Clean Coalition

Solar Microgrids

Unparalleled trifecta of economic, environmental, and resilience benefits

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Mission

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

100% renewable energy end-game

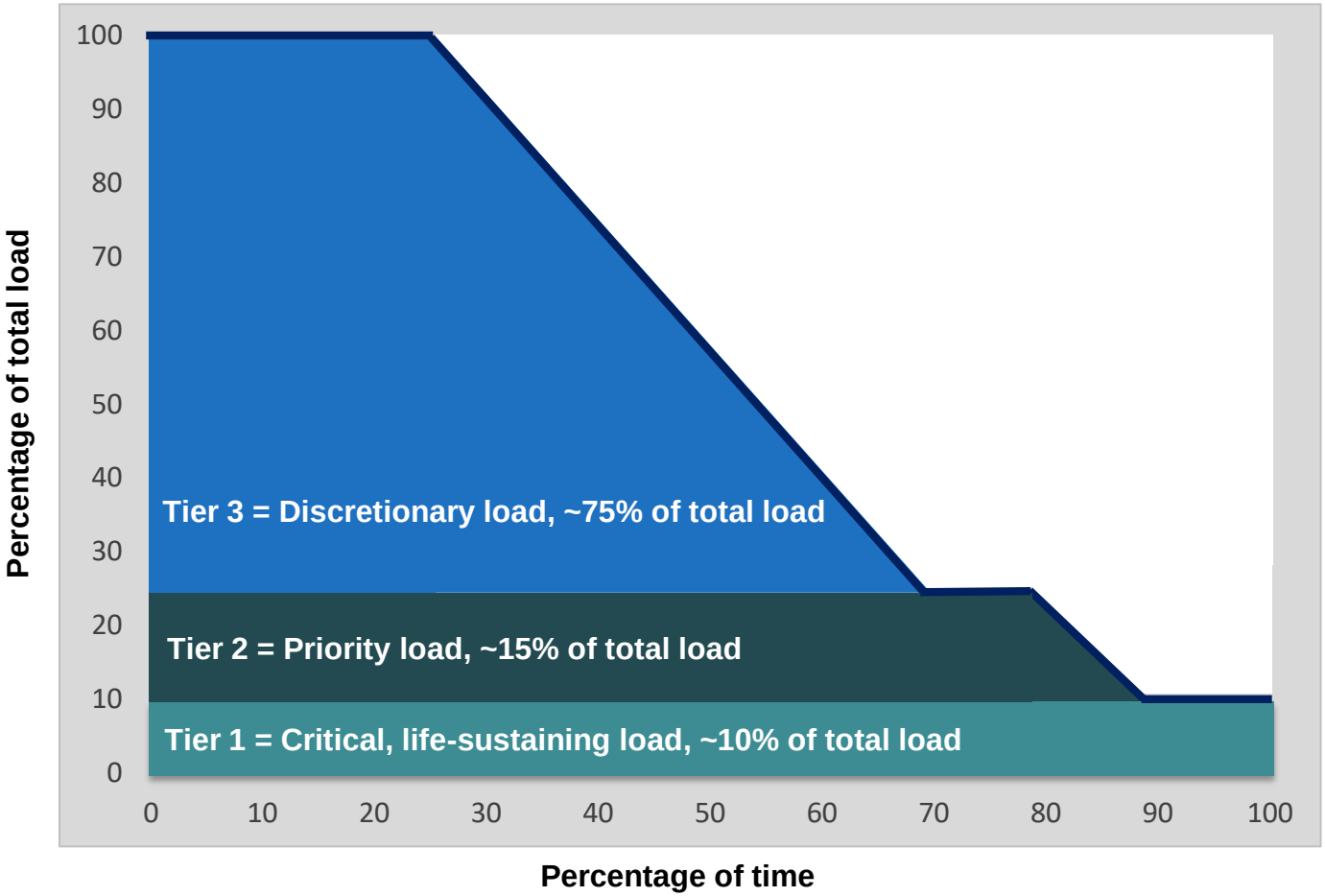
- 25% local, interconnected within the distribution grid and facilitating resilience without dependence on the transmission grid.
- 75% remote, dependent on the transmission grid for serving loads.

Solar Microgrid key concepts

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

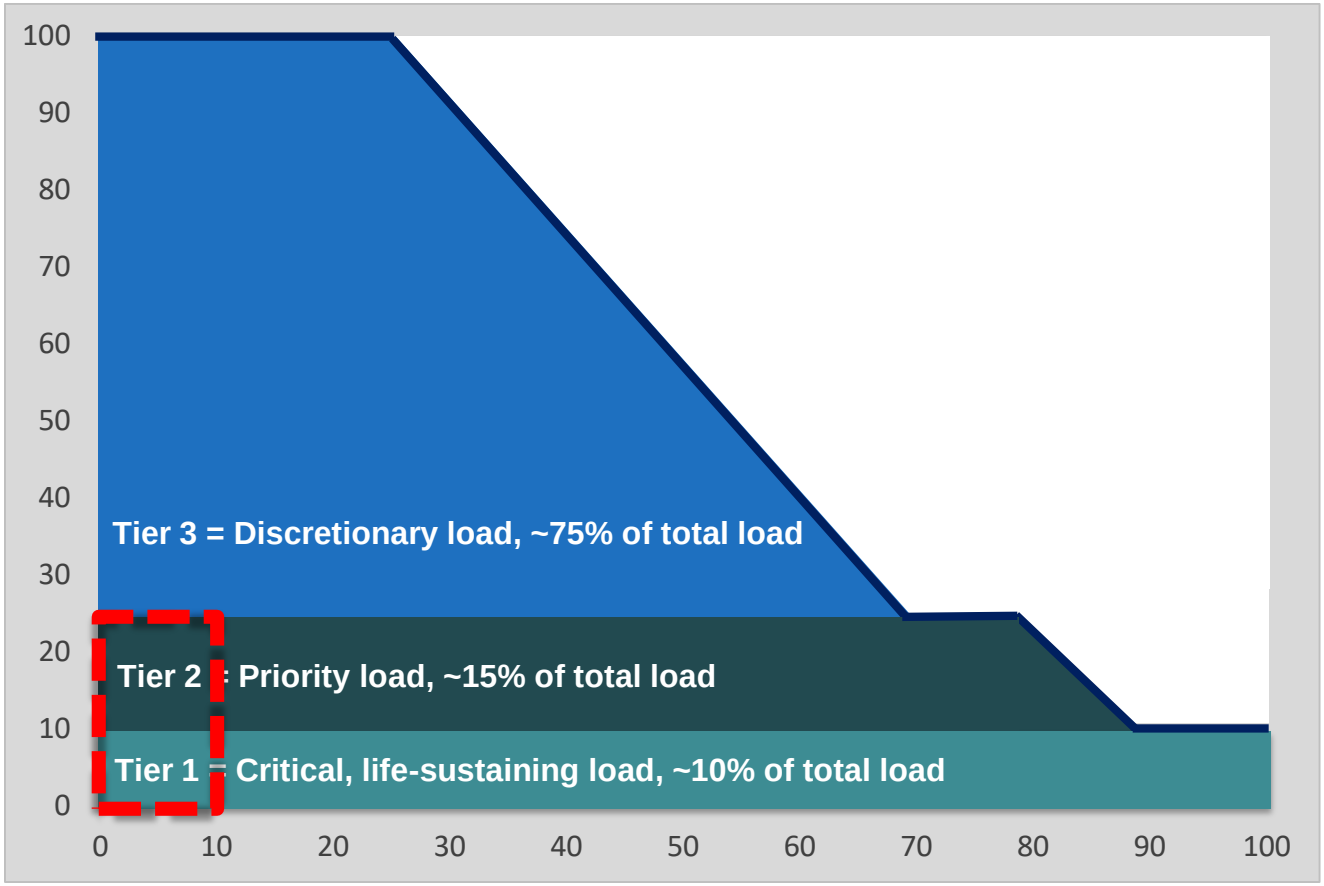
- Everyone understands there is significant value to resilience provided by indefinite renewables-driven backup power, especially for the most critical loads
  - But, nobody has quantified this value of unparalleled resilience.
  - Hence, there is a substantial economic gap for renewables-driven microgrids.
- 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 ("VOR123") 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.
  - Tier 2 are priority loads that should be maintained as long 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.
  - Tier 3 are discretionary loads make up the remaining loads, usually about 75% of the total load. Maintained when doing so does not threaten Tier 1 & 2 resilience.

Typical load tier resilience from a Solar Microgrid



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 enough energy storage capacity to hold 2 hours of the nameplate solar (200 kWh 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. f 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:

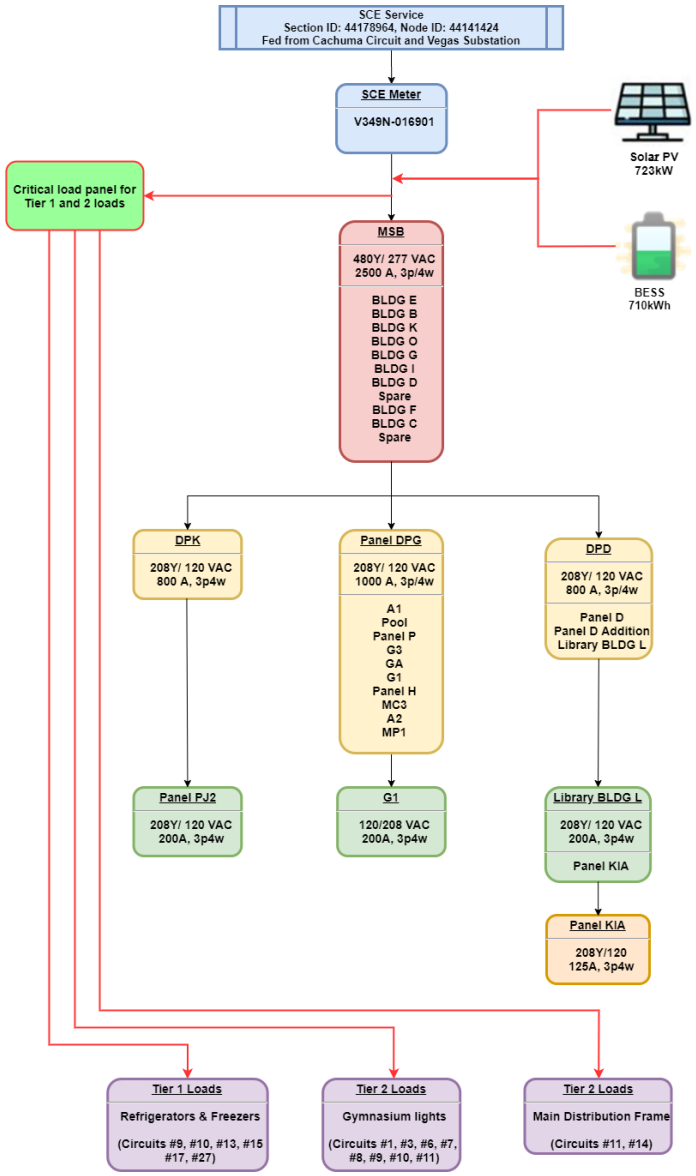
- **Tier 1**: 100% resilience is worth 3 times the average price paid for electricity. In other words, indefinite energy resilience for critical loads is worth 3 times the average price paid for electricity. Given that the typical facility has a Tier 1 load that is about 10% of the total load, applying 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.

Load Management is fundamental to VOR123

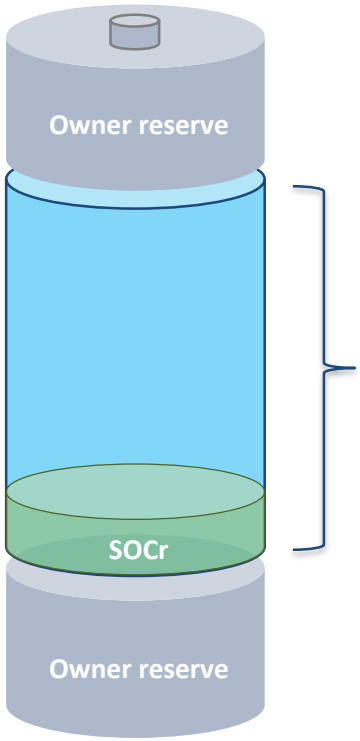
Although there are multiple potential Load Management configurations, the minimal functionality anticipated to be cost-effectively implemented is referred to as **the Critical Load Panel (CLP) approach**.

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.



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.

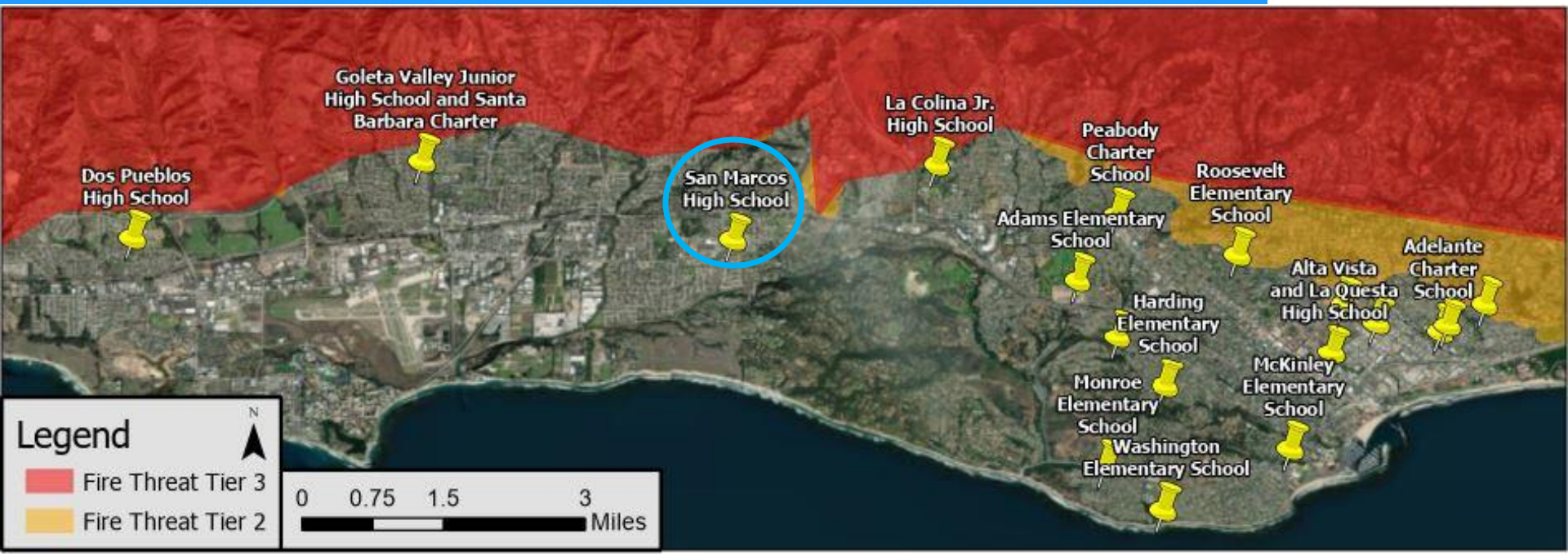
Santa Barbara Unified School District (SBUSD)

Solar Microgrids case study

SMHS is vulnerable to long transmission outages

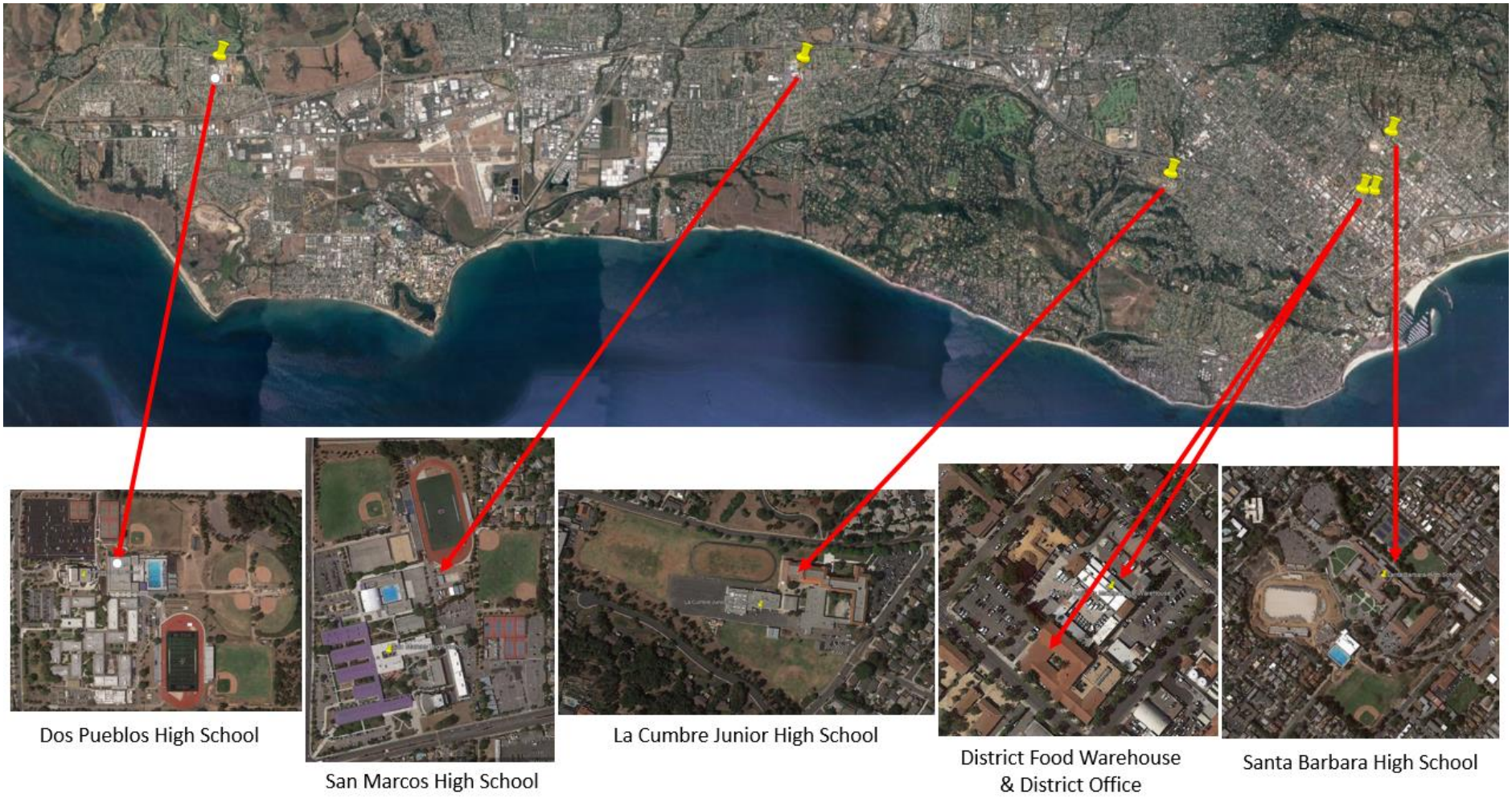
- SMHS is located in the middle of one of the most grid-vulnerable regions in California: the **Goleta Load Pocket (GLP).**
- The GLP spans 70 miles of California coastline, from Point Conception to Lake Casitas, encompassing the cities of Goleta, Santa Barbara (including Montecito), and Carpinteria.
- The GLP is served by a single 40-mile transmission line routed through mountainous and disaster-prone terrain.
- Southern California Edison (SCE) has identified the GLP's transmission path as being **vulnerable to catastrophic failure from fire, earthquake, and/or landslides that could cause a crippling, extended blackouts of weeks or even months in duration.**

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



SBUSD unanimously approves Solar Microgrids

After a comprehensive feasibility study and a state-of-the-art Request for Proposal (RFP) process, on 22 September 2020, the SBUSD Board approved moving forward with the Solar Microgrids:

- 100% for Tier 1 loads (critical loads), 80% resilience for Tier 2 loads (priority loads), and about 25% resilience for Tier 3 loads (all remaining loads, which are totally discretionary).

- Millions of dollars in economic benefits via a 28-year Power Purchase Agreement (PPA) and millions more in value-of-resilience (VOR), for free.

- In addition to the six Solar Microgrids, eight additional schools will be getting solar parking canopies, enough to approximately net zero in all cases.

Guaranteed SBUSD bill savings and free VOR

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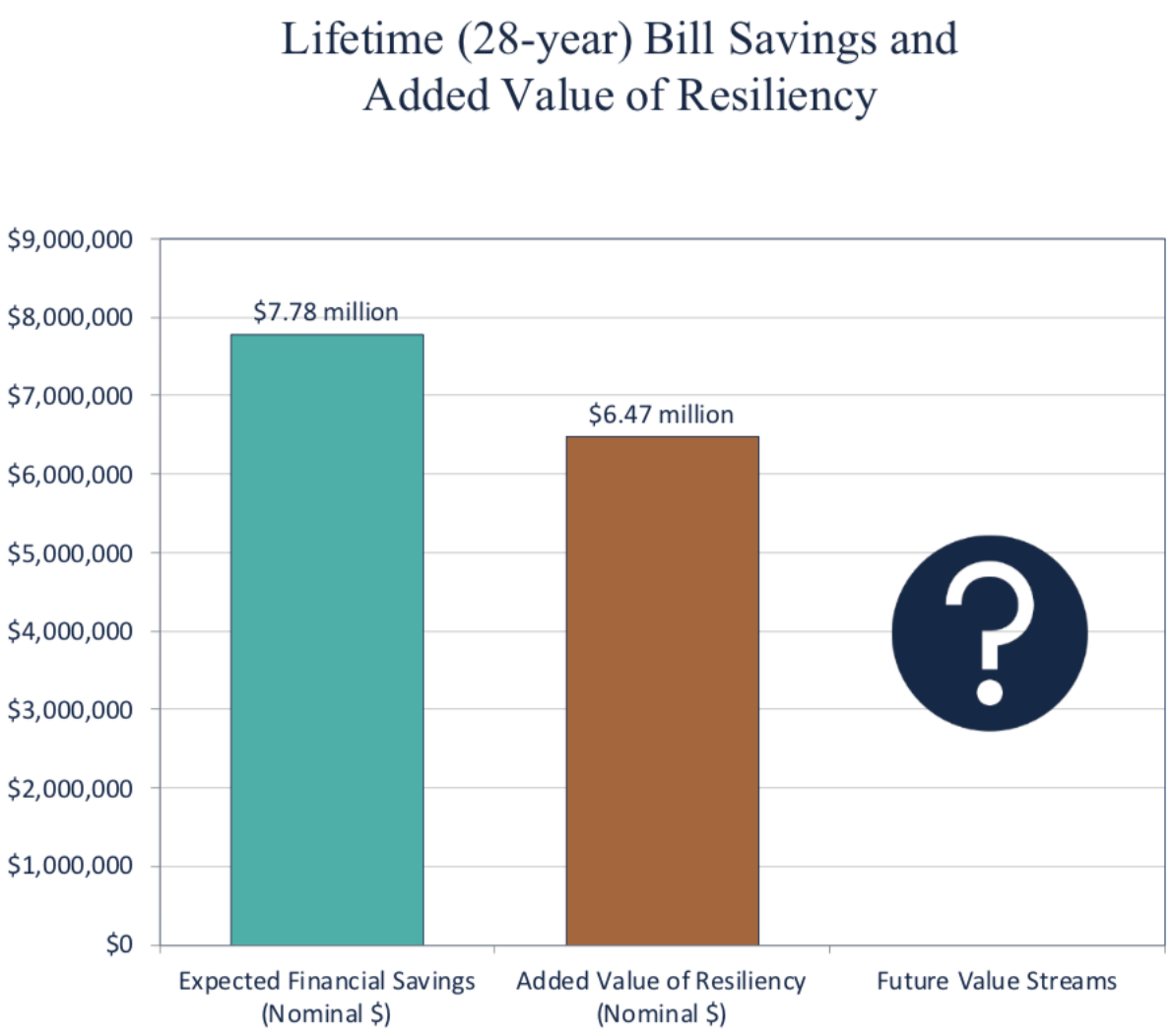

City of Camarillo feasibility study

Camarillo feasibility study sites & constraints

- Determine the critical electrical needs for each site during a power outage, including business continuity for the following sites:
  - City Hall
  - Corp Yard
  - Library
  - Police Station
  - WWTP
- Provide recommendations for a standby power system that meets the City's environmental, economic, and resilience goals.
- Analyze system power rating for 150% of the average daily use and meet peak demand.
- Analyze a system capable of serving the building loads through 120-hours (5 days) of outage.
- Recommend an optimal microgrid standby system that strengthens resiliency and is financially feasible.

Fire & earthquake risk to Camarillo critical community facilities (CCFs)

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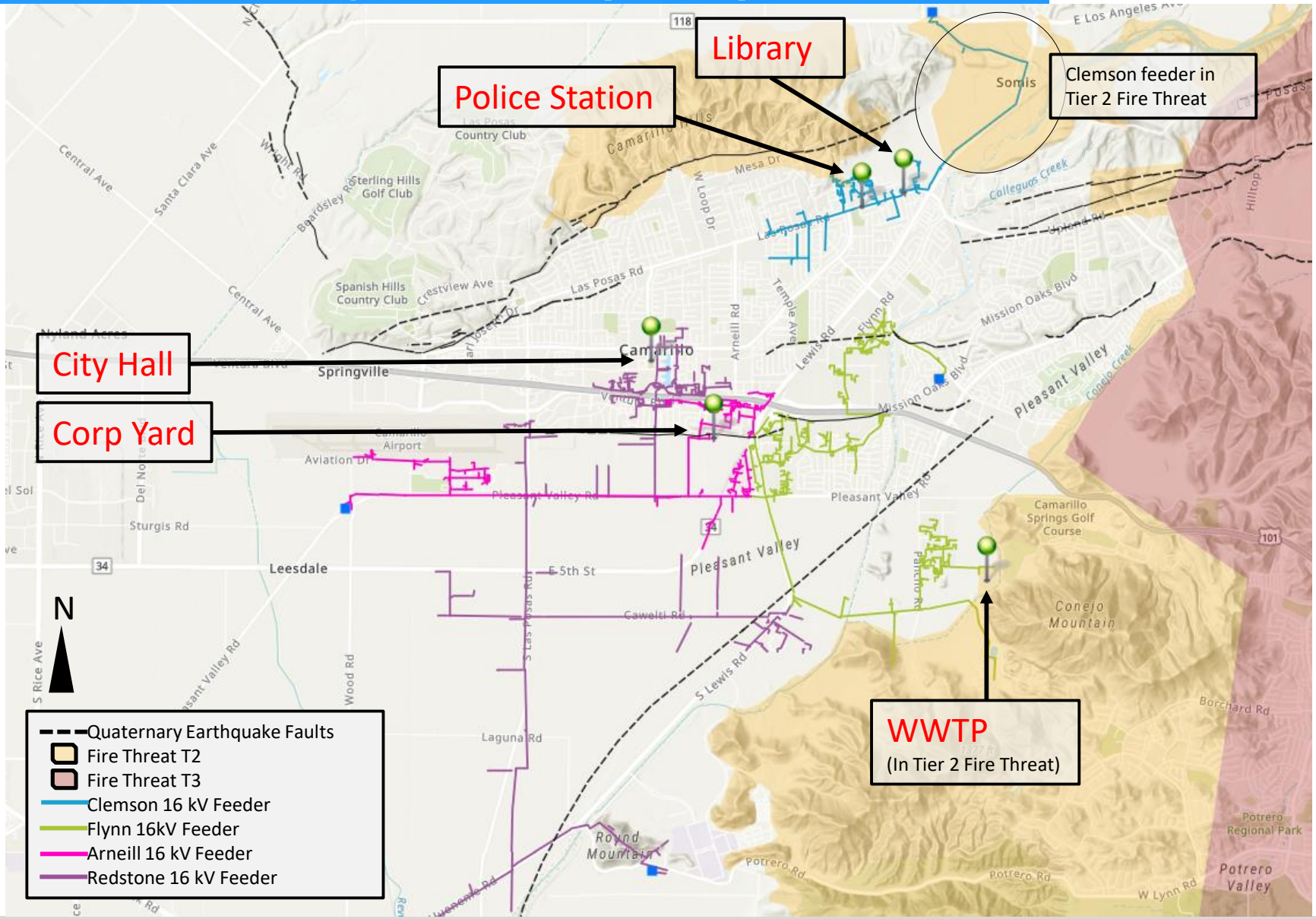

Flood risk to Camarillo CCFs

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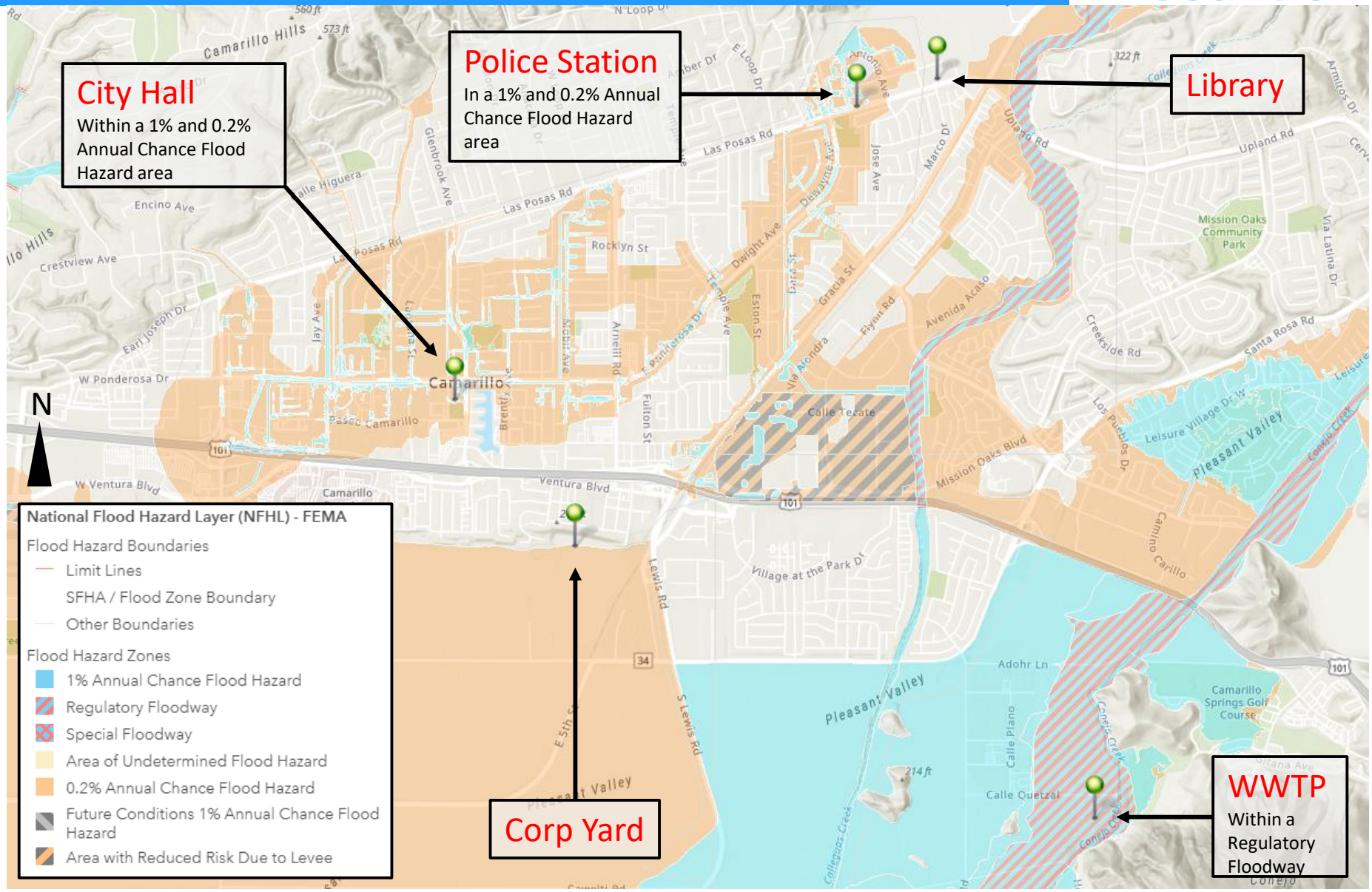

Description of scenarios, resources, and load served

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Site	Scenarios	Resources	Load served
City Hall	Solar+Storage	Solar+Storage	150% of average daily load Indefinite
	Storage Only	Storage Only	150% of average daily load for 5 days
	Diesel Only	Diesel Only	150% of average daily load for 5 days
	Solar+Storage+Diesel	Solar+Storage+Diesel	150% of average daily load for 5 days or 19.6% of average daily loads indefinite
Corp Yard	Solar+Storage	Solar+Storage	150% of average daily load Indefinite
	Storage Only	Storage Only	150% of average daily load for 5 days
	Diesel Only	Diesel Only	150% of average daily load for 5 days
	Solar+Storage+Diesel	Solar+Storage+Diesel	150% of average daily load for 5 days or 16.0% of average daily loads indefinite
Library	Solar+Storage	Solar+Storage	150% of average daily load Indefinite
	Storage Only	Storage Only	150% of average daily load for 5 days
	Diesel Only	Diesel Only	150% of average daily load for 5 days
	Solar+Storage+Diesel	Solar+Storage+Diesel	150% of average daily load for 5 days or 21.8% of average daily loads indefinite
Police Station	Solar+Storage	Solar+Storage	150% of average daily load Indefinite
	Storage Only	Storage Only	150% of average daily load for 5 days
	Diesel Only	Diesel Only	150% of average daily load for 5 days
	Solar+Storage+Diesel	Solar+Storage+Diesel	150% of average daily load for 5 days or 25.4% of average daily loads indefinite
WWTP	Solar+Storage	Solar+Storage	150% of average daily load Indefinite
	Storage Only	Storage Only	150% of average daily load for 5 days
	Diesel Only	Diesel Only	150% of average daily load for 5 days
	Solar+Storage+Diesel	Solar+Storage+Diesel	150% of average daily load for 5 days or 18.4% of average daily loads indefinite

Note: Solar+Storage is oversized to cover loads for full 120 hours during worst solar period.
Solar+Storage+Diesel is sized to ZNE solar and 1-2 hour storage.

City Hall Load 150% indefinite
Resource: Solar+Storage

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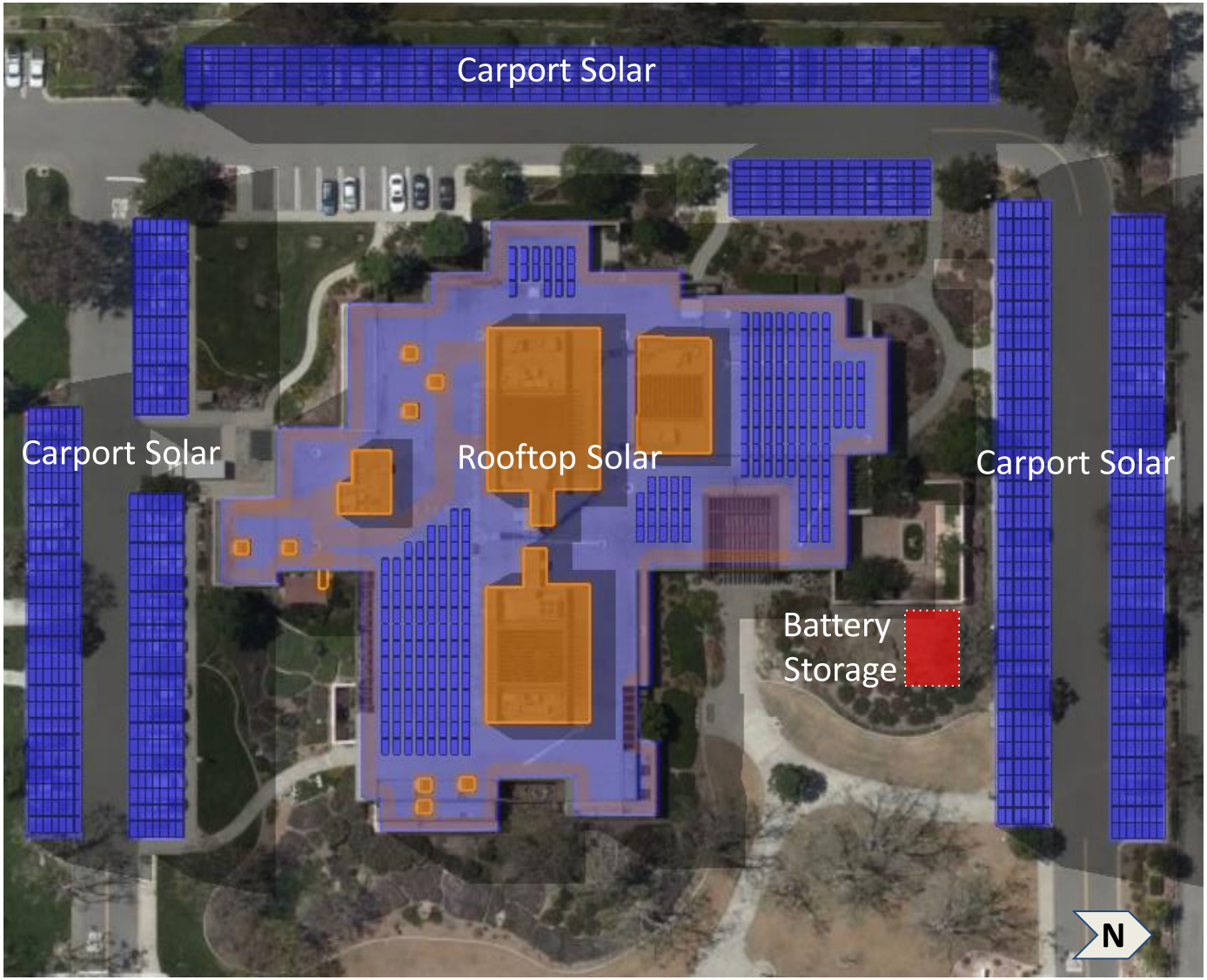
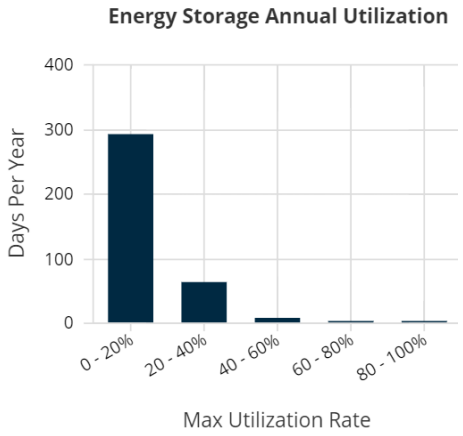
Solar: 646 kW
Storage: 3 MWh

CapEx: $5.17M





City Hall Load 150% for 5 days or 19.6% indefinite.
Resource: Solar+Storage+Diesel

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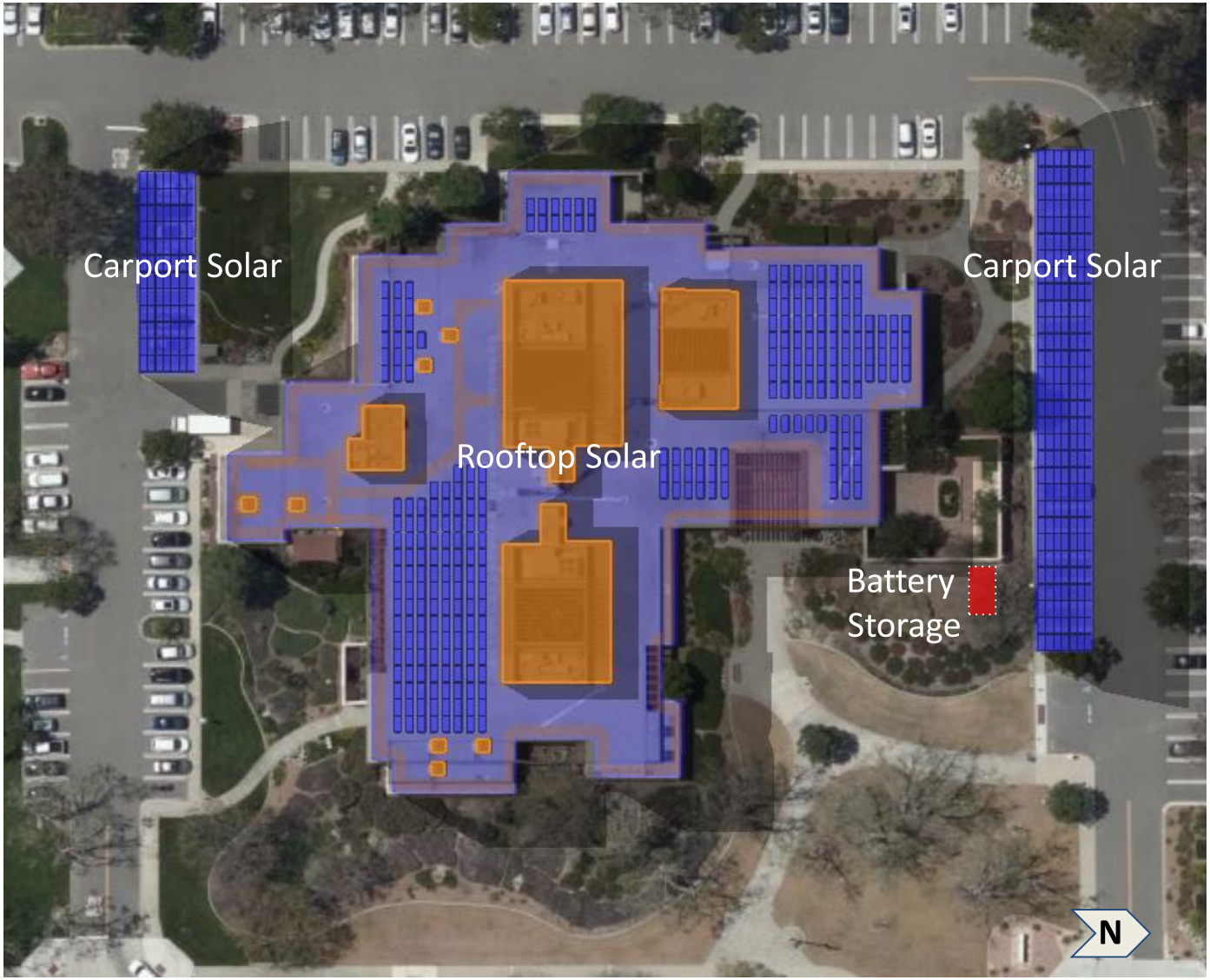
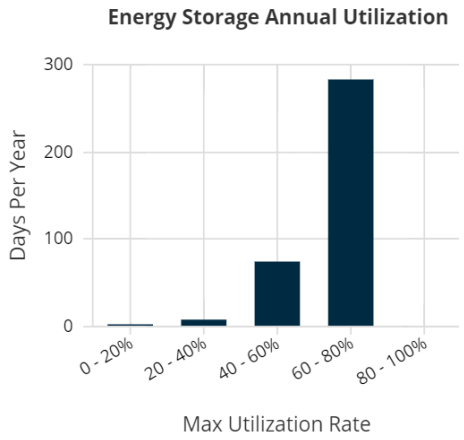
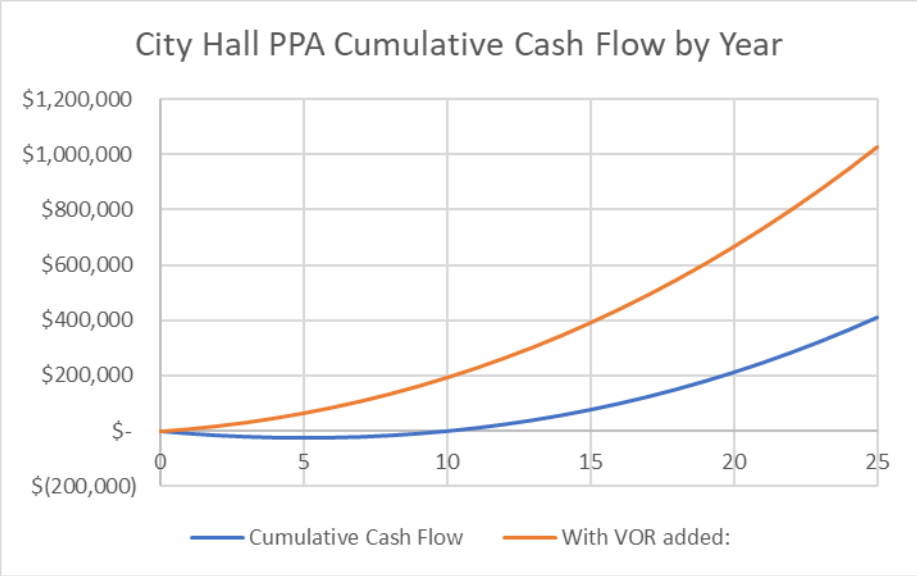
Solar: 224.4 kW
Storage: 420 kWh
Diesel: 139 kW

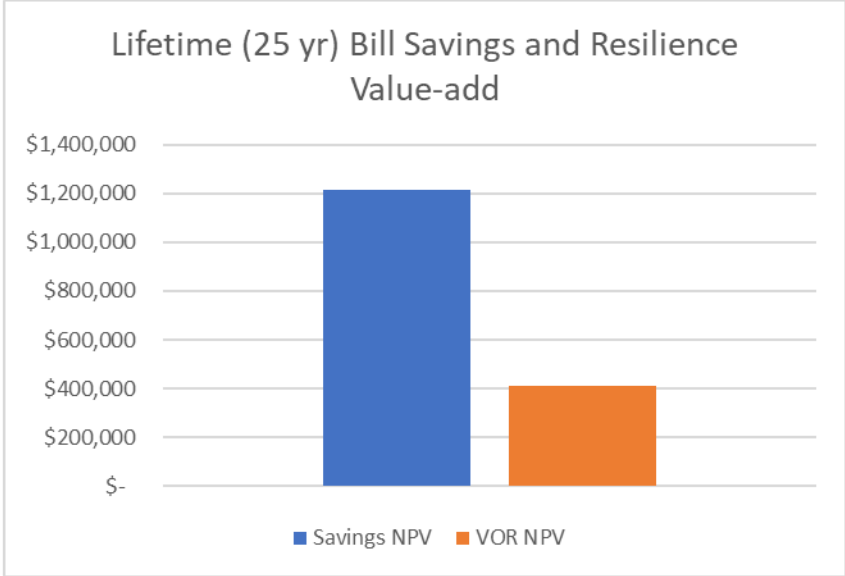
CapEx: $1.38M





City Hall bill savings and VOR





Economic assumptions:

- discount rate of 3%
- annual utility rate escalation of 3%