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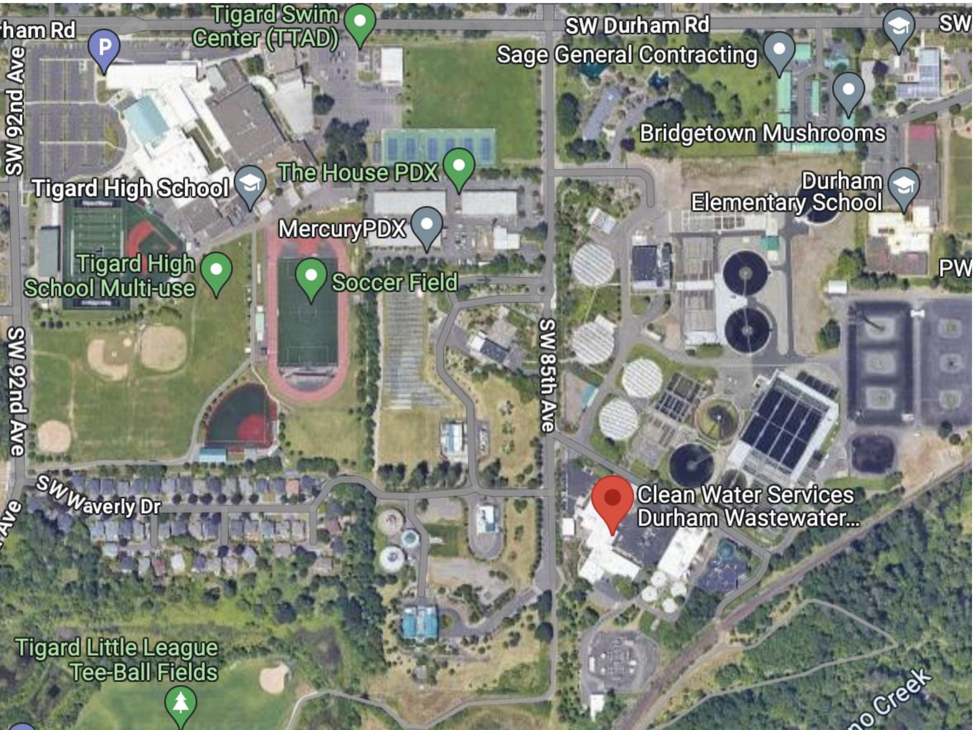
Assessing the Feasibility of Renewables-driven Microgrids and determining the Value-of-Resilience



Facility tiers

Load tiers

	Tier 1 facility	Tier 2 facility	Tier 3 facility
Tier 1 load			
Tier 2 load			
Tier 3 load			

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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.

Benefits of a Solar Microgrid

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- Economic
  - Provides electricity costs savings compared to buying electricity from the utility.
  - Provides value-of-resilience (VOR) compared to implementing & operating a fossil-fueled generator.
  - Provides a fixed cost of electricity compared to rapidly rising utility costs.
- Environmental
  - Provides solar electricity, a pure renewable energy resource.
  - Optimizes grid citizenship by reducing peak usage of the grid when it is most stressed, during the peak periods, which throughout California are currently 4-9pm.
  - Eliminates energy losses associated with traversing transmission & distribution grids. Losses are due to resistance and congestion, both of which are generally exacerbated by distance. Typically, 15% of remotely generated energy is lost.
  - Reduces the environmental impact of central generation, which typically consumes open space for the generation & transmission assets.
- Resilience
  - Provides 100% ride-through during grid outages of limited durations. Any ride-through duration can be accommodated with cost being correlated to duration.
  - Provides optionality for indefinite resilience for at least the most critical loads, again with cost being correlated to the percentage of load being served with 100% resilience.
  - Accommodates optional fossil generation as an emergency backup resource that can be minimized.

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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Preparing for a Renewables-driven Microgrid

Preparing for Renewables-driven Microgrid success

1. Prioritize basic goals
   - Resilience (Tiering loads: critical, priority, and discretionary).
   - Environmental (Net Zero Energy, emissions, electric vehicles, etc).
   - Economic (energy costs, community economic stimulation, etc).
   - Education (curriculum, workforce preparation, practical skills, etc).

2. Answer key questions beyond the basic goals
   - What forms of renewables are available?
   - Which buildings, parking lots, and/or ponds are available for solar siting?
   - Are there anticipated changes to the load, incuding from new Electric Vehicle Charging Infrastructure (EVCI)?
   - Is third-party ownership desired to eliminate capital costs, optimize tax benefits, and to limit obligations & risks – and to simply pay for <u>delivered energy</u>?
   - What is the timing of planning & construction phases?
   - Are sufficiently skilled resources (staff, consultants, and/or contractors) in place for the Feasibility Study, Request for Proposals (RFP), contracting, construction management, and Monitoring & Verification (M&V)?
   - Can the Clean Coalition help?

3. Get started – set the next few steps & assignments and execute!!!

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Solar Microgrid Methodology

Solar Microgrid Methodology for feasibility studies

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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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Determining the Value-of-Resilience (VOR)

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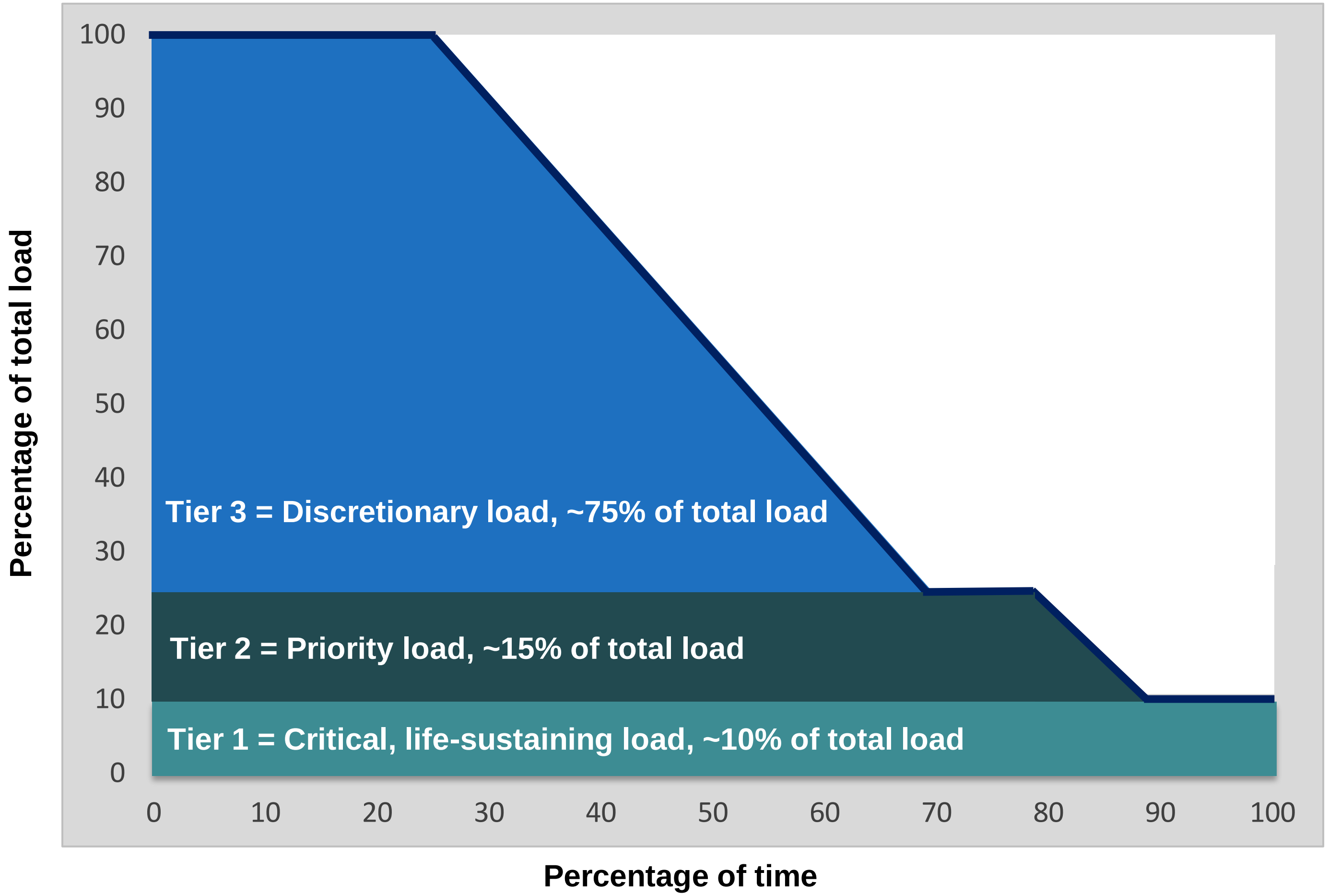
VOR123

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/

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

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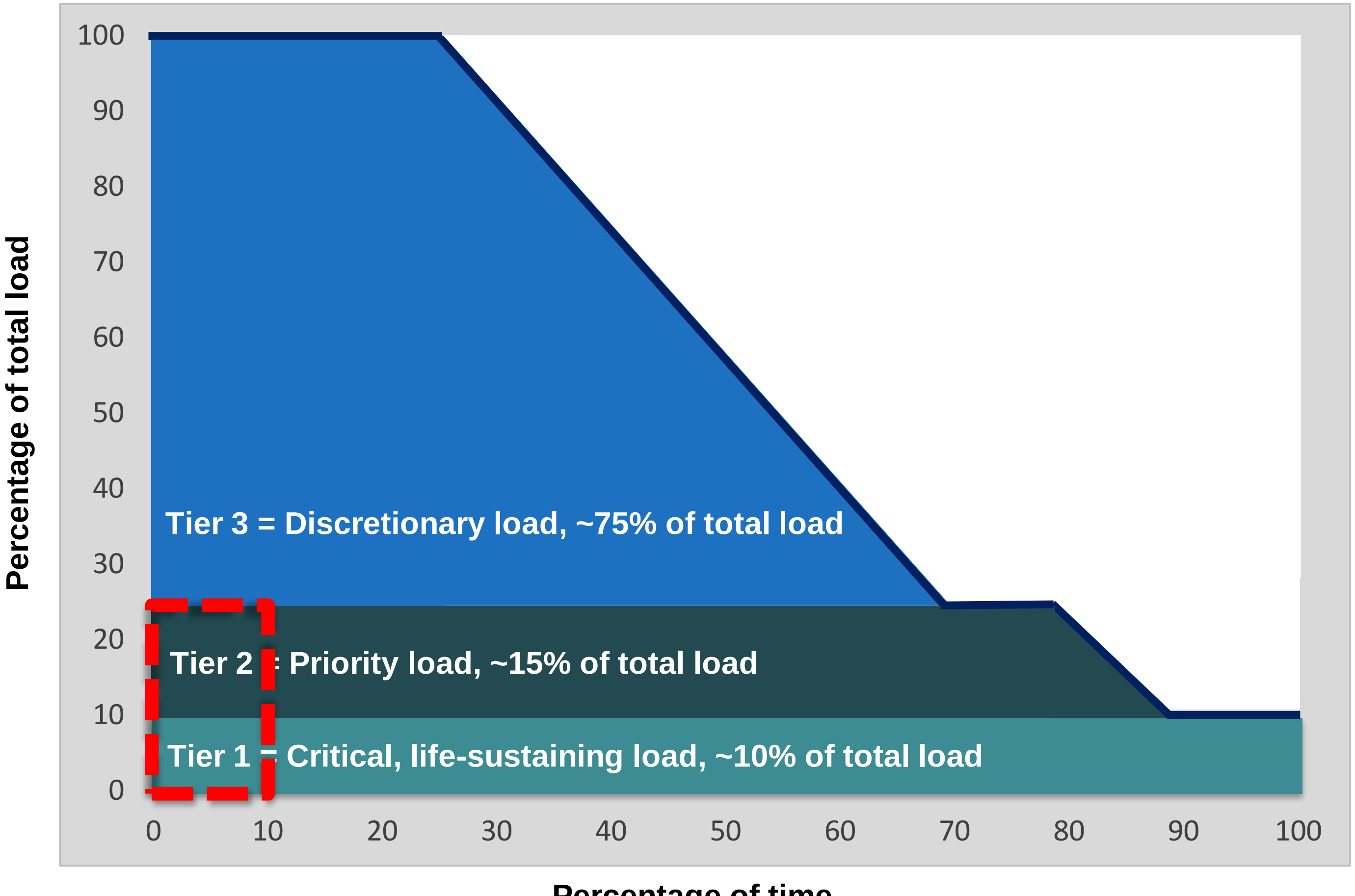


A typical diesel generator is configured to maintain 25% of the normal load for two days. If diesel fuel cannot be resupplied within two days, goodbye. This is hardly a solution for increasingly necessary long-term resilience. In California, Solar Microgrids provide a vastly superior trifecta of economic,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

VOR123 methodology yields a 25% typical adder

There are different VOR multipliers for each of the three load tiers. The following valuation ranges are typical for most sites:

- **Tier 1**: 100% resilience is worth 3 times the average price paid for electricity. In other words, indefinite energy resilience for critical loads is worth 3 times the average price paid for electricity. Given that the typical facility has a Tier 1 load that is about 10% of the total load, applying the 3x VOR Tier 1 multiplier warrants a 20% adder to the electricity bill.
- **Tier 2**: 80% resilience is worth 1.5 times the normal price paid for electricity. In other words, energy resilience that is provisioned at least 80% of the time for priority loads is worth 1.5 times the average price paid for electricity. Given that the typical facility has a Tier 2 load that is about 15% of the total load, applying the 1.5x VOR Tier 2 multiplier warrants a 7.5% adder to the electricity bill.
- **Tier 3**: Although a standard-size Solar Microgrid can provide backup power to Tier 3 loads a substantial percentage of the time, Tier 3 loads are by definition discretionary, and therefore, a Tier 3 VOR multiplier is negligible and assumed to be zero.

Taken together, the Tier 1 and Tier 2 premiums for a standard load tiering situation yields an effective VOR of between 25% and 30%. Hence, the **Clean Coalition uses 25% as the typical VOR123 adder that a site should be willing to pay**, including for indefinite renewables-driven backup power to critical loads — along with renewables-driven backup for the rest of the loads for significant percentages of time.

Validating VOR123 – four confirming approaches

Clean Coalition

Importantly, the Clean Coalition has resolved on the general 25% premium figure after conducting numerous analytical approaches, including the following three primary methodologies:

1. **Cost-of-service (COS):** This is the cost that suppliers will charge in order to offer the Solar Microgrid VOR across the Tier 1, 2, and 3 loads (VOR123). As evidenced by a case study of the Santa Barbara Unified School District (SBUSD), a COS that reflects a 25% resilience adder is sufficient to attract economically viable Solar Microgrids even the small school sites – larger sites yield pure bill savings.

2. **Department of Energy (DOE) Multiplier**: The DOE researched VOR and determined that the overall value of critical load that is missed due to grid outages over an annual period is $117/kWh. While the Clean Coalition stages Solar Microgrids to provide indefinite solar-driven backup power to critical loads, and considers 30 consecutive days to be a proxy for indefinite, the Clean Coalition assumed a conservative annual cumulative outage time of 3 days for the DOE Multiplier VOR analysis. The SBUSD case study yielded an overall 30% VOR adder to the 2019 electricity spend, as indicated in the table below.

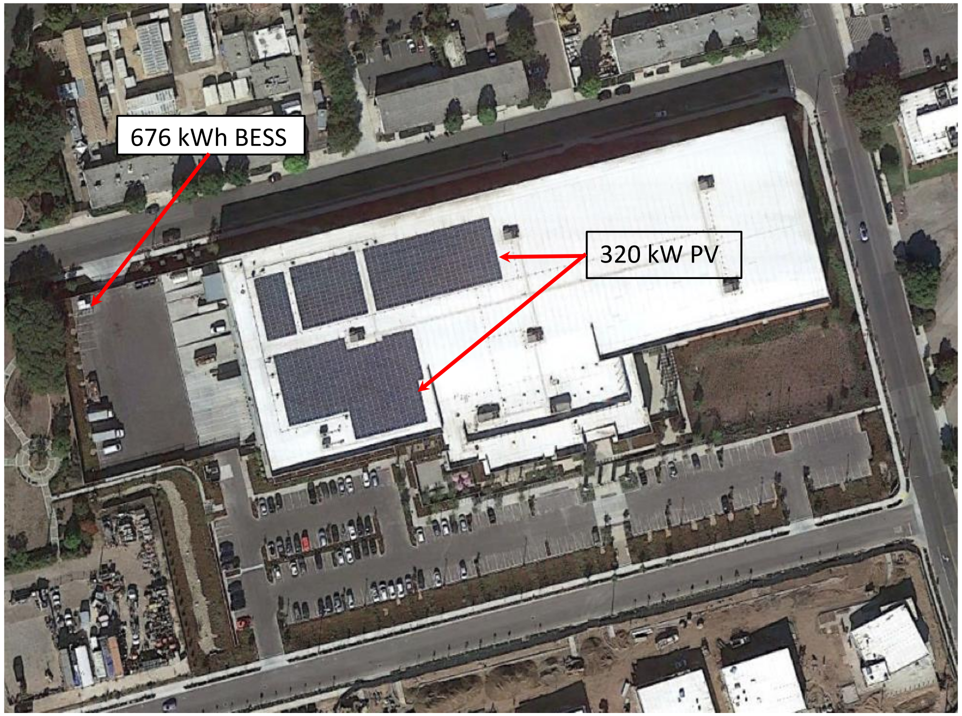
DOE Multiplier results for SBUSD prototype schools

Prototypical School	Average Tier 1 Load (kW)	Tier 1 kWh/year missed (72 hours/year)	VOR ($117/kWh)	Total 2019 electricity spend	DOE-derived VOR % of 2019 spend
Franklin ES	4.7	336	$39,256	$70,000	56%
La Cumbre JHS	2.8	202	$23,587	$78,000	30%
San Marcos HS	4.4	314	$36,729	$188,000	20%
Totals	11.8	851	$99,572	$336,000	30%

Validating VOR123 – four confirming approaches

3. **Market-Based:** This is essentially the market price, where supply meets demand, and the Direct Relief Solar Microgrid provides a local case study. Direct Relief has deployed a 320 kW PV and 676 kWh BESS Solar Microgrid, and while the PV is purchased via a roughly breakeven PPA, the BESS is leased at an annual cost of $37,500. While the size of the Direct Relief BESS (676 kWh) is a bit smaller than the size of the San Marcos Solar Microgrid BESS (710 kWh), Direct Relief is paying a bit more ($37,500/year) than the DOE Multiplier would value the San Marcos BESS ($36,729/year, as shown in Table 2-2).

Direct Relief Solar Microgrid



Validating VOR123 – four confirming approaches

Clean Coalition

4. **Avoided Diesel Generator Cost:** This approach is analogous to the previous cost-of-service (COS) approach, except it calculates the adder needed for a diesel generator to fulfill the VOR123 level of resilience. For this calculation, we equate “indefinite backup” to 30 days, and assume such a grid outage occurs once per year, during which the loads need to be maintained according to the standard VOR123 profile. The result, for a diesel backup system sized for a 1 million kWh/year site in Santa Barbara, is a **21 % adder** to the electricity bill.

Site Load Inputs

Total Site Annual Load (kWh)	1,000,000
Outage Duration (days)	30
Number of outages/year	1
Average cost of utility-purchased electricity ($/kWh)	$0.18
Average Site Power (kW)	114
Yearly cost of utility-purchased electricity	$180,000

VOR123 Parameters

Tier 1 % of time	100%
Tier 2 % of time	80%
Tier 3 % of time	30%
Tier 1 % of load	10%
Tier 2 % of load	15%
Tier 3 % of load	75%

TCLR (kWh)	36,575

Diesel Genset Size Check

Diesel genset size (kW)	200
Peak load (kW)	171

Diesel Tank Capacity Check

Diesel genset tank capacity (gallons)	3,000
Diesel used for TCLR (gallons)	3,040

Financials

Diesel Genset Depreciation Life (years)	15
Diesel Genset Capex	$350,000
Diesel Genset Opex ($/year)	$14,694
Diesel Genset Depreciated Capex ($/year)	$23,333
Diesel Genset Total Yearly Cost	$38,027

Cost of Diesel Genset backup energy ($/kWh)	**$1.04**
% adder of Diesel backup cost on top of utility-purchased electricity	**21%**

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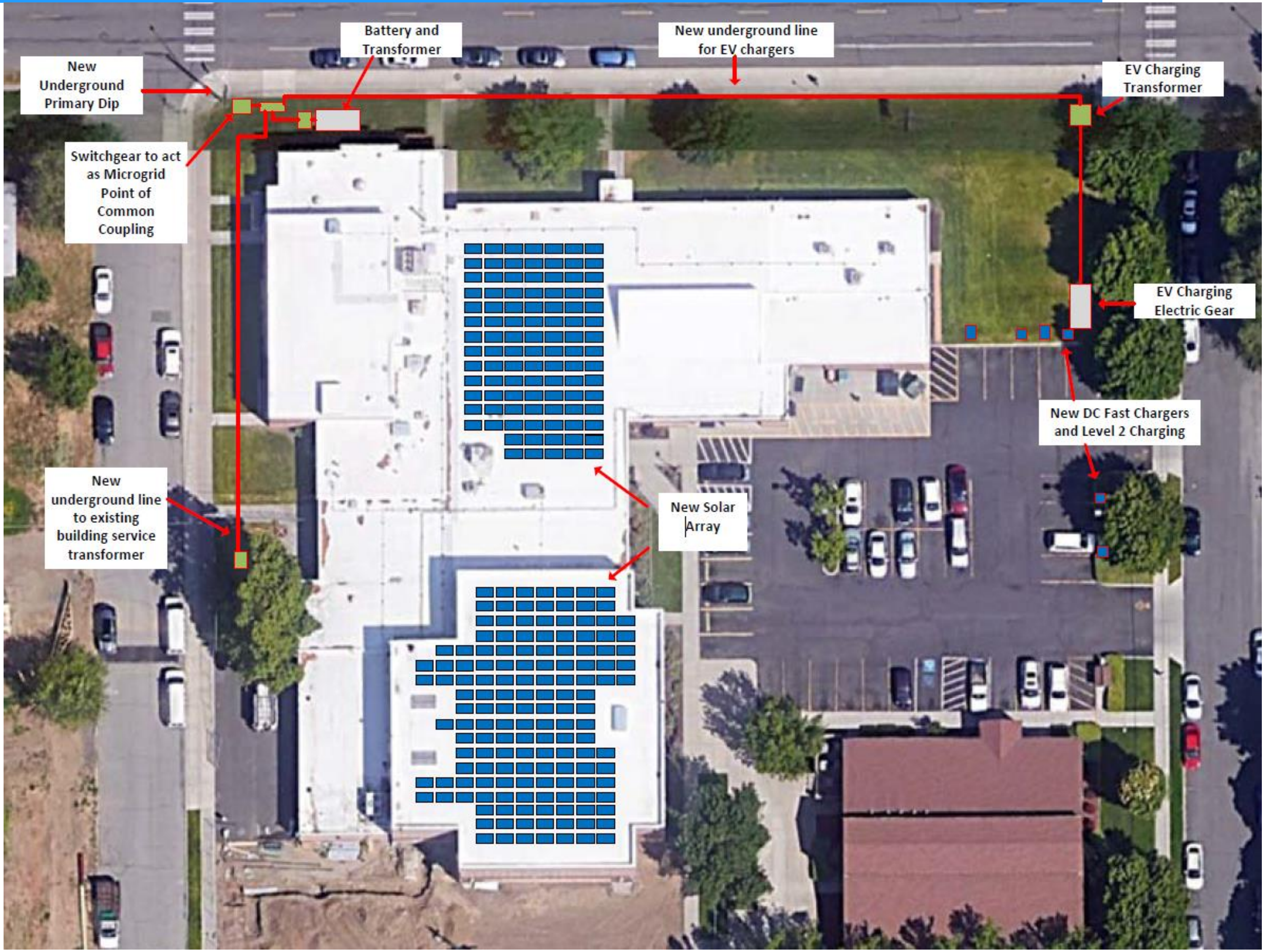
MLK Community Center case study in Spokane, WA

MLK Solar Microgrid site plan

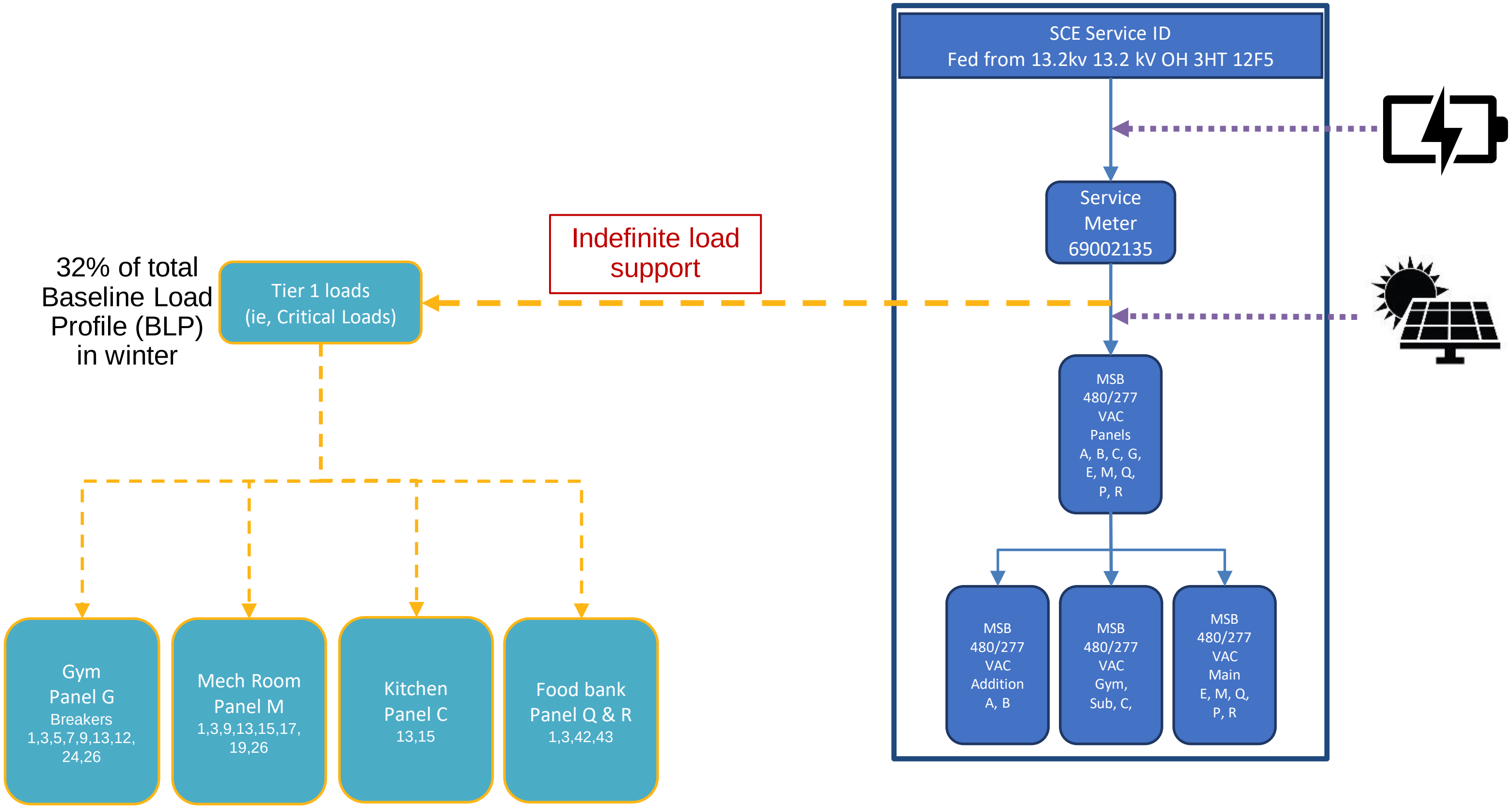
Clean Coalition



MLK Solar Microgrid scenarios

- Scenario A: Grant-covered plan-of-record
  - 99 kWac of behind-the-meter (BTM) solar.
  - 500 kW & 1.1 MWh of front-of-meter (FOM) Battery Energy Storage System (BESS).
- Scenario B: Double the BESS energy capacity from Scenario A
  - 99 kWac of BTM solar.
  - 500 kW & **2.2 MWh** of FOM BESS.
- Scenario C: 2.3x the solar of Scenario A
  - **230 kWac** of BTM solar.
  - 500 kW & 1.1 MWh of FOM BESS.
- Scenario D: 2.3x the solar and double the BESS energy capacity of Scenario A
  - **230 kWac** of BTM solar.
  - 500 kW & **2.2 MWh** of FOM BESS.
- Scenario E: Add a 150 kW gas generator to Scenario A
  - 99 kWac of BTM solar.
  - 500 kW & 1.1 MWh of FOM BESS.
  - **150 kW gas generator**

Circuit Flow Diagram concept for MLK



MLK Critical Load Profile (T1%) estimation method

Clean Coalition

Location	Shutoff	Panel	Load	Breaker #s	Brkr Amps	Qty	Brkr capacity used	Operating Amps	Operating Power	Daily capacity factor	Daily energy	Daily panel total	Daily panel total as % of all panels total	Winter ON = 1	Winter Energy	Summer ON = 1	Summer Energy
					[A]	[ea]	[% estim]	[A]	[kVA]	[% estim]	[kWh]	[kWh]			[kWh]		[kWh]
Sub Panels																	
	MSB	M			225												
			S. Circulating Pump 2	1, 3	20	2	50%	20	2.40	20%	11.52			1	11.52	1	11.52
			Boiler #1	9	20	1	50%	10	1.20	20%	5.76			1	5.76	1	5.76
			Air Compressor	13, 15, 17	20	3	50%	30	3.60	20%	17.28			0.25	4.32	1	17.28
			Boiler Controls	19	20	1	15%	3	0.36	100%	8.64			1	8.64	1	8.64
			HVAC controls	26	20	1	15%	3	0.36	100%	8.64	51.84	12%	1	8.64	1	8.64
	MSB	G			225												
			Main Lights	1, 3, 5, 7, 9, 11, 13, 15	20	8	50%	80	9.60	33%	76.03			1	76.03	1	76.03
			Bath lighting & showers	12	20	1	50%	10	1.20	100%	28.80			1	28.80	1	28.80
			HVAC air handler 3	22, 24, 26	50	3	50%	75	9.00	100%	216.00	320.83	73%	0.25	54.00	1	216.00
	?	C			1525												
			Walk-in	13, 15	20	2	50%	20	2.40	20%	11.52	11.52	3%	1	11.52	1	11.52
	?	Q			?												
			Refrigeration?	1, 3	20	2	50%	20	2.40	20%	11.52			1	11.52	1	11.52
			walk-in cooler	40, 42	15	2	50%	15	1.80	20%	8.64	20.16	5%	1	8.64	1	8.64
	Unknown panels																
	MSB	?	Condensing unit 3	?	?	?	?	30	3.60	20%	17.28			0	-	1	17.28
			Existing switchboard	?	?	?	?	3	0.36	100%	8.64			1	8.64	1	8.64
			panel a off, 35, 37,39 egress l	?	?	?	?	3	0.36	100%	8.64	34.56	8%	1	8.64	1	8.64

Energy Flow Diagram (EFD) for Scenario A, normal

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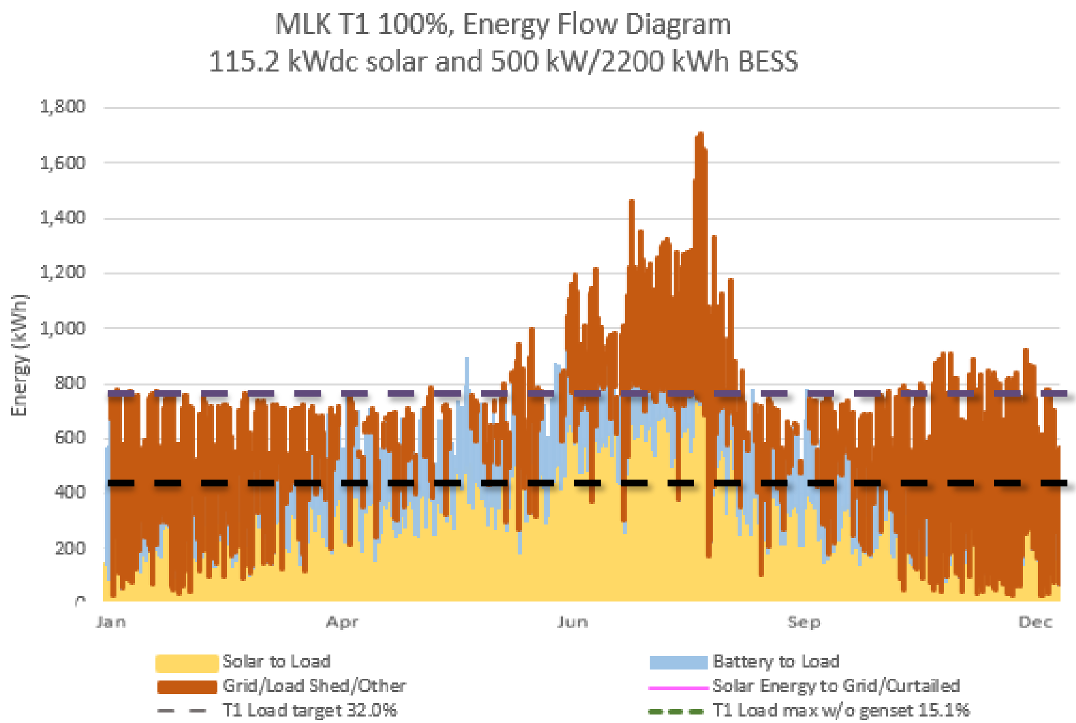

Current MLK Load

Daily average: 782kWh
Yearly: 285,463 kWh

Solar Production

Daily average: 436kWh
Yearly: 159,340 kwh

Solar shortfall

Daily average: 346 kWh
Yearly:126.123kWh

Large farm case study in Carpinteria, CA

1.5 MWdc of solar for GH2 meter

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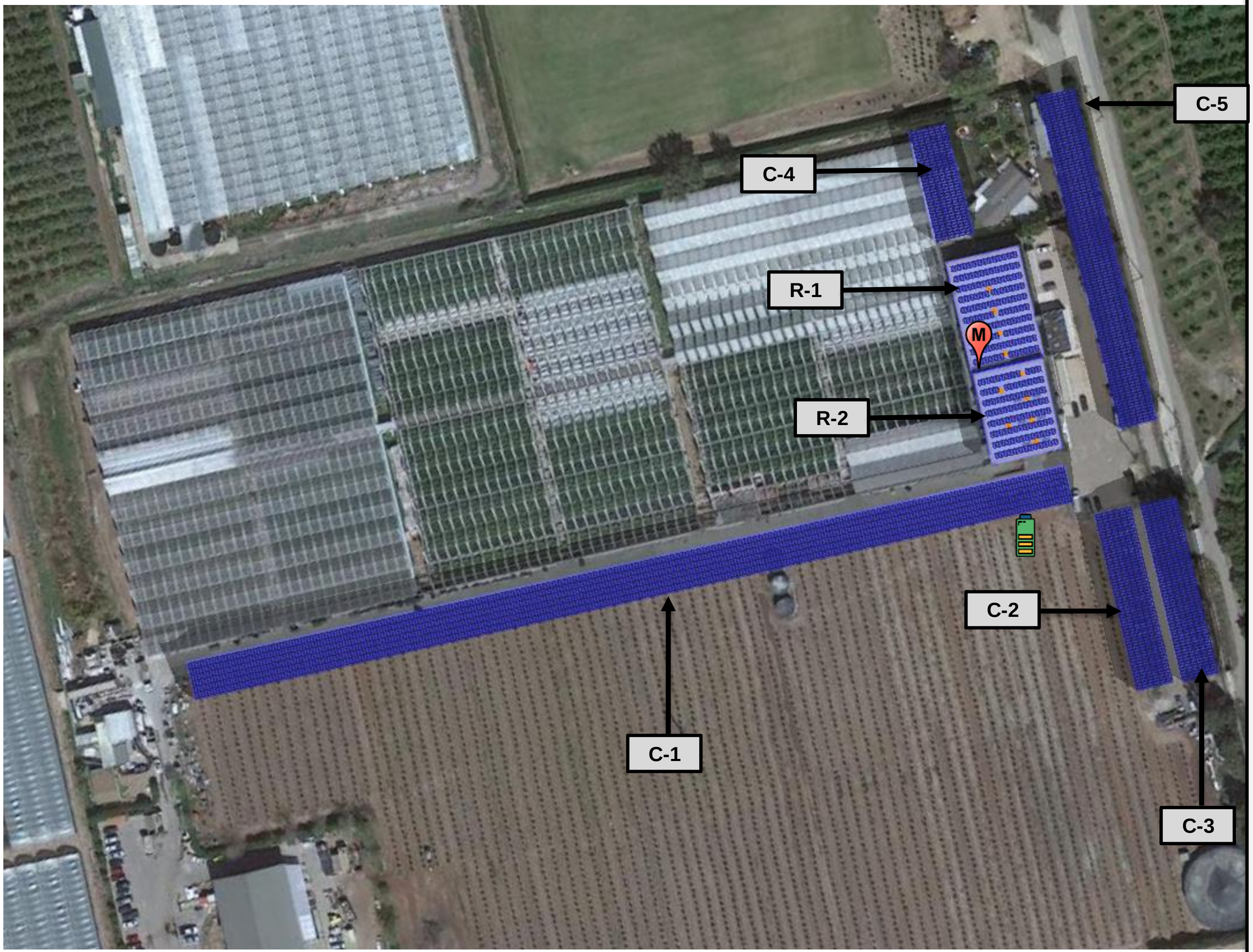


Brand Farms

Greenhouse #2 Meter
Solar Microgrid Site Layout

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

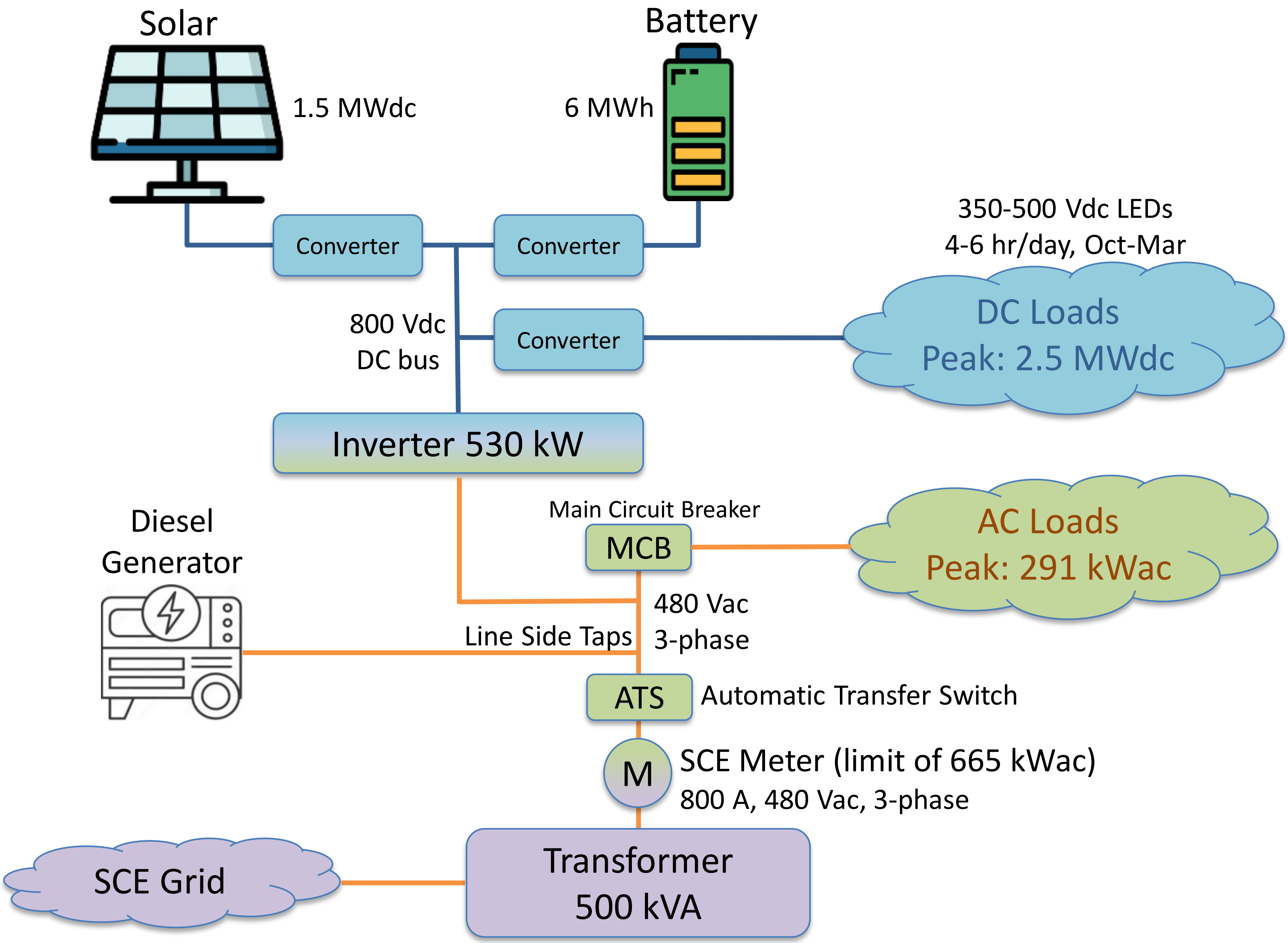
Total Solar Siting Potential: 1,500 kW

- **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

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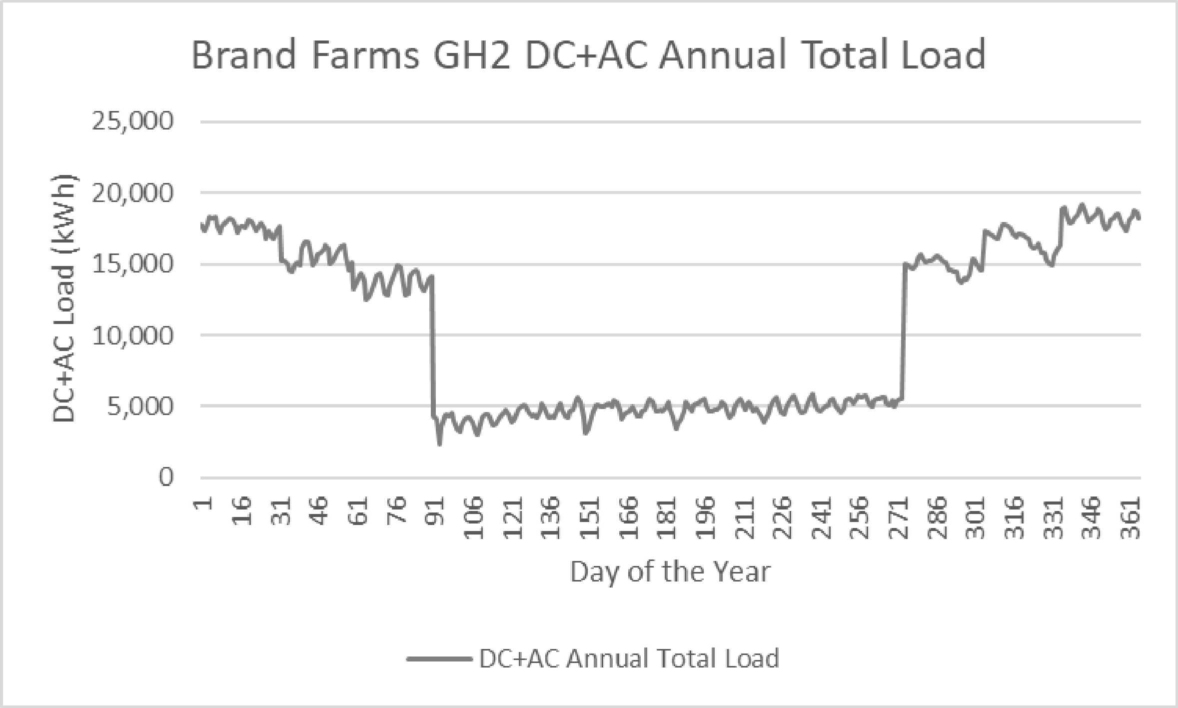

Brand Farms Greenhouse 2 (DC + AC Loads) Business-As-Usual Electricity Bill Cost Based on TOU-8-D and 3CE Rates								
Meter	Scenario Types	Business-As-Usual Blended Utility Rate Over Time at a 5% Utility Price Increase (¢/kWh)			25 Year Electricity Bill Cost			
		Year 1	Year 10	Year 25	Year 1 Total 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

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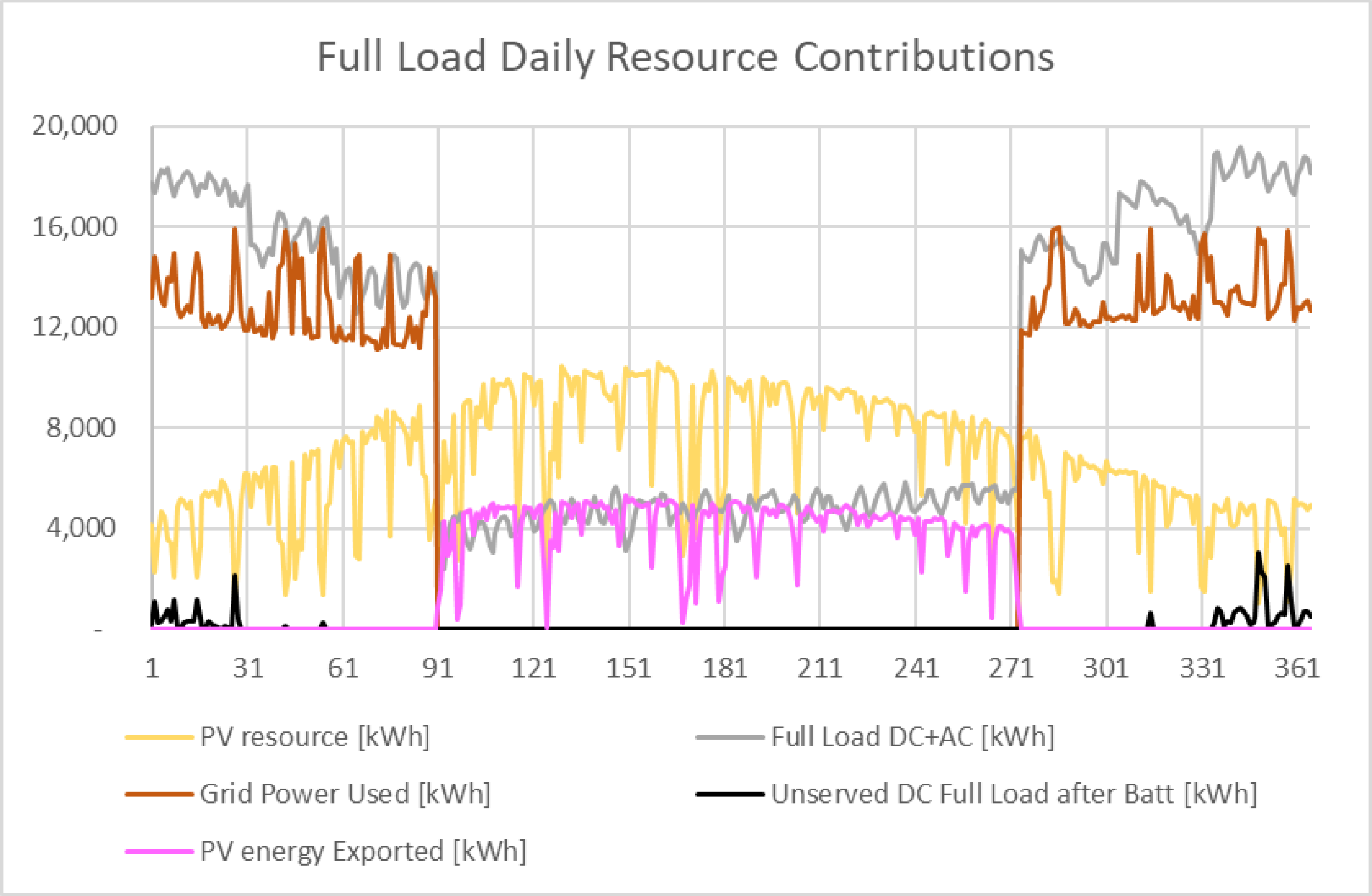
Energy Flow Diagram
1.5 MW solar and 3 MW / 6 MWh energy storage



Santa Barbara region is vulnerable to grid outages

Santa Barbara region is vulnerable to grid outages

Goleta Load Pocket (GLP)

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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

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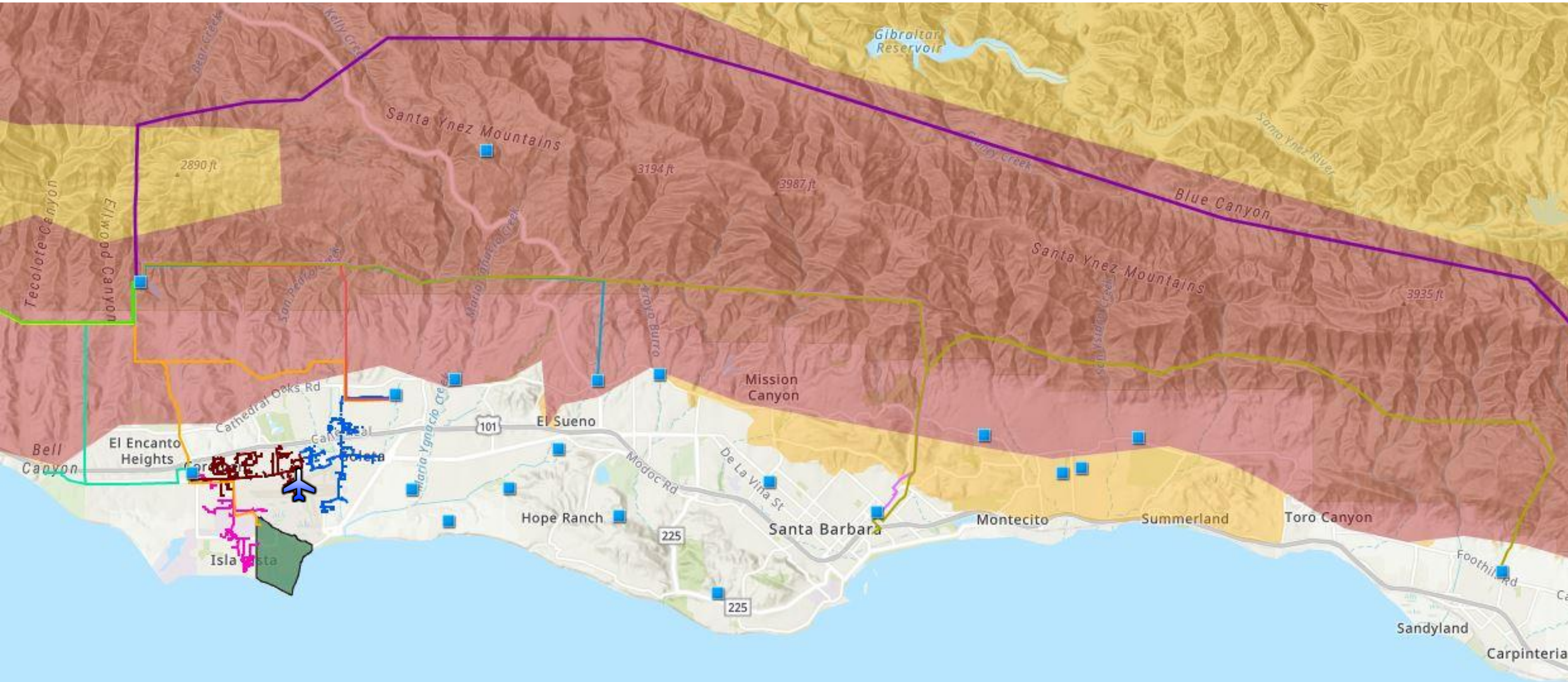

Legend

220 kV Transmission	Tier 3 Fire Threat	16kV Gladiola Feeder
Santa Barbara Airport	Tier 2 Fire Threat	16kV Gaucho Feeder
Substations	UCSB	16kV Professor Feeder

Feeder #4157	Feeder #4169
Feeder #3556	Feeder #4227
Feeder #4311	Feeder #3565
Feeder #3559	

Target 66kV feeder serves critical GLP loads

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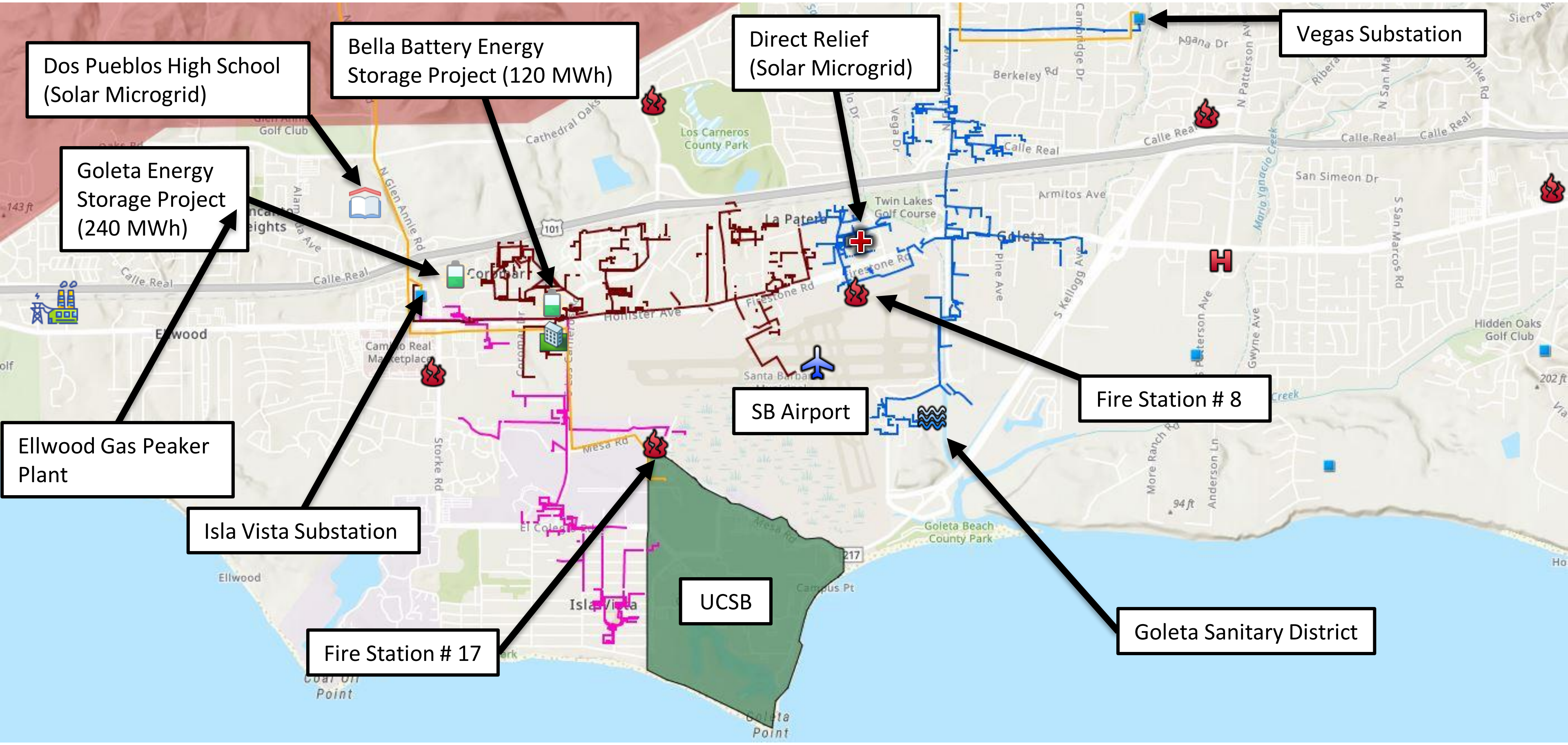

Legend

- 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

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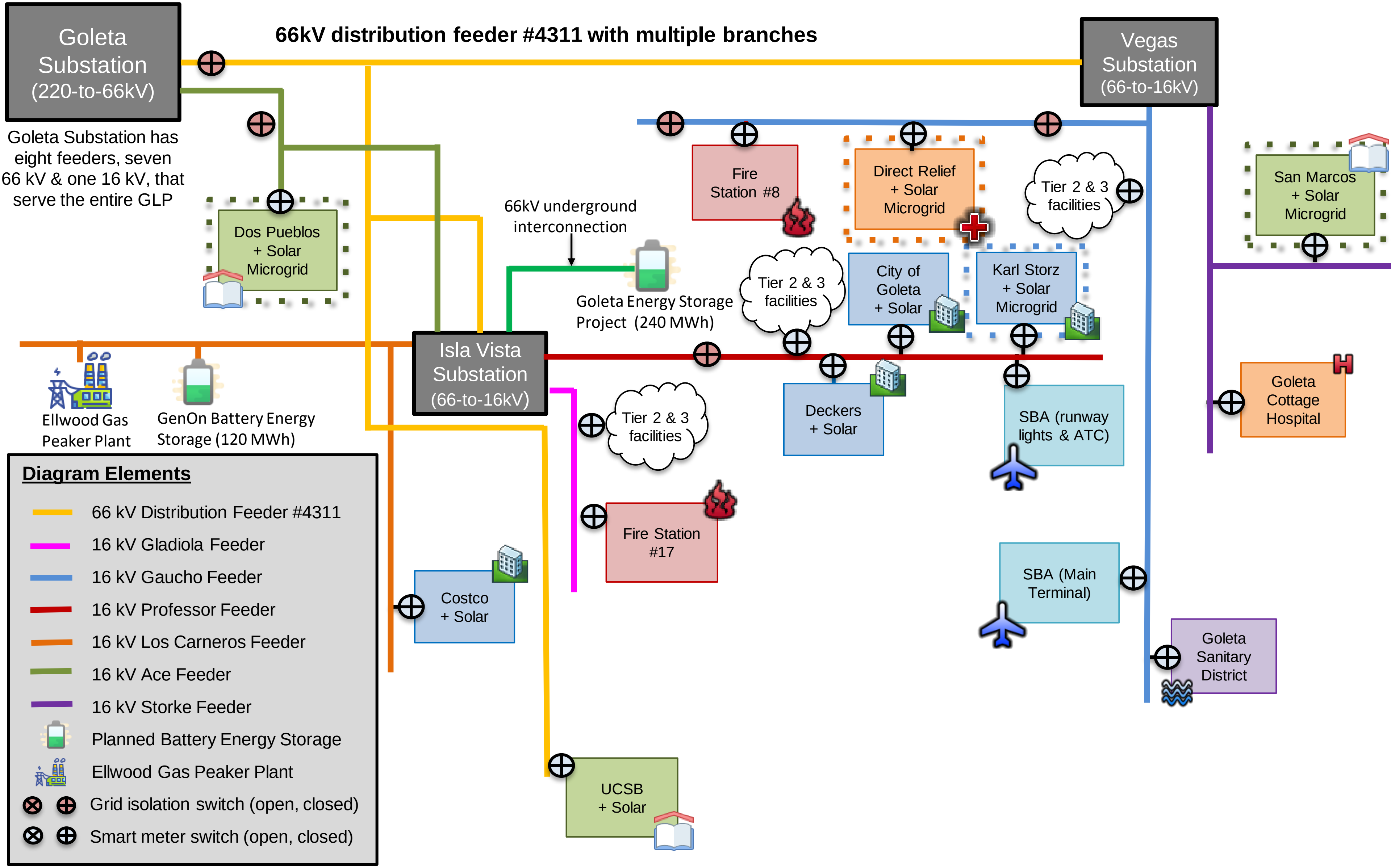

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Santa Barbara Unified School District (SBUSD)

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

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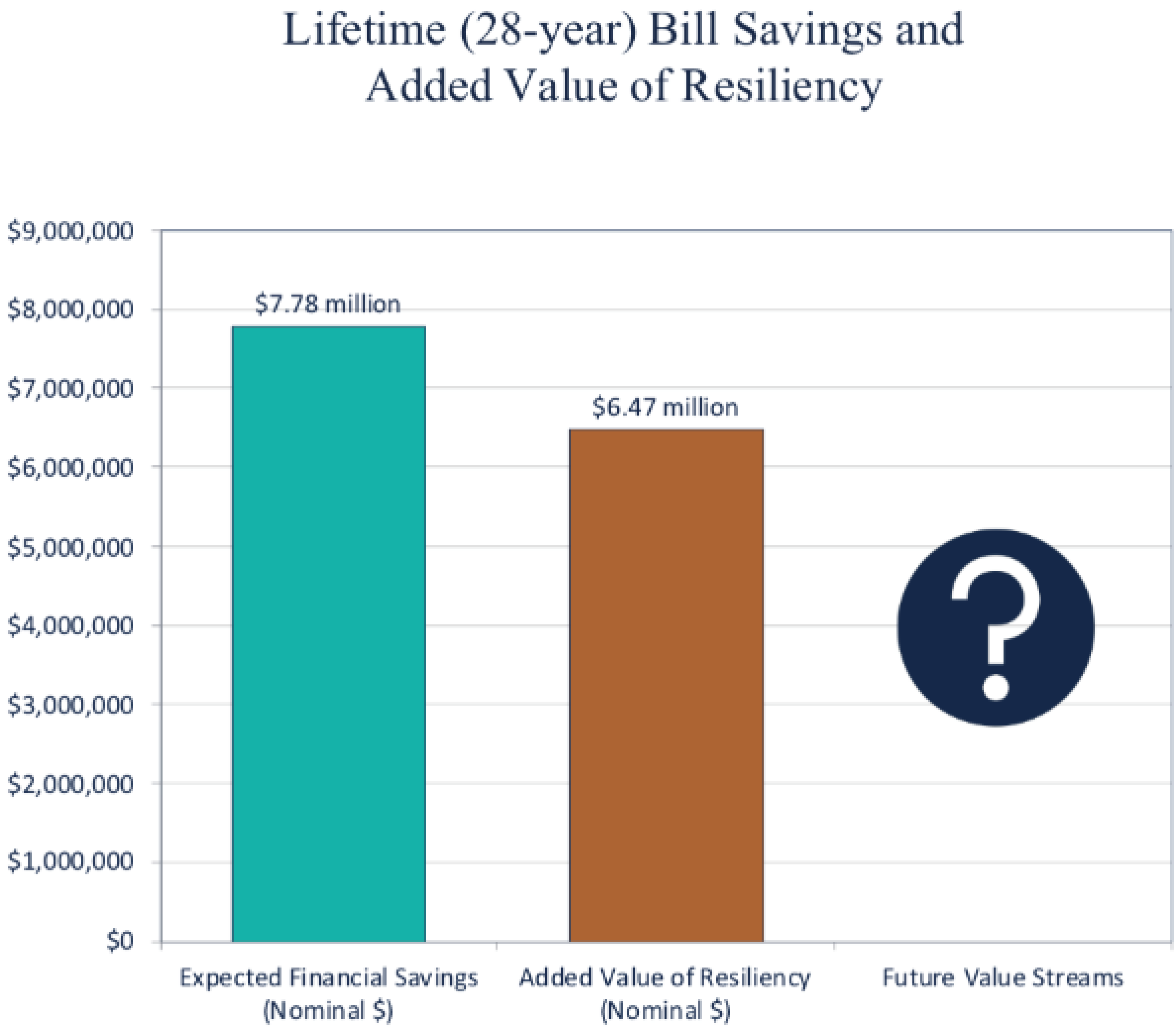

East LA Solar Microgrids case study

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

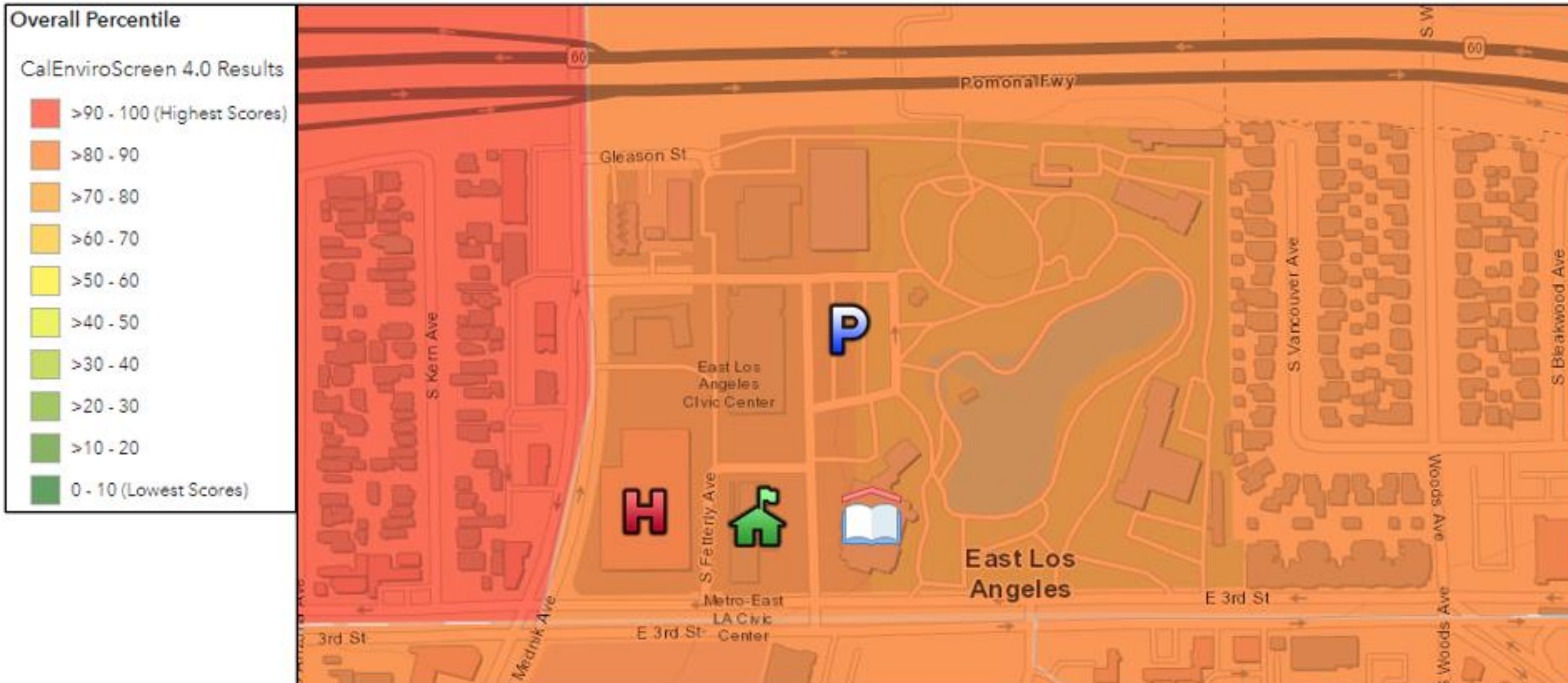
Other noteworthy facilities:

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)

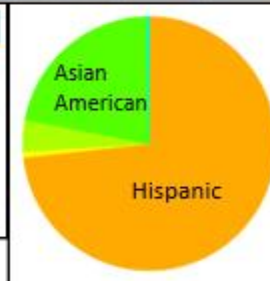


Overall Percentiles	
CalEnviroScreen 4.0 Percentile	89
Pollution Burden Percentile	92
Population Characteristics Percentile	75

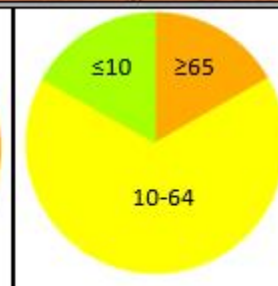
Sensitive Populations	
Asthma	35
Low Birth Weight	98
Cardiovascular Disease	20

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

Clean Coalition

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:

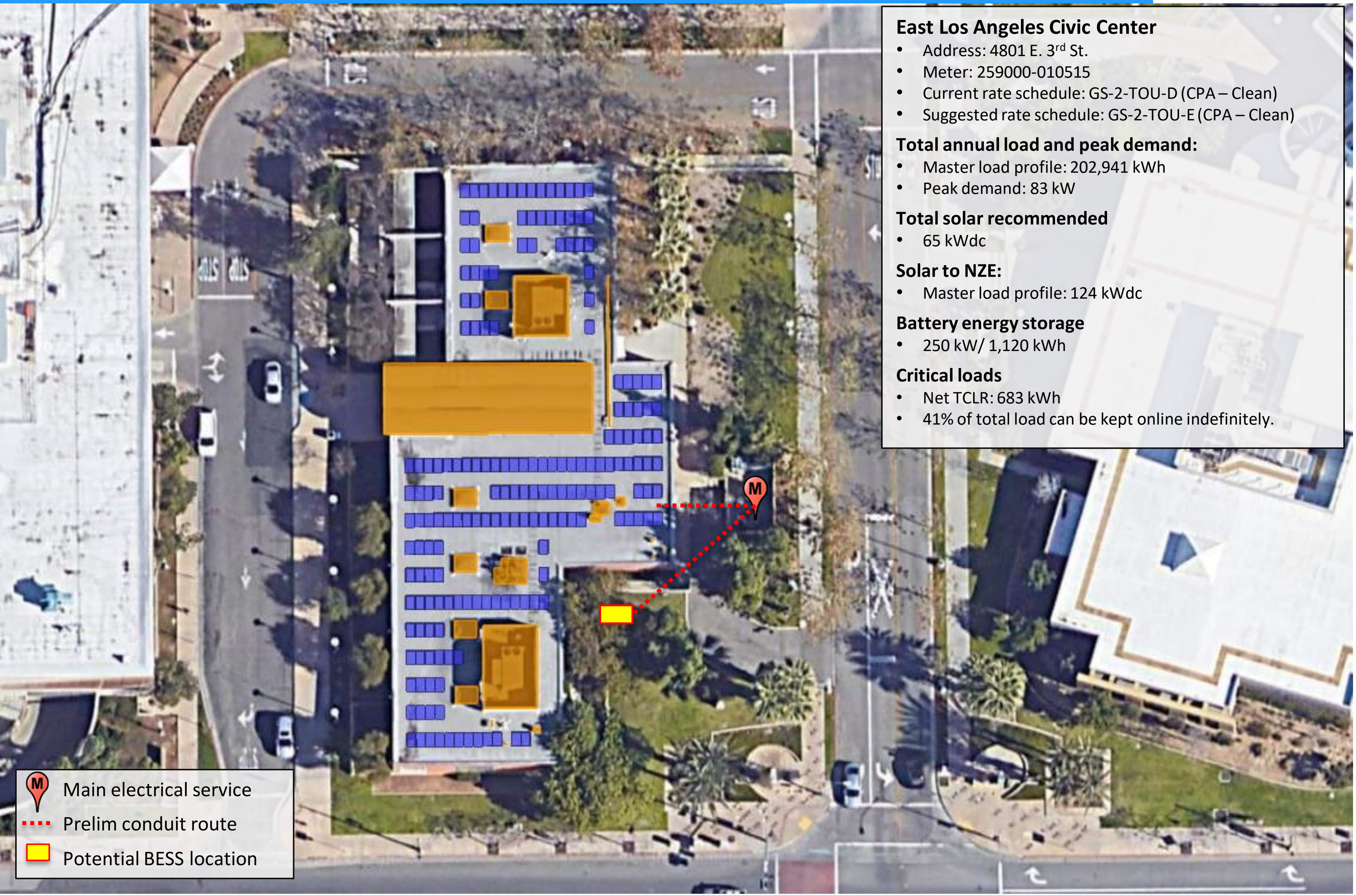
- Master load profile: 124 kWdc

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

Clean Coalition

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

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

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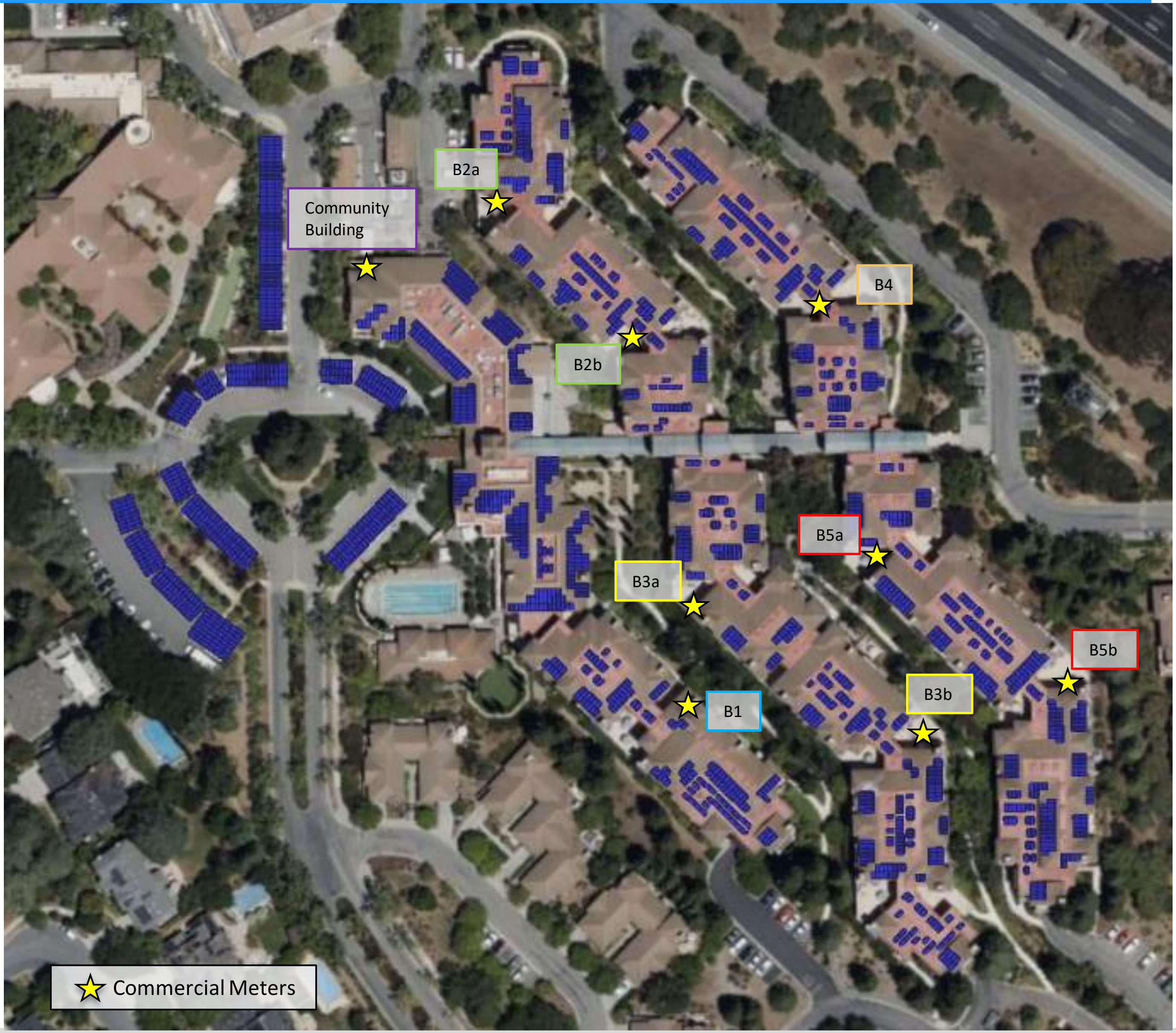
Solar & storage sizing across all targeted meters

Clean Coalition

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.

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Policy innovations needed

Existing barriers preventing the widespread deployment of Microgrids

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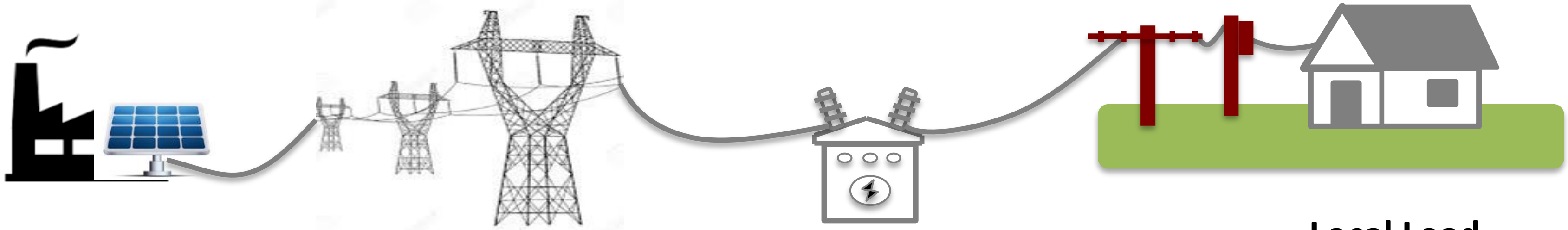
The electric grid was designed with 20th century principles about a grid with a one-way flow of energy. Remotely-generated energy is transmitted across long distance transmission lines and delivered to end users located in load centers (on the distribution grid).



- **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

Clean Coalition

- 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.

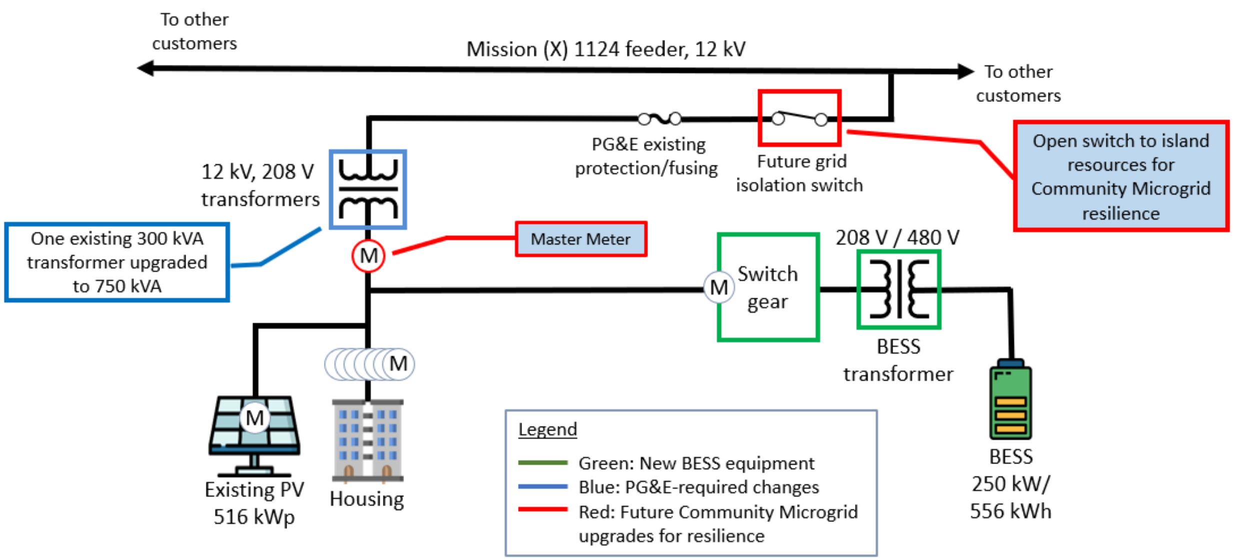
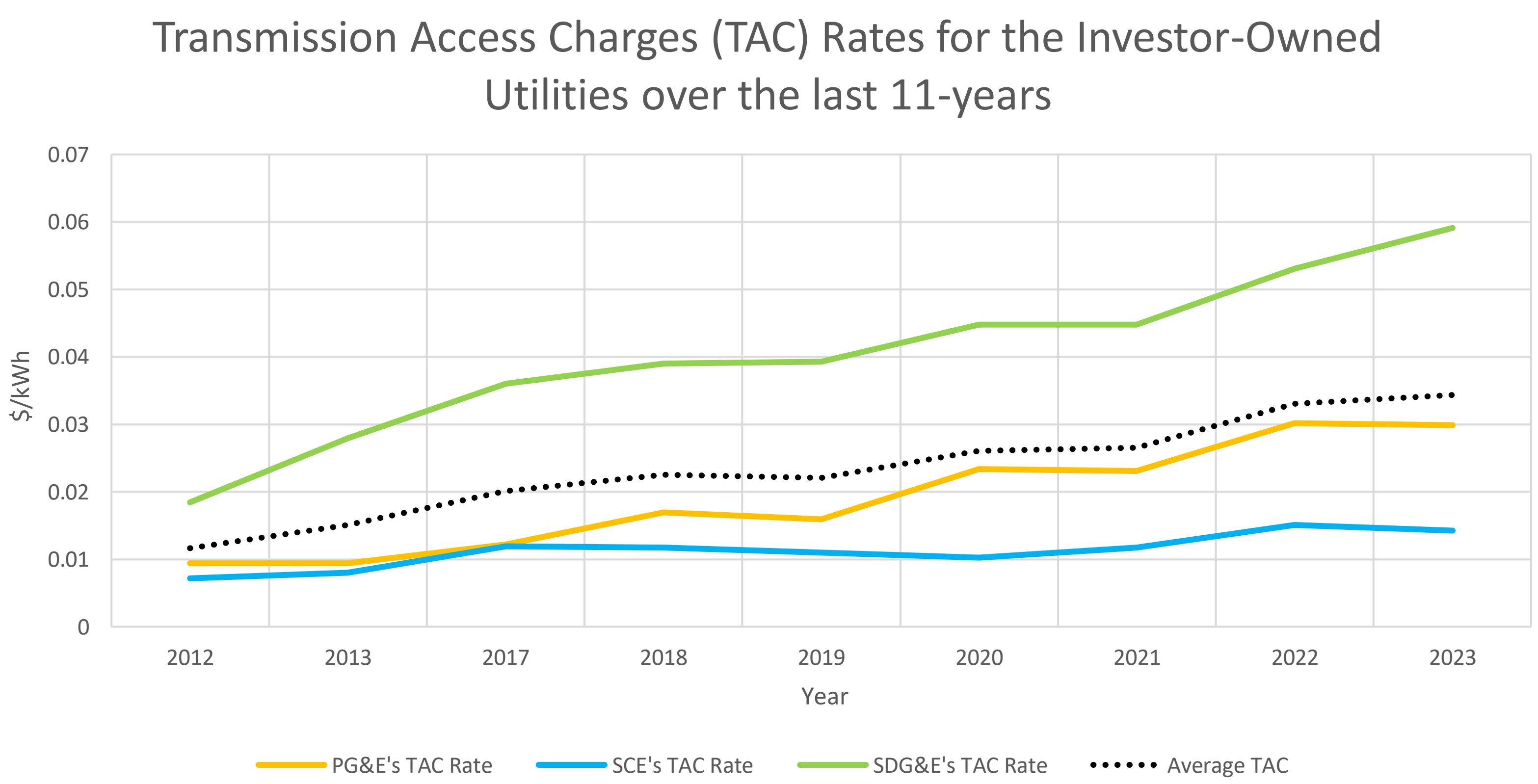


Diagram of the Valencia Gardens Energy Storage (VGES) project provisioned for resilience

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**

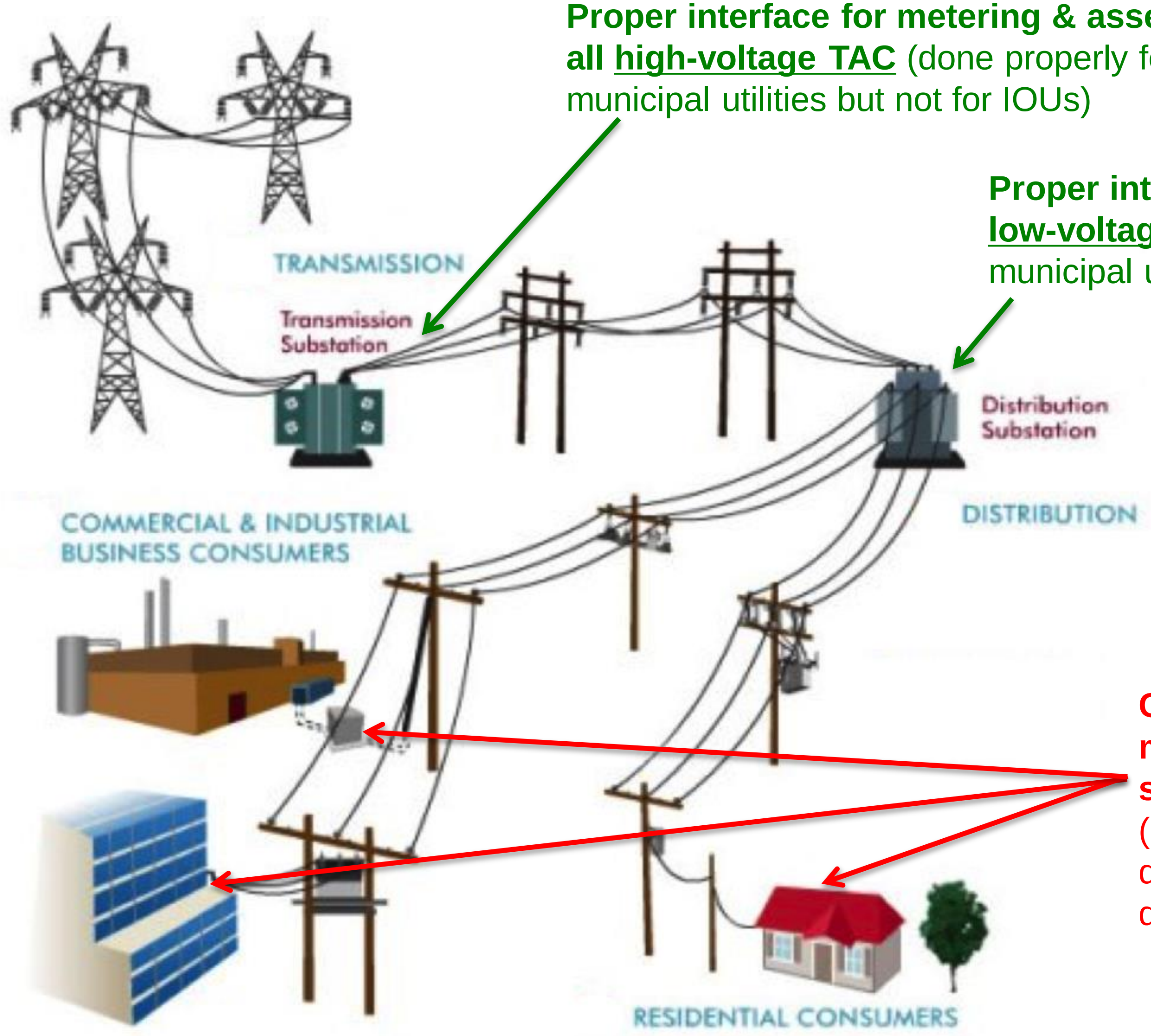
Real costs, discounted for inflation

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)