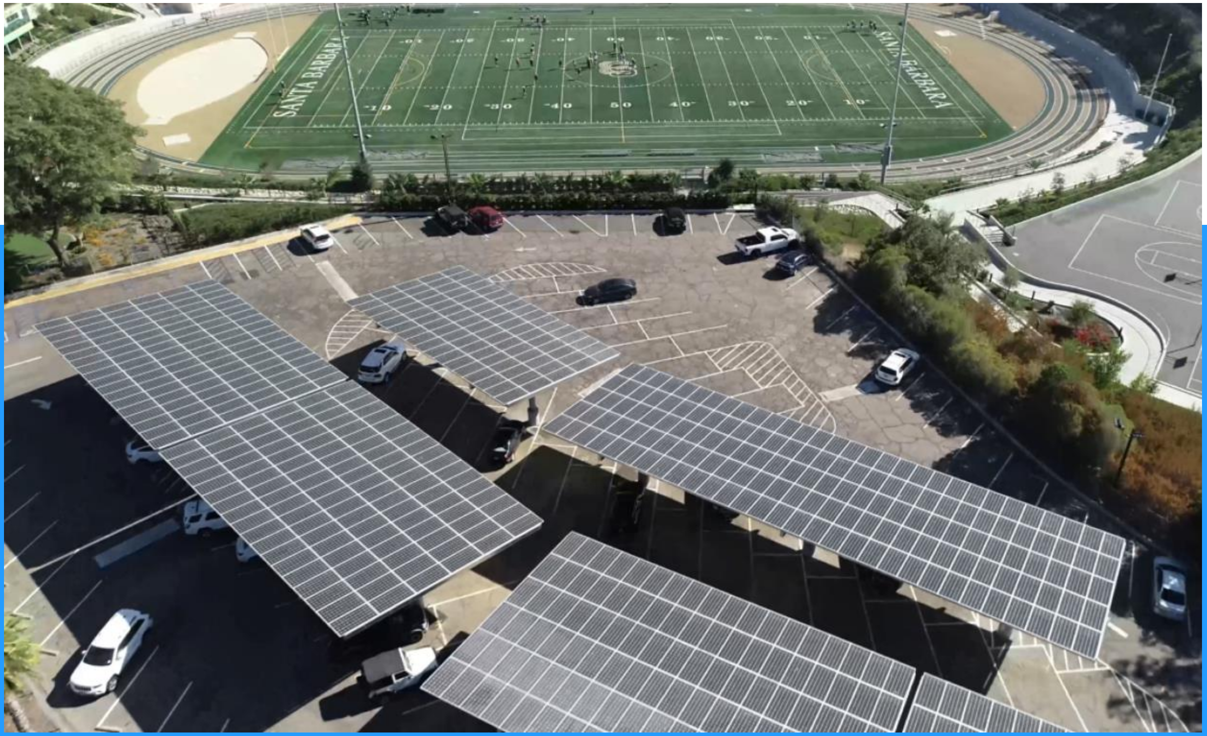
Clean Coalition

Solar Microgrids

delivering unparalleled economic, environmental, and resilience benefits



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Clean Coalition (nonprofit)

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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.

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Update on the GLP Community Microgrid

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.

Value-of-Resilience (VOR)

Typical load tier resilience from Solar Microgrids

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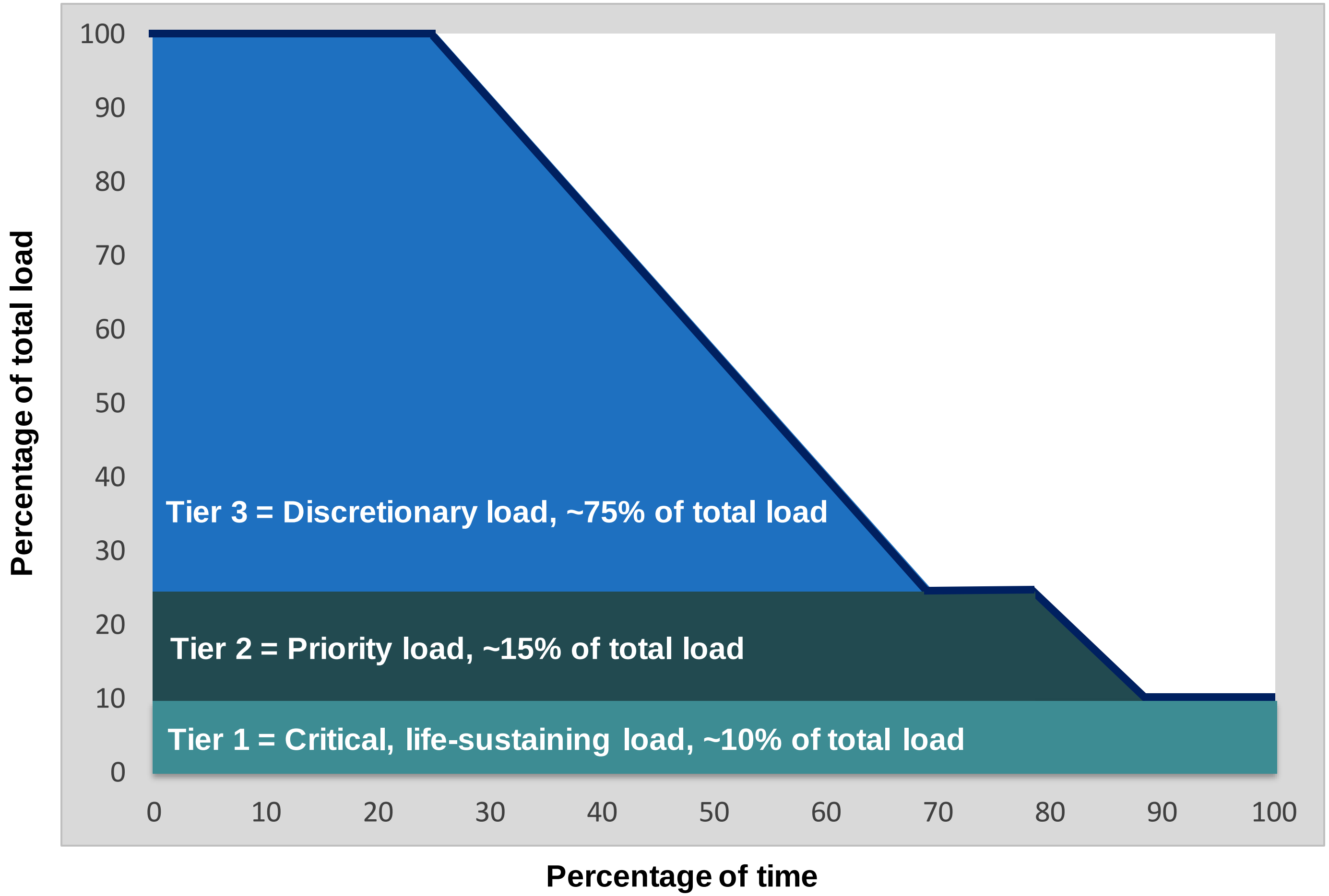

Percentage of time online for Tier 1, 2, and 3 loads for a Solar Microgrid designed for the University of California Santa Barbara (UCSB) with enough solar to achieve net zero and 200 kWh of energy storage per 100 kW solar.

Diesel generators are designed for limited resilience

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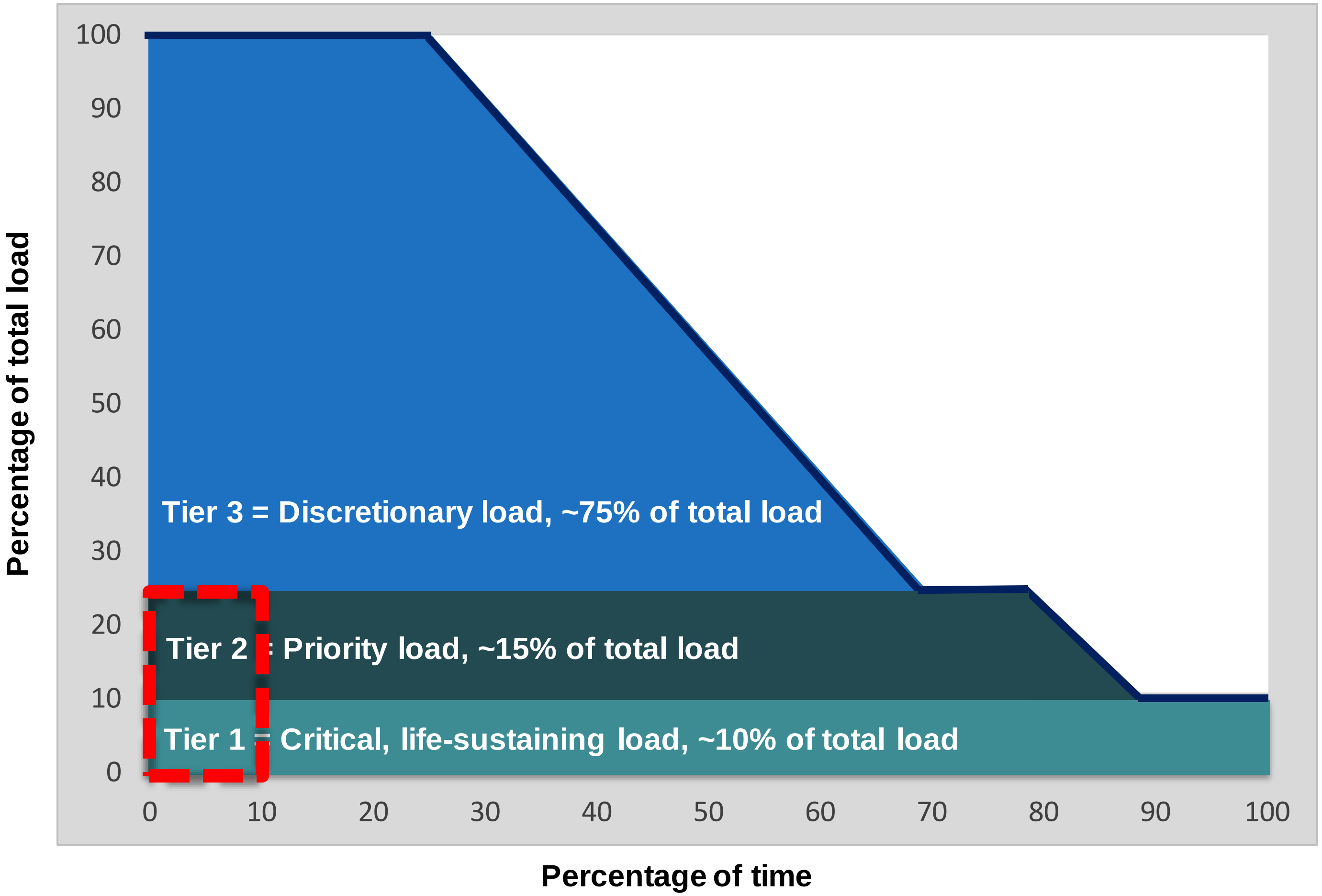

A typical diesel generator is configured to maintain 25% of the normal load for two days. If diesel fuel cannot be resupplied within two days, goodbye. This is hardly a solution for increasingly necessary long-term resilience. In California, Solar Microgrids provide a vastly superior trifecta of economic,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

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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/

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.

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

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Guaranteed SBUSD bill savings and free VOR

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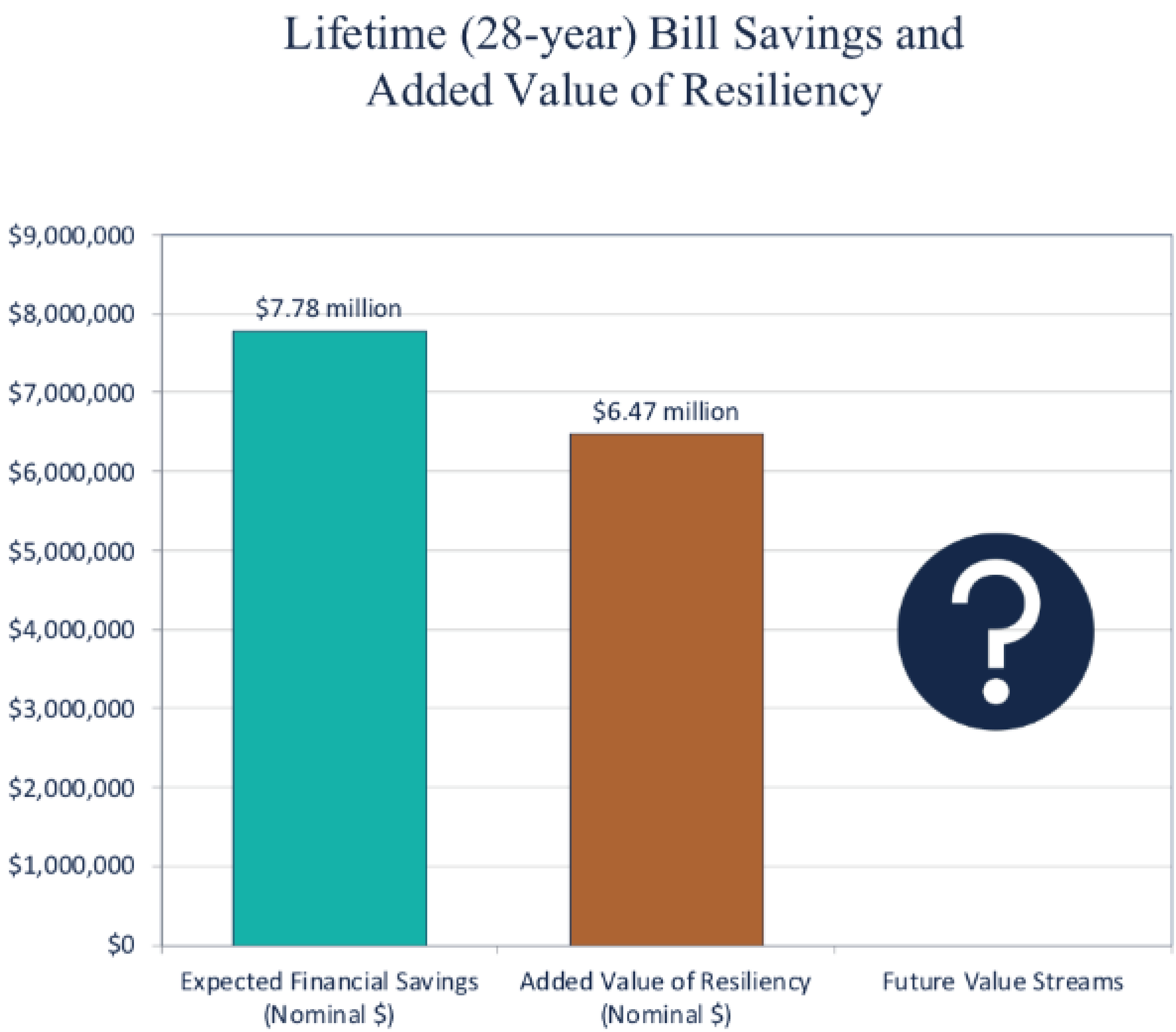

Large farm case study in Carpinteria, CA

Large farm case study in Carpinteria, CA

1.5 MWdc of solar for GH2 meter

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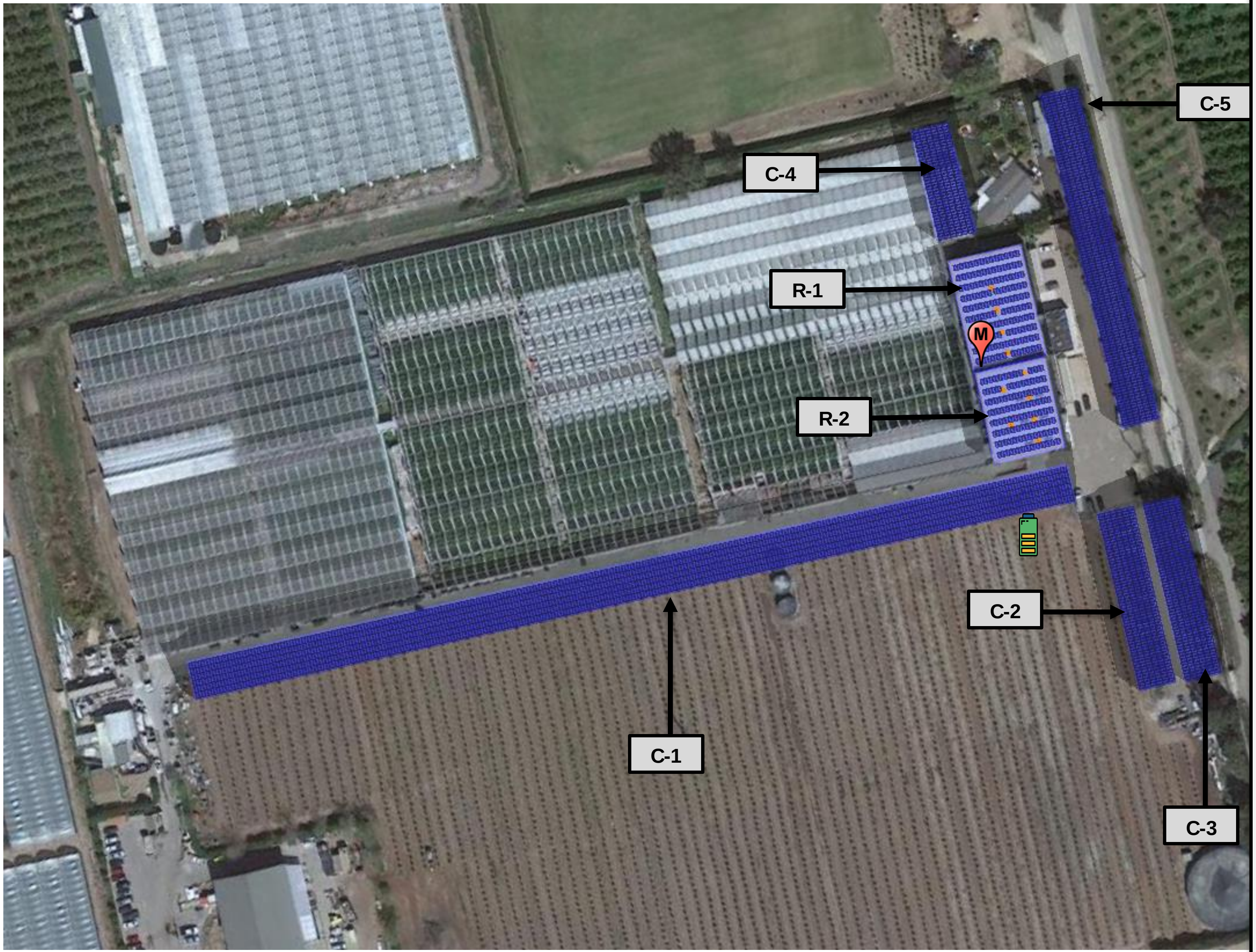

Brand Farms

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

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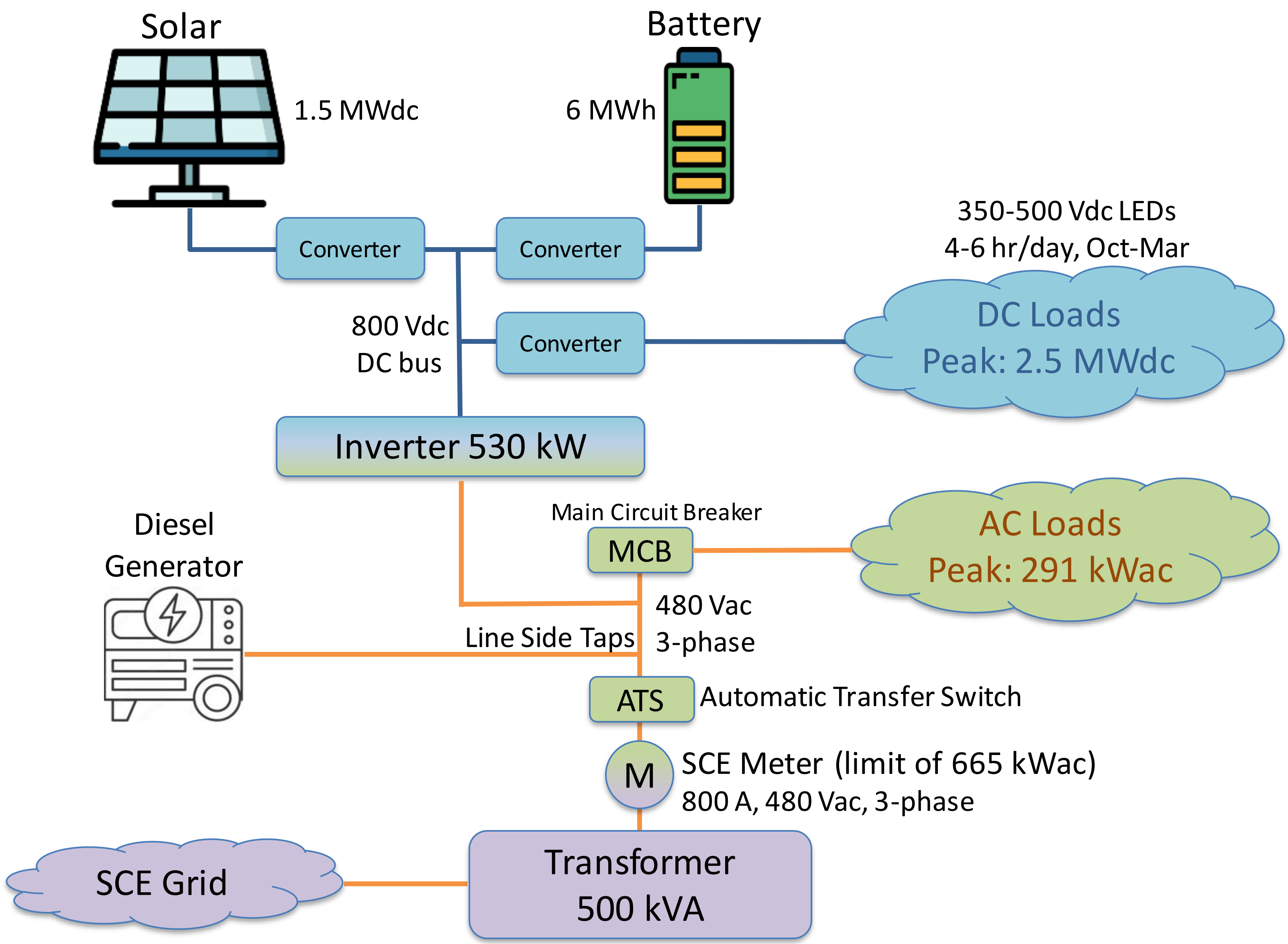

Greenhouse2 economics assuming all future AC & DC loads can be served by the grid

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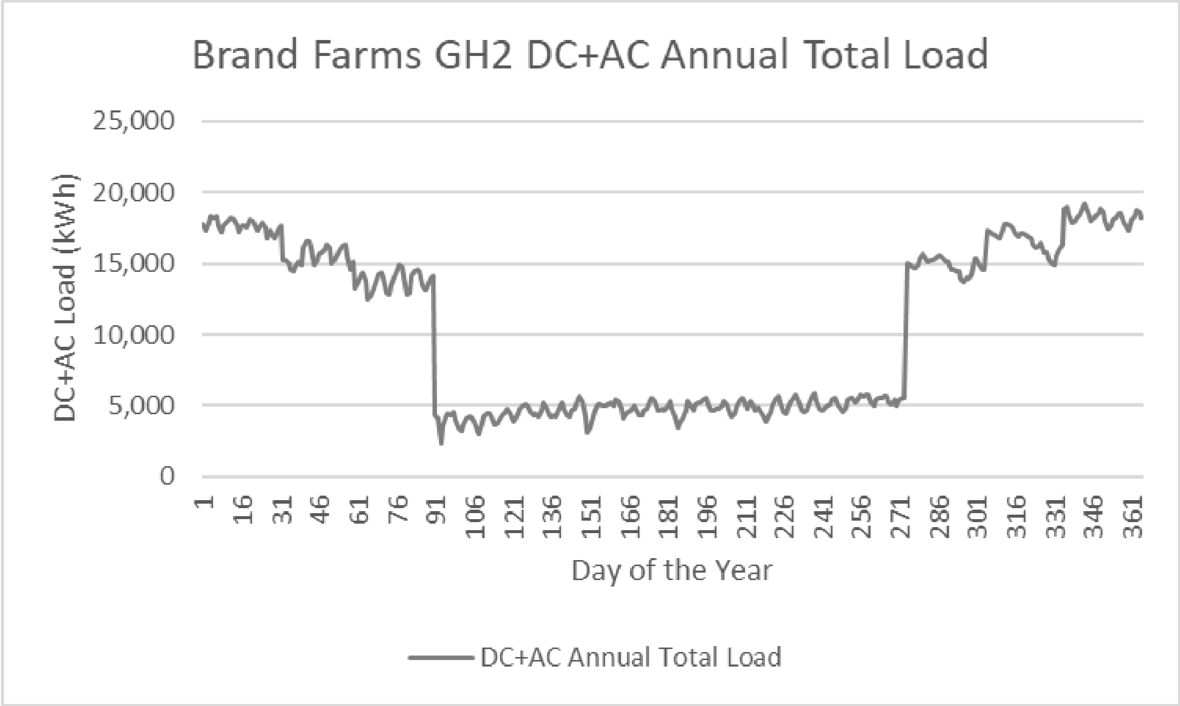

Brand Farms Greenhouse 2 (DC + AC Loads) Business-As-Usual Electricity Bill Cost Based on TOU-8-D and 3CE Rates								
Meter	Scenario Types	Business-As-Usual Blended Utility Rate Over Time at a 5% Utility Price Increase (¢/kWh)			25 Year Electricity Bill Cost			
		Year 1	Year 10	Year 25	Year 1 Total 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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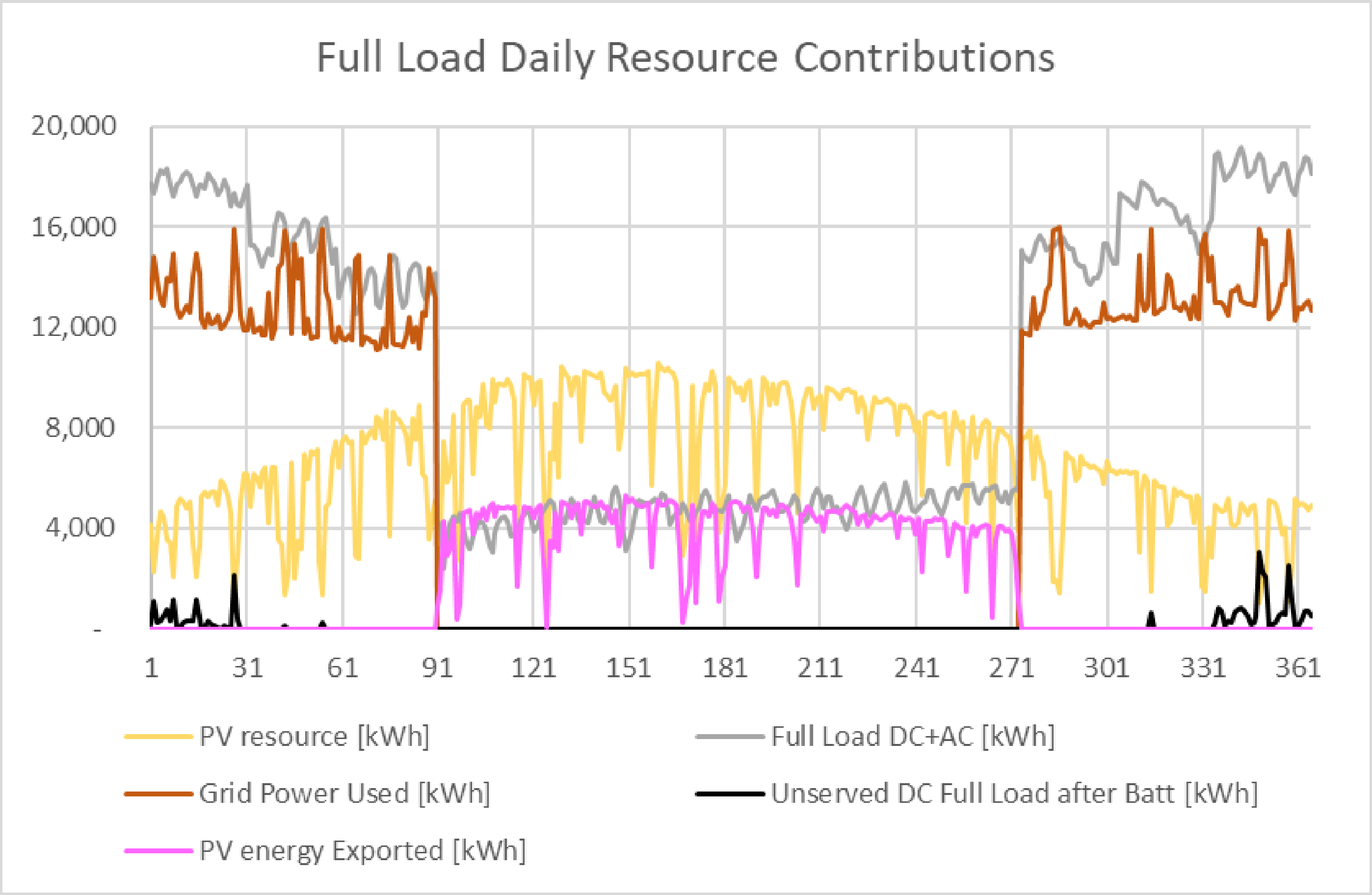
Energy Flow Diagram
1.5 MW solar and 3 MW / 6 MWh energy storage



Backup slides

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Backup Slides

Benefits of Renewables-driven Microgrids

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- Economic
  - Reduces peak transmission usage, which is the biggest driver of increasing electricity rates.
  - Provides value-of-resilience (VOR) that is simply unavailable from remote generation and that is superior compared to fossil-fueled generators.
  - When behind-the-meter (BTM):
    - Provides electricity costs savings compared to buying electricity from the utility.
    - 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 in California are 4-9pm.
  - Eliminates energy losses associated with traversing the transmission grid. An average, more than 10% of remote energy is lost over the transmission grid, due to a combination of resistance and congestion.
  - 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 microgrids

- 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 Solar Microgrid relies on energy storage to time-shift solar and ensure energy availability at night etc.
- 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.

Local means within the distribution grid

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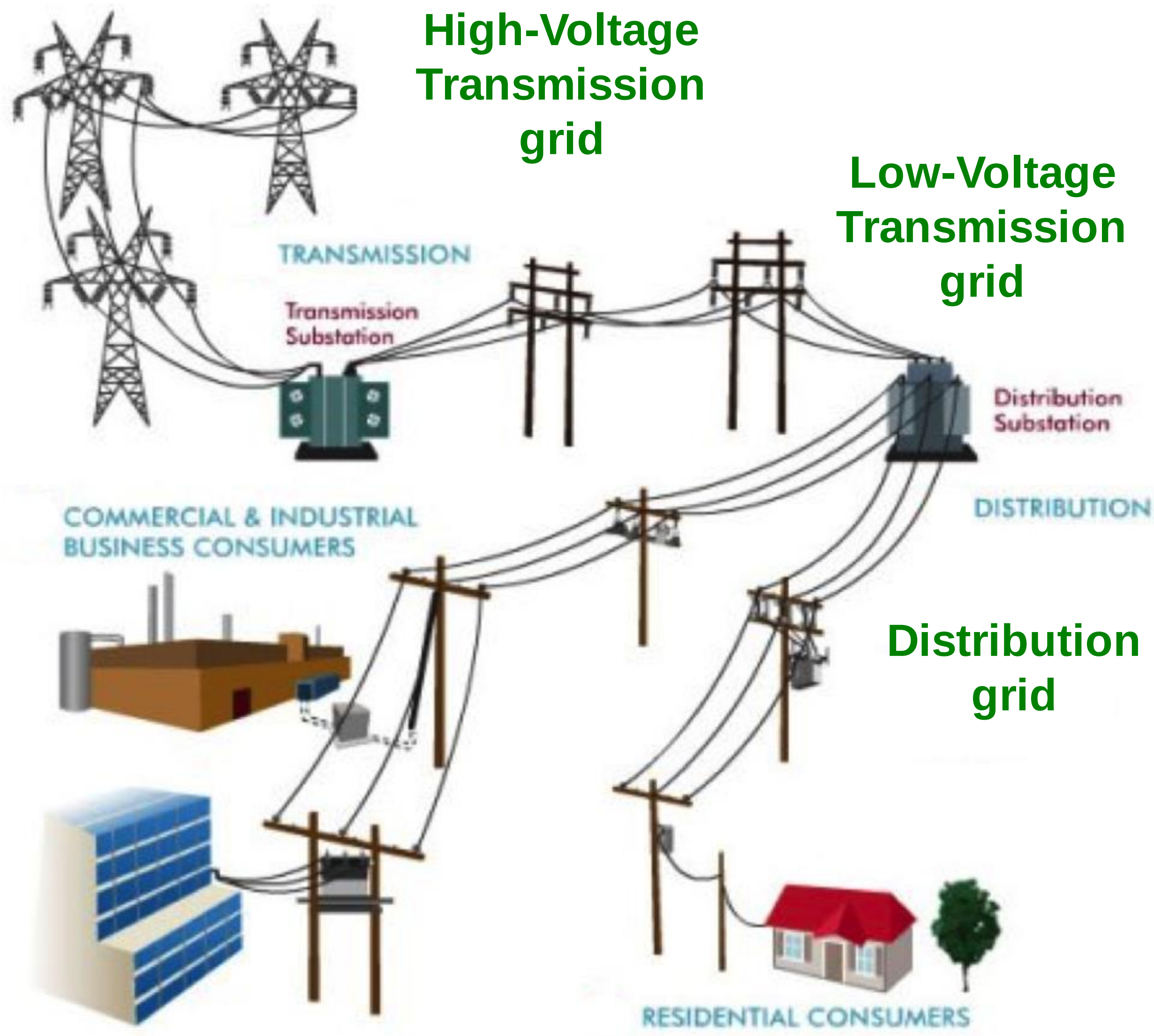

Transmission stress & cost is a massive problem

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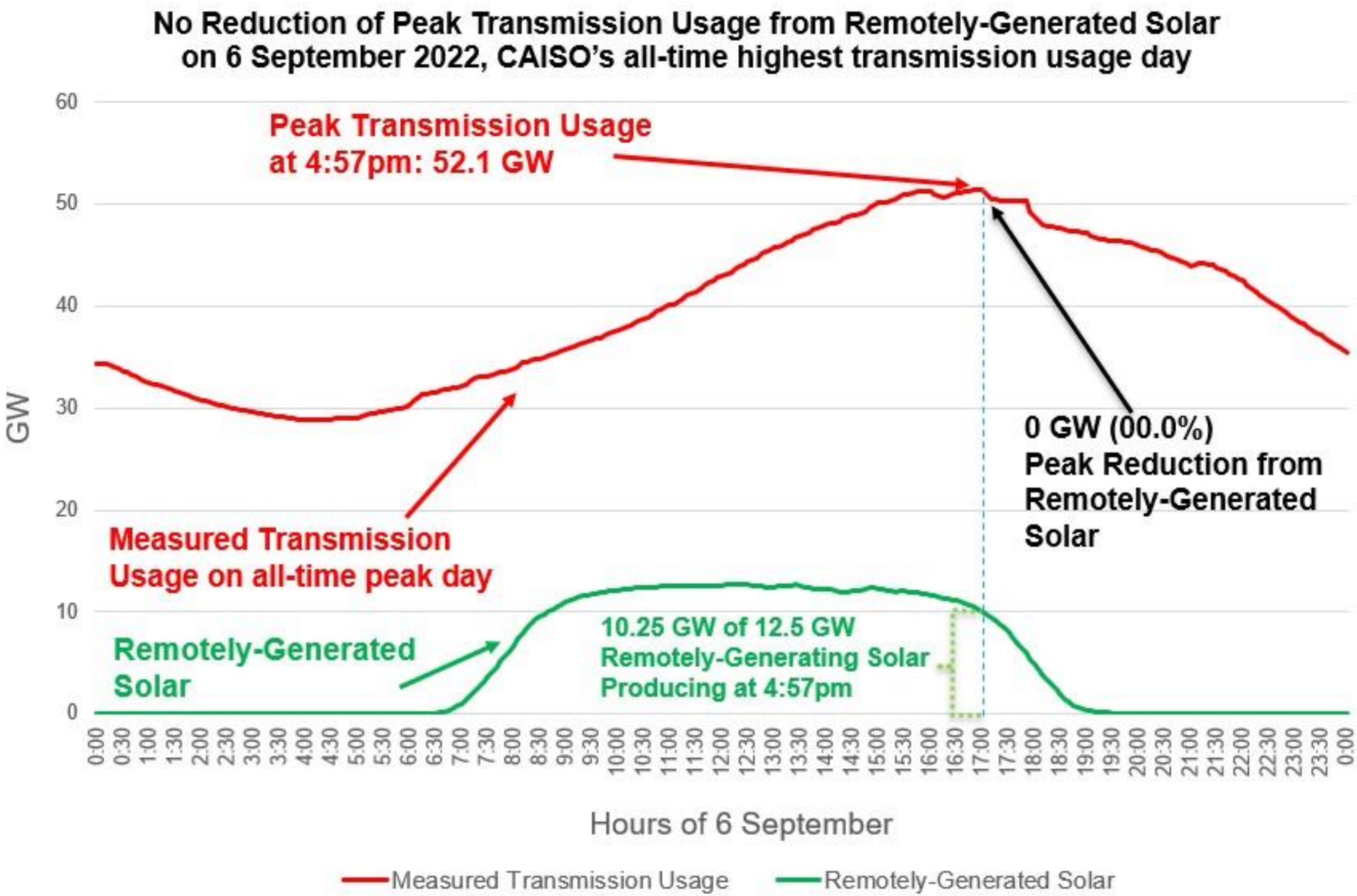

Local Solar reduces transmission stress & costs

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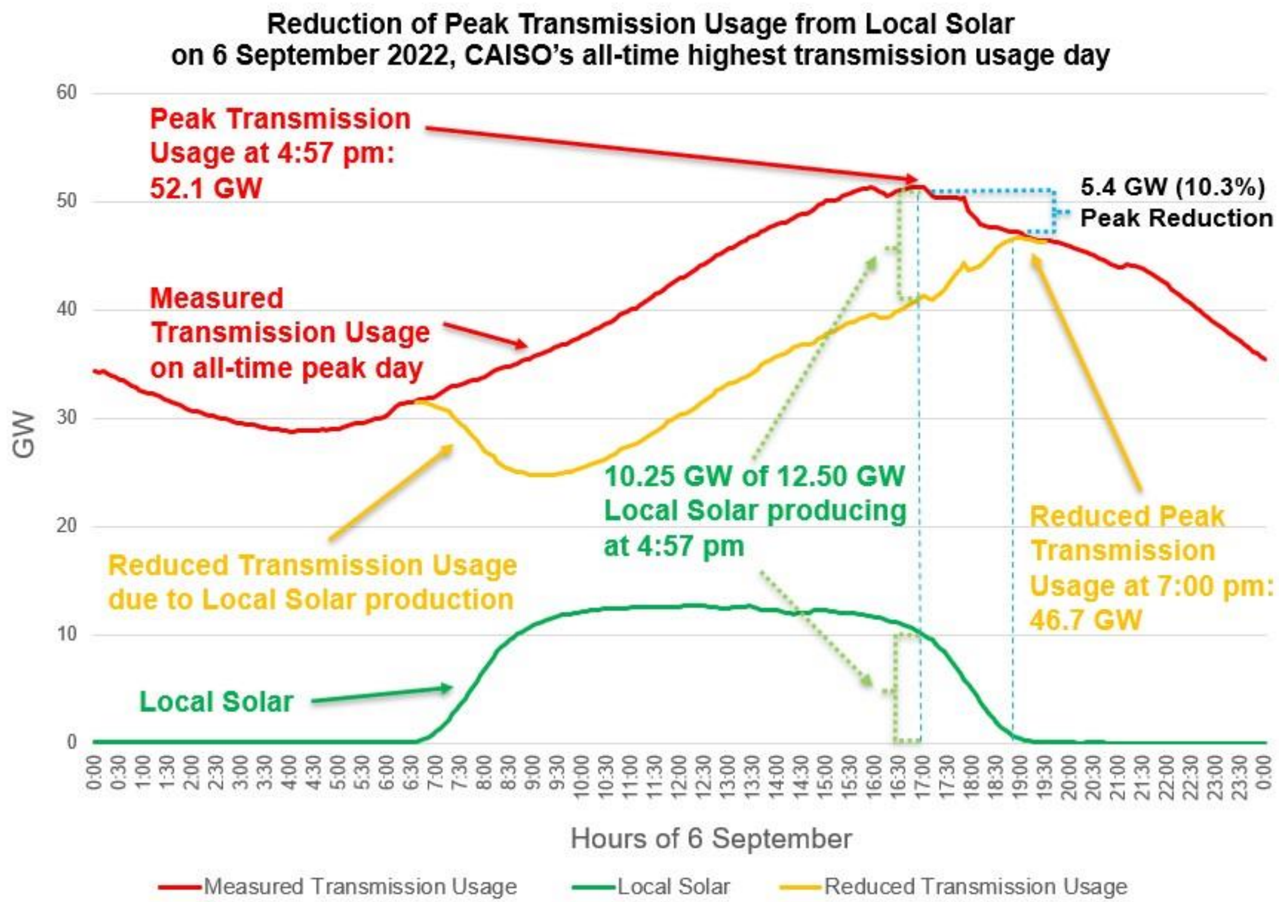

1. Local Solar reduces Peak Transmission Usage by close to 50% of the installed capacity. The effect is amplified by energy storage.
2. Bringing down the peak with distributed generation and demand flexibility will reduce transmission investments, saving ratepayers hundreds of billions of dollars over the next two decades.
3. Reducing the Peak Transmission Usage by around 10% is enough to prevent most major outages.

Core load area of the GLP

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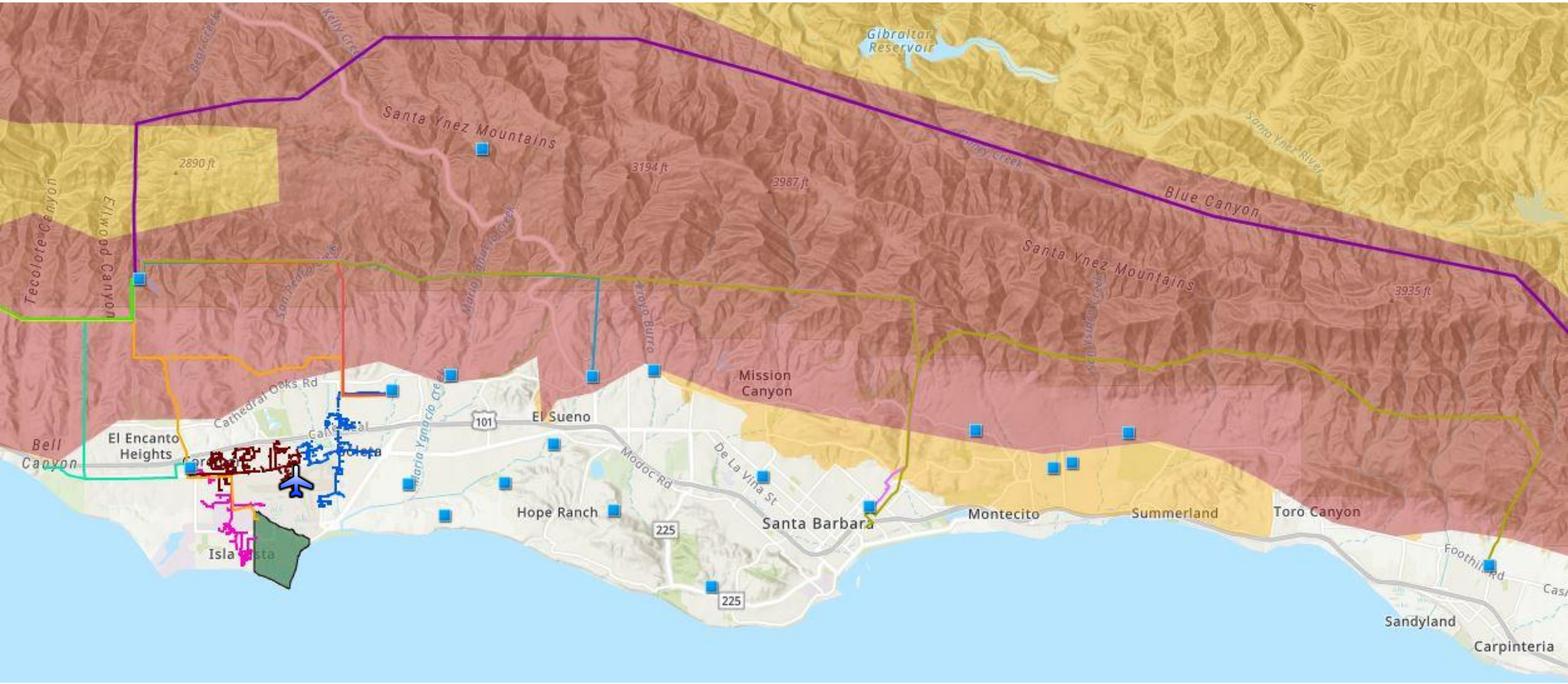
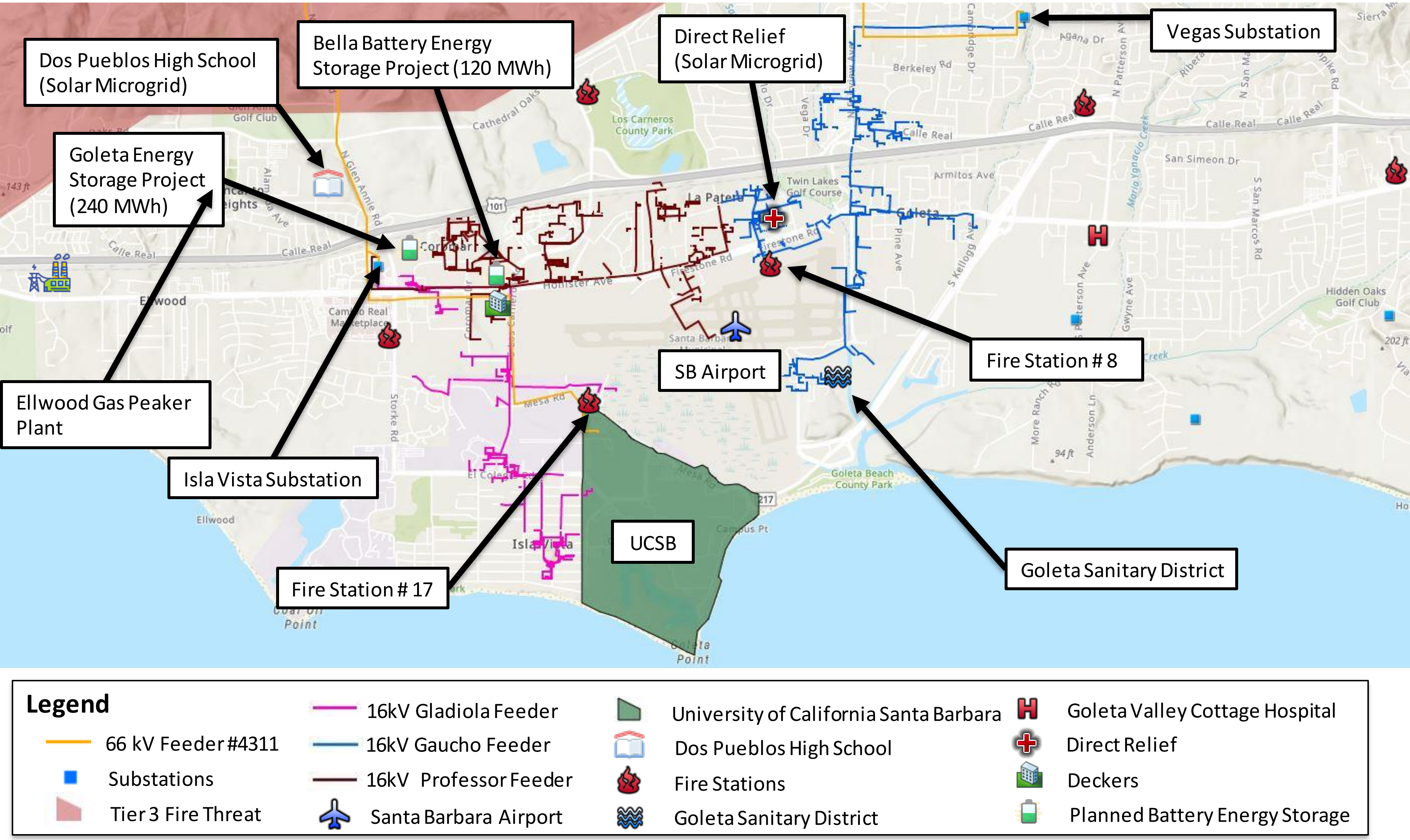


Legend

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



Target 66kV feeder grid area block diagram

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