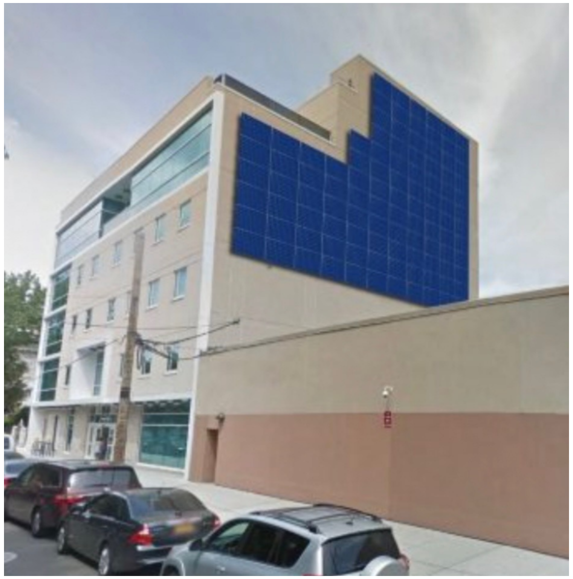
Example Façade (Not as shown in table)



Fixed Tilt South Facing

Fixed Tilt West Facing

BERMUS Solar Generation by Orientation Type for 1,000 SQFT													
	System Size and Annual Generation			Summer and Winter Generation				System Layout Details					
Orientation Type	PV System Size (kWdc)	Annual Generation (kWh)	Annual kWh/kWp	21 June Generation (kWh)	21 June kWh/kWp	21 December Generation (kWh)	21 December (kWh/kWp)	Module Type	Number of Modules	Azumith (Degrees)	Tilt (Degrees)	Row Spacing (Feet)	Panel Orientation	Field Segment Size in Feet (Length x Width)
Façade South Facing	19.20	21,701	1,130	26.89	1.40	4.47	0.23	Q Cells (400W)	48	180	89	0	Portrait	-
Façade West Facing	19.20	18,221	949	27.09	1.41	4.61	0.24	Q Cells (400W)	48	270	89	0	Portrait	-
Fixed Tilt (Rooftop Canopy) South Facing	14.00	23,323	1,666	34.54	2.47	5.92	0.42	Q Cells (400W)	35	180	23	2.4	Portrait	25 x 40
Fixed Tilt (Rooftop Canopy) West Facing	14.40	20,789	1,444	35.04	2.43	6.17	0.43	Q Cells (400W)	36	270	23	1	Portrait	25 x 40

Daily generation by orientation type

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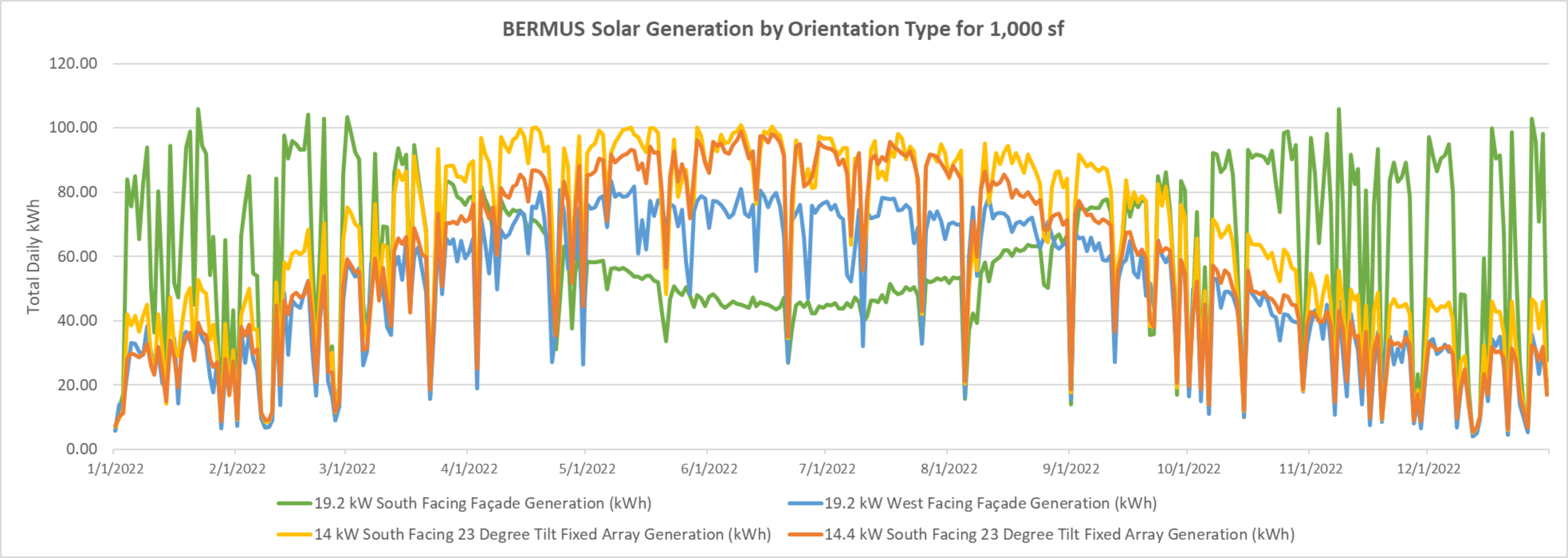
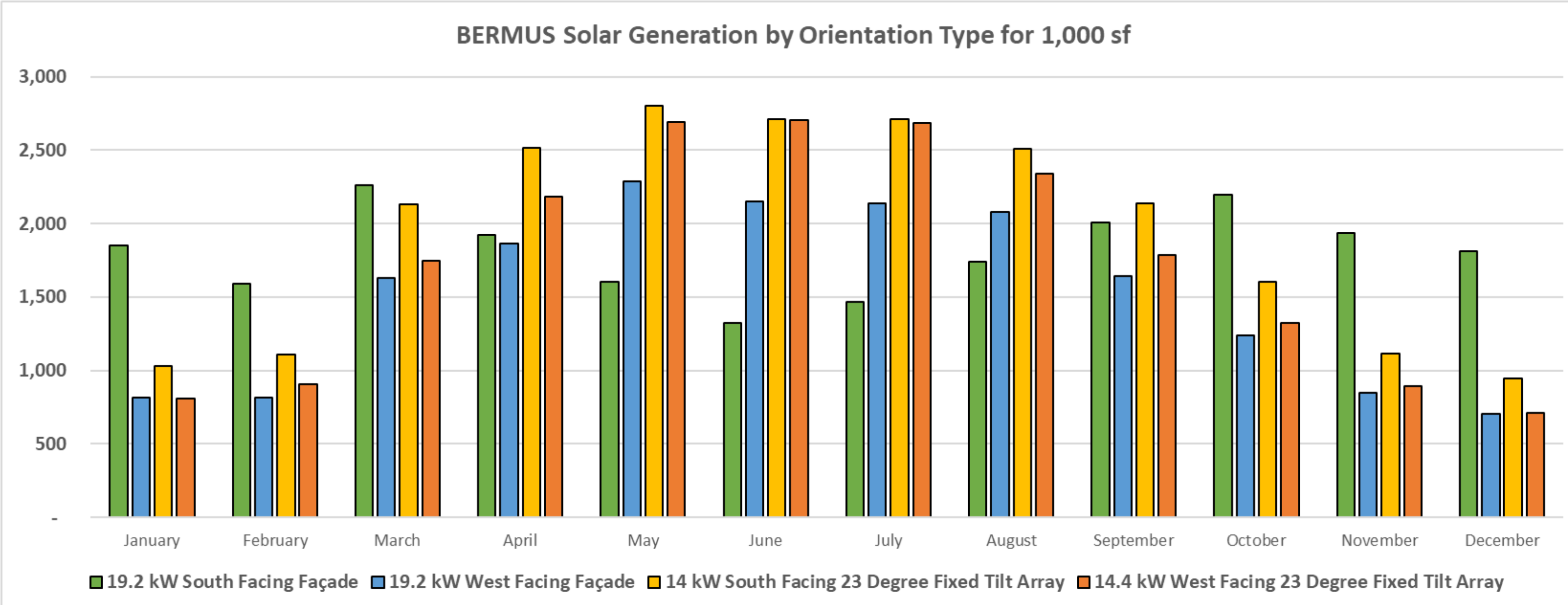


BERMUS - Max and Min Daily Solar Generation by Orientation Type and Date for 1,000 sf					
Time Period		19.2 kW South Facing Façade	19.2 kW West Facing Façade	14 kW South Facing 23 Degree Fixed Tilt Array	14.4 kW West Facing 23 Degree Fixed Tilt Array
Max Daily (kWh)	Annual	106	83	101	99
Max Day		11/8/2022	5/7/2022	6/9/2022	6/9/2022
Min Daily (kWh)		4	4	5	6
Min Day		12/12/2022	12/12/2022	12/12/2022	12/12/2022
Max Daily (kWh)	November - March	105.93	67.41	93.43	73.21
Max Day		11/8/2022	3/24/2022	3/24/2022	3/24/2022
Min Daily (kWh)		4	4	44	6
Min Day		12/12/2022	12/12/2022	12/12/2022	12/12/2022

Monthly generation by orientation type



BERMUS - Total, Max, Average, and Min Daily Solar Generation by Orientation Type and Month for 1,000 sf

Month	19.2 kW South Facing Façade				19.2 kW West Facing Façade				14 kW South Facing 23 Degree Fixed Tilt Array				14.4 kW West Facing 23 Degree Fixed Tilt Array			
	Total Generation (kWh)	Max Daily Generation (kWh)	Average Daily Generation (kWh)	Min Daily Generation (kWh)	Total Generation (kWh)	Max Daily Generation (kWh)	Average Daily Generation (kWh)	Min Daily Generation (kWh)	Total Generation (kWh)	Max Daily Generation (kWh)	Average Daily Generation (kWh)	Min Daily Generation (kWh)	Total Generation (kWh)	Max Daily Generation (kWh)	Average Daily Generation (kWh)	Min Daily Generation (kWh)
January	1,853	106	60	6	816	39	26	6	1,033	53	33	7	812	39	26	7
February	1,594	104	56	7	816	53	28	7	1,112	70	39	9	904	54	32	9
March	2,261	103	73	16	1,632	67	52	16	2,131	93	68	19	1,747	73	56	19
April	1,920	82	65	25	1,867	81	63	19	2,514	100	85	30	2,185	88	74	25
May	1,603	59	52	34	2,290	83	74	48	2,801	100	90	48	2,693	96	87	56
June	1,325	48	44	27	2,150	81	71	27	2,713	101	90	35	2,704	99	90	35
July	1,464	53	47	33	2,141	78	69	32	2,710	98	87	42	2,688	96	87	43
August	1,738	67	56	16	2,078	78	67	16	2,508	95	81	20	2,341	88	76	21
September	2,006	86	66	14	1,642	67	55	15	2,135	92	71	18	1,789	77	60	19
October	2,194	99	71	10	1,238	54	40	10	1,601	71	52	12	1,323	57	43	12
November	1,934	106	65	8	850	46	29	7	1,117	56	38	9	892	43	30	9
December	1,814	103	59	4	706	36	23	4	948	47	31	5	712	33	23	6
Total	21,706	85	60	17	18,226	64	50	17	23,323	81	64	21	20,790	70	57	22

Santa Barbara region is vulnerable to grid outages

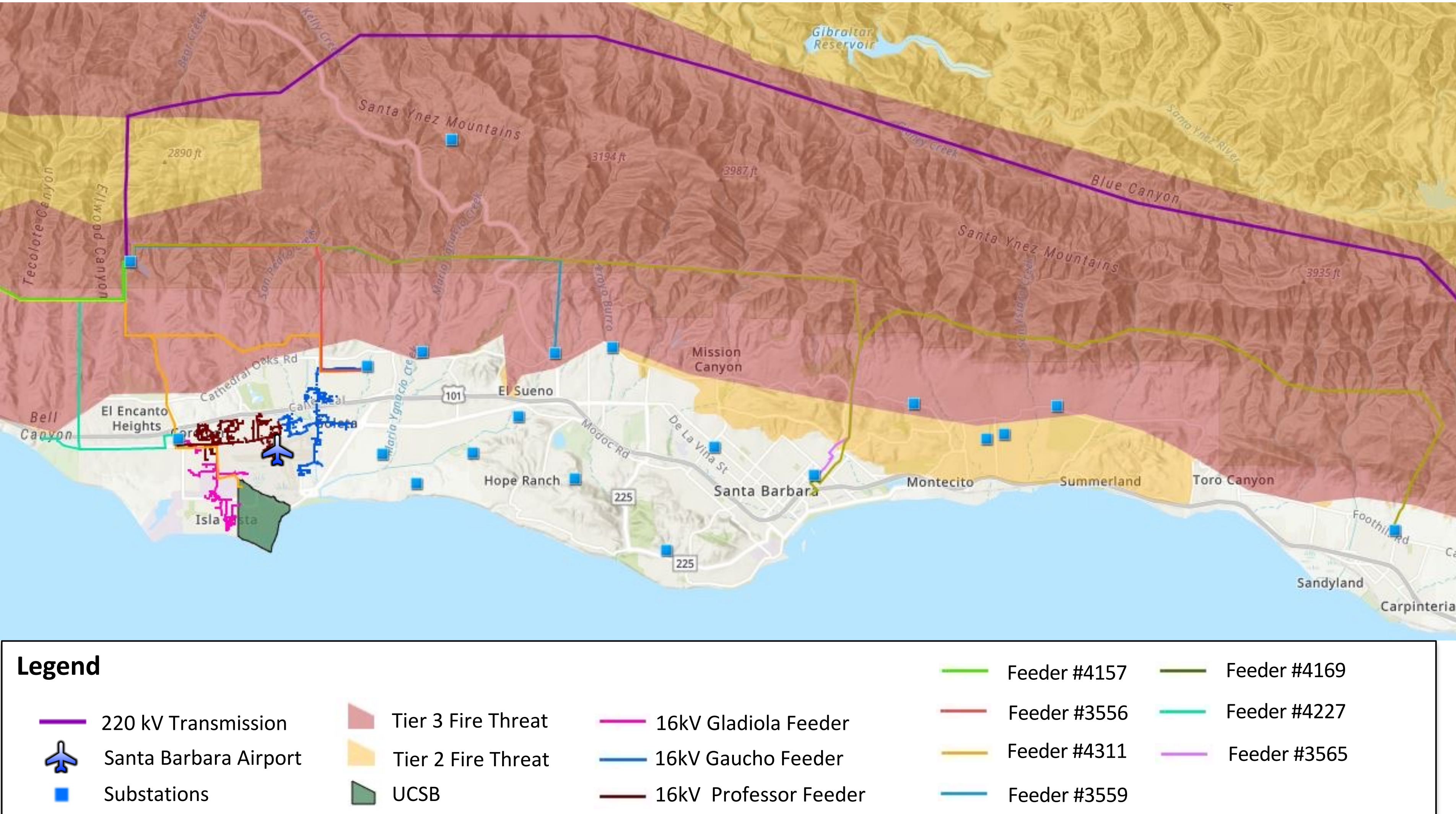
Goleta Load Pocket (GLP)

Clean Coalition

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



Target 66kV feeder serves critical GLP loads

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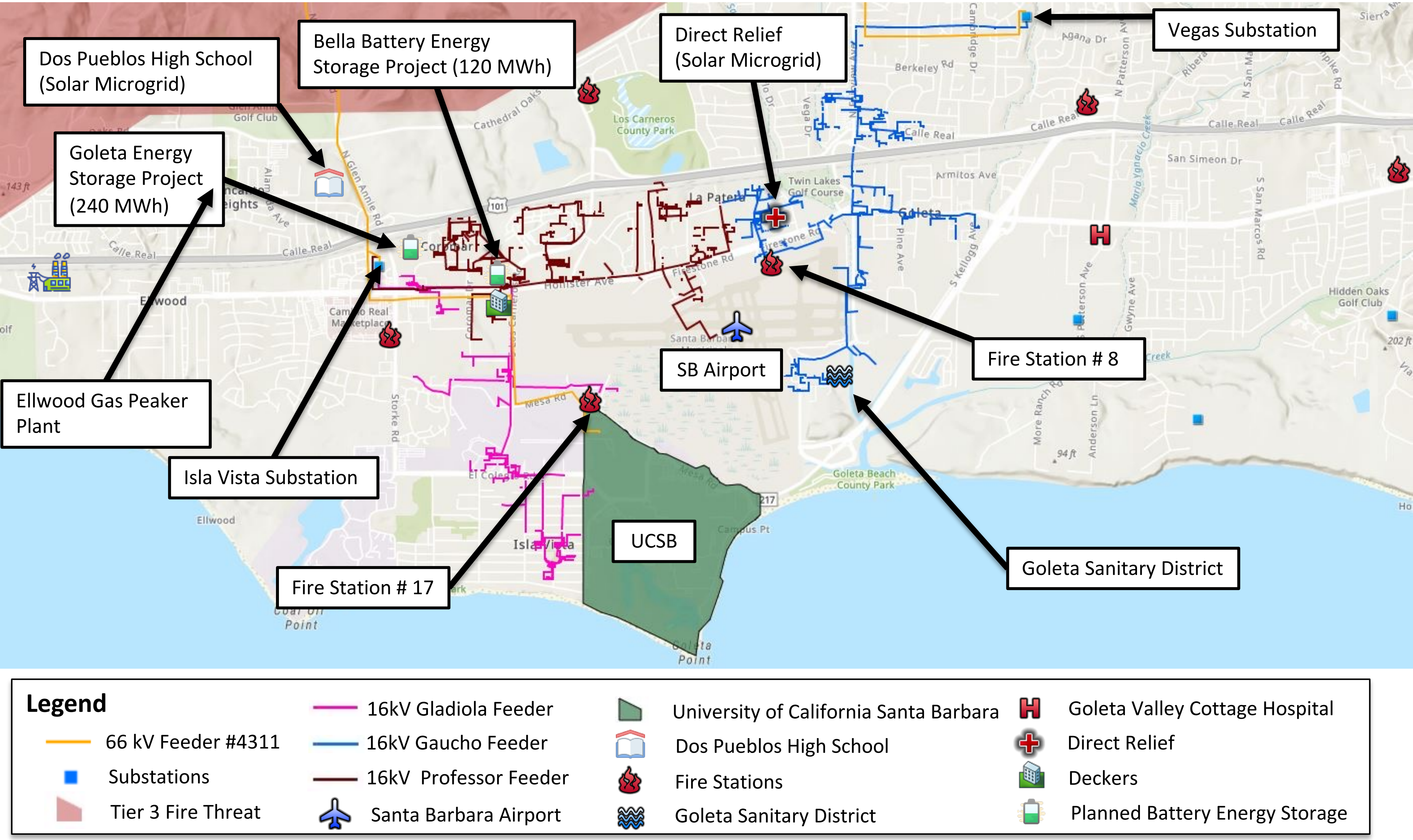
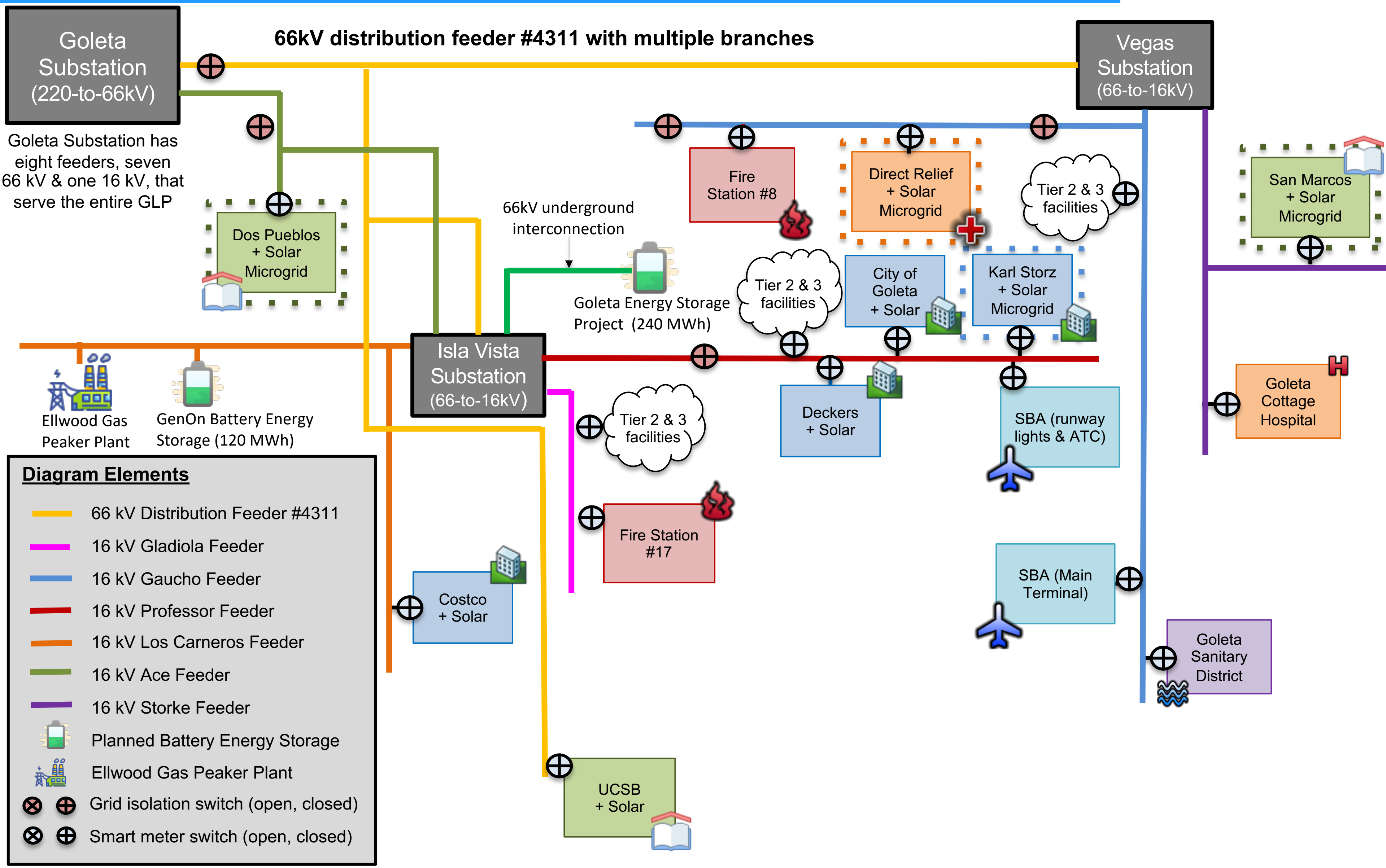


Target 66kV feeder grid area block diagram



Solar Microgrid Methodology

Solar Microgrid Methodology for feasibility studies

Clean Coalition

Step 1

Load Profiles

- Baseline: recent annual loads.
- Master: adds future expected loads, e.g. EV charging.
- Critical: loads required to be maintained during outages.

Industry Tools:

- Clean Coalition: load analysis calculators.
- UtilityAPI: 15-minute load intervals.

Step 2

Resource Scenarios

- Optimal solar, storage, and other potential onsite resources.
- Sizing and combinations to achieve the required critical load and economic outcomes.

Industry Tools:

- Helioscope: solar siting.
- Energy Toolbase: resource sizing.

Step 3

Site Layouts

- Specific locations & sizing for solar, storage, and any other viable resources.
- Location of key electrical assets e.g. panels, etc.
- Energy usage profiles including load profiles.

Industry Tools:

- Clean Coalition: site layout tool.

Step 4

Economic Analysis

- Costs and financing options covering each viable resource scenario.
- Added resilience value.

Industry Tools:

- Energy Toolbase: economic analysis.
- Clean Coalition: resilience calculator (e.g. avoided diesel).

Step 5

Reporting & Recommendations

- Project Review Meetings.
- Reports and Presentations.
- Recommended options & next steps.

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Santa Barbara Unified School District (SBUSD)

Solar Microgrids case study

Santa Barbara Unified School District (SBUSD)

Clean Coalition

- 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

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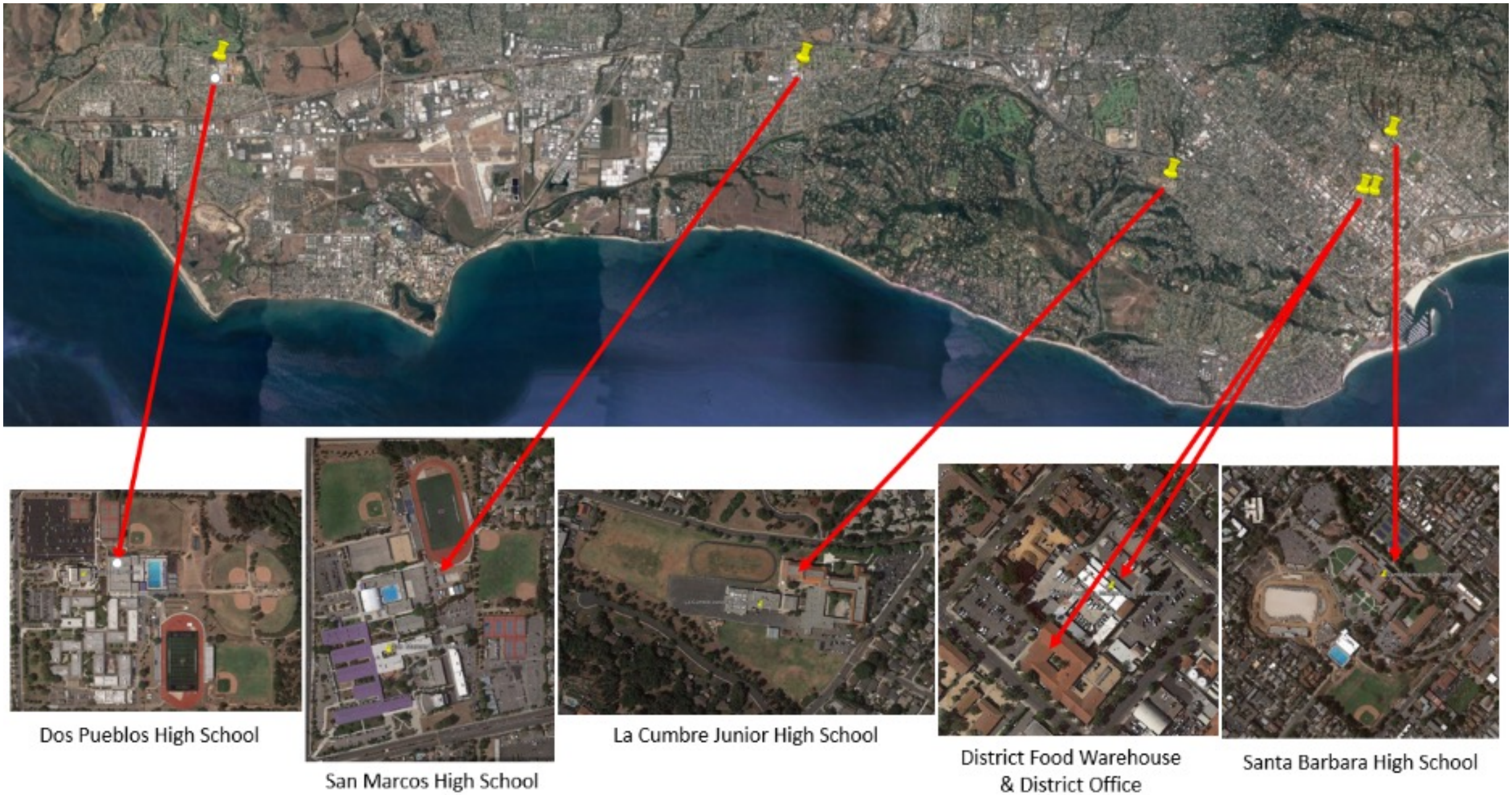
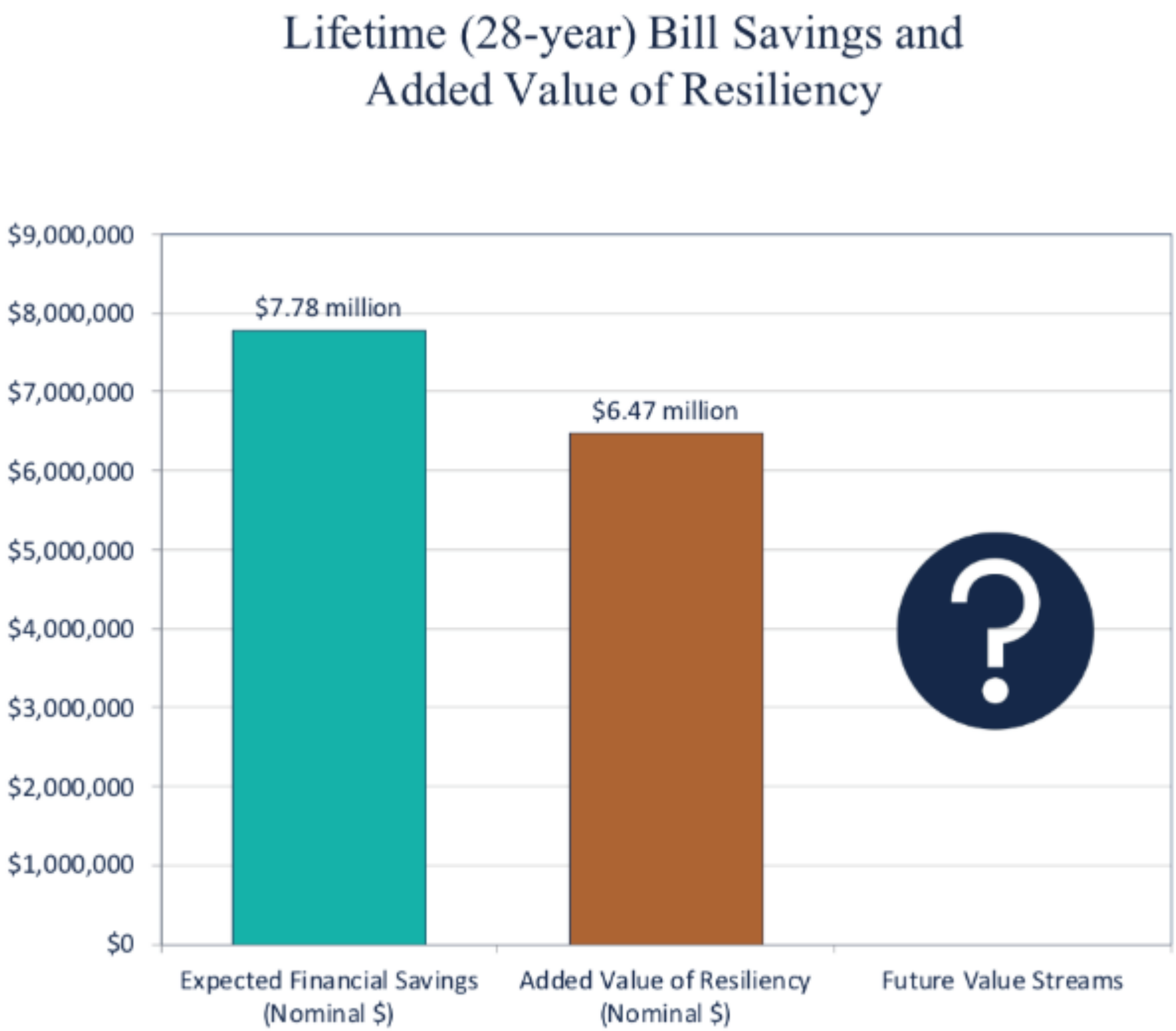


Guaranteed SBUSD bill savings and free VOR



East LA Solar Microgrids case study

East Los Angeles hub of critical community facilities

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County facilities:

1. Health Center
2. Civic Center
3. Library
4. Belvedere Park Lake
5. Sheriff Patrol Station
6. Probation Department
7. Vaccination site
8. Food distribution site

Other noteworthy facilities:

A. Early Childhood Education Center
B. State Superior Courthouse with many county operation within
C. Middle School
D. Health Center

East LA hub

Parking garage
Parking lot/auxiliary services
Civic Center
Edward R. Roybal Health Center
Library

East LA hub in disadvantaged community (89 CES score)

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Overall Percentile

CalEnviroScreen 4.0 Results

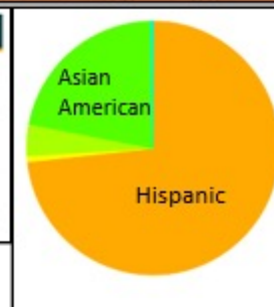
- >90 - 100 (Highest Scores)
- >80 - 90
- >70 - 80
- >60 - 70
- >50 - 60
- >40 - 50
- >30 - 40
- >20 - 30
- >10 - 20
- 0 - 10 (Lowest Scores)

Overall Percentiles	
CalEnviroScreen 4.0 Percentile	89
Pollution Burden Percentile	92
Population Characteristics Percentile	75

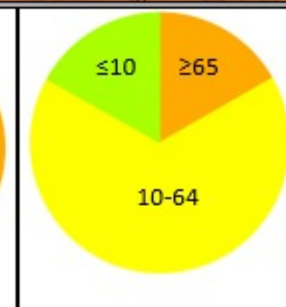
Sensitive Populations	
Asthma	35
Low Birth Weight	98
Cardiovascular Disease	20

Environmental Effects	
Cleanup Sites	50
Groundwater Threats	11
Hazardous Waste	68
Impaired Waters	0
Solid Waste	59

Socioeconomic Factors	
Education	78
Linguistic Isolation	90
Poverty	81
Unemployment	92
Housing Burden	69



Race/Ethnicity Profiles



Age Profiles

Solar siting potential on initial facilities is 2.5 MW

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Edward R. Roybal Health Center – site layout

Edward R. Roybal Health Center

- Address: 245 S. Fetterly Ave.
- Meter: V349N-016268
- Current rate schedule: TOU-8-D (CPA-Clean)
- Suggested new rate schedule: TOU-8-E (CPA-Clean)

Total annual load and peak demand:

- Baseline load profile: 2,637,146 kWh
- Master load profile: 2,714,395 kWh
- Peak demand: 603 kW

Total solar recommended

- 1,268 kWdc

Solar recommended by location:

- R-1: 317 kWdc
- C-1: 154 kWdc
- C-2: 150 kWdc
- C-3: 139 kWdc
- C-4: 46 kWdc
- G-1: 462 kWdc

Solar to NZE:

- Baseline load profile: 1,599 kWdc
- Master load profile: 1,646 kWdc

Battery energy storage recommended:

- 500 kW/ 2,230 kWh

Electric vehicles:

- EV-1: Ten new L2 ports
- Estimated annual load of ten L2 charging ports - 77,249 kWh

Critical loads

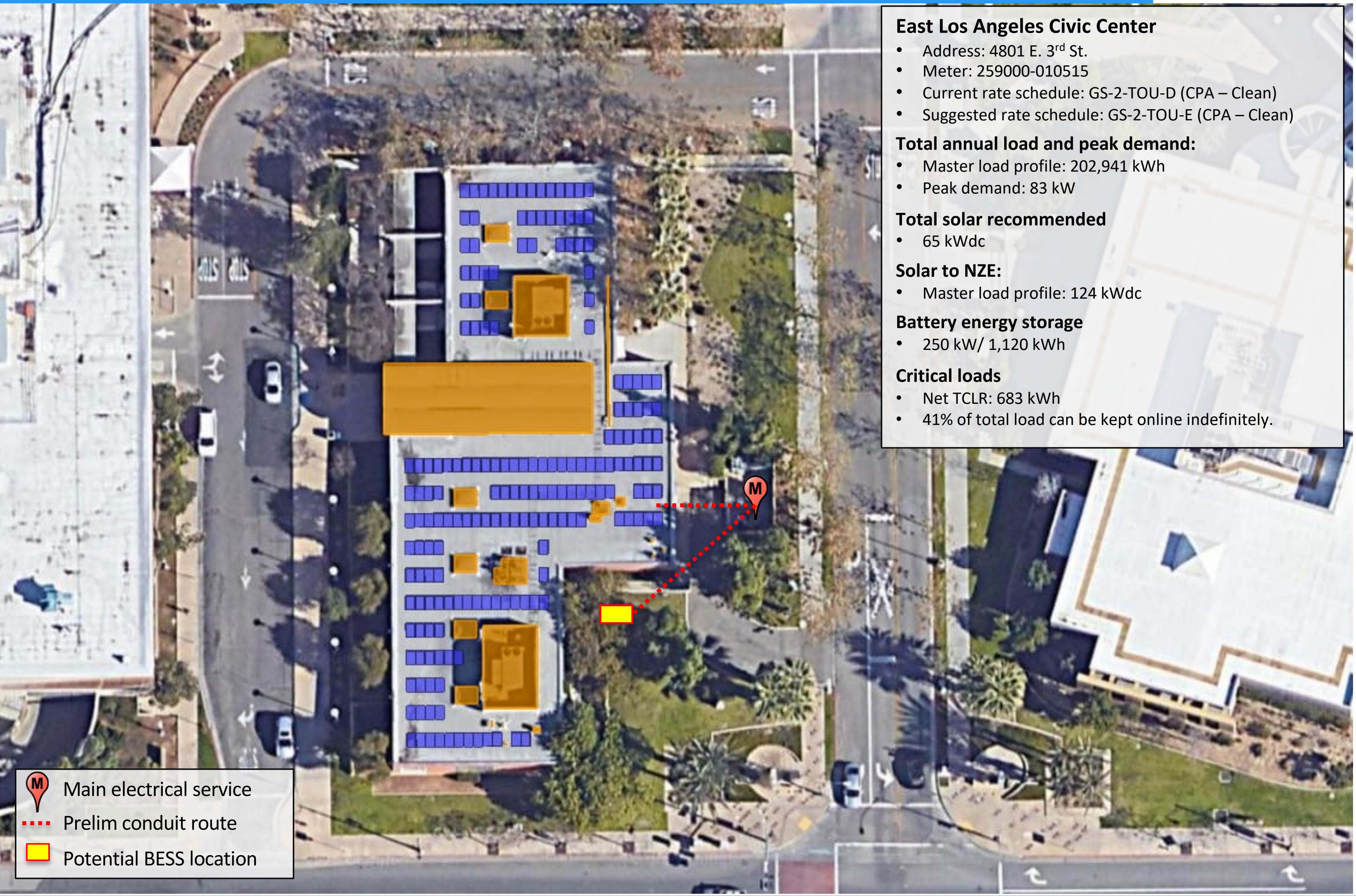
- 20% of total load is critical
- Net TCLR: 4,119 kWh

Notes

- Solar on the parking lot and parking garage will be routed to Health Center meter.

East Los Angeles Civic Center – site layout

Clean Coalition



East Los Angeles Civic Center

- Address: 4801 E. 3rd St.
- Meter: 259000-010515
- Current rate schedule: GS-2-TOU-D (CPA – Clean)
- Suggested rate schedule: GS-2-TOU-E (CPA – Clean)

Total annual load and peak demand:

- Master load profile: 202,941 kWh
- Peak demand: 83 kW

Total solar recommended

- 65 kWdc

Solar to NZE:

- Master load profile: 124 kWdc

Battery energy storage

- 250 kW/ 1,120 kWh

Critical loads

- Net TCLR: 683 kWh
- 41% of total load can be kept online indefinitely.

East Los Angeles Library – site layout

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East Los Angeles Library

- Address: 4837 E. 3rd St.
- Meter: 259000-010517
- Current rate schedule: GS-2-TOU-D (CPA – Clean)
- Suggested rate schedule: GS-2-TOU-E (CPA – Clean)

Total annual load and peak demand:

- Master load profile: 403,627 kWh
- Peak demand: 117 kW

Total solar recommended

- 117 kWdc

Solar to NZE:

- Master load profile: 245 kWdc

Battery energy storage

- 300 kW/ 1,670 kWh

Critical loads

- Net TCLR: 1,207 kWh
- 37% of total load can be kept online indefinitely in Year 1.

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Retirement community case study

Overview of The Forum in Cupertino, CA

- The Forum is a 350-unit retirement community in Cupertino California that is staged for 92 Solar Microgrids, which will be deployed in coordination with a major re-roofing project:
  - There will be 9 commercial-scale Solar Microgrids, each interconnected behind a single commercial meter serving the Community Building and the five apartment-style buildings (Buildings 1-5) that will be re-roofed.
  - Additionally, there will be 83 residential-scale Solar Microgrids, each attached to an individually metered residential Villa that is essentially a single-family residence sited along the property perimeter. There are two vintages of Villas, 60 Originals and 23 New.
  - Total estimated solar is just over **1.25 MWdc** and the total estimated energy storage is just over **2.85 MWh**.
  - Installations of the solar should be anticipated in two Phases: 1) rooftop solar of 1,038 kW and storage of 2,862 kWh, and 2) addition of 223 kW solar parking canopies (no added storage).

- A roofing company has been selected and the selected EPC needs to be tightly coordinated with the re-roofing process.
- The Forum plans to pay the roofing costs directly, but a **a single master PPA** is desired across all **92 Solar Microgrids**, which incorporate 100% of the solar & storage being specified.

Full view of The Forum site

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Electrical room locations & number of meters in each

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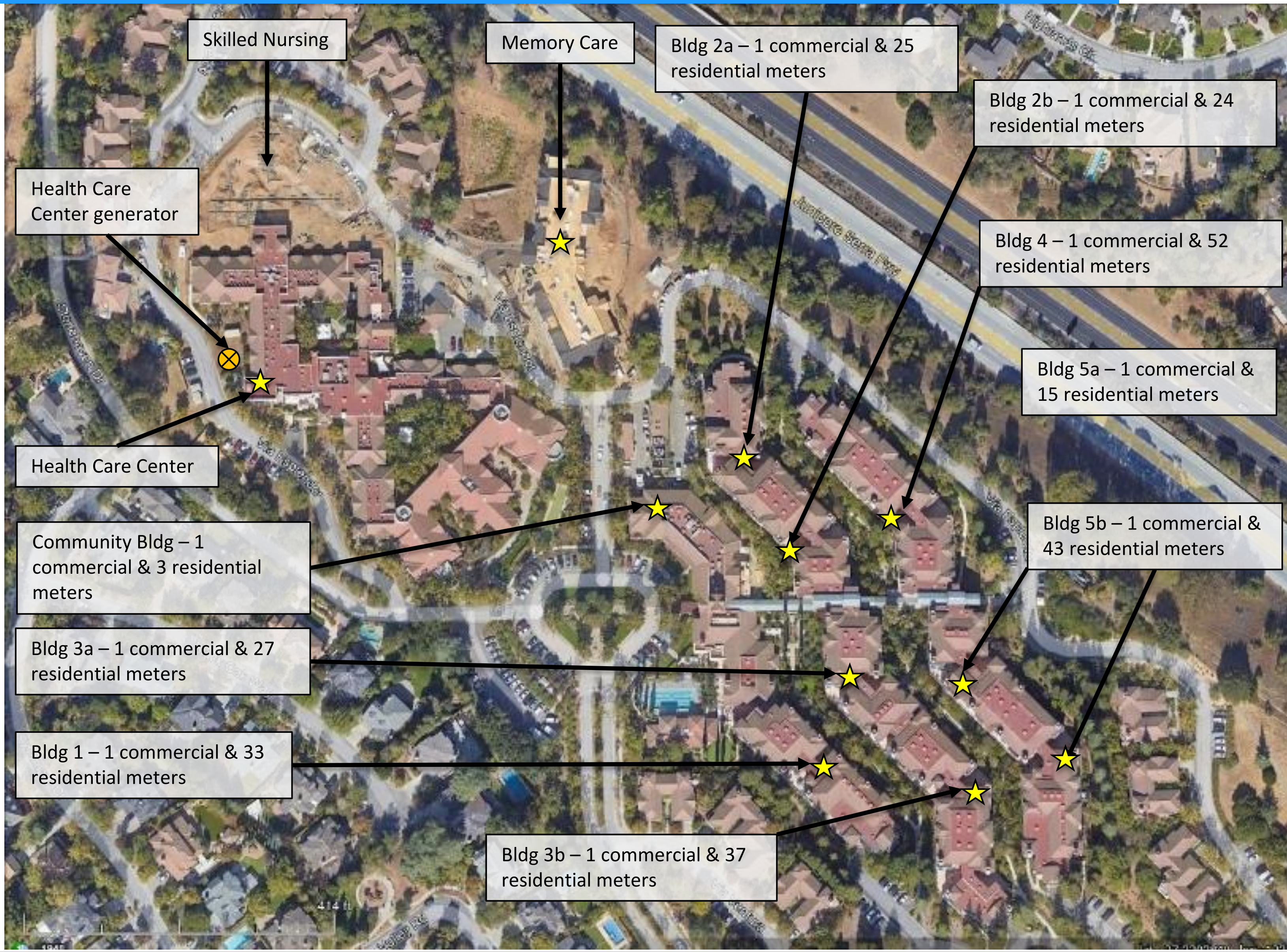

Typical electrical room meter layout: Building 3a with 1 commercial meter (left) and an array of 27 residential meters (right)

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Solar & storage sizing across all targeted meters

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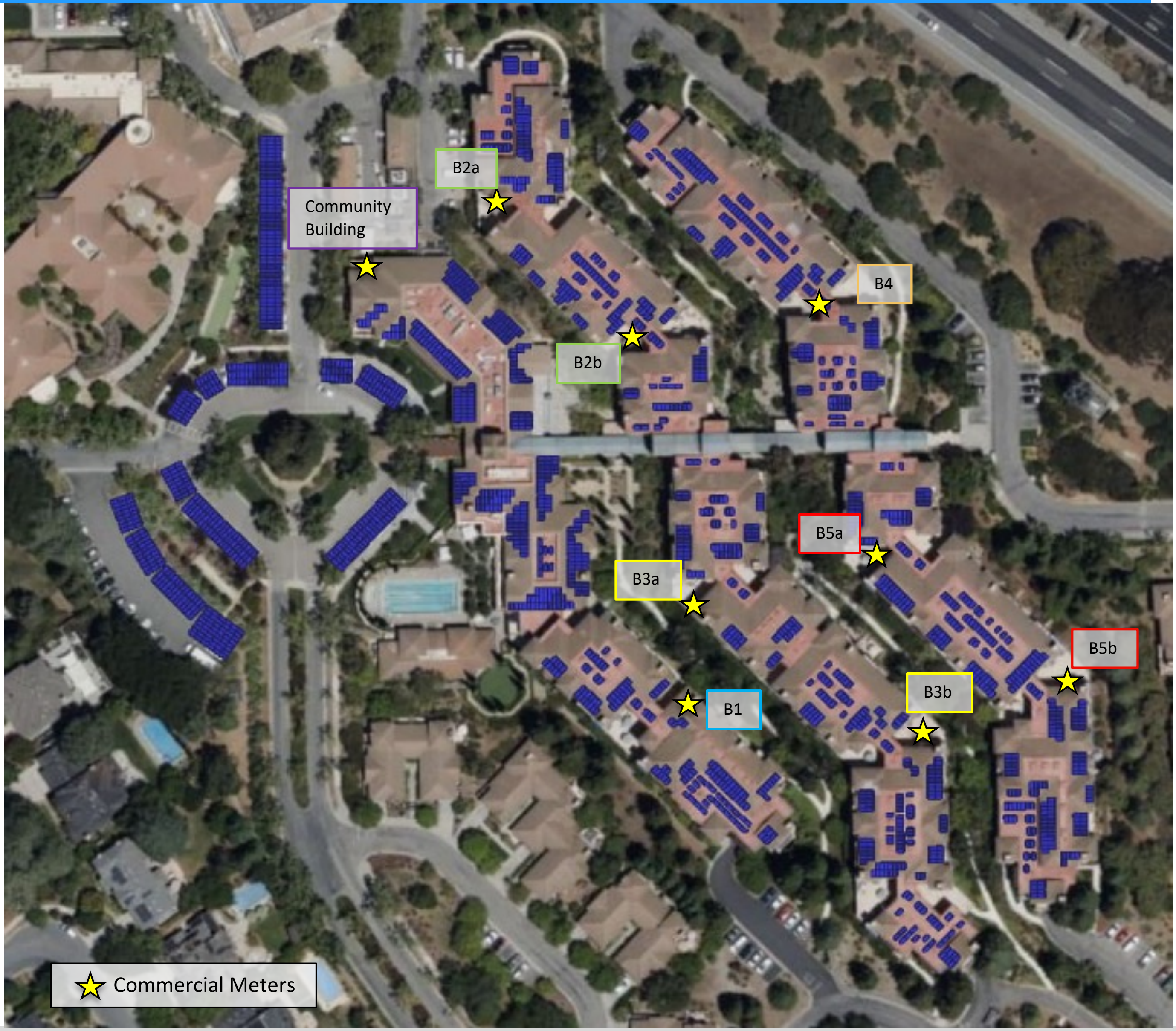
The Forum - Solar and Storage Sizing for Community Building & Buildings 1-5 Commercial Meters and Original & New Villas							
		Solar System Sizes by Facility and System Type		Solar Generation by Facility and System Type		Battery Energy Storage System Sizes by Facility	
Facility	Total Annual Load of Commercial Meters with Forecasted Additional EV Load, NZE Goal (kWh)	Rooftop Solar System Size (kW)	Solar Parking Canopy System Size (kW)	Total Solar Generation from Rooftop Solar (kWh)	Total Solar Generation from Rooftop and Parking Canopy Solar (kWh)	Battery Power Capacity (kW)	Battery Energy Capacity (kWh)
Community Building (One Commercial Meter)	1,358,552	135	223	198,000	550,100	300	1,120
Building 1 (One Commercial Meter)	71,155	48	-	71,600	71,600	25	66.0
Building 2 (Two Commercial Meters)	117,804	78	-	124,700	124,700	40	105.6
Building 3 (Two Commercial Meters)	190,442	131	-	195,800	195,800	75	198.0
Building 4 (One Commercial Meter)	79,300	64	-	100,200	100,200	25	66.0
Building 5 (Two Commercial Meters)	171,053	117	-	175,500	175,500	80	211.2
Original Villas (60 Residential Meters)	359,564	336	-	485,400	485,400	300	792.0
New Villas (23 Residential Meters)	137,833	129	-	186,070	186,070	115	303.6
Total	2,485,703	1,038	223	1,537,270	1,889,370	960	2,862

- **Total estimated solar of 1,261 kW** is anticipated to deploy over two Phases, starting with 1,038 kW on rooftops and following with 223 kW on added solar parking canopies.
- The **average estimated solar per Villa is 5.6 kW**, achieving an estimated 135% of Net Zero at each based on approximated average existing loads. The oversizing prepares for significantly increased loads from expected shifts to Electric Vehicles (EVs) and other electrification measures like heat pumps, electric dryers, and induction cooktops.
- All 223 kW of solar parking canopies is anticipated to be added to the Solar Microgrid serving the Community Building and raise the expected Net Zero achievement on the Community Building from 15% to 40%.
- All of the **estimated 2,862 kWh of storage** is anticipated to deploy in Phase 1, along with the rooftop solar.

Rooftop solar & solar parking canopies serving Community Building and Buildings 1-5



Battery sizing and resilience for Community Building

Clean Coalition

Tesla Megapack

The Forum Phase 1(a) & 3: Community Building with Rooftop Solar & Solar Parking Canopies, Optimal Battery Energy Storage Sizing and Resilience					
Building Associated with Commercial Meter	Peak Demand (kW)	Optimal Battery Energy Storage System Size		Indefinite Resilience	
		Battery Power Capacity (kW)	Battery Energy Capacity (kWh)	Total Percentage of Load Kept Online Indefinitely - Year 1	Total Percentage of Load Kept Online Indefinitely - Year 15
Community Building with Rooftop Solar & Solar Parking Canopies	307	300	1,120	17%	14%

- All battery sizes are configured for TOU arbitrage & demand charge management.
- Optimal battery sizes are based on resilience benefits. In order to cover all loads during an outage, a battery’s power capacity needs to be at or above a meter’s peak demand.

Battery sizing and resilience for Buildings 1-5

Clean Coalition

The Forum Phase 1(a): Building 1-5, Optimal Battery Energy Storage Sizing and Resilience					
Building Associated with Commercial Meter	Peak Demand (kW)	Optimal Battery Energy Storage System Size		Indefinite Resilience	
		Battery Power Capacity (kW)	Battery Energy Capacity (kWh)	Total Percentage of Load Kept Online Indefinitely - Year 1	Total Percentage of Load Kept Online Indefinitely - Year 15
Building 1	17	25	66	23%	18%
Building 2a	14	20	52.8	27%	20%
Building 2b	19	20	52.8	24%	22%
Building 3a	26	35	92.4	18%	14%
Building 3b	14	40	105.6	33%	28%
Building 4	18	25	66	28%	24%
Building 5a	16	40	105.6	29%	22%
Building 5b	27	40	105.6	29%	22%
Total	19	245	646.8	26%	21%

- Except for the Community Building, all battery storage sizes are based on some multiple of Tesla Powerwalls with each Powerwall having a power capacity of 5 kW and energy capacity of 13.2 kWh.
- All battery sizes are configured for TOU arbitrage & demand charge management.
- Optimal battery sizes are based on resilience benefits. In order to cover all loads during an outage, a battery's power capacity needs to be at or above a meter's peak demand.

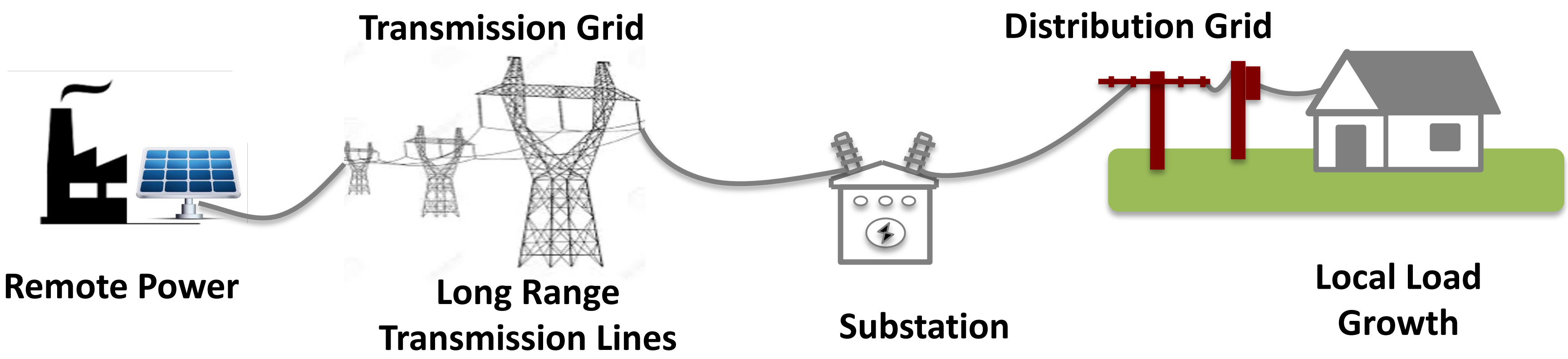
Policy innovations needed

Policy innovations needed

Existing barriers preventing the widespread deployment of Microgrids

Clean Coalition

The electric grid was designed with 20th century principles about a grid with a one-way flow of energy. Remotely-generated energy is transmitted across long distance transmission lines and delivered to end users located in load centers (on the distribution grid).



- **Unique/Complicated Configurations:** Microgrids, particularly Community Microgrids are complicated since they require generation, storage, and software to control and optimize the resources for use in real time and for resilience in the event of a grid outage.
- **Rule 218(b), called the "Over-the-fence" rule:** Any entity that transmits energy to more than one facility and/or uses the distribution grid must register as an electrical corporation (making them subject to the same requirements as the large Investor-Owned Utilities).
- **Lack of a standard value of resilience:** One of the biggest benefits a microgrid provides is resilience. Without a standard methodology to value resilience, it is difficult to deploy a microgrid without multiple sources of funding.
- **Lack of Value Stacking:** Microgrids provide a range of benefits (economic, environmental, and resilience) where they are deployed, including on the facility level, for the community, and the broader grid. Ensuring that markets and off-takers exist is key to commercializing the technology.
  - The grid does not fully value the benefits of distributed energy resources, making it difficult to value stack and create multiple bankable revenue streams for a single resource.
- **Interconnection:** A lack of streamlined interconnection procedures for distributed energy resources and microgrids makes deploying a microgrid a significant time investment.

Multi-family housing needs Master Metering

- Currently, master metering is prohibited in multi-family housing, including apartment buildings.
- This blocks opportunities for resilience, because existing Virtual Net Energy Metering (VNEM) programs, including SOMAH, require solar to be interconnected front-of-meter (FOM).
- While it is technically possible to install a behind-the-meter (BTM) microgrid at every residential meter, it is not practical due to overwhelming costs & space requirements associated with such slicing.
- What is needed is a "master meter" that serves the entire community and has a single utility meter.
- The utilities were able to make Master Metering illegal in the early 2000s, prior to the opportunities presented by renewables-driven microgrids.
- A legislative solution is needed to allow master metering for microgrid deployments and clarify how the utilities should treat mixed-use developments.

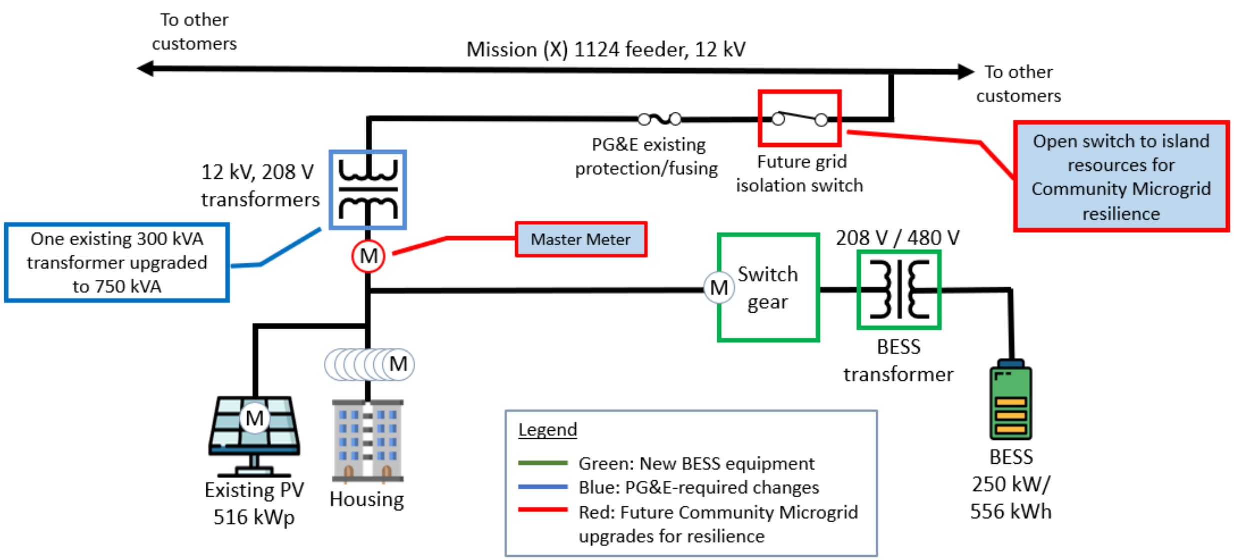
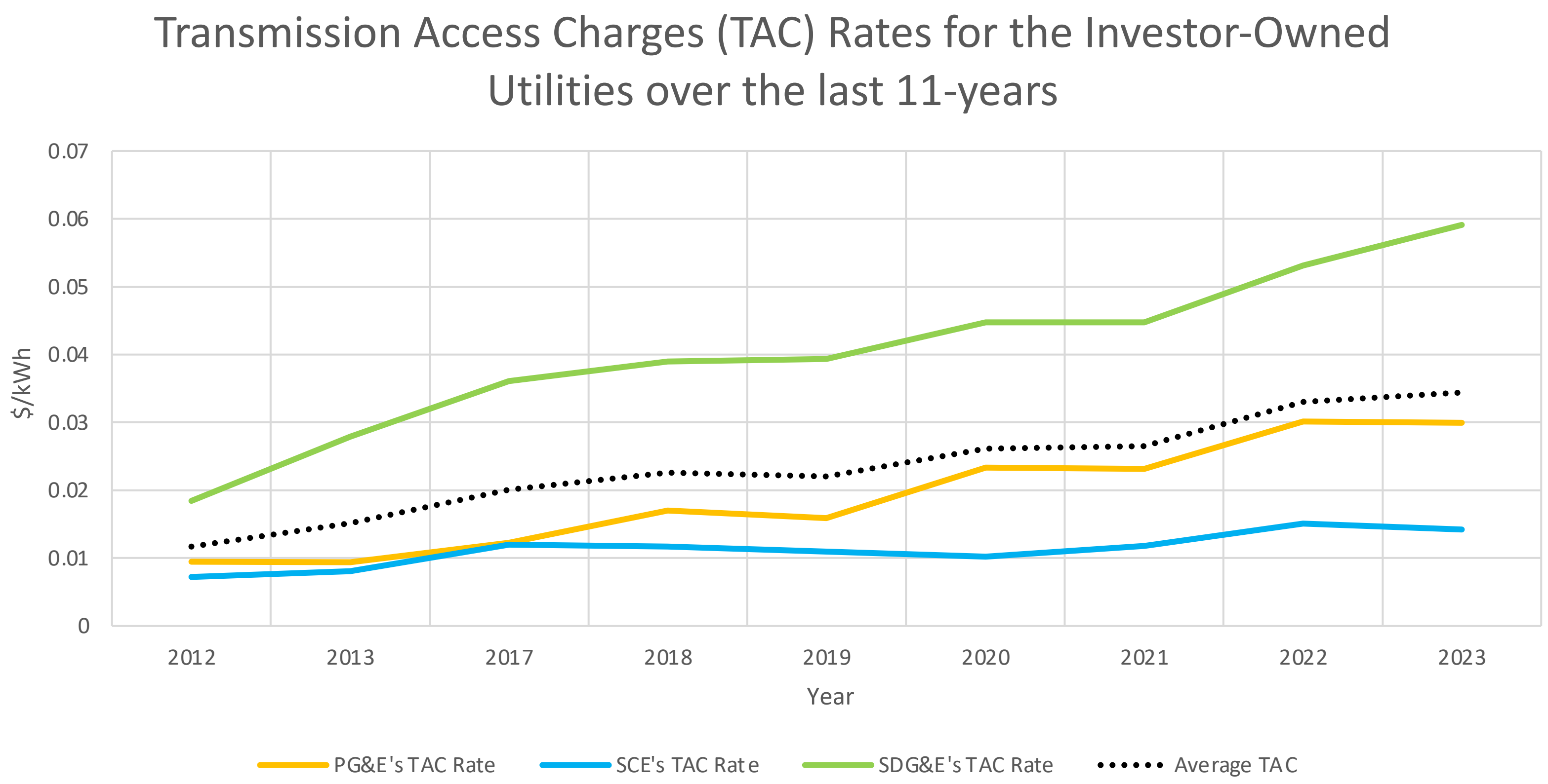


Diagram of the Valencia Gardens Energy Storage (VGES) project provisioned for resilience

Transmission costs are driving up electric rates

Clean Coalition

- Transmission costs are the number one driver of increasing electric rates.
- Other drivers include grid hardening costs for Wildfire Mitigation (including more transmission costs) and wildfire insurance/criminal liability payouts for fires caused by utility infrastructure.
- The graph below shows the increase in Transmission Access Charges, which recover historical transmission costs. TAC **does not** include current spending or projected spending.
- As a reference, the most recent Transmission Planning Process estimated that $30 billion in investments will be needed over the next 20 years, which will result in astronomically high TAC costs.



Transmission costs higher than they seem due to O&M driving ~10x increase to upfront costs

Clean Coalition

- Capital costs of transmission infrastructure represent a fraction of total transmission costs.
- Operations and maintenance (O&M) and ROE drive up transmission costs significantly over asset lifetime, with those excessive costs borne by ratepayers.

Nominal costs

Asset value capital cost ($100 base)	$100
Return	$197
O&M	$631
Total nominal ratepayer cost per $100 investment (50 years)	**$928**

Real costs, discounted for inflation

Discount rate	2.19%
Asset value capital cost ($100 base)	$100
Return, discounted	$140
O&M, discounted	$296
Total discounted (real) ratepayer cost per $100 investment (50 years)	**$536**

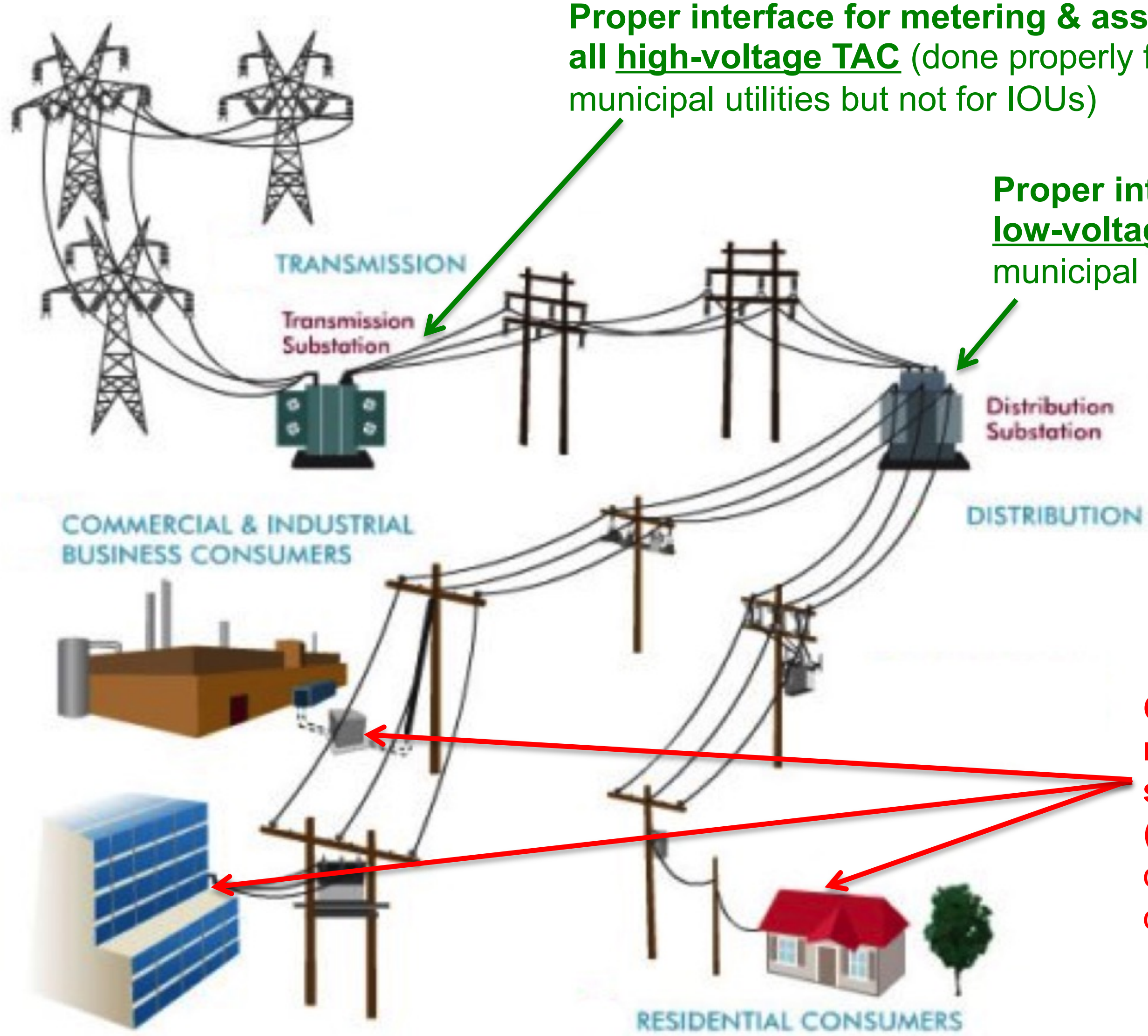
In nominal dollars, total lifetime ratepayer cost is nearly 10x the initial capital cost; O&M accounts for 68% of this because it increases much faster than inflation. In real dollars (constant value dollars, accounting for inflation), the total lifetime cost is 5x the initial capital cost, and O&M accounts for 55% of this.

TAC cause massive market distortions — the real cost shift happening in California

Clean Coalition

Proper interface for metering & assessing all <u>high-voltage TAC</u> (done properly for municipal utilities but not for IOUs)

Proper interface for metering all <u>low-voltage TAC</u> (done properly for municipal utilities but not for IOUs)



Current interface for metering TAC in IOU service territories
(at customer meters, with no distinction of energy from next door vs 1,000 miles away)