Clean Coalition

Solar Microgrids with EV charging optimization

Economic, environmental & resilience benefits

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Mission

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

100% renewable energy end-game

- 25% local, interconnected within the distribution grid and facilitating resilience without dependence on the transmission grid.
- 75% remote, dependent on the transmission grid for serving loads.

Microgrids defined

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- A microgrid is a combination of energy resources, definitely including generation & storage, 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.

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

- 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.

Typical load tier resilience from Solar Microgrids

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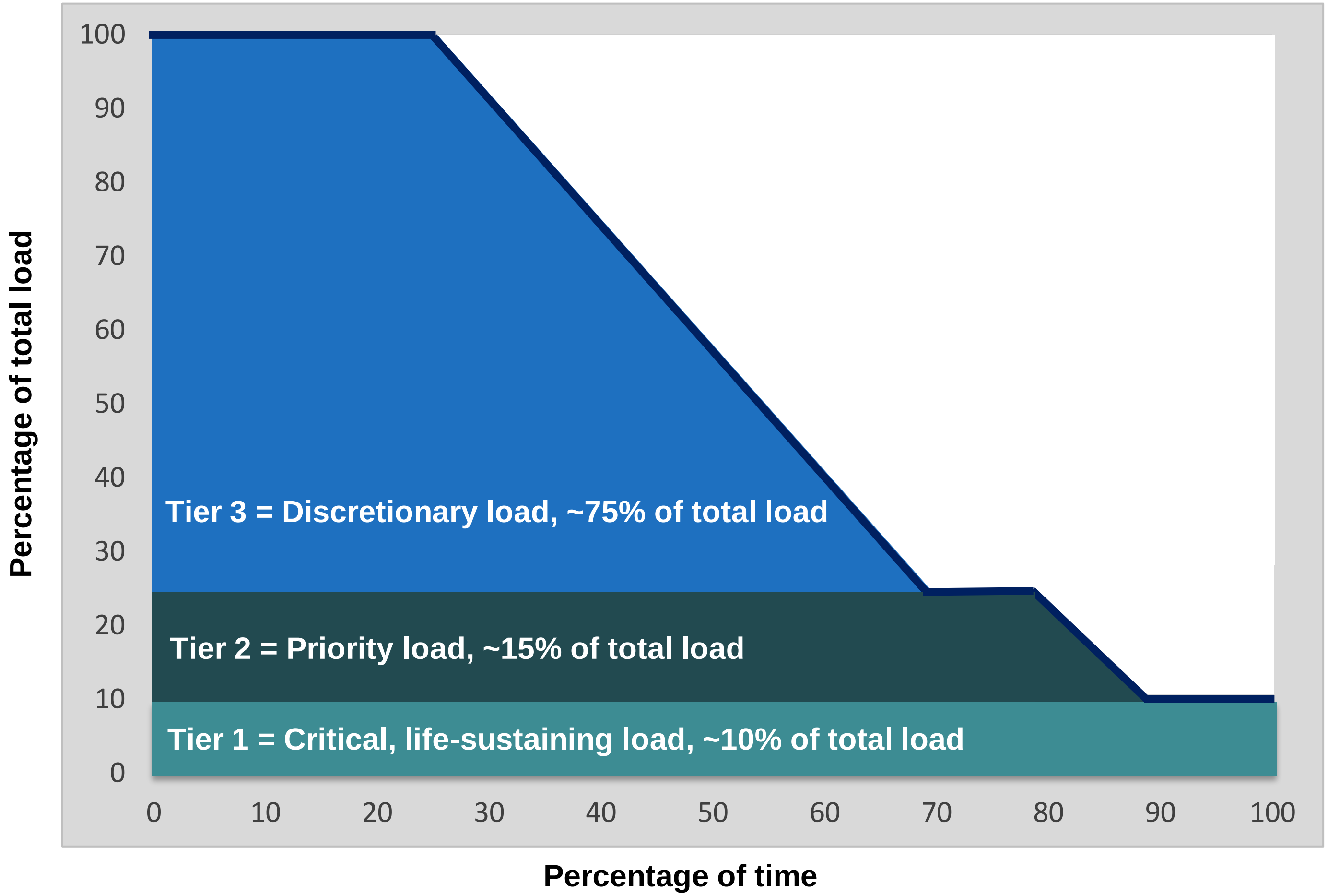

Percentage of time online for Tier 1, 2, and 3 loads for a Solar Microgrid designed for the University of California Santa Barbara (UCSB) with enough solar to achieve net zero and 200 kWh of energy storage per 100 kW solar.

Diesel generators are designed for limited resilience

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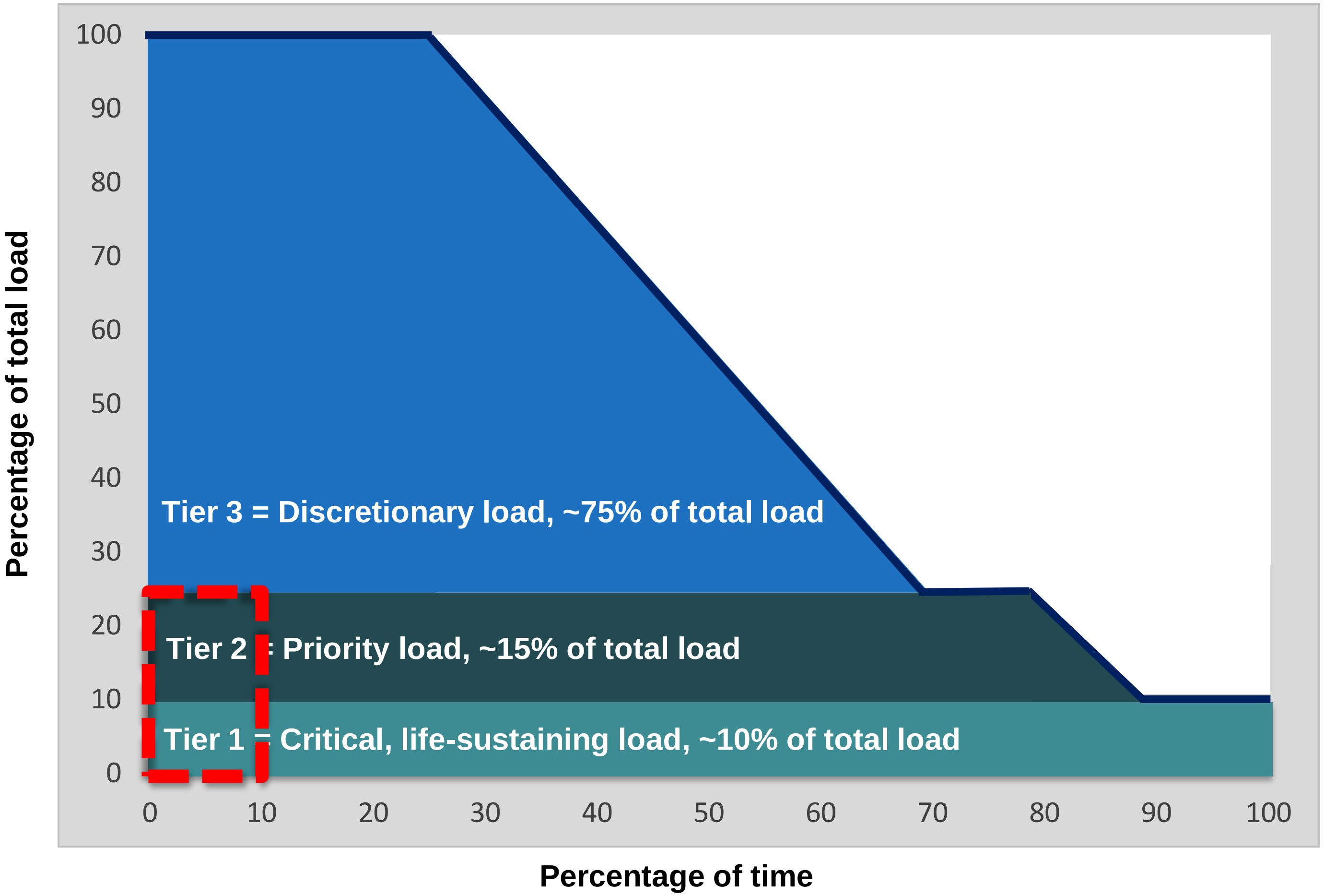

A typical diesel generator is configured to maintain 25% of the normal load for two days. If diesel fuel cannot be resupplied within two days, goodbye. This is hardly a solution for increasingly necessary long-term resilience. In California, Solar Microgrids provide a vastly superior trifecta of economic,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

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Santa Barbara Unified School District (SBUSD)
case study

Santa Barbara Unified School District (SBUSD)

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- 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.

SBUSD sites pursued, contracted, and in construction

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Site	Battery Power (kW)	Battery Energy (kWh)	PV Size (kWdc)	Status
Adams ES			98	Final electrical
Cleveland ES			45	Final electrical
District Office & La Cuesta Continuation HS	112	223	110	in construction
Central Food Warehouse & Maintence Facilities	112	223	76	in construction
Dos Pueblos HS	558	1,115	1,134	Scheduled for June
Franklin ES & Adelante Charter			181	Scheduled for February
Goleta Valley JHS			249	in construction
La Colina JHS			207	Final electrical
La Cumbre JHS & SB Community Academy	223	446	272	Scheduled for March
Monroe ES			106	in construction
Roosevelt ES			121	Scheduled for March
Santa Barbara HS	446	892	620	Scheduled for June
Santa Barbara JHS			219	Final electrical
San Marcos HS	446	892	713	Scheduled for June
	1,896	3,791	4,152	

Six SBUSD Solar Microgrid sites

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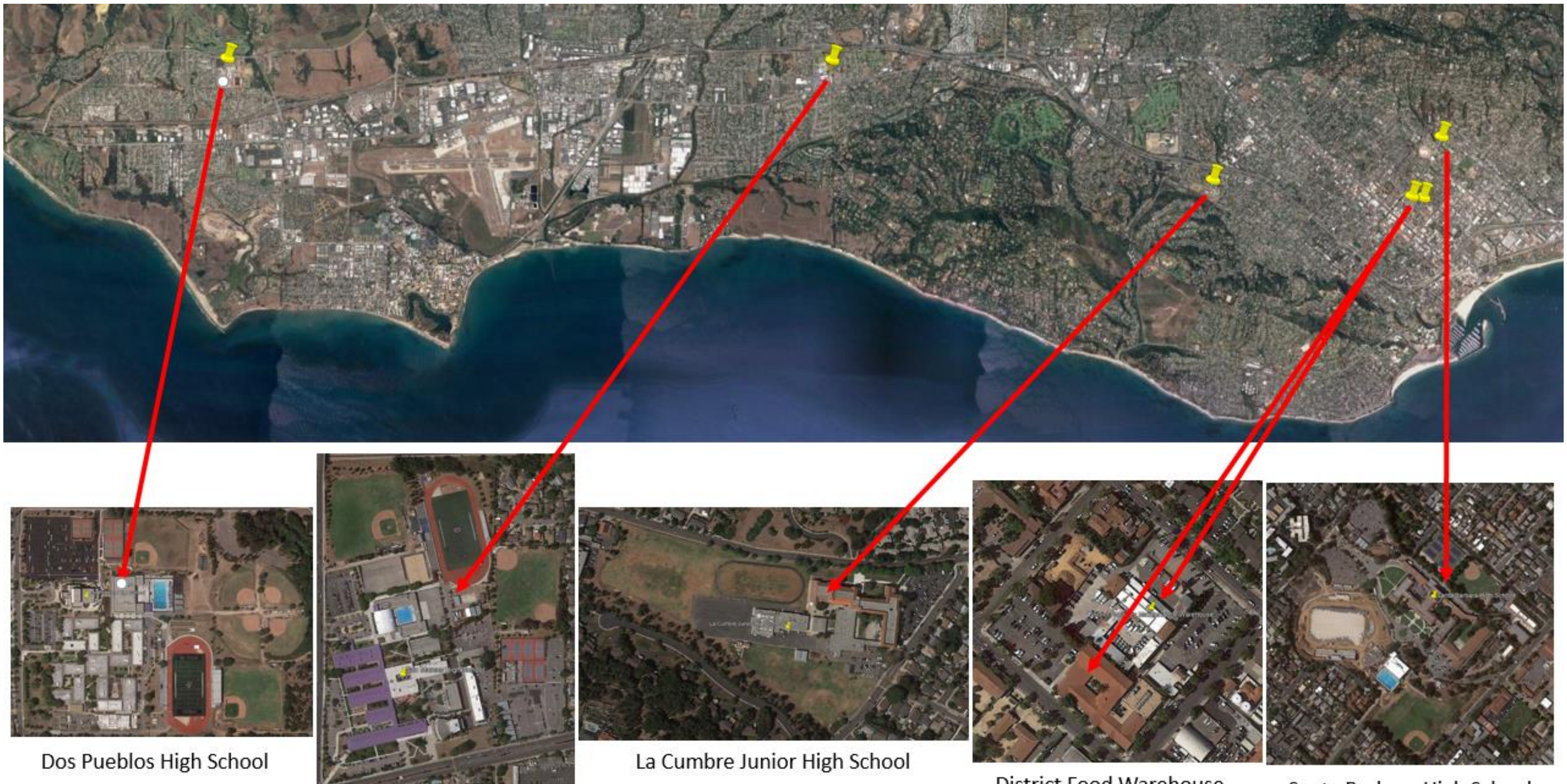


Dos Pueblos High School

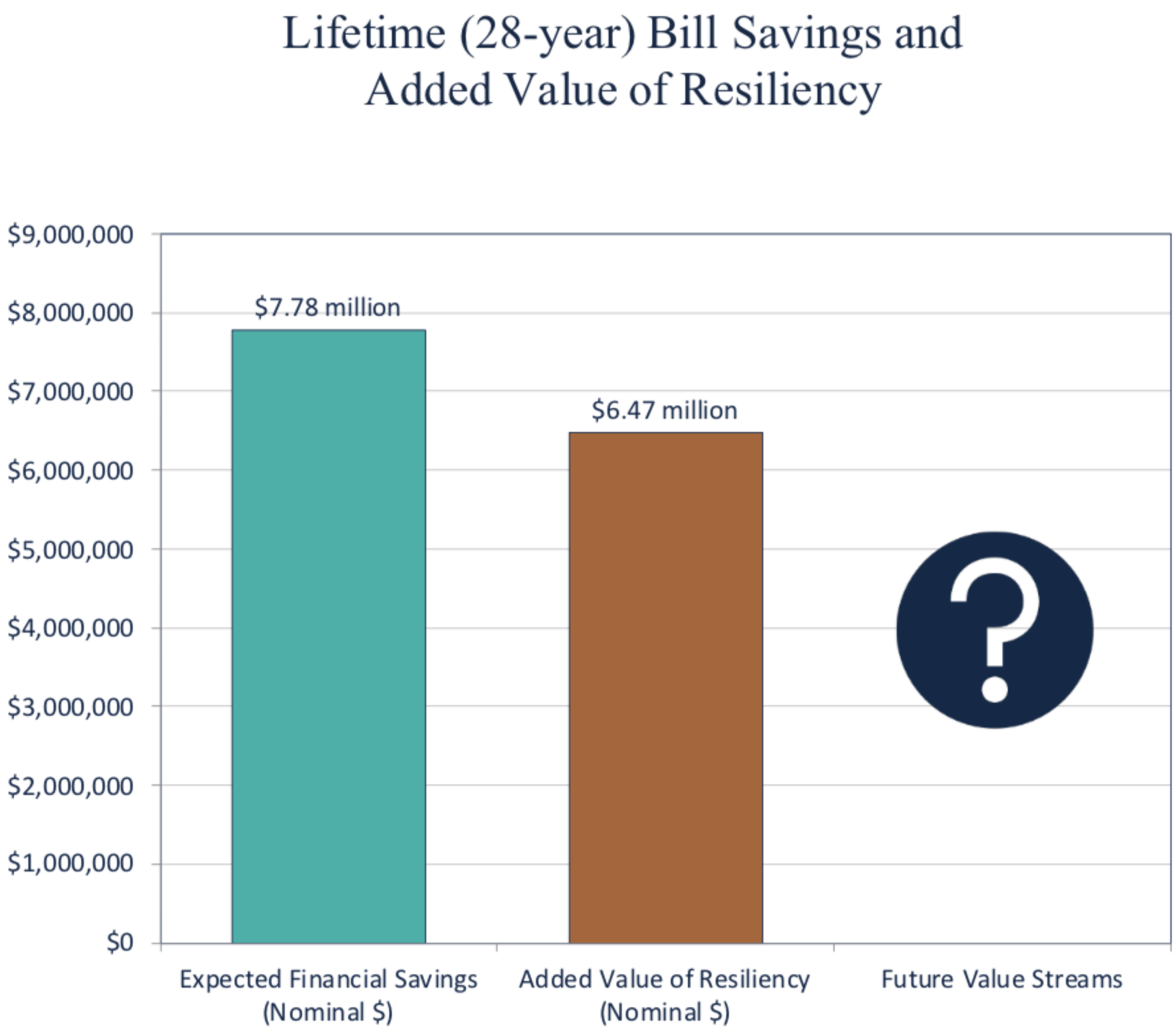
San Marcos High School

La Cumbre Junior High School

District Food Warehouse & District Office

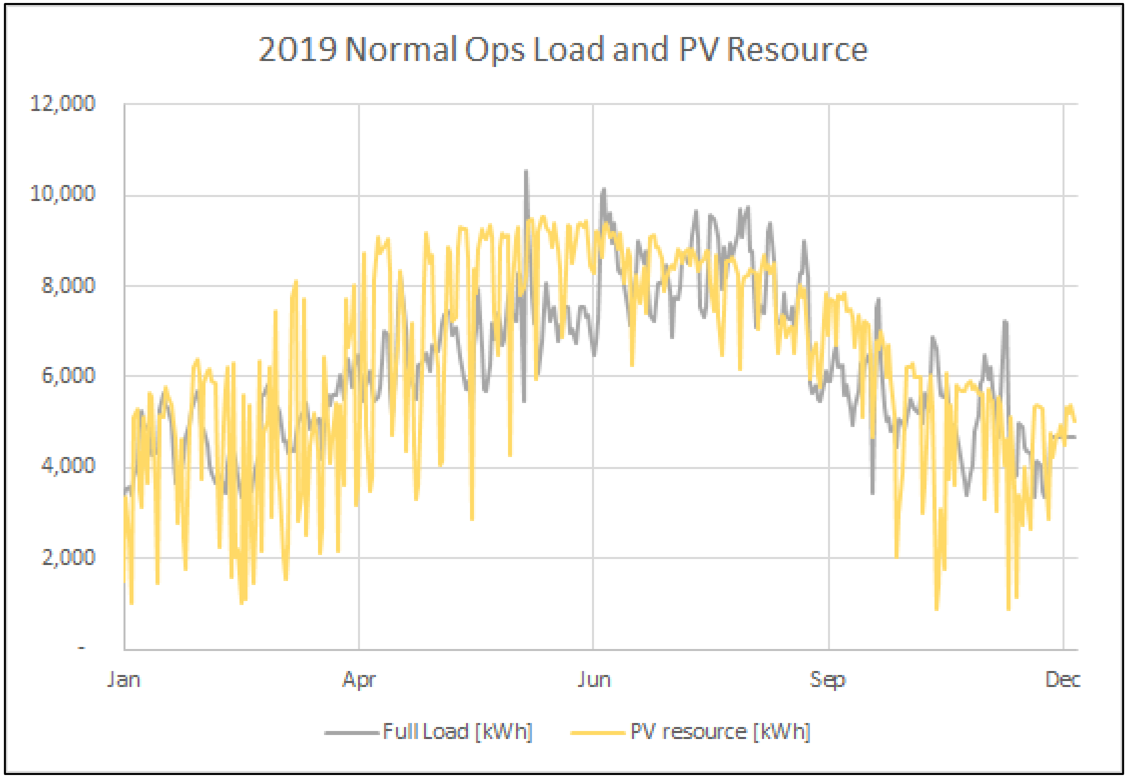
Santa Barbara High School

Guaranteed SBUSD bill savings and free VOR



Solar Microgrids deliver unparalleled resilience

Example NZE total solar generation vs total load



Islanding full load for an entire year with Hybrid Solar Microgrid

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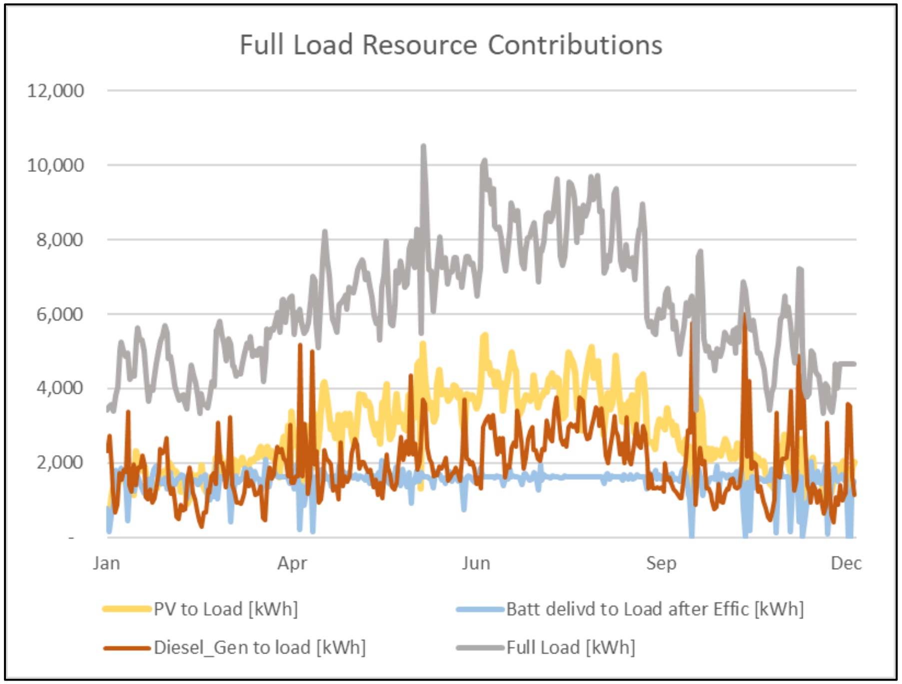

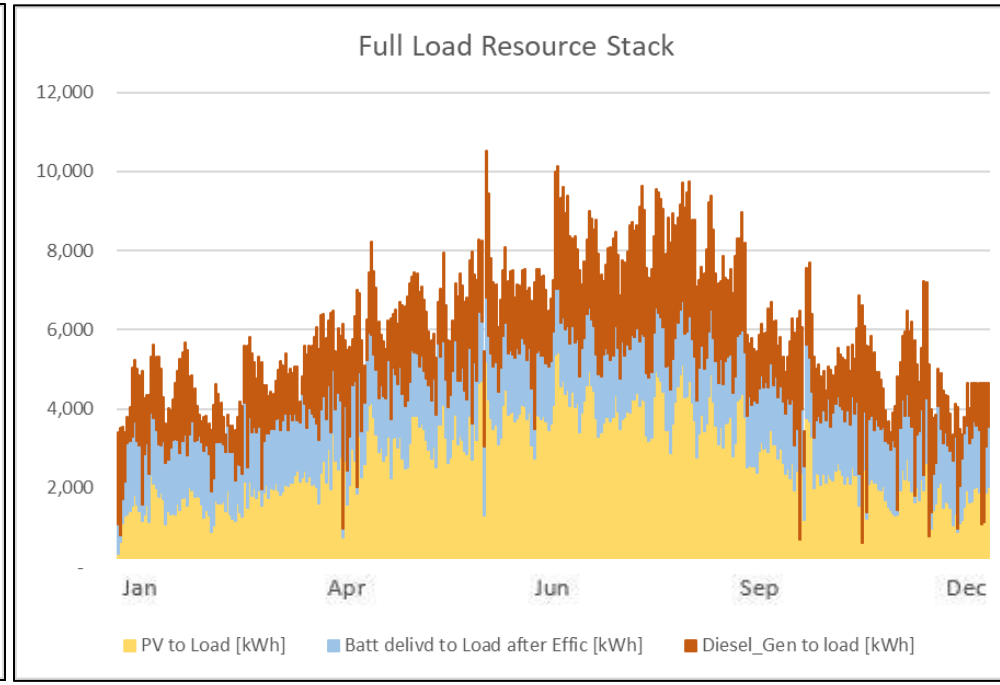

- **31.6%** (716,015kWh requiring 57,076 gallons) of the full load needs to be served by the diesel generator in order to keep the full load online for an entire year.
  - 6,013kWh (481 gallons) served by the diesel generator on the max day (8 Nov 2019)
  - Some level of diesel generation is required every day of the year.

57,281 gallons (~95 fuel tank refills) of diesel needed throughout the entire year

Islanding T1 load (30% of normal load) for an entire year with Hybrid Solar Microgrid

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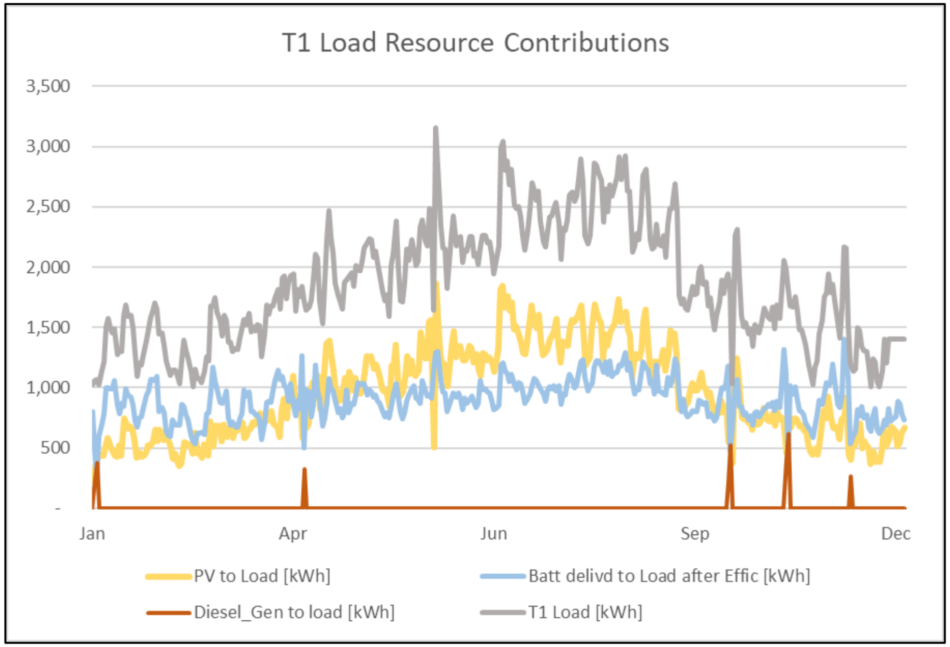

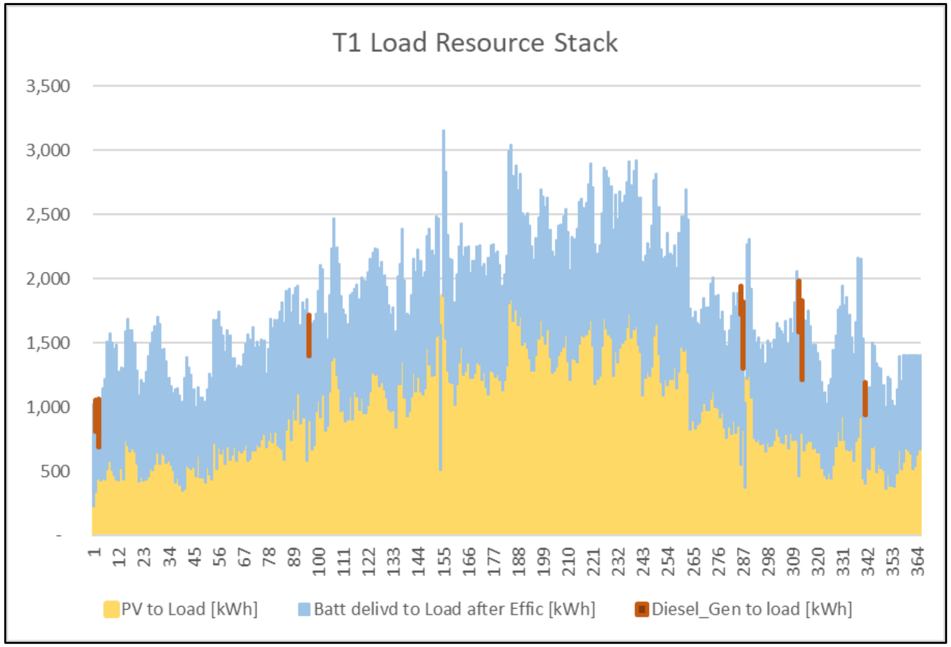

- **0.4%** (2,976kWh requiring 212 gallons) of the T1 load needs to be served by the diesel generator in order to keep the T1 load online for an entire year.
  - 615kWh (49 gallons) served by the diesel generator on the max day (9 Nov 2019)
  - Diesel generation is required for 8 days of the year
    - January 2, January 3, April 6, October 13, October 14, November 8, November 9, December 7

212 gallons (35% of existing fuel tank) needed throughout the entire year

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EV charging can be critical – and economically viable

EV charger resilience requires BTM configuration

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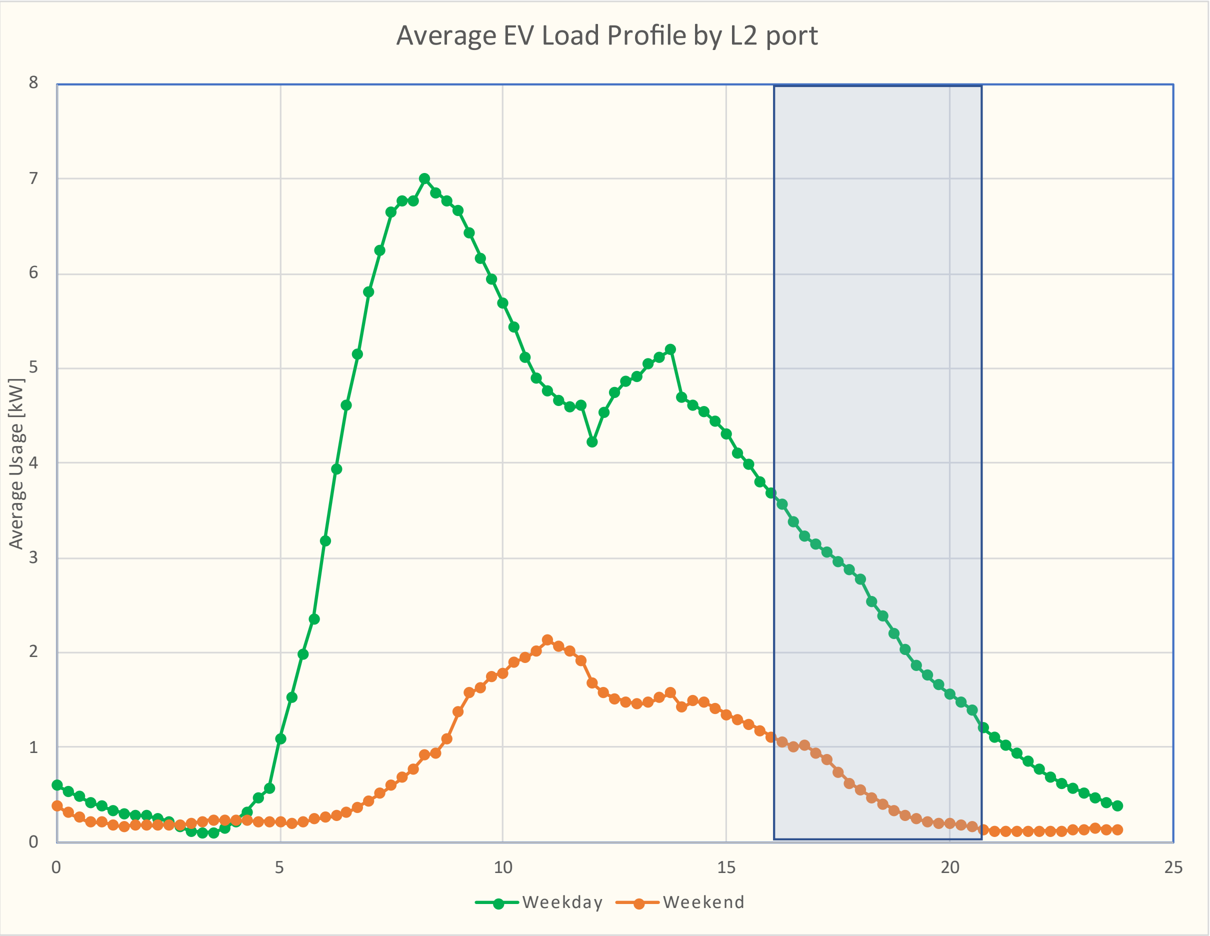
- If EV charging is on a dedicated meter, it cannot benefit from the resilience provided by a Solar Microgrid serving the main facility.
- Hence, some or all of the EV Charging Infrastructure (EVCI) should be configured behind-the-meter (BTM).
- EV charging load profiles can be easily developed and added to historical load profiles to perform net zero and economic analyses.

BTM EV charging is also required to optimize economic benefits from coming Policies & Market Mechanisms (P&MM) like those that can be reaped from vehicle-to-building capabilities.

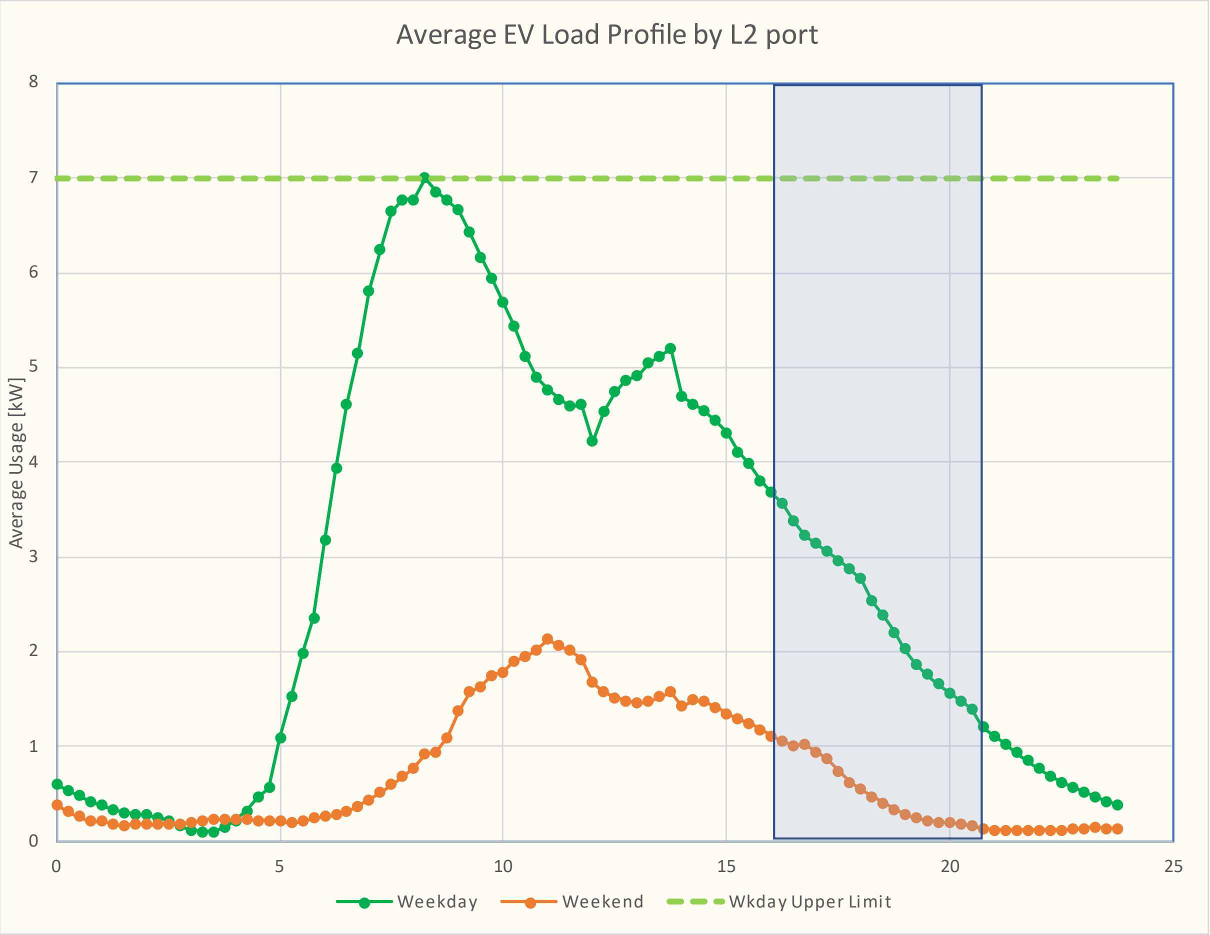
Typical office charging profile

- Weekday and weekend profiles for an office environment.
- Values show actual data gathered & averaged from a large bank of Level-2 (L2) charging ports capped at 7 kW.
- Note the weekday lunchtime curve as EVs are moved.
- The weekend (orange) curve does not reach the same peak as weekday because the lower utilization reduces the average value.



Economics could warrant EV charging constraints

- The only natural charging constraint is the power capacity of the L2 EV chargers, which is 7 kW for each port in this example.
- Economic considerations could warrant charging constraints that avoid excessive demand charges and/or minimize energy usage at peak energy rates.
- Additional economic considerations could result from monetizing demand response (DR) and other grid services.



Example profile for optimizing EV charging economics

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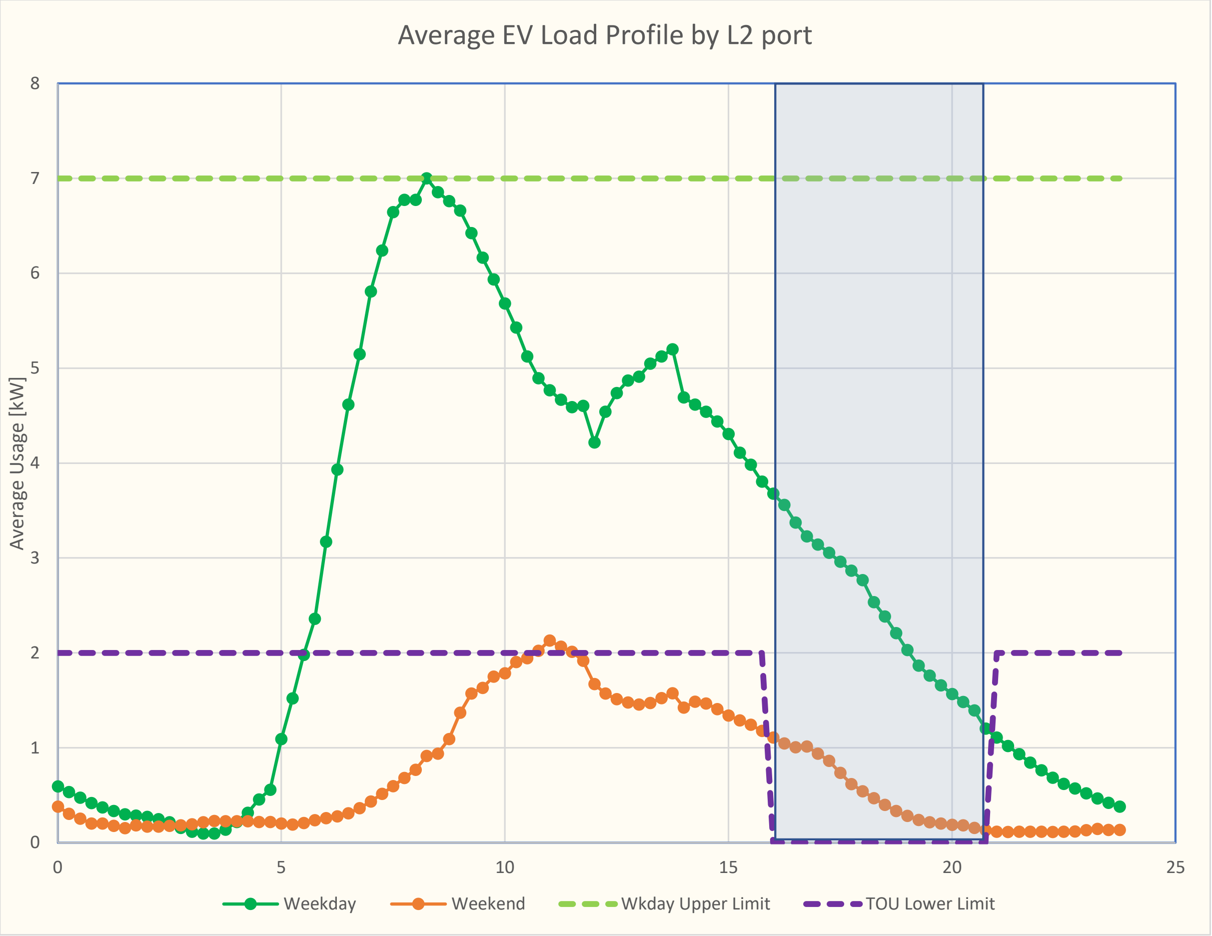
- The purple line shows a maximum EV charging profile that could be set to avoid excessive demand charges and prohibit EV charging via peak energy rates.
- Such limits will be increasingly important as more EV charging proliferates.
- The constrained profile limits charging to 2 kW per port and completely prohibits charging during 4-9pm peak energy rates.



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Valencia Gardens Energy Storage (VGES) case study

Valencia Gardens Apartments in San Francisco

Lots of solar on the Valencia Gardens Apartments

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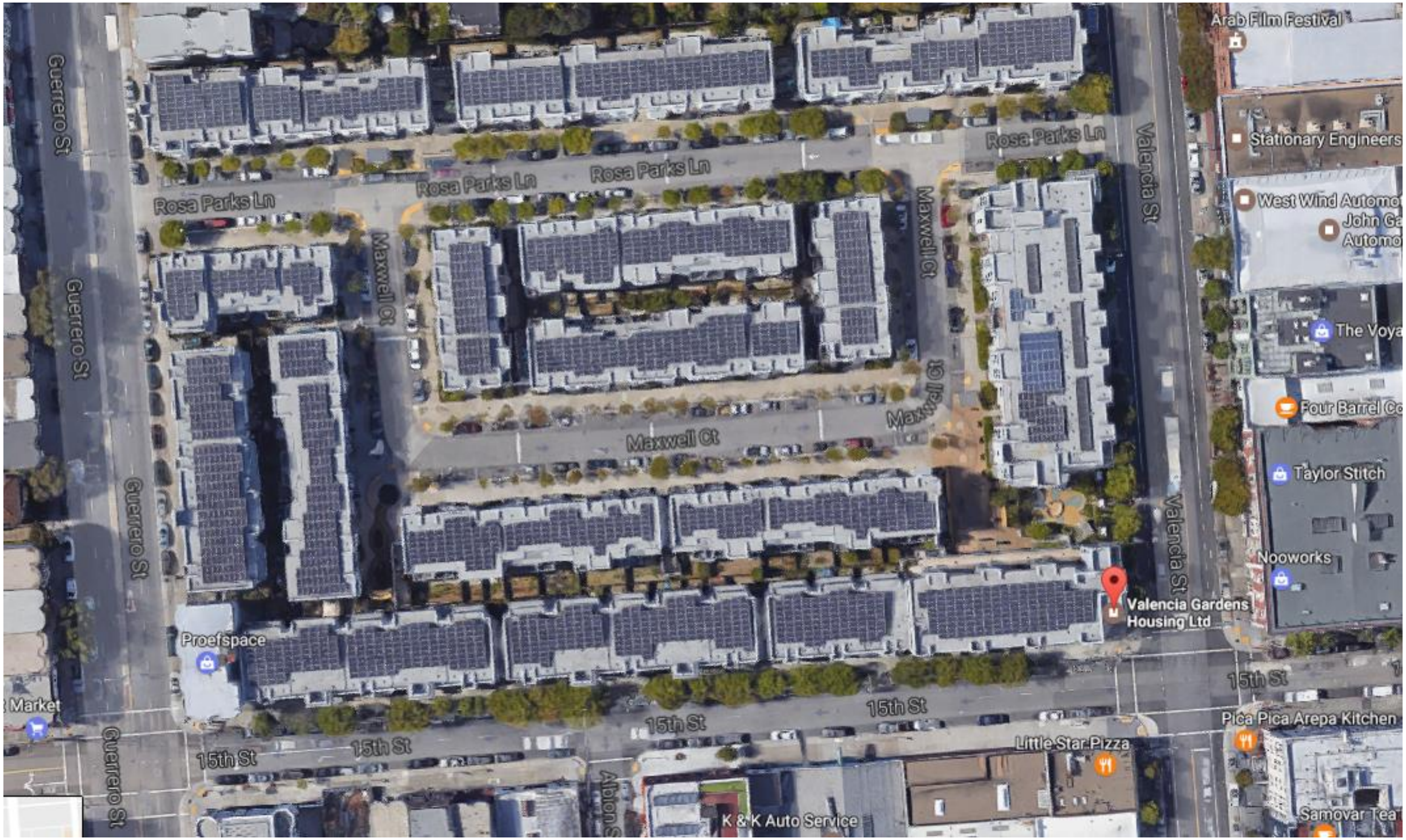

Future VGES Community Microgrid opportunity

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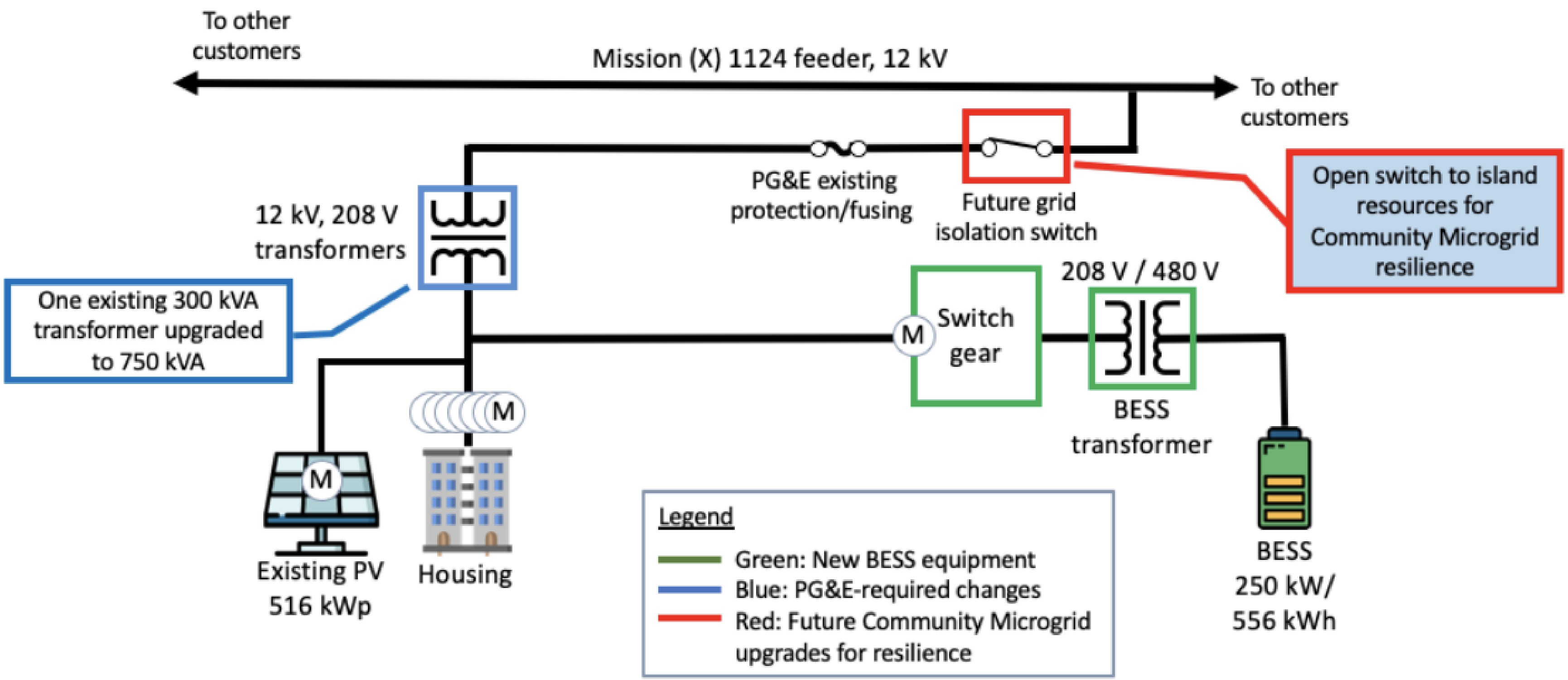

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Goleta Load Pocket (GLP) Community Microgrid case study

Goleta Load Pocket (GLP) and attaining resilience

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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.

Target 66kV feeder at the core of the GLP

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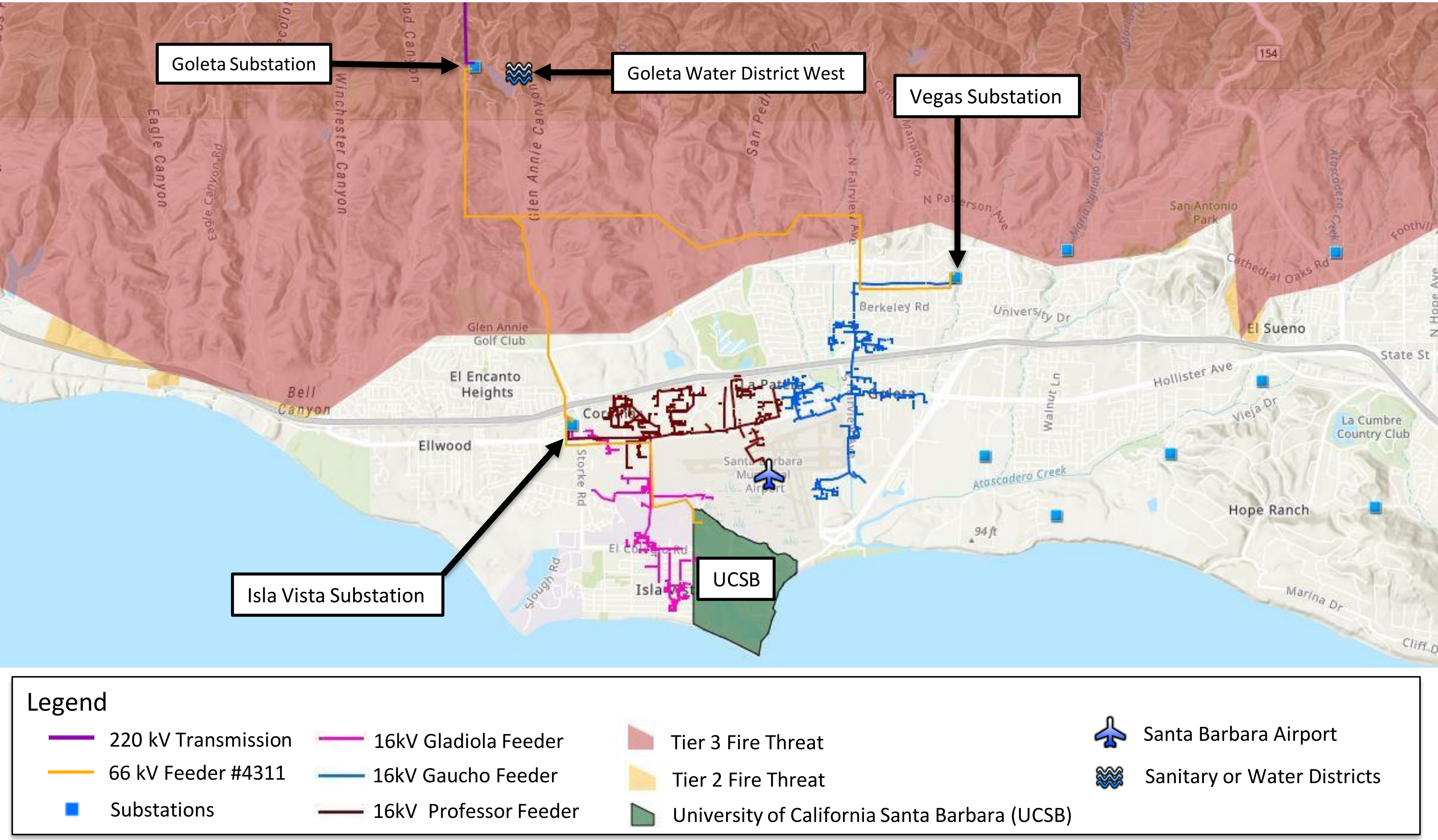

Target 66kV feeder serves critical GLP loads

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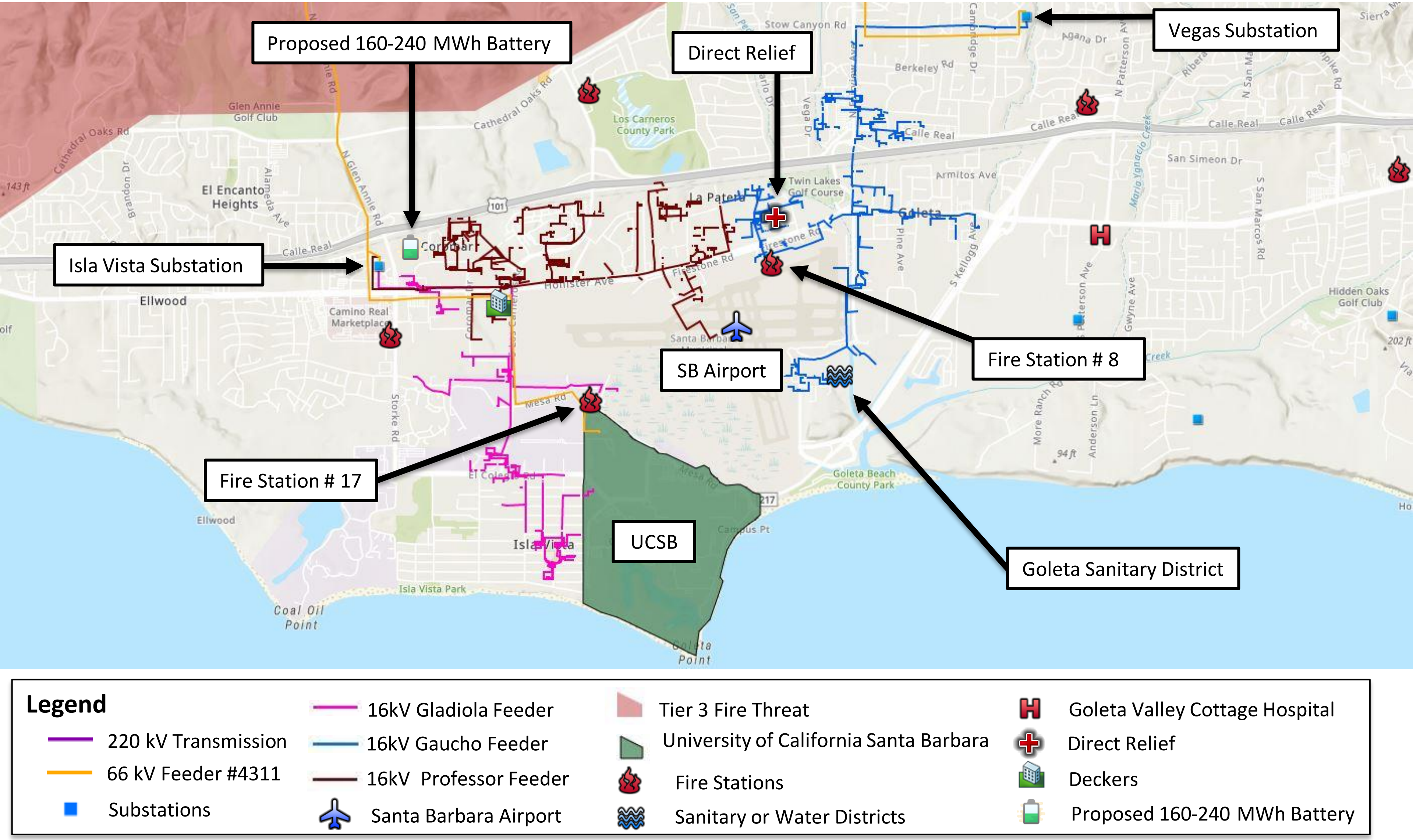

Target 66kV feeder grid area block diagram

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