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.

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.

Typical load tier resilience from Solar Microgrids

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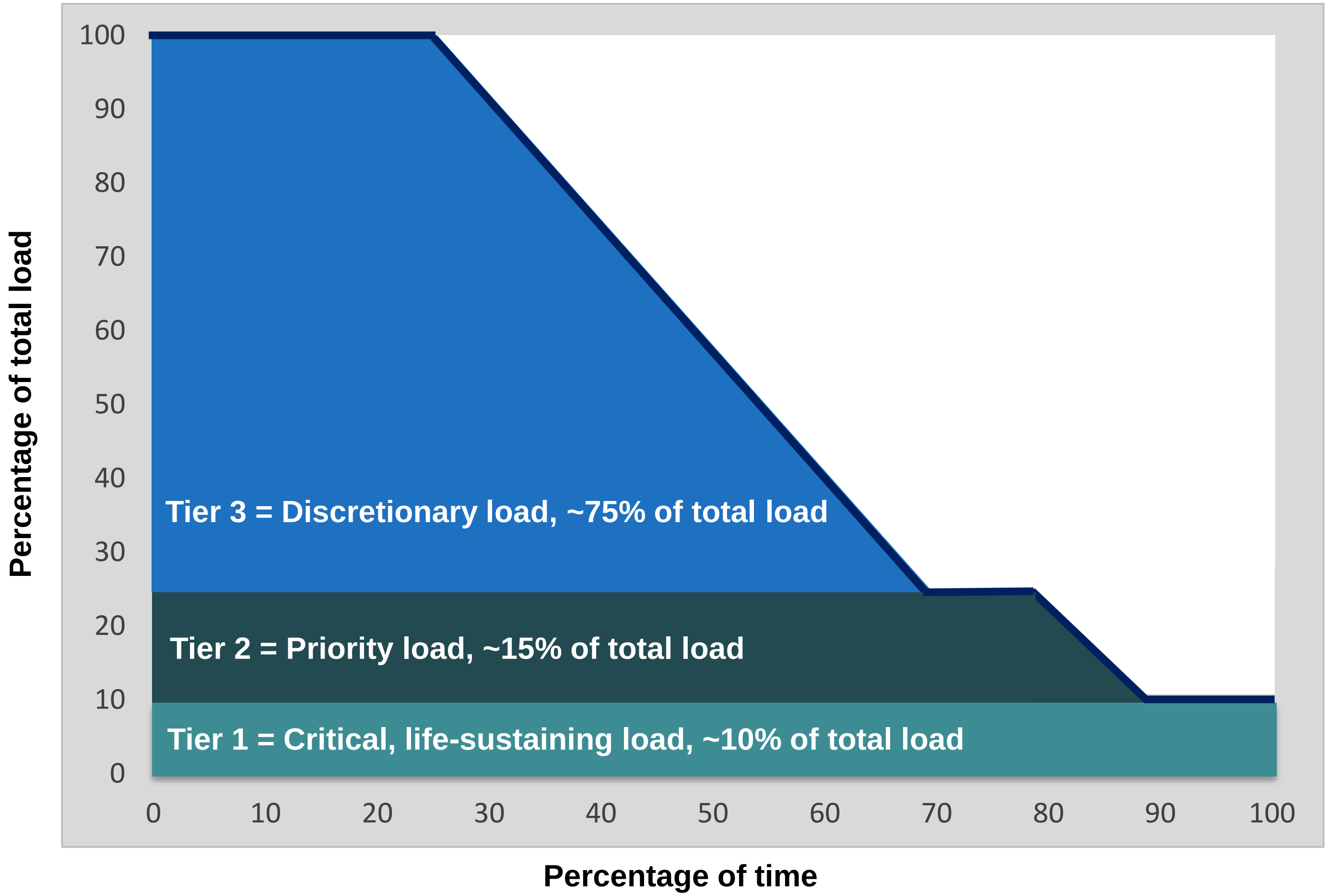

Percentage of time online for Tier 1, 2, and 3 loads for a Solar Microgrid designed for the University of California Santa Barbara (UCSB) with enough solar to achieve net zero and 200 kWh of energy storage per 100 kW solar.

Diesel generators are designed for limited resilience

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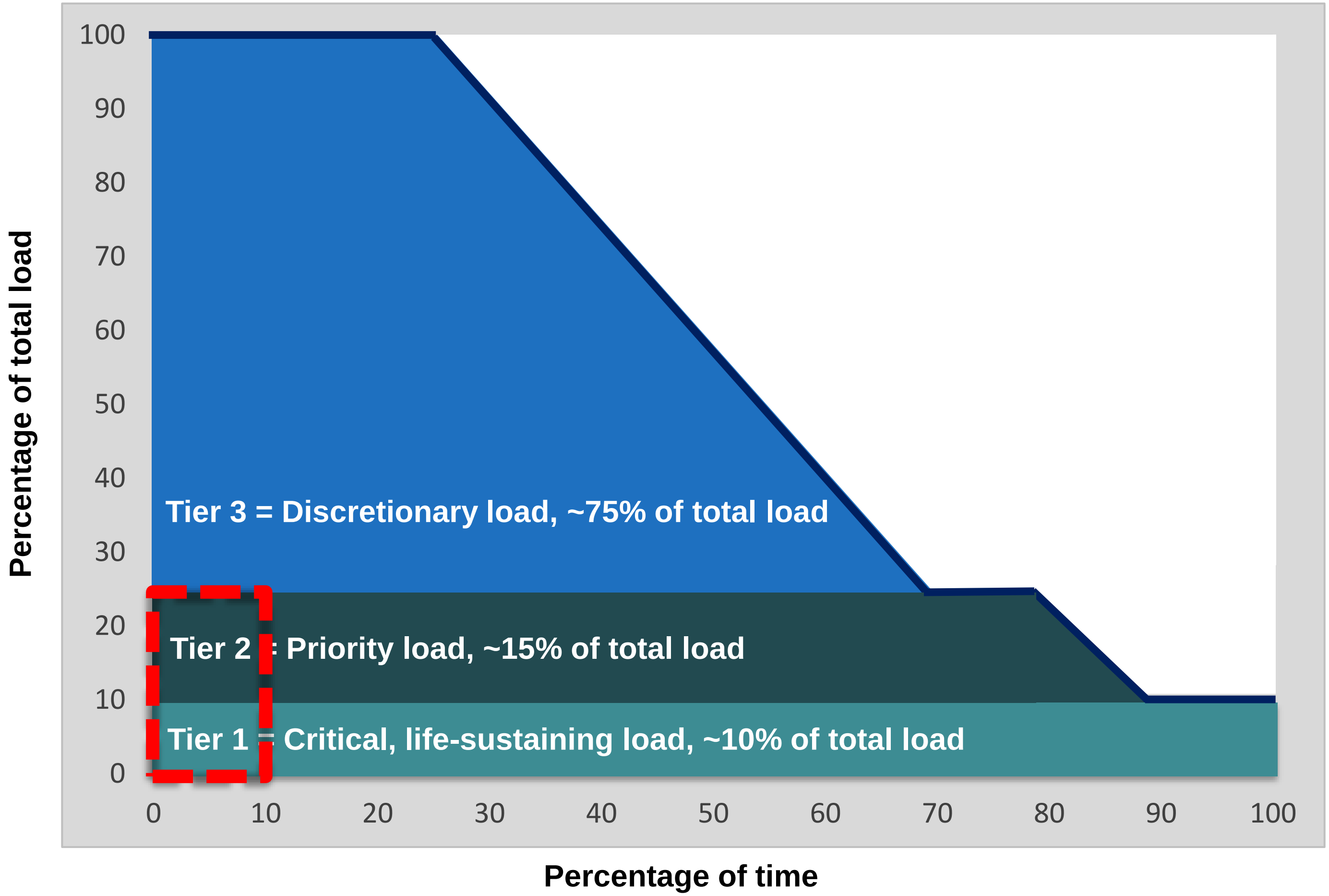

A typical diesel generator is configured to maintain 25% of the normal load for two days. If diesel fuel cannot be resupplied within two days, goodbye. This is hardly a solution for increasingly necessary long-term resilience. In California, Solar Microgrids provide a vastly superior trifecta of economic,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

Santa Barbara Unified School District (SBUSD) 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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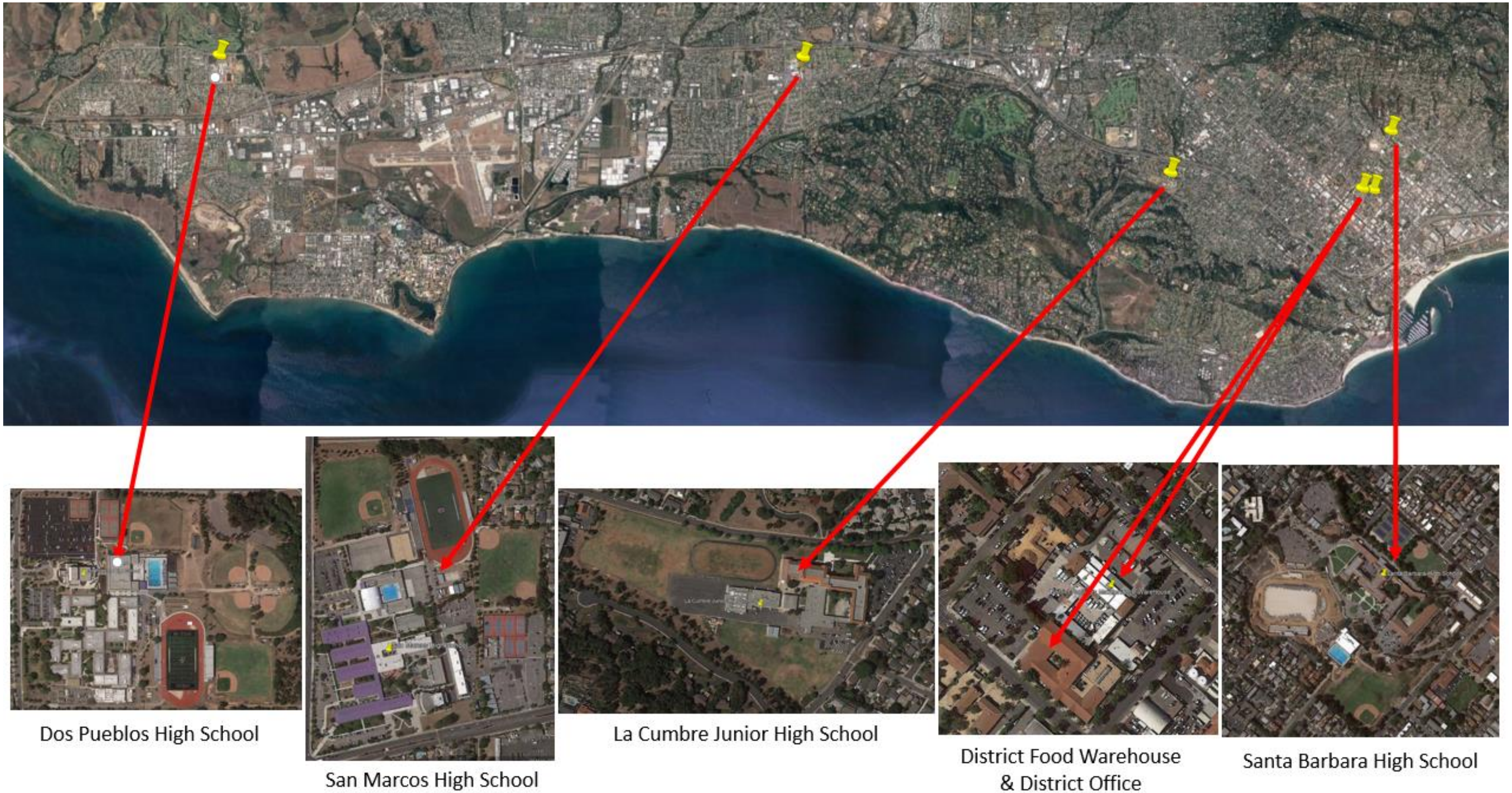
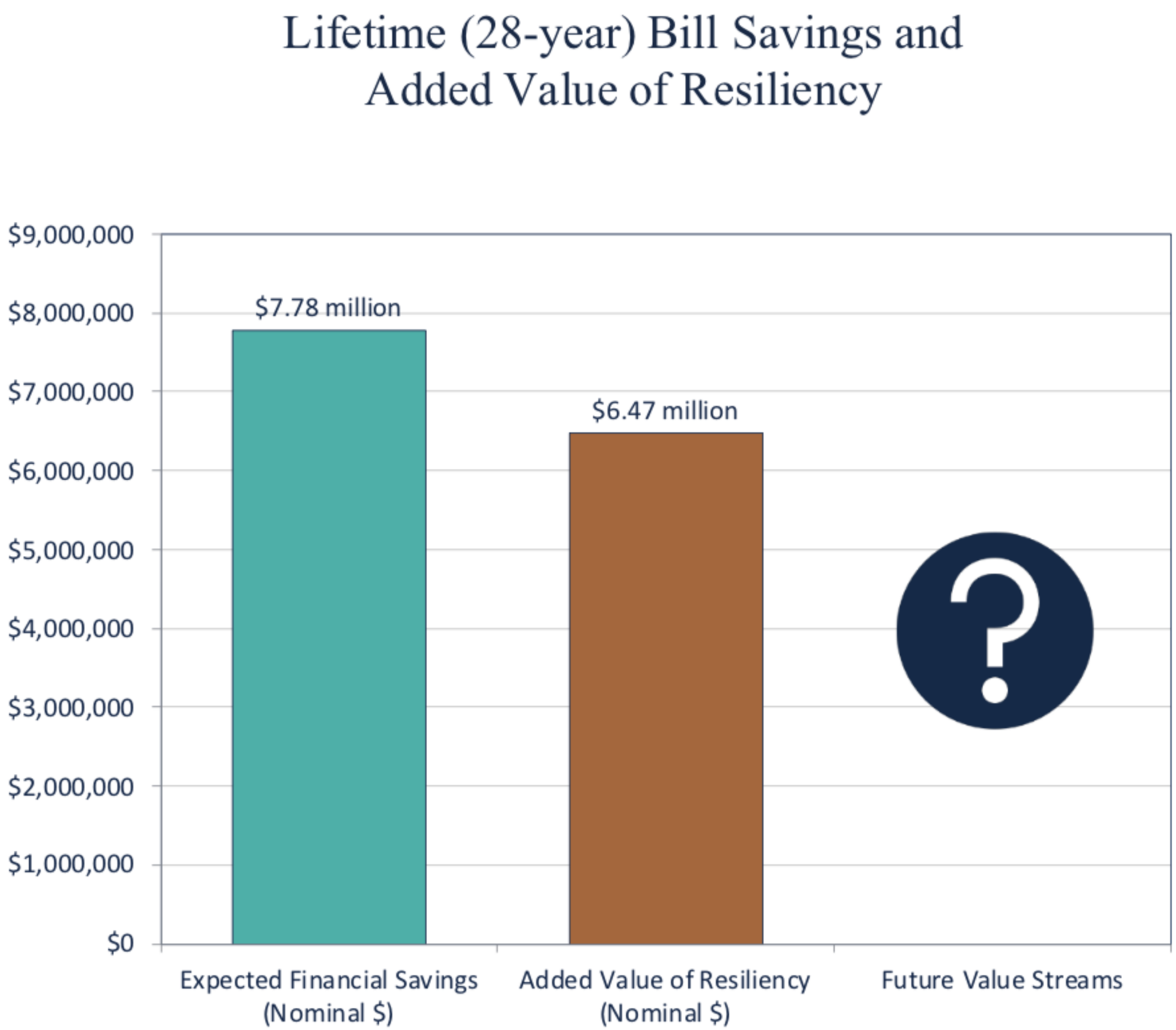


Guaranteed SBUSD bill savings and free VOR



Solar Microgrids deliver unparalleled resilience

Example NZE total solar generation vs total load

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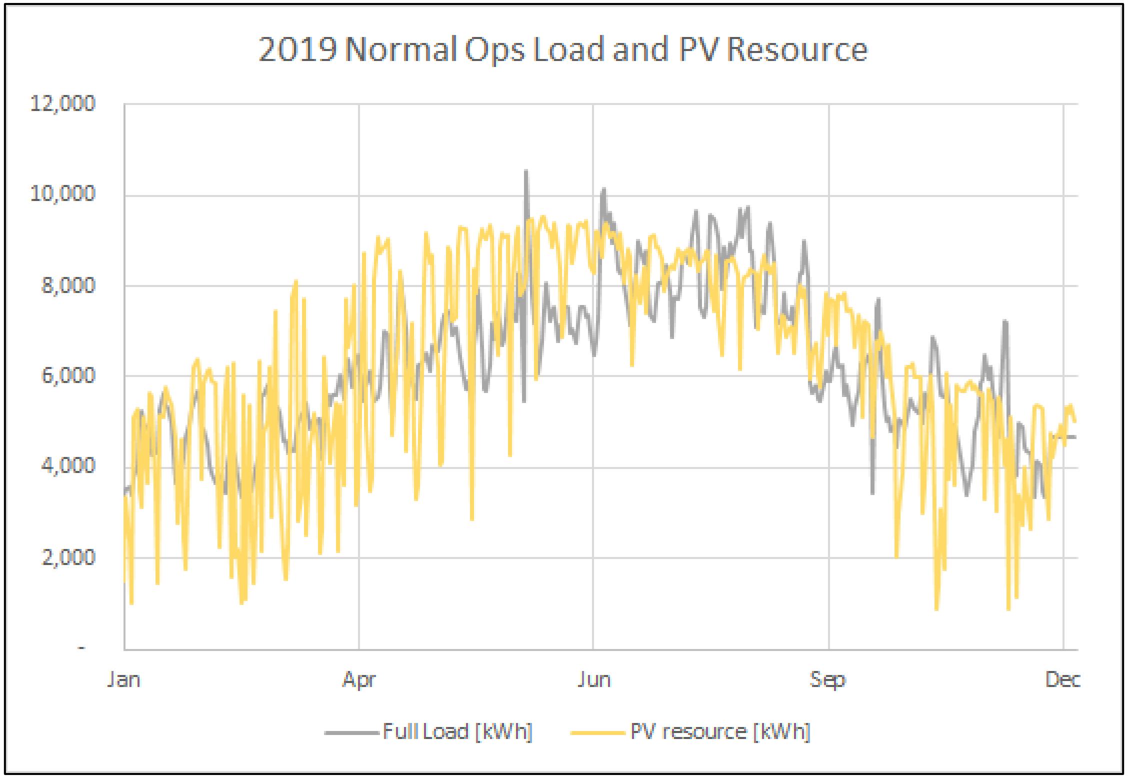

Islanding full load for an entire year with Hybrid Solar Microgrid

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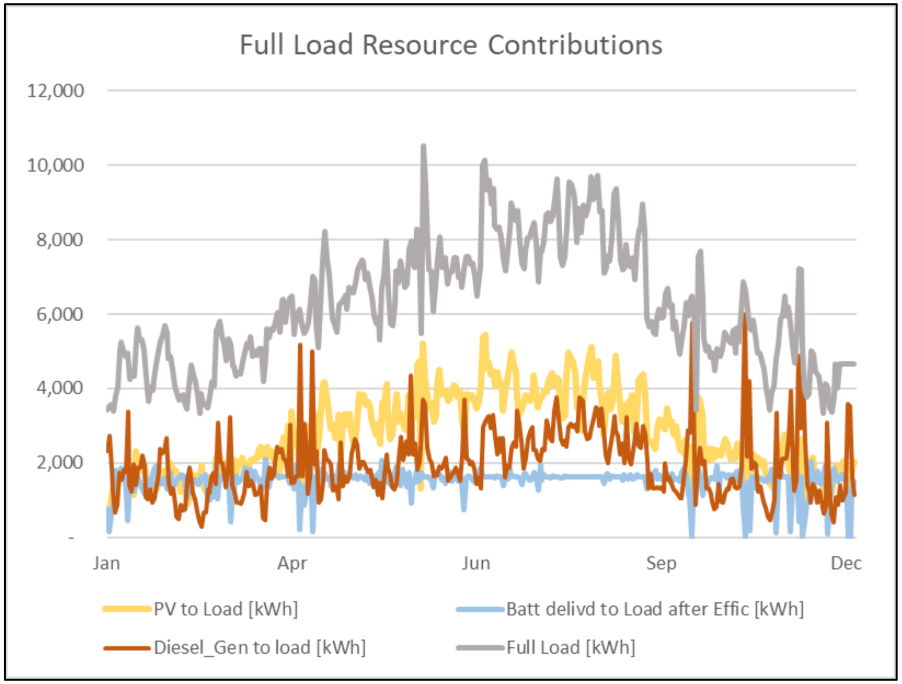

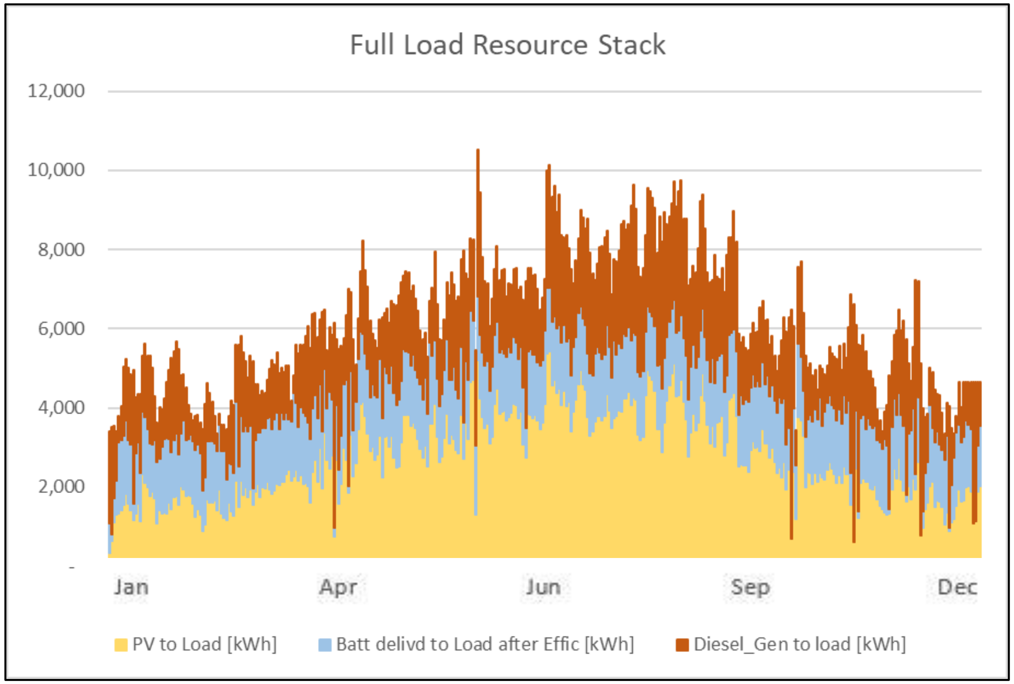

- **31.6%** (716,015kWh requiring 57,076 gallons) of the full load needs to be served by the diesel generator in order to keep the full load online for an entire year.
  - 6,013kWh (481 gallons) served by the diesel generator on the max day (8 Nov 2019)
  - Some level of diesel generation is required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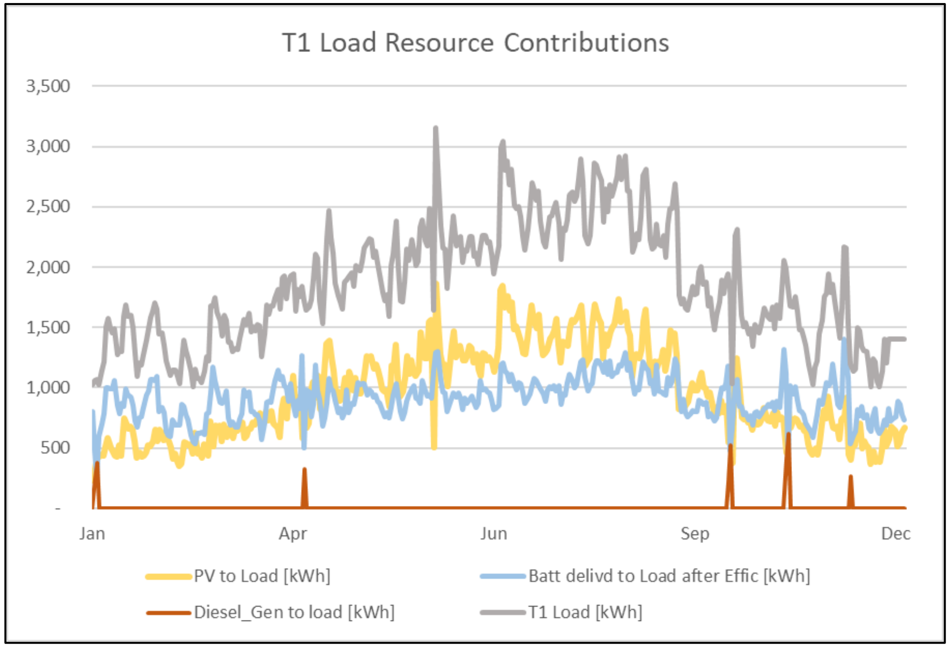

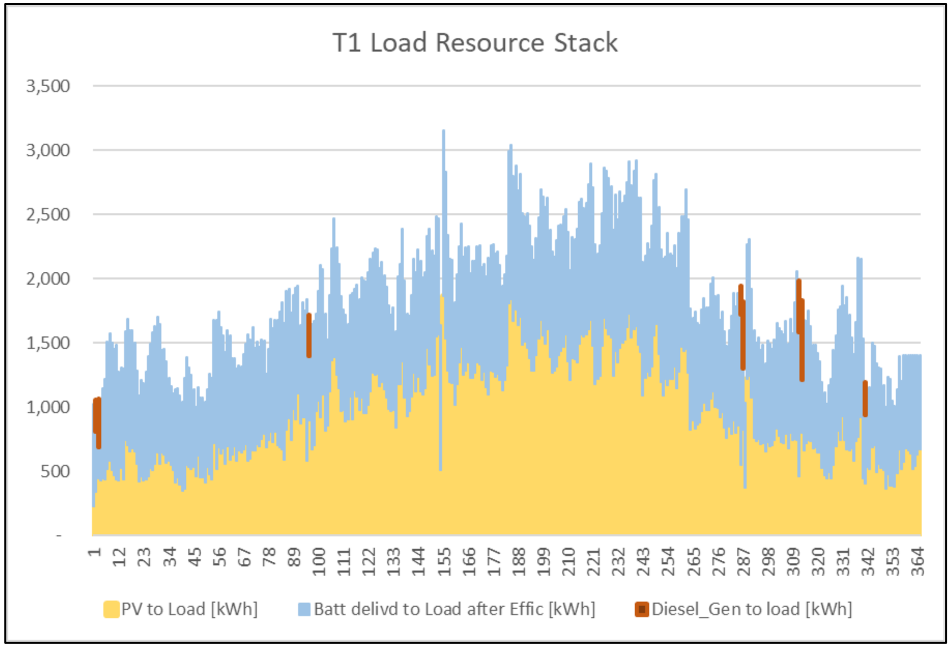

- **0.4%** (2,976kWh requiring 212 gallons) of the T1 load needs to be served by the diesel generator in order to keep the T1 load online for an entire year.
  - 615kWh (49 gallons) served by the diesel generator on the max day (9 Nov 2019)
  - Diesel generation is required for 8 days of the year
  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

EV charging can be critical – and economically viable

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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

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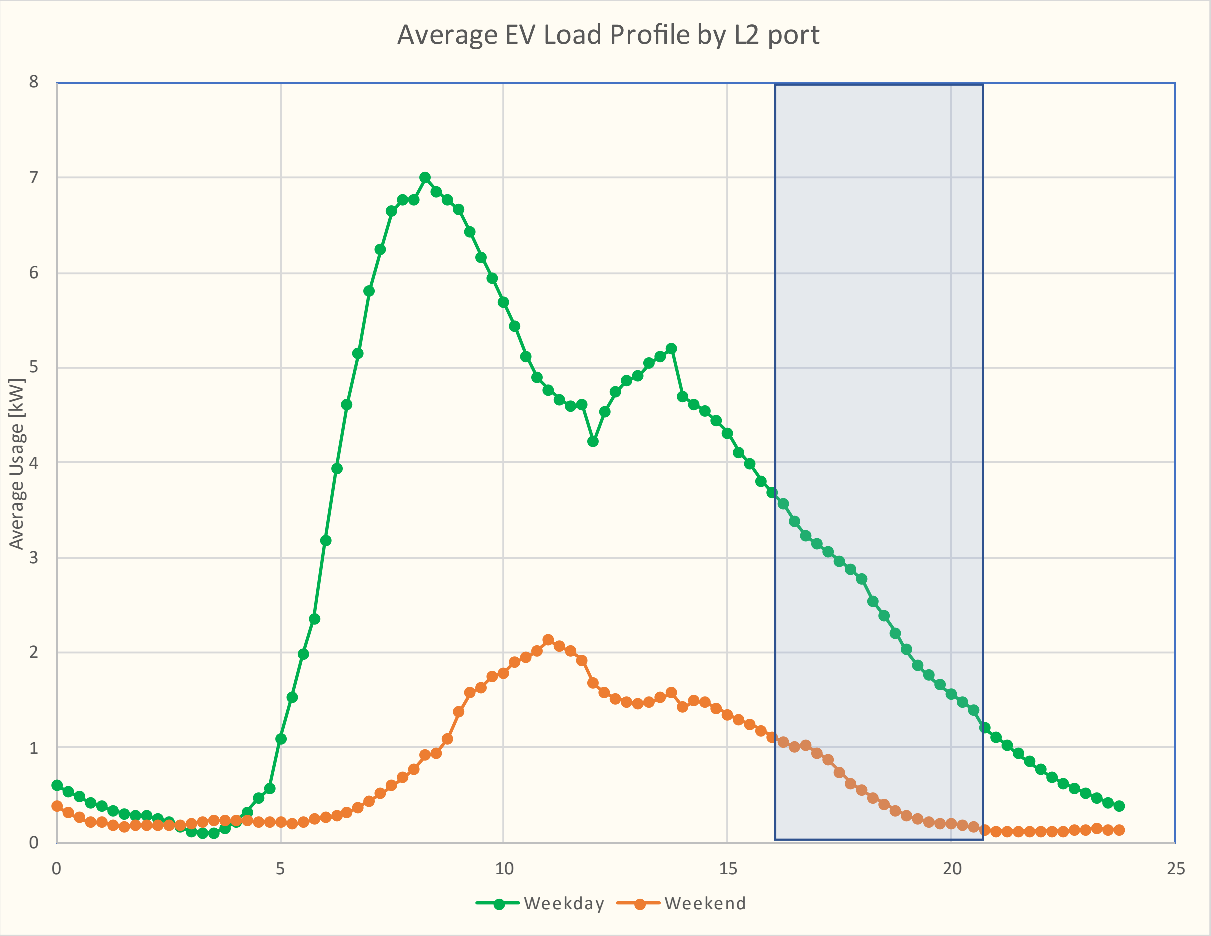
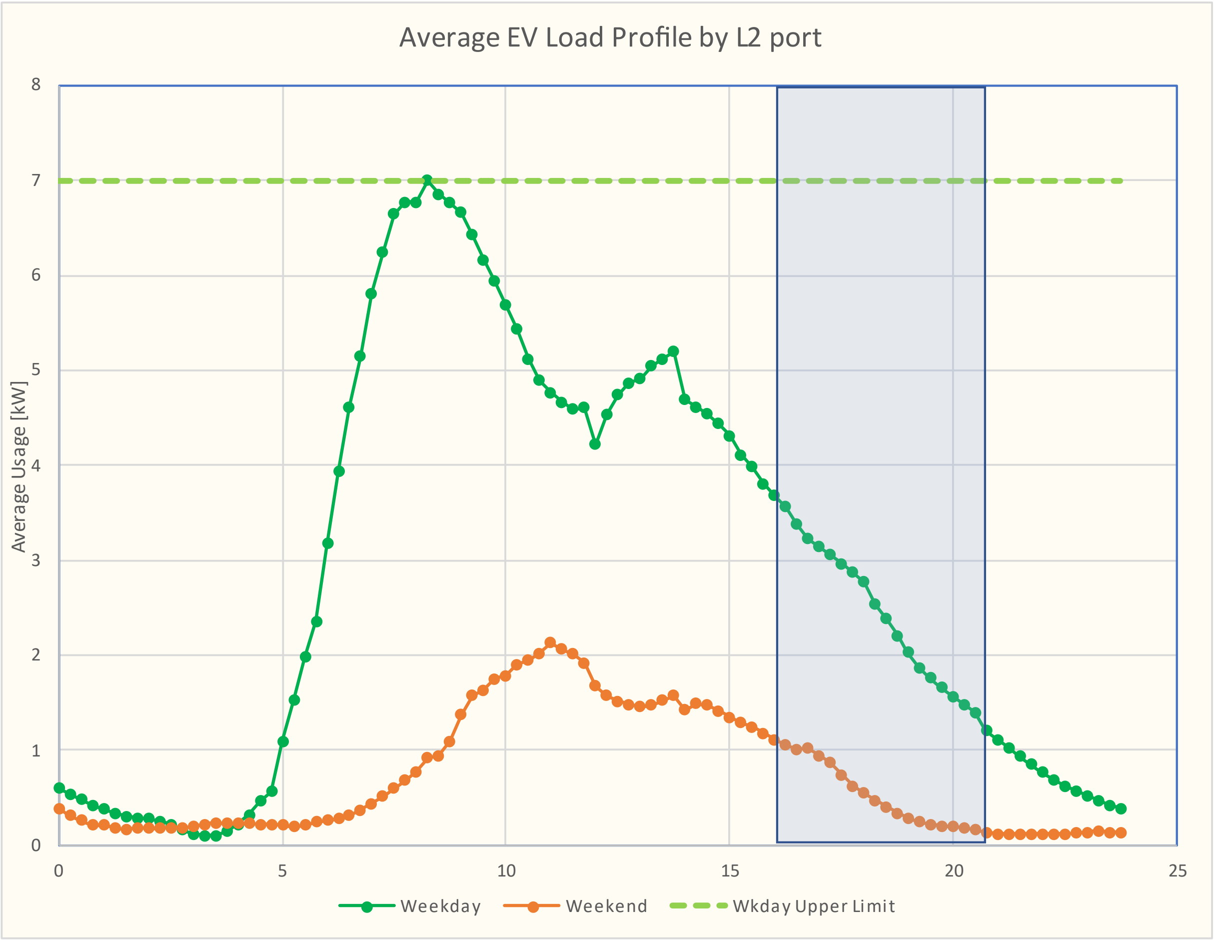
- Weekday and weekend profiles for an office environment.
- Values show actual data gathered & averaged from a large bank of Level-2 (L2) charging ports capped at 7 kW.
- Note the weekday lunchtime curve as EVs are moved.
- The weekend (orange) curve does not reach the same peak as weekday because the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