Clean Coalition
Making Clean Local Energy Accessible Now

Establishing a Community Microgrid

A resilient, renewable energy solution

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Presentation outline

Clean Coalition

- About the Clean Coalition
- Current situation & potential solutions
- Traditional Grid versus Microgrids
    - Microgrid vs. Community Microgrid
    - Benefits and components
- Solutions
    - Phased approach
    - Potential deployment sites
- Process and regulatory issues with community microgrids
- Proposal details

About the Clean Coalition

- We have a wealth of experience in microgrid planning and engineering and focus on economic, environmental, and resilience benefits.
- Renewable energy modeling and design
  - 15+ Community Microgrid feasibility assessments completed to date with clients including Stanford University, various Fortune 500 companies, and multi-national IPPs
  - 2 California Energy Commission (CEC) grants
  - 1 Department of Energy (DoE) grant
  - 1 National Renewable Energy Labs (NREL) contract
- Experience working with utilities
  - IOUs: PG&E, SCE, SDG&E, PSEG Long Island.
  - Municipal utilities: CPAU, LADWP, SMUD.
  - Current active projects with PG&E, SDG&E, SCE, CPAU.

Clean Coalition (non-profit) Mission

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

Traditional Grid Operations

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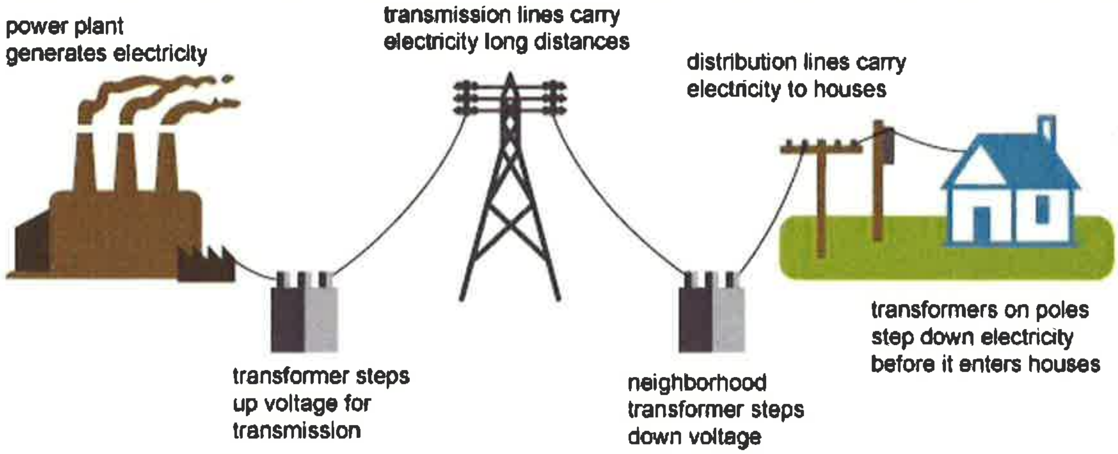
Electricity generation, transmission, and distribution



Source: Adapted from National Energy Education Development Project (public domain)

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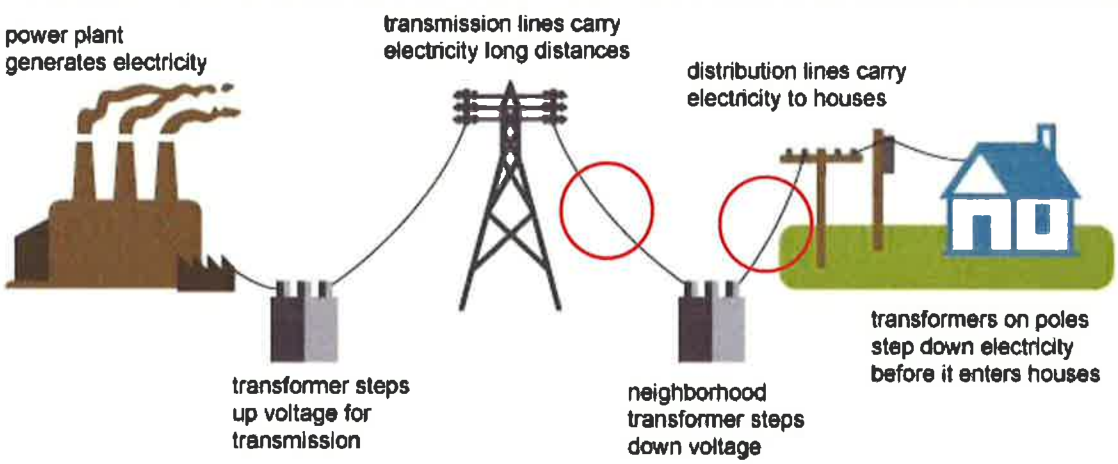

Source: Adapted from National Energy Education Development Project (public domain)

Long-term vision: Community Microgrid

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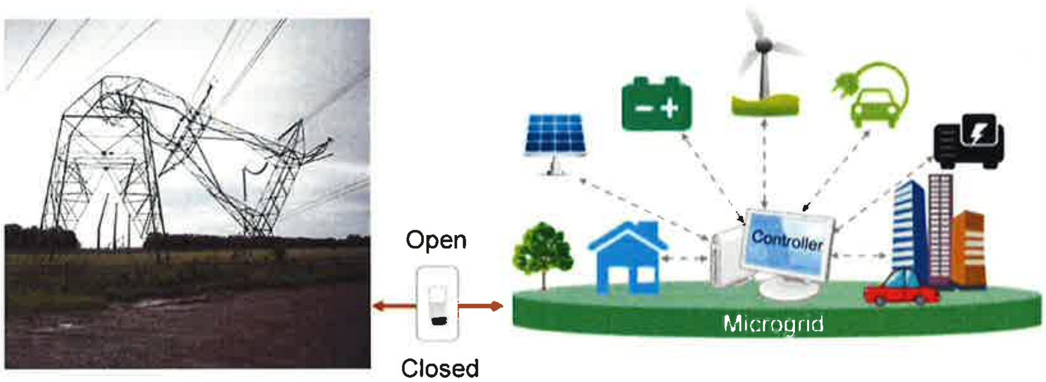
- Long-term vision: Develop a **Community Microgrid** serving the full Calistoga substation grid area- 2,285 electric accounts.



What is a microgrid?

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What is a microgrid?

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- "A Microgrid is a group of interconnected loads and distributed energy resources (DER) within clearly defined electrical boundaries that acts as a single controllable load with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island mode“.
- Microgrid is an umbrella term that incorporates a variety of scopes, scales and use-cases.
- A microgrid can provide cost savings, but it can also be more expensive than energy from PG&E.

Potential Microgrid Solutions

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	Community Microgrid	Pre-Installed Interconnection Hub (PIH) Microgrid	Behind-the-Meter Microgrid at Critical Facilities
Timeline for deployment	Long-term 5-10 years	Mid-term 3-5 years	Near-term 1-3 years
Scope & scale	• All of Calistoga • Municipal buildings, businesses & residences	• Neighborhood • Priority sections of the distribution grid • Determined by Calistoga & PG&E	• Single building • Critical Facilities are key target sites • Businesses and residences can also choose to deploy
Loads to be served	• All loads (28 GWh/ year) • Critical and priority loads	• All loads within the priority sections of the distribution grid	• Design can accommodate critical, priority and non-critical loads
Renewable Energy Demand*	• All loads- 18MW PV • Critical and priority loads- 5 MW PV	• TBD based on the loads of the PIH area	• TBD based on desired loads

*Renewable energy supply can be augmented with existing diesel generators

Regulatory challenges & solutions

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Challenges	Solutions
• Over-the-fence rule: Entities cannot share power across public rights of way when the larger grid is operational.	• Requires intervention by the California Public Utilities Commission (CPUC). • Develop behind-the-meter (BTM) microgrids. Can either be single-meter microgrids, or connected via a dedicated line for use during grid outages only.
• No special compensation during island mode.	• Develop Community Microgrids or PIH microgrids that emulate normal grid operations.
• Installing wholesale power can be expensive due to interconnection costs.	• Utilize net-metering BTM interconnections where possible. • Use ICA data to site projects that minimize interconnection costs and delays. • Work with PG&E to reduce interconnection costs at PIH locations.
• Building codes can make permitting local DER a lengthy process.	• Work with municipal officials to ensure that permitting for renewable energy resources is streamlined.
• Lack of standardized rate tariffs that enable microgrids.	• SB 901, now in implementation, requires IOUs to develop microgrid rate tariffs, but does not require implementation. • Deploy projects that are favorable with existing rate tariffs.

Solutions to regulatory challenges

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- Implement a phased approach, with technology that is future-compatible
  - Near-term: Implement behind-the-meter microgrids at critical facilities first, and stage them for the capability to participate in a future Community Microgrid.
    - Critical facilities include essential city services (fire departments, water treatment, public works), emergency shelters at schools and churches.
    - Automated load shedding can reduce system size and cost, but can be expensive to implement due to re-wiring costs. However, there a low-cost devices that can be used to shed plug loads and individual circuits from the electrical panel. Manual load shedding is also a possibility.
    - Critical loads within facilities can be powered indefinitely with renewable energy and energy storage.
  - Mid-term: Work with CPUC and PG&E to incorporate renewable DER into PIH priority zones
    - All customers within the PIH priority zone will continue to have power.
    - Load-shedding can be a part of this strategy to reduce demand.

Steps to establish a microgrid

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- Discuss short-term and long-term goals and requirements of a microgrid solution.
- Perform a high-level feasibility assessment of each configuration to determine ballpark costs and benefits.
- Detailed engineering and design for promising configurations & sites. Produce functional designs and electrical single-line diagrams.
- Develop an RFP, collect responses and select winning proposal.
- Identify project team: EPC, financier, vendors, utility engineers, etc.

Steps to establish a microgrid continued

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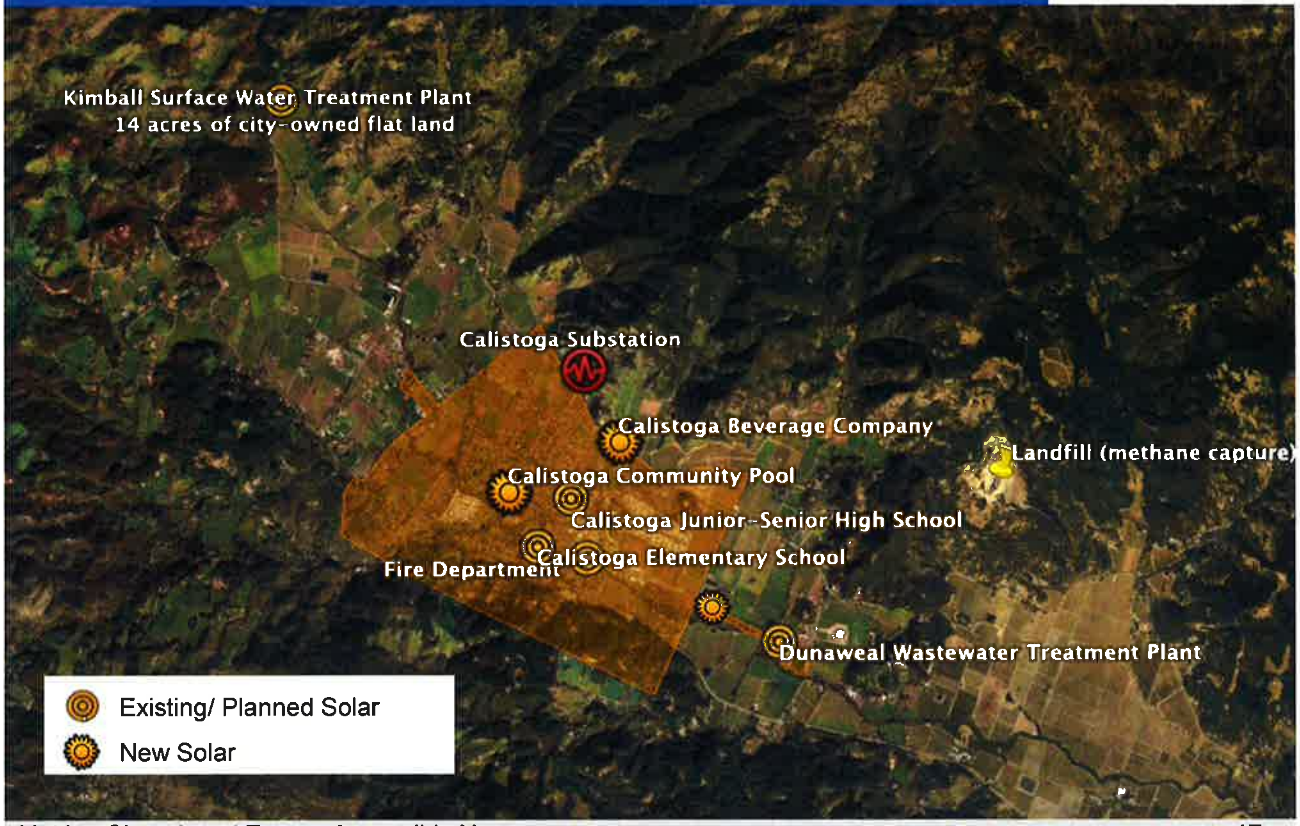
- Develop finance-ready collateral.
- Secure financing with a letter of intent (LOI), a signed power purchase agreement (PPA), or energy services agreement (ESA).
- Develop permit-ready drawings and secure permits
- Submit interconnection application.
- Procure equipment (solar, batteries, etc.).
- Construction.
- Commissioning.
- Measurement & verification of system operation and cost savings.

Community Microgrid Proposal Summary

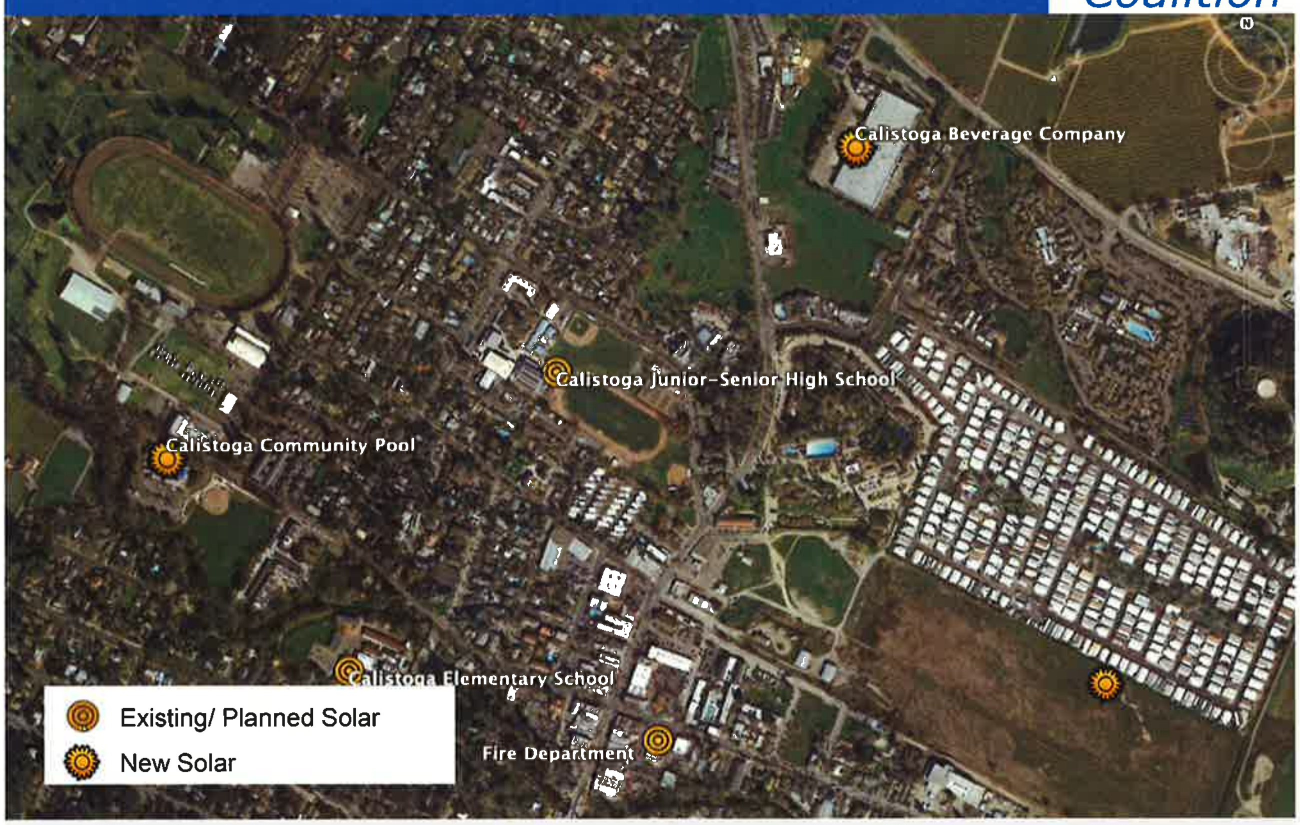
- Phase I: Preliminary feasibility assessment
  - Perform solar siting survey.
  - Shortlist 5 sites for basic technical and economic analysis.
  - Gather basic site details including load data, and perform a technical and economic analysis.
    - Aim for 70% accurate cost estimates.
- Phase 2: Planning and Engineering
  - Gather all site details to develop more accurate cost estimates.
  - Detailed technical and economic analysis.
  - Develop conceptual and functional design.
  - Engage EPC to develop key engineering documents needed for utility buy-in (single-line diagram).
    - Aim for 90% accurate cost estimates.
- Develop RFP specifications.

Calistoga feeder maps

Potential project sites



Potential project sites



Roles & Responsibilities

Clean Coalition

- Clean Coalition project team
  - Dr. Frank Wasko, Managing Director
  - Wendy Boyle, Grants & Contracts Manager
  - Malini Kannan, Program Engineer & technical project lead & engineer
  - Bob O'Hagan, Engineering support
- City of Calistoga
  - Dylan Feik, City Manager - Main point of contact
- PG&E
  - Jackie Janowicz - Calistoga account manager, main point of contact
- Others will be included as we progress with this project

Next steps

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- Finalize scope and contract:
  - Discuss and finalize scope for feasibility assessment.
  - Consulting fees for Phase 1 are $25k.
- Secure council approval for contract.
- Move forward with feasibility assessment activities:
  - Perform solar siting survey, ideally identify 2-5 MW.
  - Agree on five Phase I target facilities, align stakeholders.
  - Gather basic site information (load data), model and design system.
  - Develop basic conceptual design and economic analysis.

Thank you & questions

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Backup Slides

Summary of potential solutions

1) Calistoga Municipal Utility
   - Expensive, lengthy process that will likely result is higher electric rates for customers.
2) Relocate/ add new transmission line
   - Expensive, might not solve the issue long-term as wildfire risk changes.
3) Community Microgrid
   - Phased approach allows critical facilities to be addressed first, followed by other priority loads.
   - We developed a proposal for this solution because it provides the most flexible solution.

Public Safety Power Shutoffs (PSPS) outages

WHICH CUSTOMERS ARE MOST LIKELY TO HAVE THEIR POWER TURNED OFF?

If we need to turn off power for safety, it will be limited to neighborhoods or communities served by electric lines that run through areas experiencing extreme fire danger conditions. We will turn the power back on as soon as it is safe to do so. The most likely electric lines to be considered for shutting off for safety will be those in areas that have been designated by the California Public Utilities Commission (CPUC) as at extreme risk for wildfire (Tier 3 areas).

Source: https://www.pge.com

- Oct. 14th PSPS left Calistoga without power.
- Nov. 7th planned PSPS- PG&E brought in mobile fossil-fuel generators to connect at the substation.
- Negative impact: business owners (primarily hospitality, retail and food production industries) are not able to serve customers and lose revenue during planned power shutdowns.

Solution 2: Relocate/ add new transmission line CPUC fire threat map

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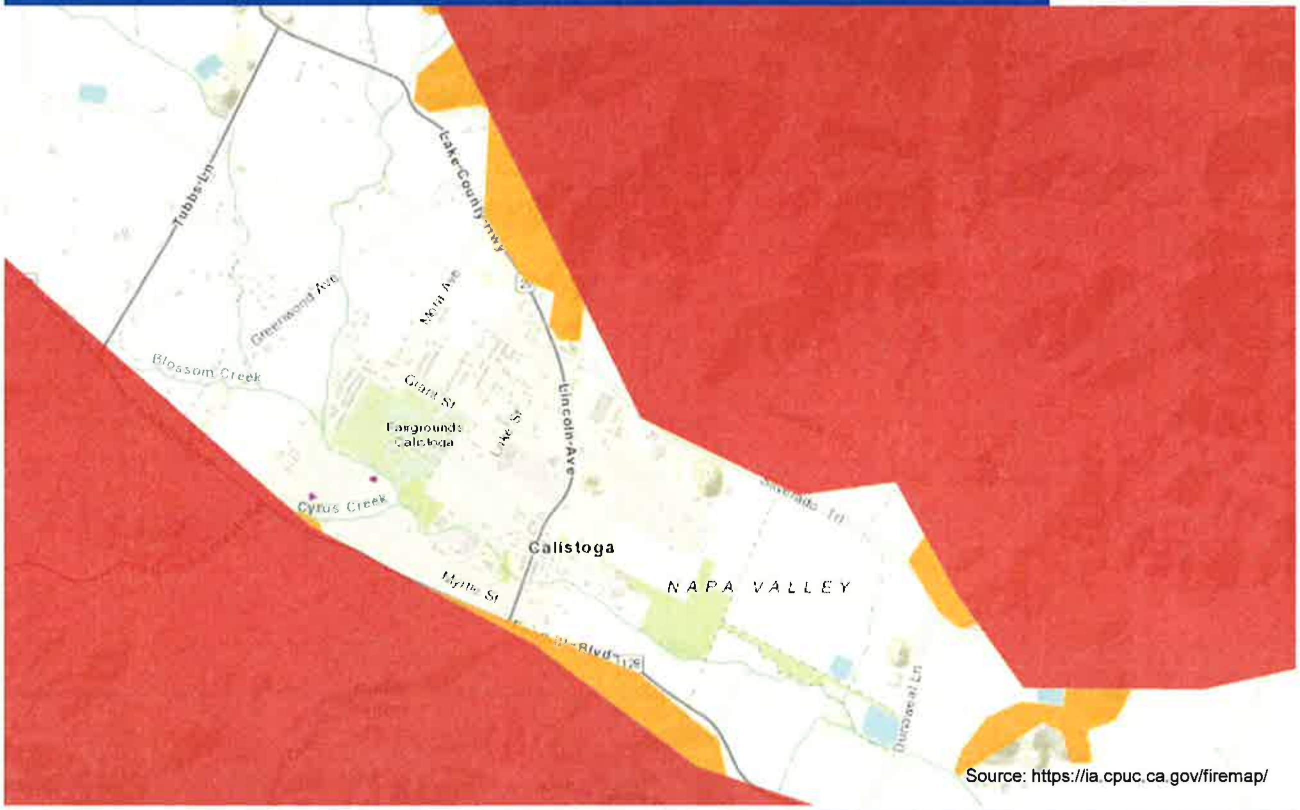

Source: https://ia.cpuc.ca.gov/firemap/

Resilience provided by Community Microgrids has tremendous value

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- **Powers critical loads until utility services are restored**
  - Eliminates expensive startup costs and the need to relocate vulnerable populations.
- **Ensures continued critical services**
  - Water supply, medical and elder-care facilities, grocery stores, gas stations, shelters, communications centers.
  - Avoids the cost of emergency shipments.
- **Provides power for essential recovery operations**
  - Lighting for buildings, flood control, emergency shelters, food refrigeration.
  - Minimizes emergency response expenses.
- **Reduces dependence on diesel generators**
  - Diesel can be expensive and difficult to deliver in emergencies.
- **Keeps businesses open**
  - Serves the community and maintains revenue streams.

Example of PV canopy for parking

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From: Zapotec Energy, Commercial Solar Project in Wakefield, MA

Renewables for community resilience

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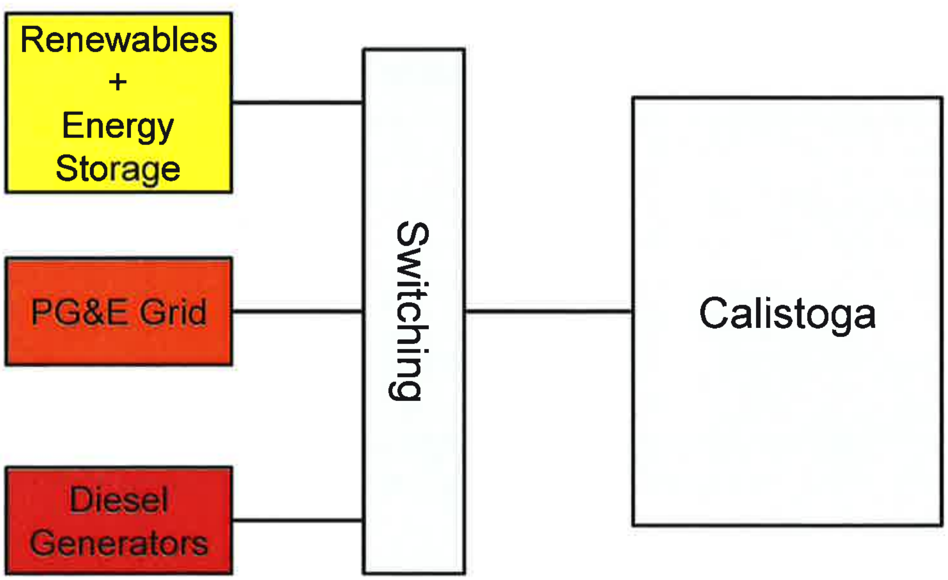

How does energy storage provide value?

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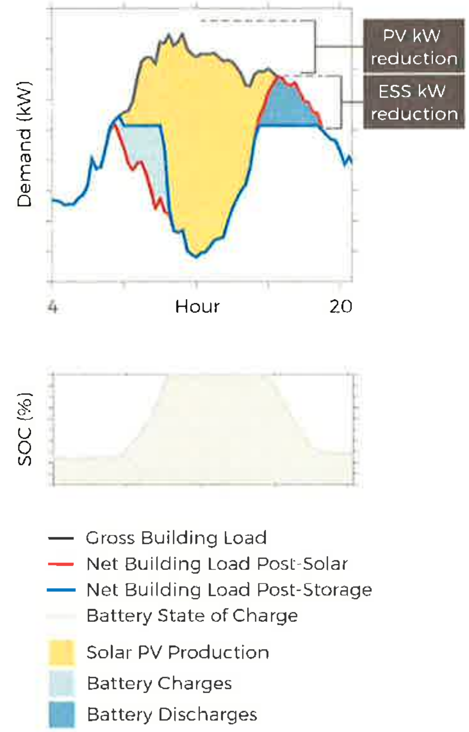
- Energy storage batteries could help considerably in Demand Charge Management for individual buildings or electric accounts, especial those with high peak usage compared to average usage, such as sites with daytime EV charging peaks.
- Energy storage also enabled renewables-driven resilience.



Community Microgrid case study

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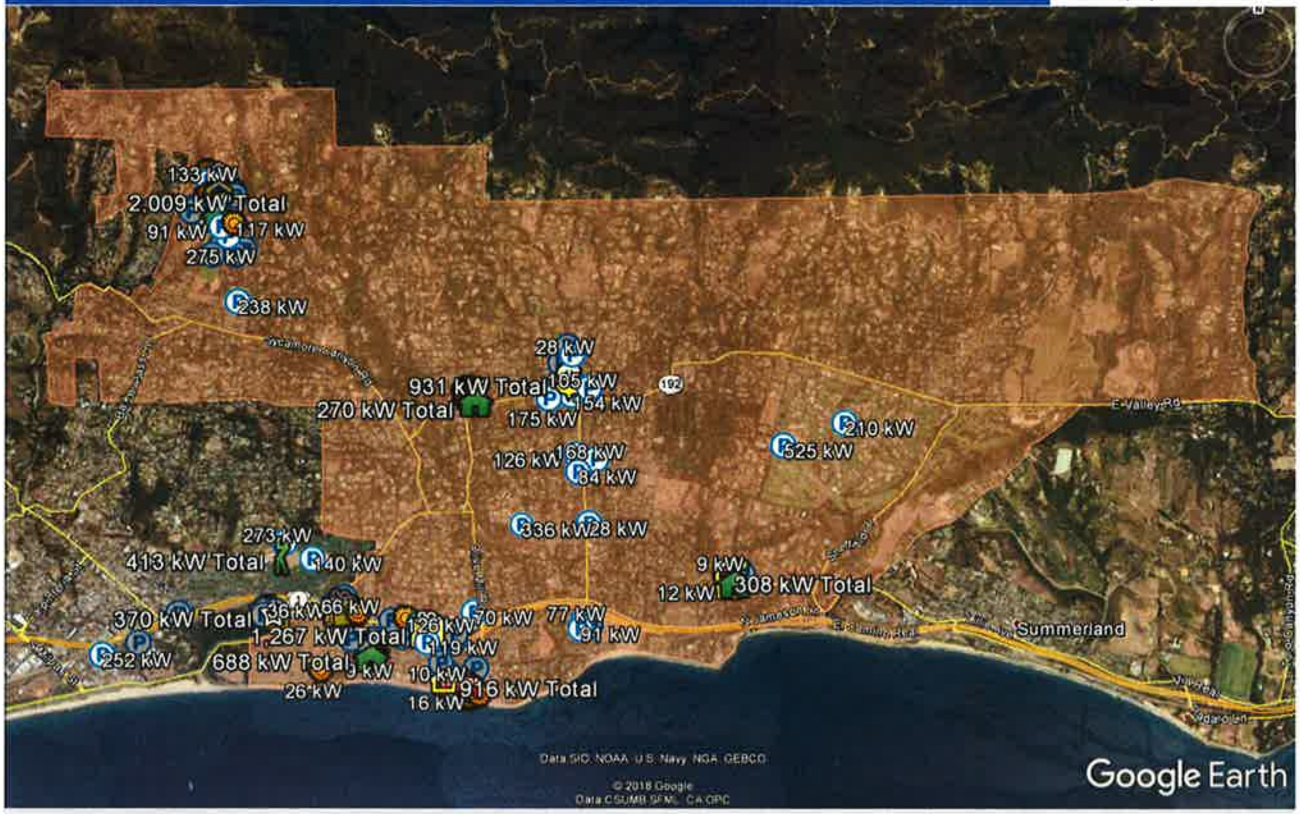
- Clean Coalition is working on the Montecito Community Microgrid to achieve resilience in the Goleta Load Pocket in the Santa Barbara area.
- There are a lot of similarities between Montecito and Calistoga- both communities are threatened by natural disasters, and have an energy system that lacks redundancy
- Clean Coalition hopes to develop a similar design for Calistoga

Solar Siting Survey (SSS) for Montecito

Clean Coalition



Hot Springs Feeder via Santa Barbara Substation

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Upper Village Community Microgrid block diagram

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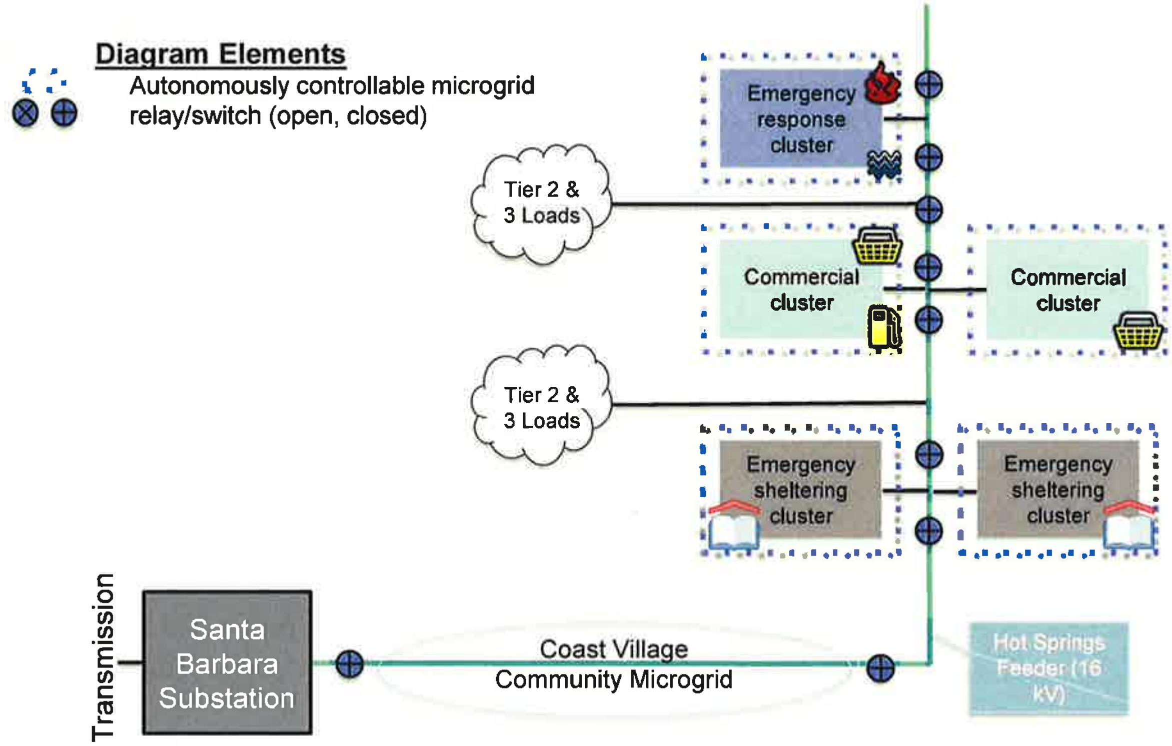

Upper Village critical facilities include five along Hot Springs Feeder

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Upper Village emergency response facilities

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Site	Annual Historic Use	Proposed Solar PV Capacity (DC)	Solar PV Annual Production
Fire District	103,623 kWh	70 kW	102,533 kWh
Pump House	21,415 kWh	14.5 kW	21,379 kWh
WD Office	28,716 kWh	19.5 kW	28,765 kWh
WD Mech Yard	14,933 kWh	10.2 kW	15,141 kWh
Sand Lot	NA	75.9 kW	112,069 kWh
Phase 1 Total	168,687 kWh	190.1 kW	279,887 kWh

Note that the 75.9 kW Solar PV system proposed for the Sand Lot would be used to offset electricity from other municipal electric accounts, such as the Water District accounts not located in this site, via the Renewable Energy Self-Generation Bill Credit Transfer (RES-BCT) program.

But how do we determine the monetary value of resilience?

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Factors to consider

- **Cost of outages**: Varies by location, population density, customer type. Can include lost output and wages, spoiled inventory, delayed production, damage to the electric grid
- **Cost of storage**: Varies by size of electric load and size of critical load
- **Cost of islanding**: 3% - 21% of non-islandable solar+storage cost

Consequence of disaster	Resilience assessment metric
Unavailable electrical service	- Cumulative customer-hours of outages - Cumulative customer energy demand not served - Average percentage of customers experiencing an outage in a specified time period
Grid restoration	- Time to recovery - Cost of recovery
Monetary impact	- Loss of utility revenue - Cost of grid repair and replacement - Cost of recovery - Avoided outage cost - Lost business revenue
Community impact	- Critical services without power

Source: Grid Modernization Laboratory Consortium, 2017

Valuing resilience at any facility: The Clean Coalition Value of Resilience (VOR) Model

Clean Coalition

The size of your load: How much electricity do you use per year?

The size of your critical load: What percentage of your electrical load is essential to keep running during an extended outage? For many facilities, this is 10%.

The length of outage you want to prepare for: Do you want to have energy during short outages of a few minutes, or prepare for outages lasting several days or more?

The cost of an outage: How much revenue or productivity do you lose per hour during an outage? If you don't have this figure, you can use the national average of $117 per kilowatt-hour, based on data from the Department of Energy's National Renewable Energy Lab.

Your energy storage system: The minimum and maximum state of charge you'd like to allow for your battery; the initial state of charge at the time of an outage; and your battery cost (including costs for demand charge reduction), capacity, and round-trip efficiency.

The amount of sunshine in your area: Average amount of sunshine in your area, as well as the amount of sunshine on the worst 5 solar days of the year. PVWatts (https://pvwatts.nrel.gov/) provides these figures for your area.

Valuing resilience: How the VOR model works

Clean Coalition

- **Resilience cost (one-time)**:
  - Using information about your site and the solar resource in your area, we calculate the battery size you need for demand charge reduction. That gives us the cost for the demand charge portion of your system.
  - Using information about your critical load, solar resource in your area, and your energy storage system, we calculate the battery size and other Community Microgrid elements you need for resilience. That gives us the total resilient system cost.
  - We subtract the demand charge cost from the total system cost to get the **cost for the resilience portion of your system**.
- **Resilience value (annual)**:
  - Using information about the cost of an outage, your critical load, and the length of outage to prepare for, we get **your annual value of resilience**.
  - Your value of resilience will be higher if:
    - Your cost of outage is higher than the national average of $117 per kilowatt-hour
    - You want to prepare for outages lasting longer than one day

Value of Resilience:
$2,808/kW of critical load per year

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Annually, resilience is worth $2,808 per kilowatt of critical load
(preliminary estimate)

- Based on real-world scenarios run through the Clean Coalition VOR model
- Based on keeping critical (Tier 1) load online for one day on the worst-case solar day
  - If outage spans days with greater solar resource, may be able to keep Tier 2 or even Tier 3 loads online
- **Tier 1** = Critical load, usually 10% of total load
  * Life-sustaining or crucial to keep operational during a grid outage
  - **Tier 2** = Priority load (15%):
    * Important but not necessary to keep operational during an outage
  - **Tier 3** = Discretionary load (75%):
    * Remainder of the total load