Clean Coalition

Making Clean Local Energy Accessible Now

Community Microgrids

Optimizing economics, environment, & resilience

Craig Lewis

Executive Director

Clean Coalition

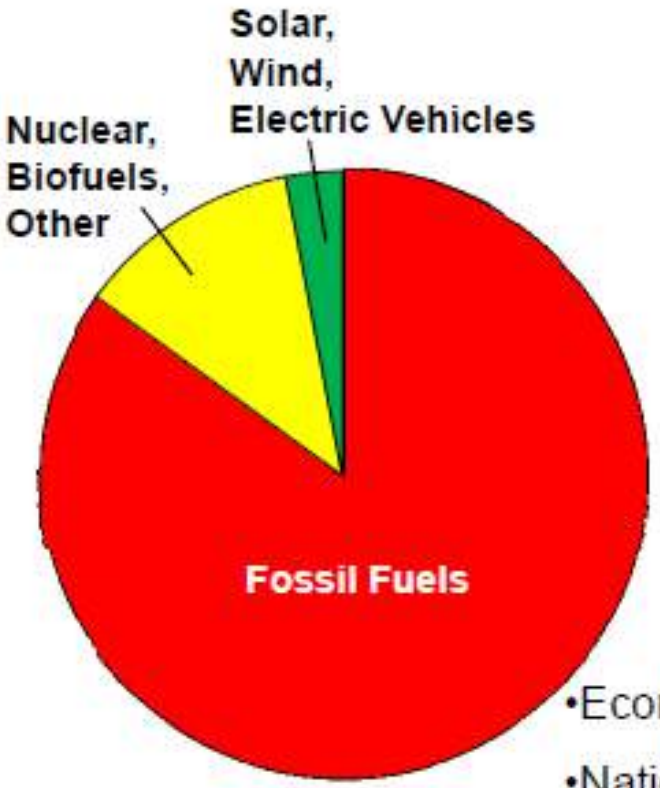
650-796-2353 mobile

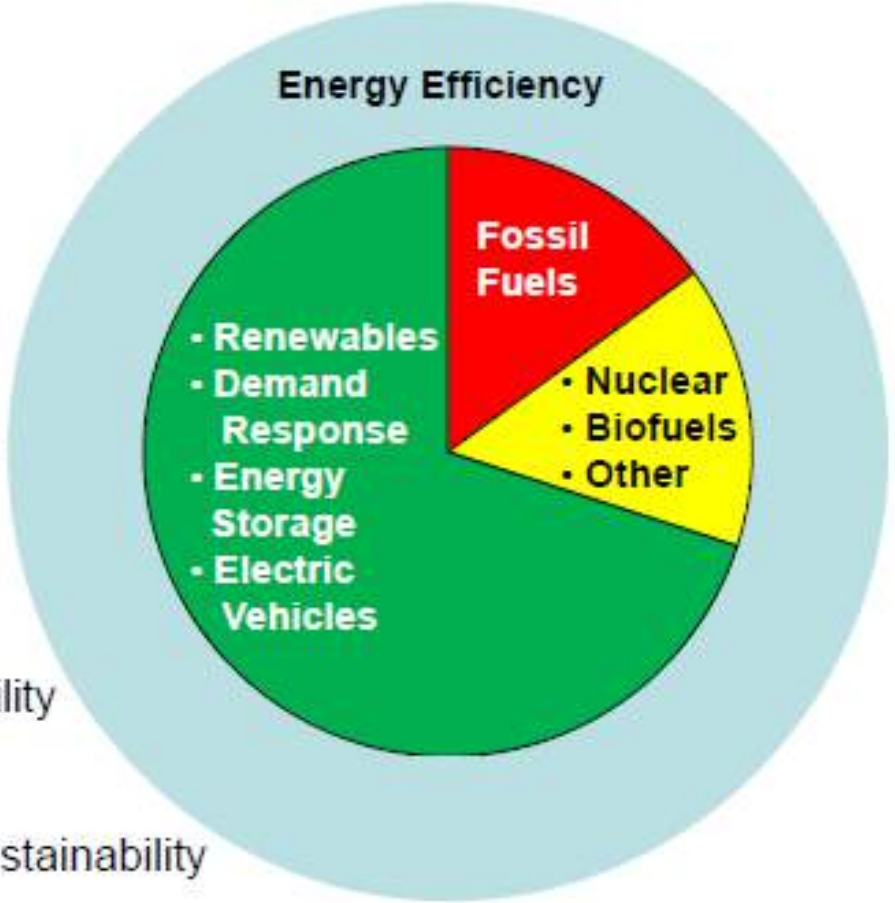
craig@clean-coalition.org

Clean Coalition (non-profit) Mission

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

Clean Coalition Vision





- Economic sensibility
- National security
- Environmental sustainability

The $6 trillion energy market will transition to Smart Energy

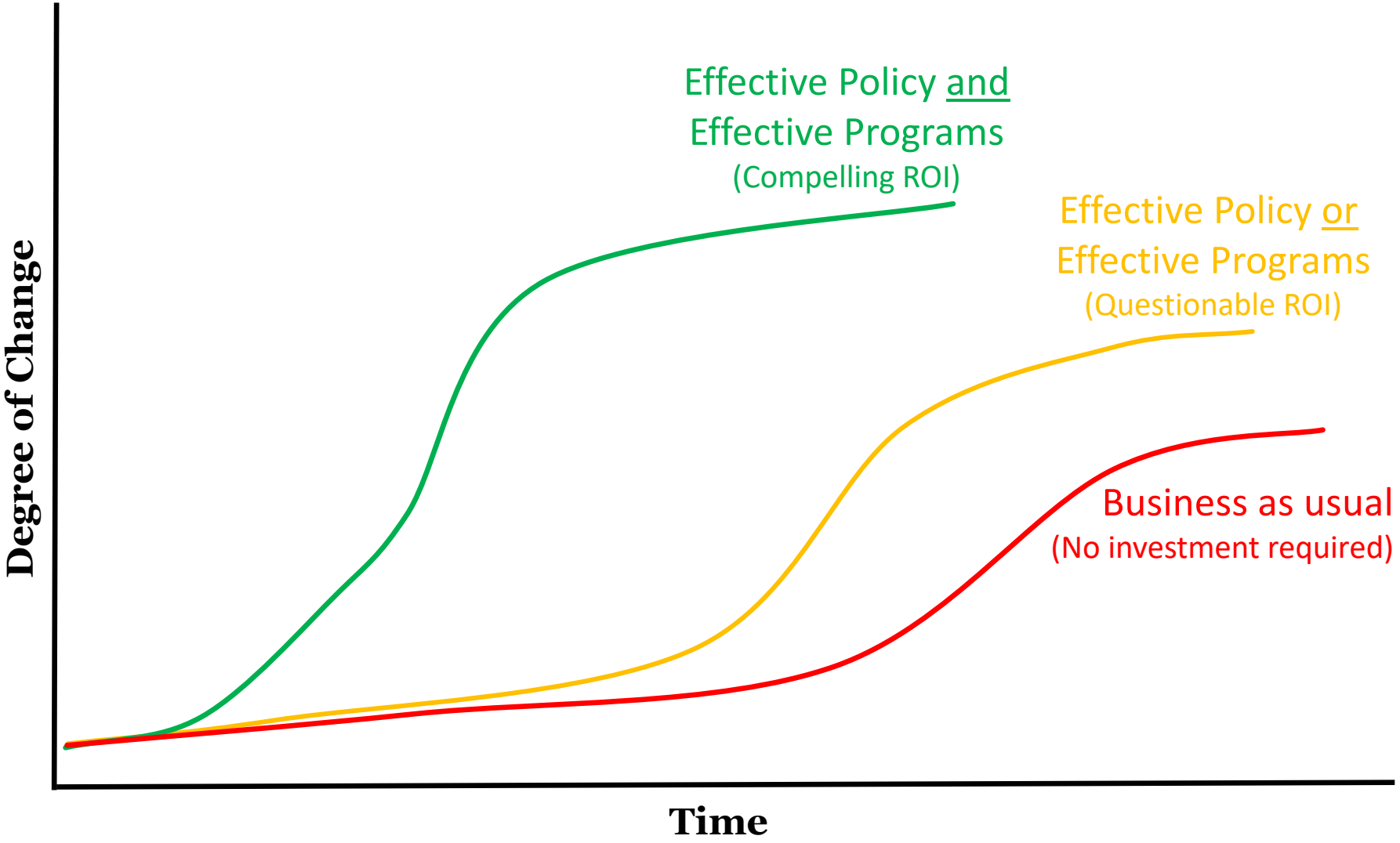
Top overarching objective: 25 by 25

Clean Coalition

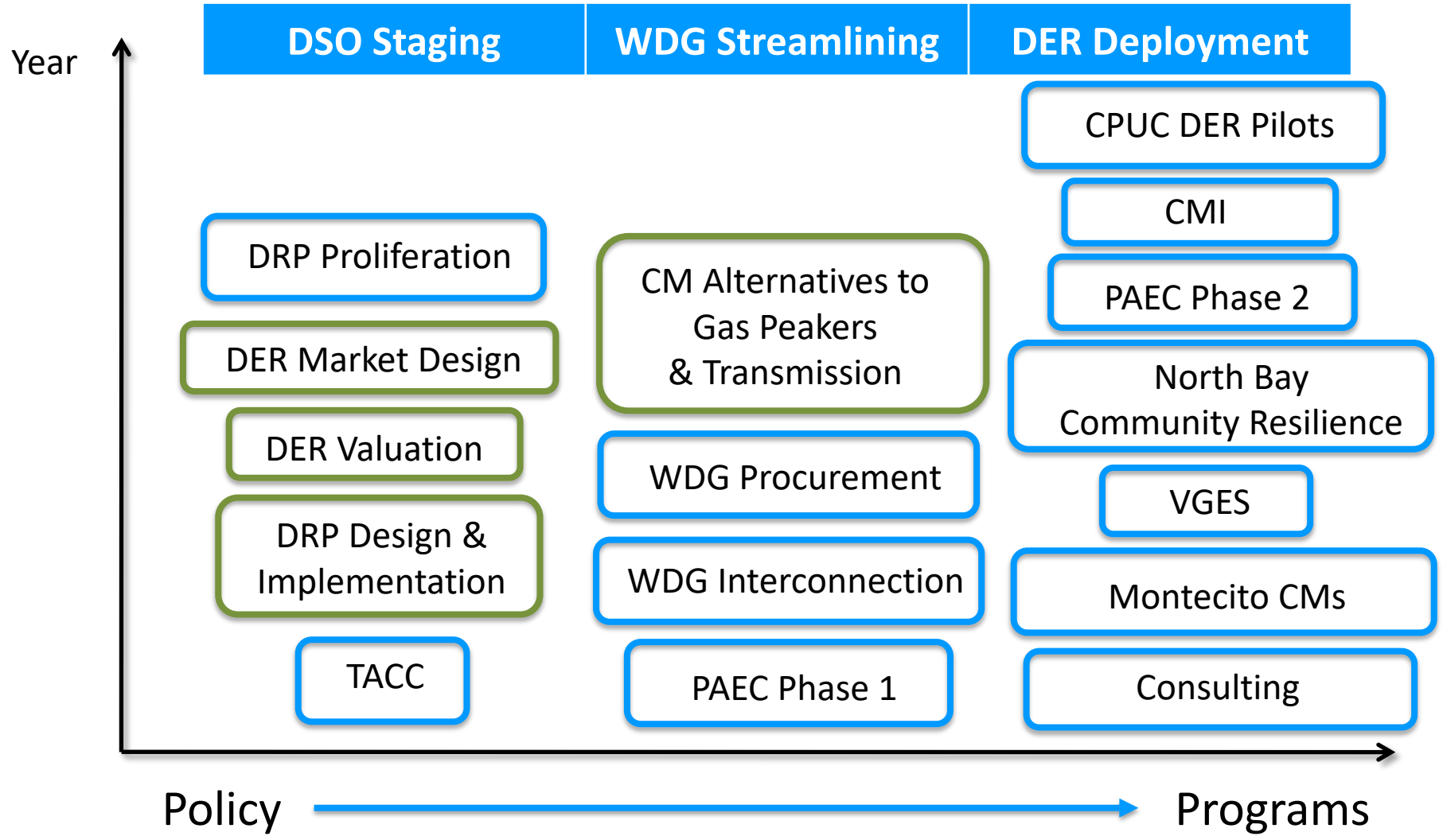
- Ensure that by 2025, at least 25% of all electricity consumption in the United States is from local renewable energy sources
  - Locally generated electricity does not travel over the transmission grid to get from the location it is generated to where it is consumed

Accelerating & Amplifying Change ROI

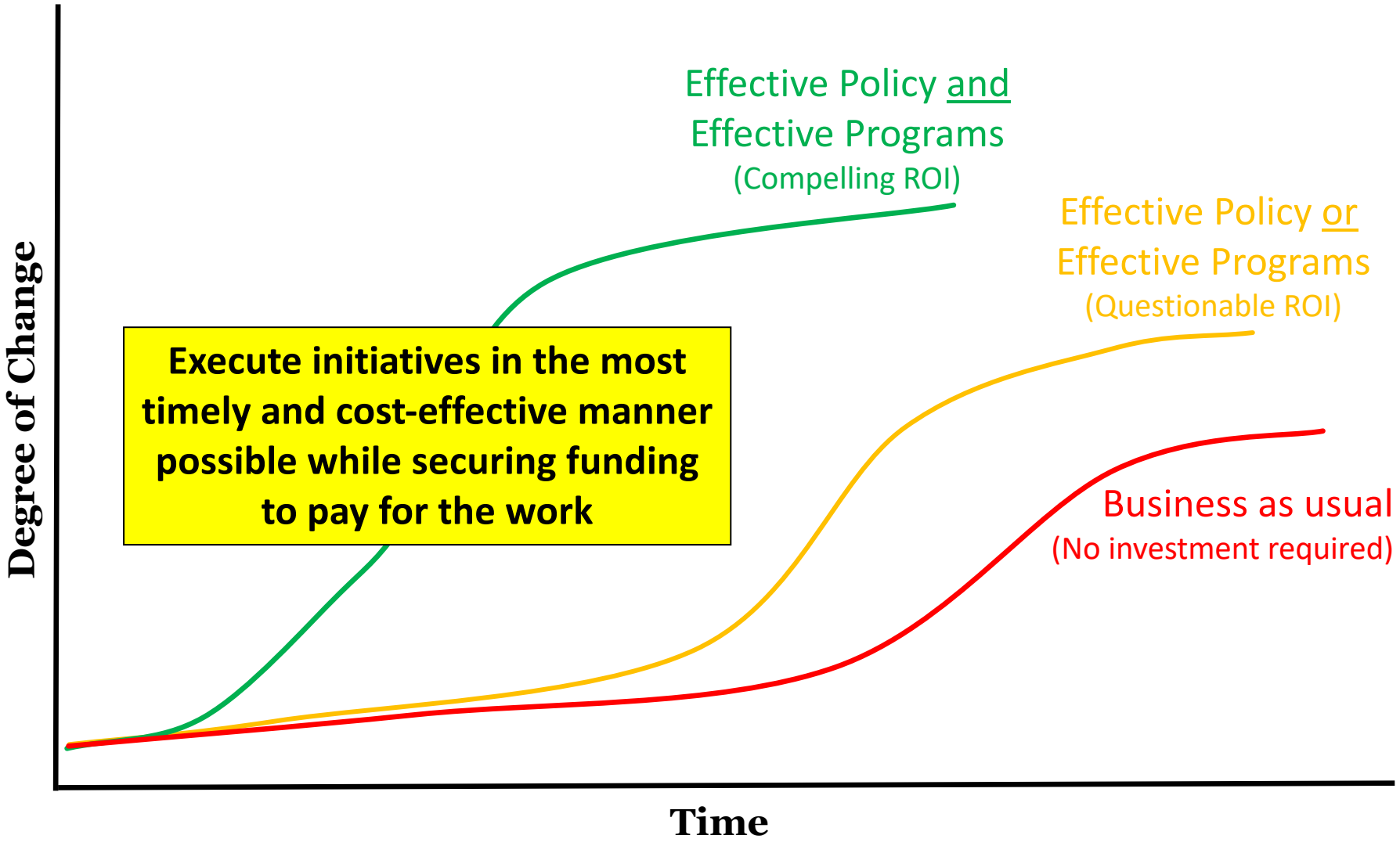
Clean Coalition



Clean Coalition Initiatives Map



Clean Coalition Business Model



Clean Coalition program expertise

Analysis & Planning

Full cost and value accounting for DER*; siting analysis

Grid Modeling & Optimization

Powerflow modeling; DER optimization

Program and Policy Design

Grid planning, procurement, and interconnection

Community Microgrid Projects

Design and implementation

* Distributed energy resources (DER) = local renewable generation, energy efficiency, energy storage, electric vehicles and charging infrastructure, and demand response technologies.

WDG Unleashes Renewables

Clean Coalition

Project Size

50+ MW

500 kW

5 kW

Wholesale DG

Serves Local Loads

Central Generation

Serves Remote Loads

Retail DG

Serves Onsite Loads

Behind the Meter

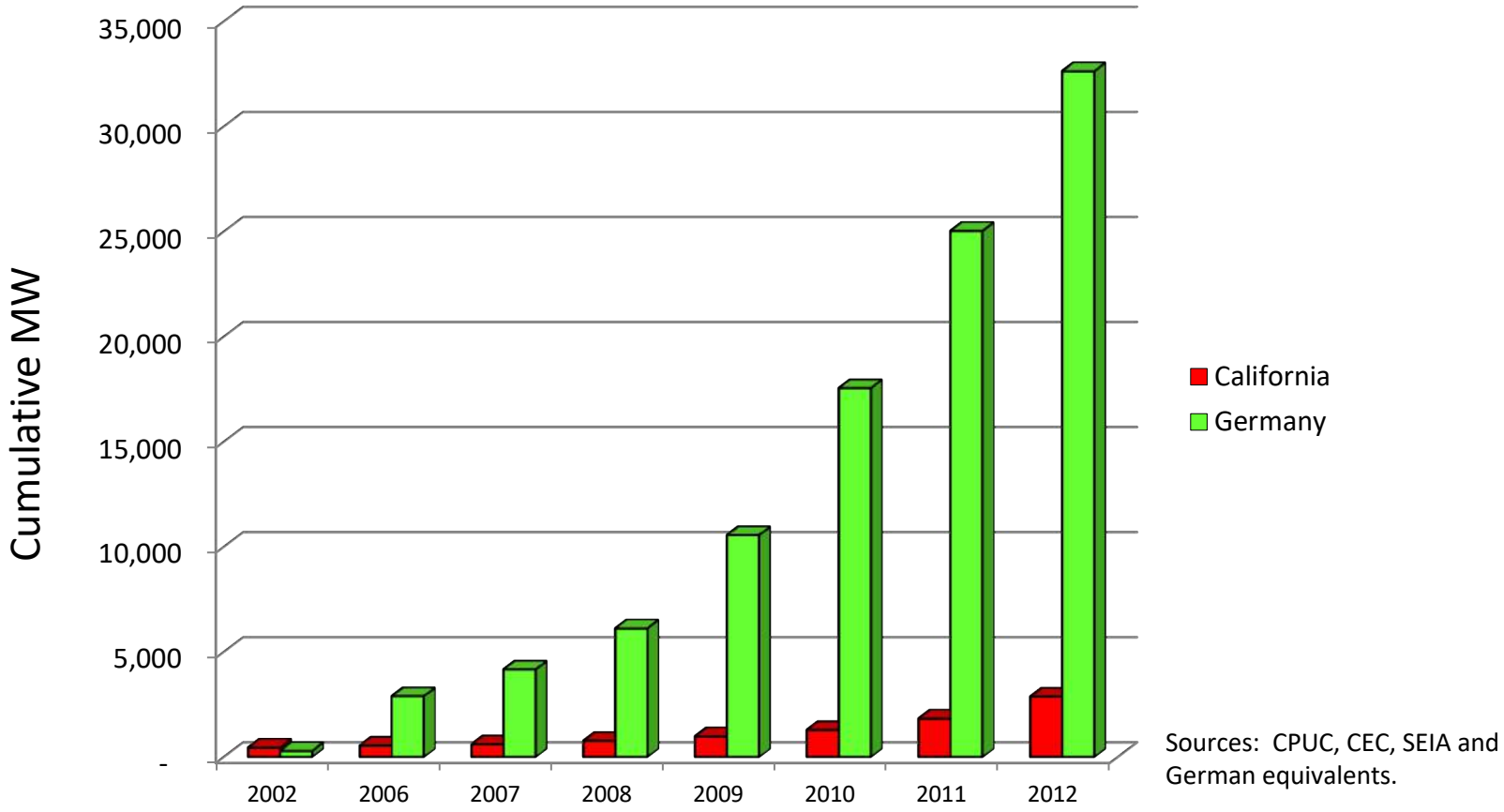
Distribution Grid

Transmission Grid

WDG Unleashed Solar in Germany

Clean Coalition

Solar Markets: Germany vs California (RPS + CSI + other)



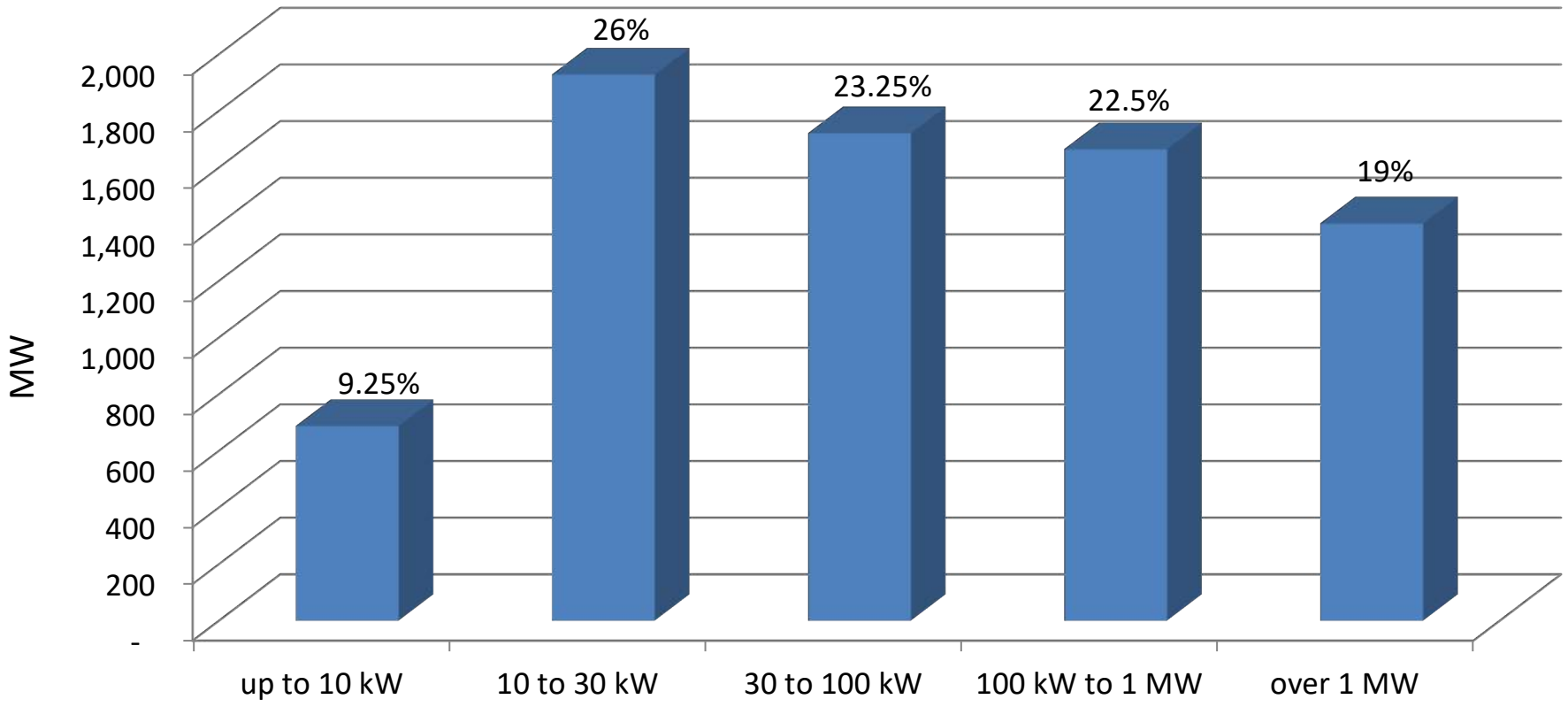
Sources: CPUC, CEC, SEIA and German equivalents.

Germany deployed over 10 times more solar than California, mostly on built-environments, in the decade from 2002 despite California having 70% better solar resource

German solar is mostly local (on rooftops)

Clean Coalition

German Solar Capacity Installed through 2012



Source: Paul Gipe, March 2011

Germany's solar deployments are almost entirely sub-2 MW projects on built-environments and interconnected to the distribution grid (not behind-the-meter)

German rooftop solar is 4 to 6 cents/kWh today

Clean Coalition

Project Size	Euros/kWh	USD/kWh	California Effective Rate $/kWh
Under 10 kW	0.1270	0.1359	0.0628
10 kW to 40 kW	0.1236	0.1323	0.0611
40.1 kW to 750 kW	0.1109	0.1187	0.0548
Other projects up to 750 kW*	0.0891	0.0953	0.0440

- Conversion rate for Euros to Dollars is €1:$1.07
- California's effective rate is reduced 40% due to tax incentives and then an additional 33% due to the superior solar resource

Replicating German scale and efficiencies would yield rooftop solar today at only between 4 and 6 cents/kWh to California ratepayers

* For projects that are not sited on residential structures or sound barriers.

Community Microgrid Vision

Clean Coalition

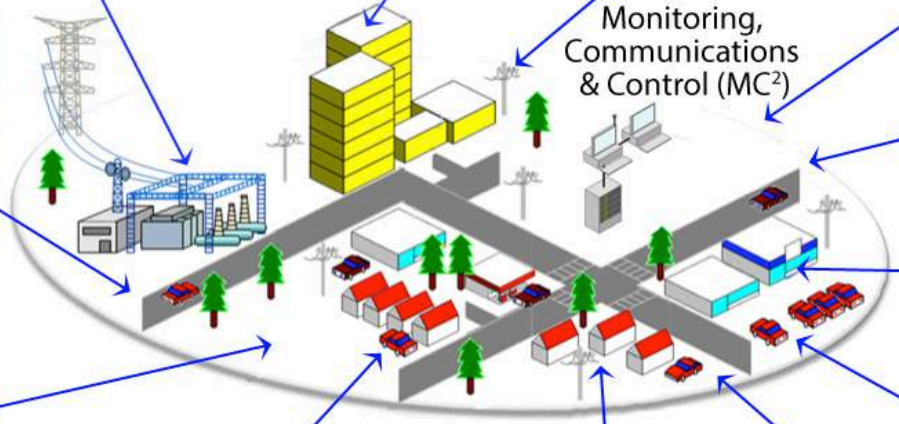
Grid Energy Storage

Distributed Generation

Switches & Power Electronics

Distributed Generation

Biopower Generation



Monitoring, Communications & Control (MC^2)

Energy Storage

Microturbine

Distributed Generation

Electric Vehicles (EV)

Home Energy System

Fuel Cells

Distributed Generation

Community Microgrids = the Grid of the Future

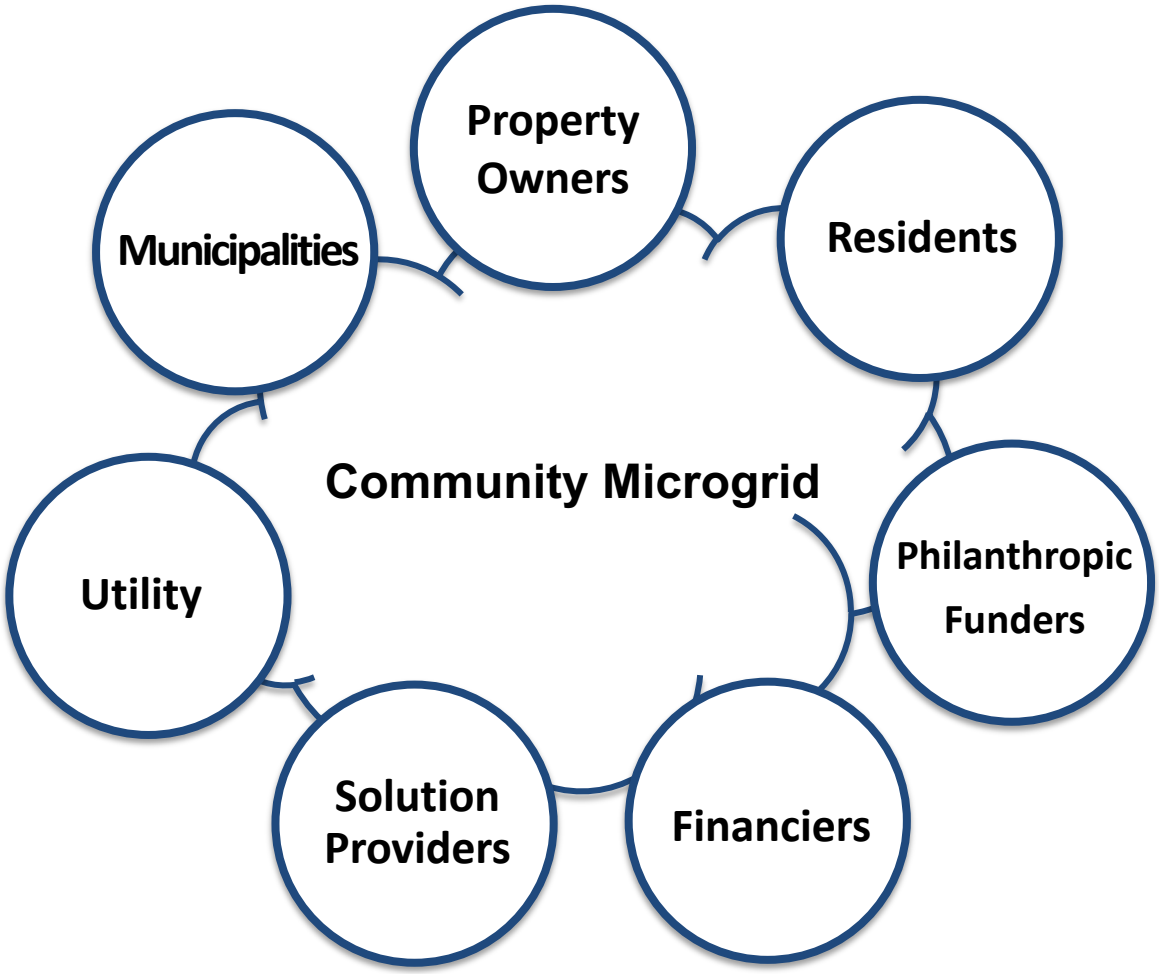
Clean Coalition

A Community Microgrid is a new approach for designing and operating the electric grid, stacked with local renewables and staged for resilience.

Key features:

- A targeted and coordinated local grid area served by one or more distribution substations
- High penetrations of local renewables and other Distributed Energy Resources (DER) such as energy storage and demand response
- Staged capability for ongoing renewables-driven power backup for critical and prioritized loads across the grid area
- A solution that can be readily extended throughout a utility service territory – and replicated into any utility service territory around the world

Community Microgrid key stakeholders



Community Microgrids in Six Steps

Clean Coalition

1. Goals

Desired goals & performance metrics of the target grid area based on local resources and known or anticipated grid issues.

Includes renewables penetration goals, grid reliability & power quality performance targets, and power backup requirements.

2. Baseline Analysis

Inventory of the existing grid assets including load profiles, voltage regulation, feeder and transformer capacities, and existing generation.

Includes identifying prioritized services that require backup power during outages.

3. Siting Survey

Comprehensive survey of the renewable energy potential in the target grid area specific to local resources & site characteristics

Informs other requirements such as energy storage capacity needs and control system functionality.

4. DER Optimization

Design of optimal DER portfolios combining renewables, energy storage, and demand response.

Incorporates Baseline Grid Analysis and Renewables Survey to achieve optimal outcomes based on local resources and grid assets.

5. Benefits Analysis

Full analysis of cost- benefits and net value including reductions in T&D investments, ratepayer impacts, and local job creation.

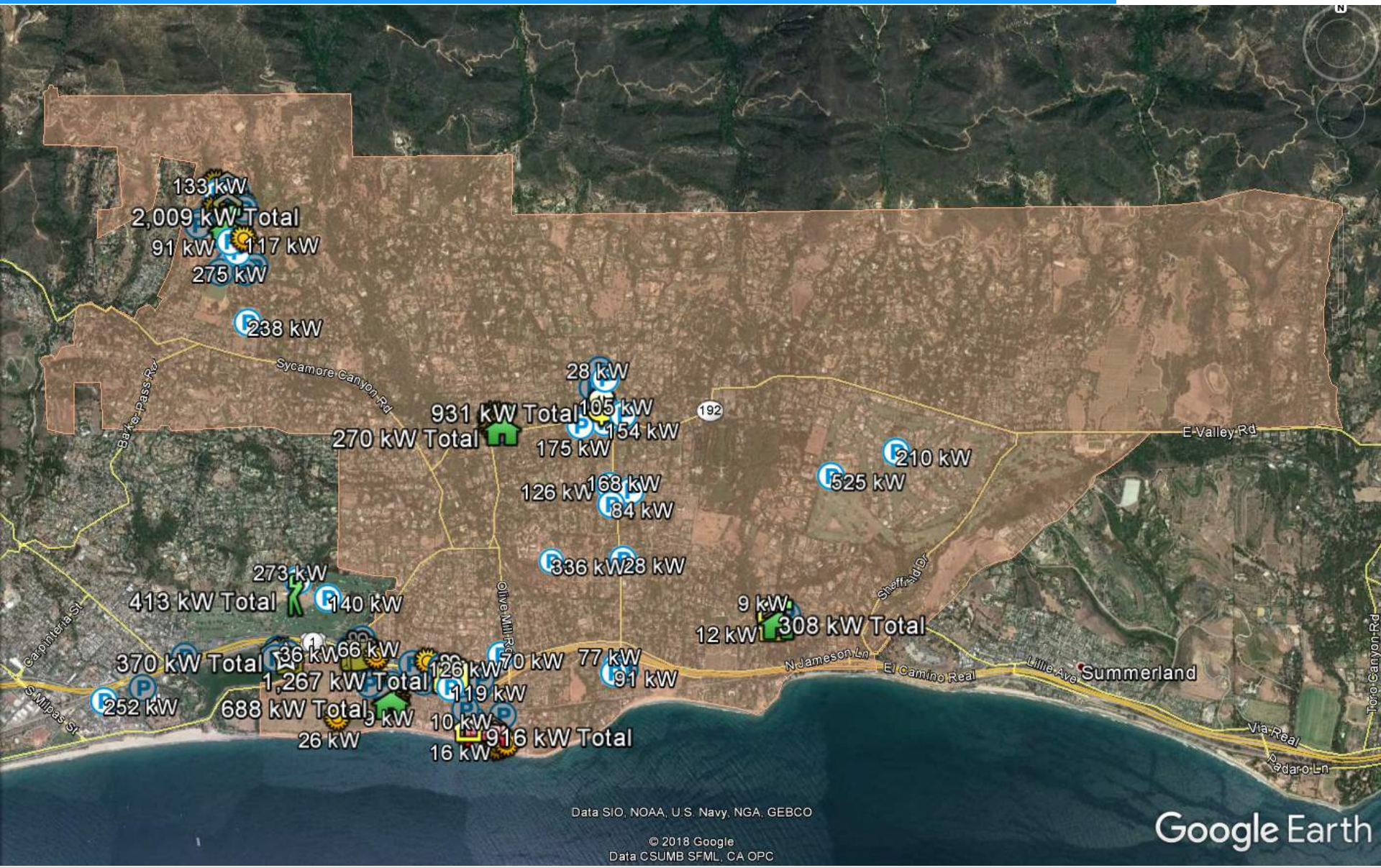
Includes bulk procurement & interconnection that achieve a “plug-and-play” model, further reducing costs.

6.Deployment Plan

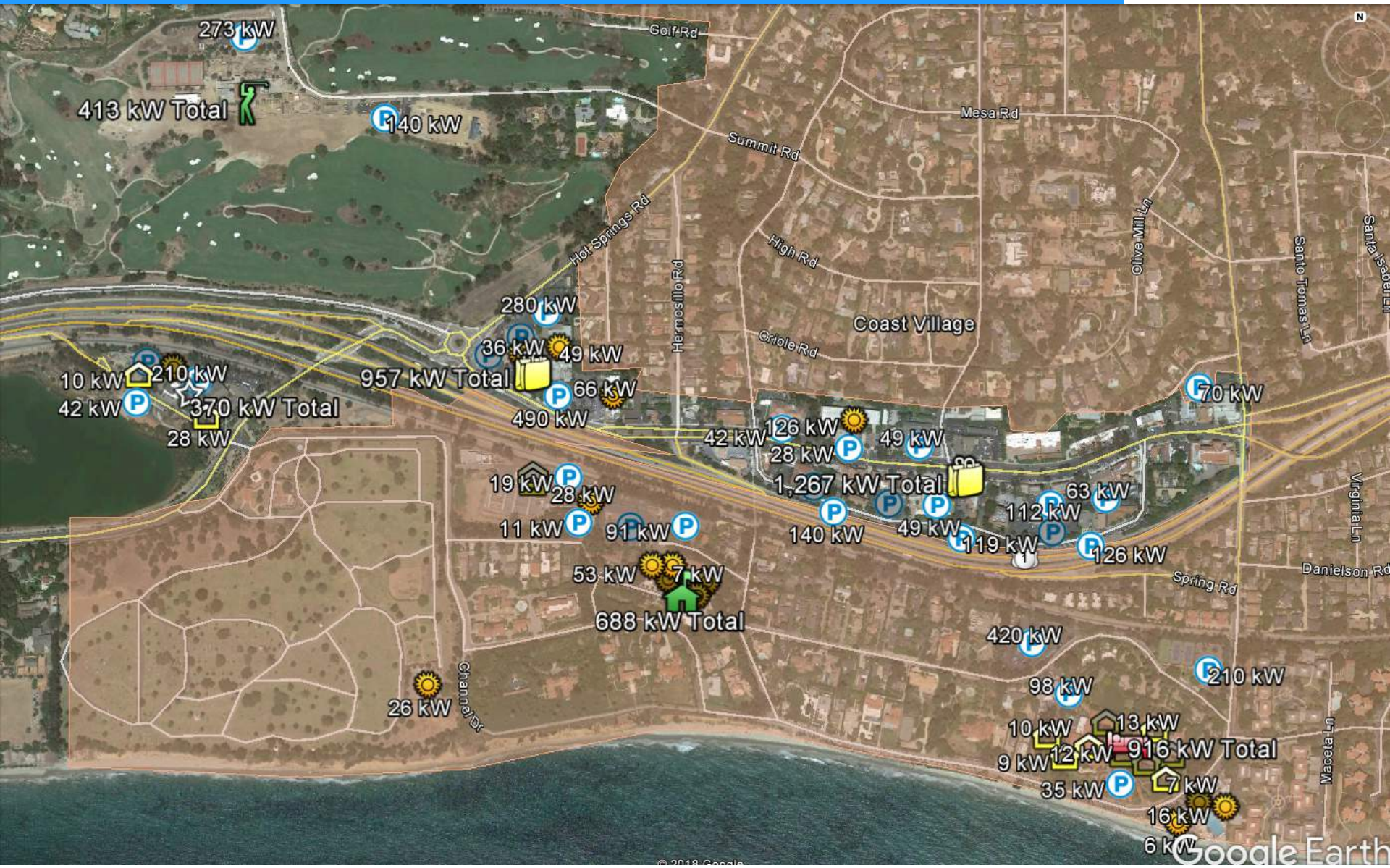
Final system design, financial model and operational plan for the Community Microgrid.

Includes vendor analysis (e.g. RFIs, RFPs) appropriate to the final design criteria, financial model, and operational requirements.

Solar Siting Survey (SSS) for Montecito

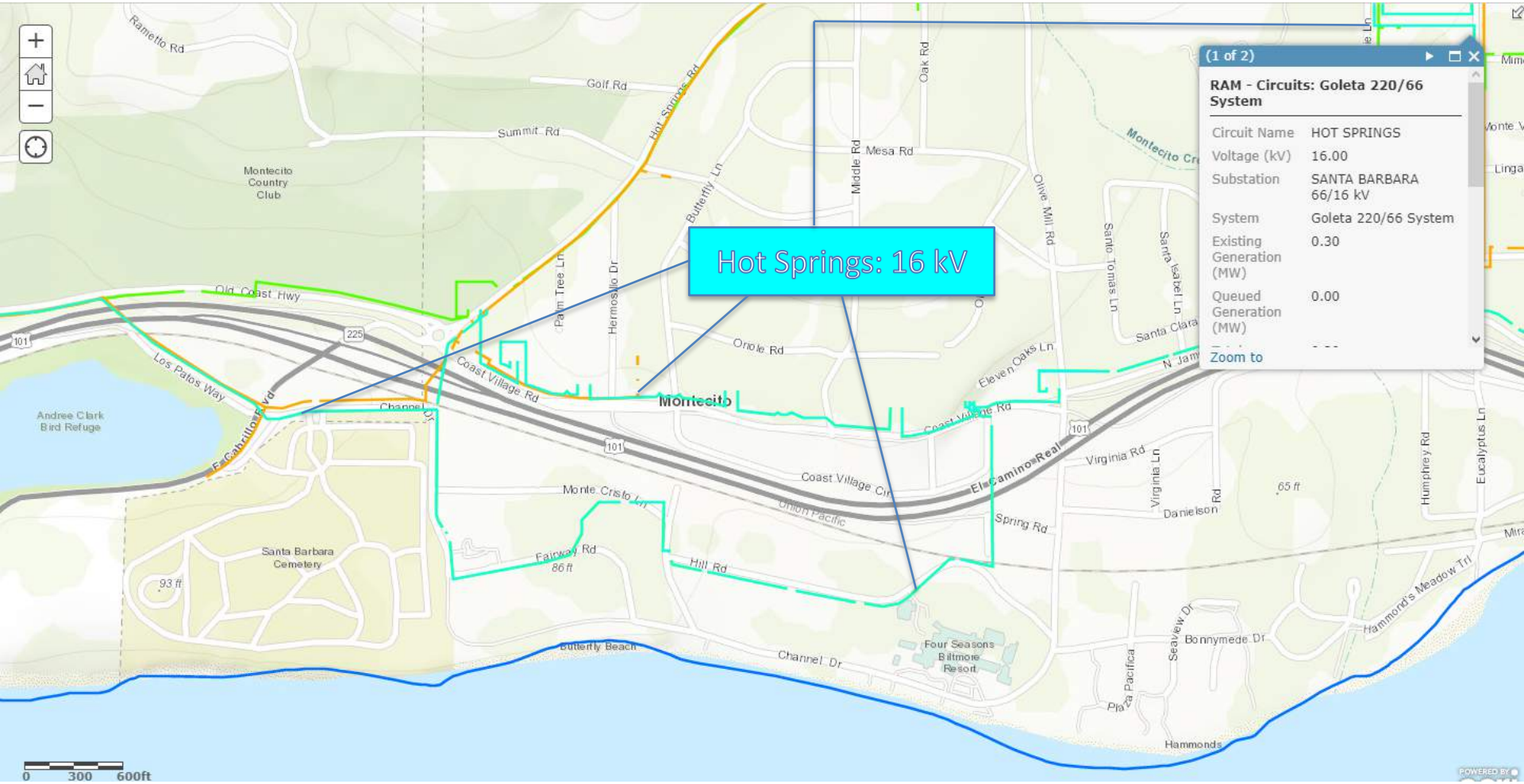


Lower Village Community Microgrid map view



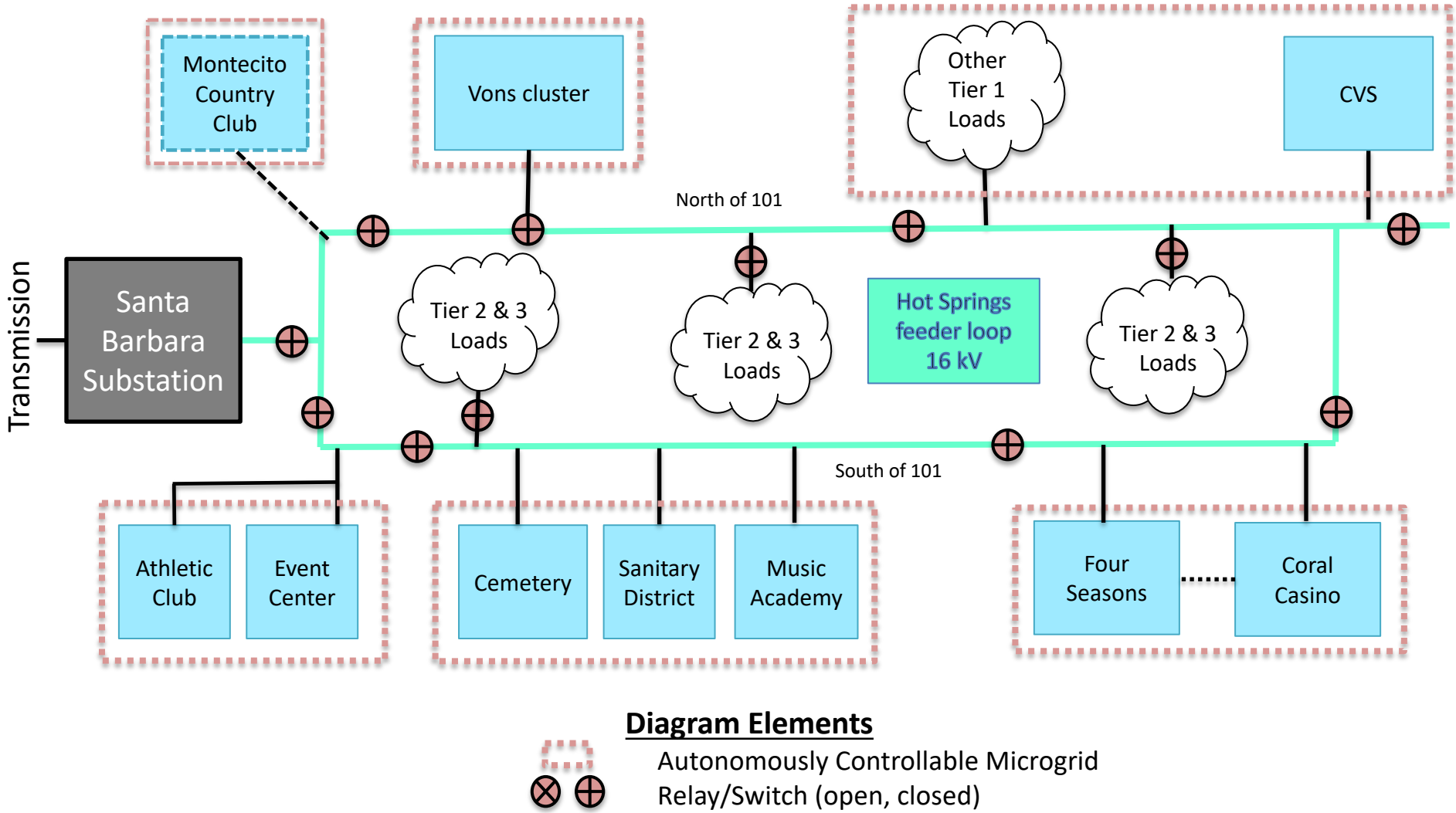
Hot Springs Feeder is a key to success

Clean Coalition



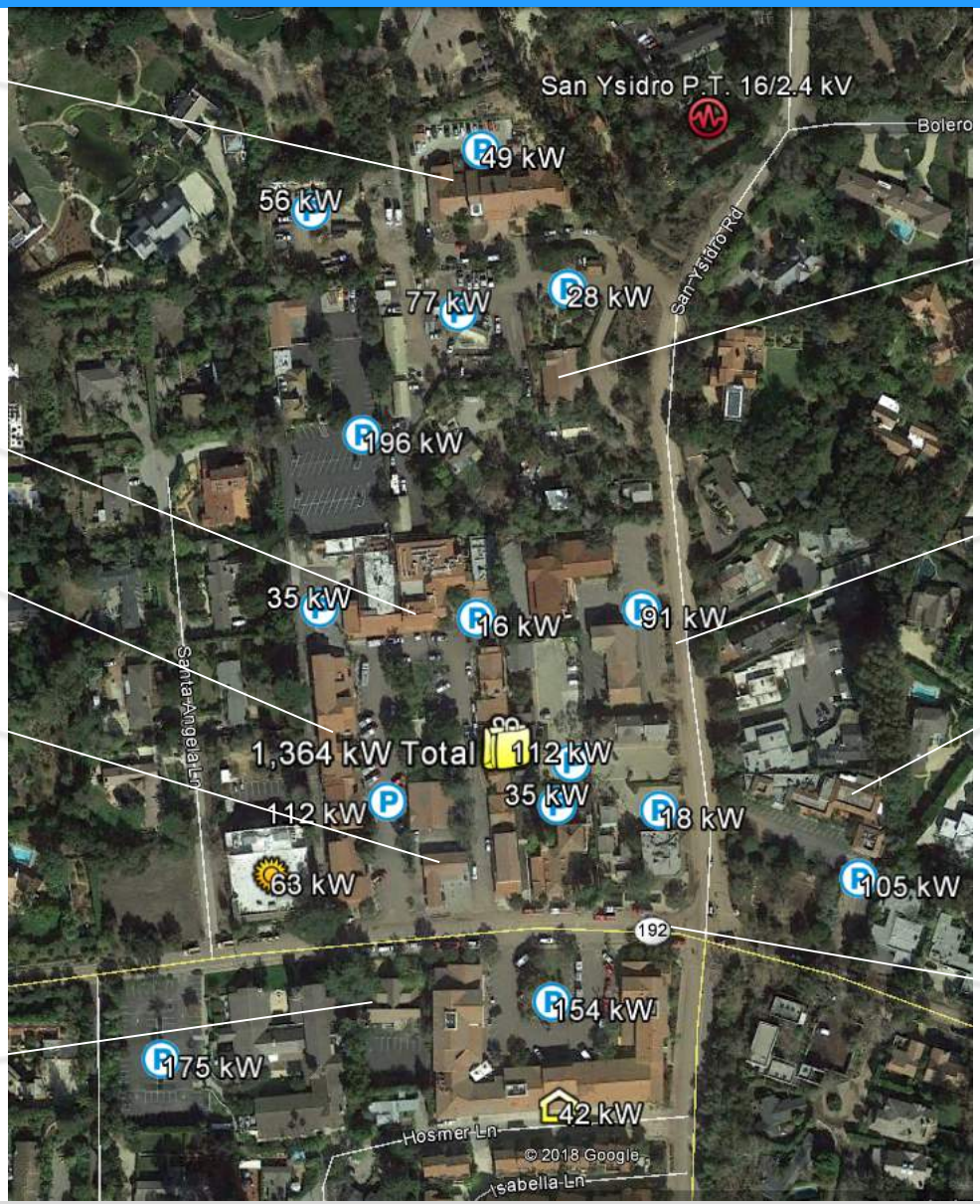
Lower Village Community Microgrid block diagram

Clean Coalition



Upper Village Community Microgrid potential

Clean Coalition



Fire Dist. HQ

Water Dist. HQ

Wells Fargo Bank

San Ysidro Rd

US Post Office

Gas Station

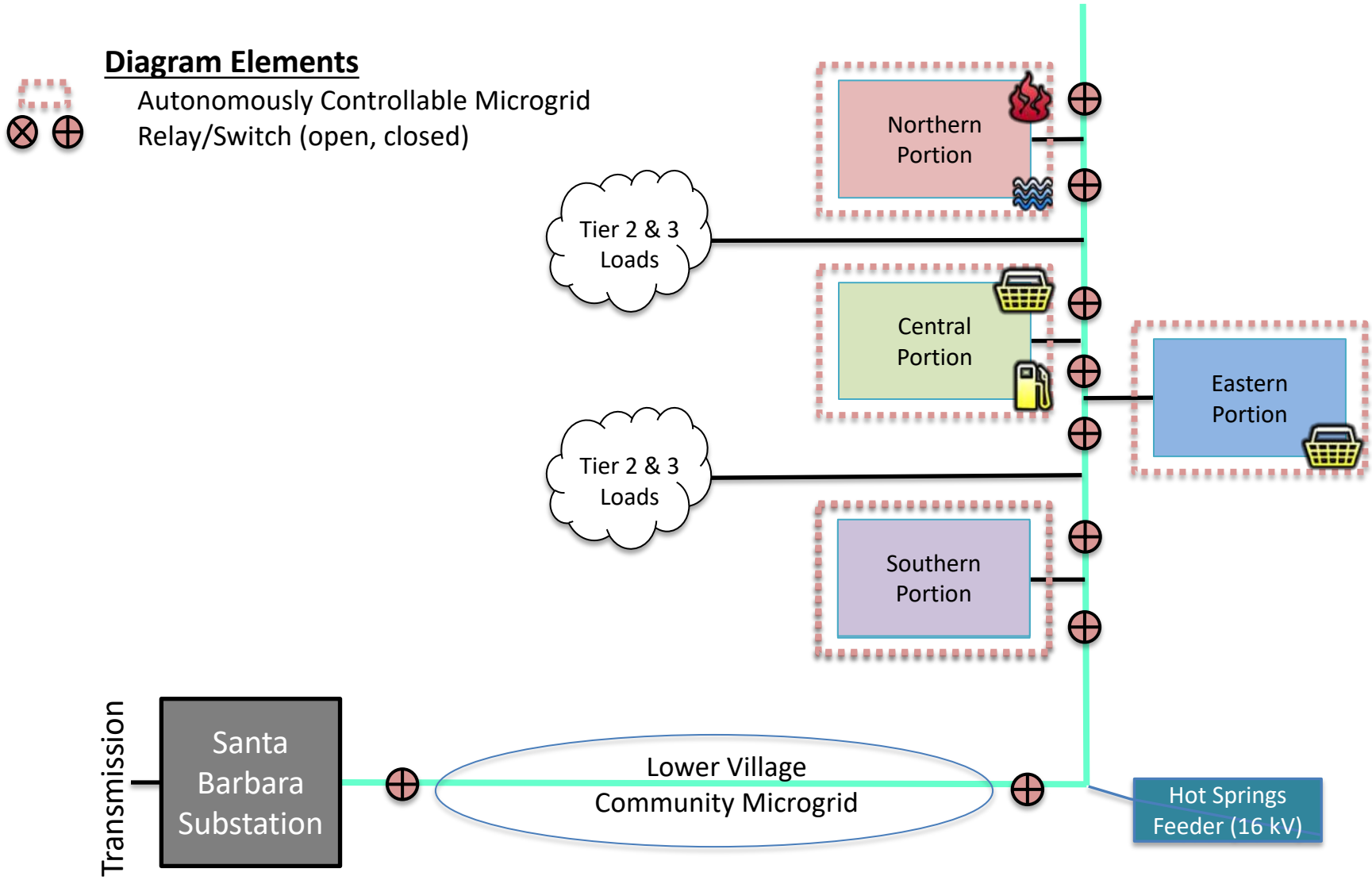
Market

East Valley Road / Hwy 192

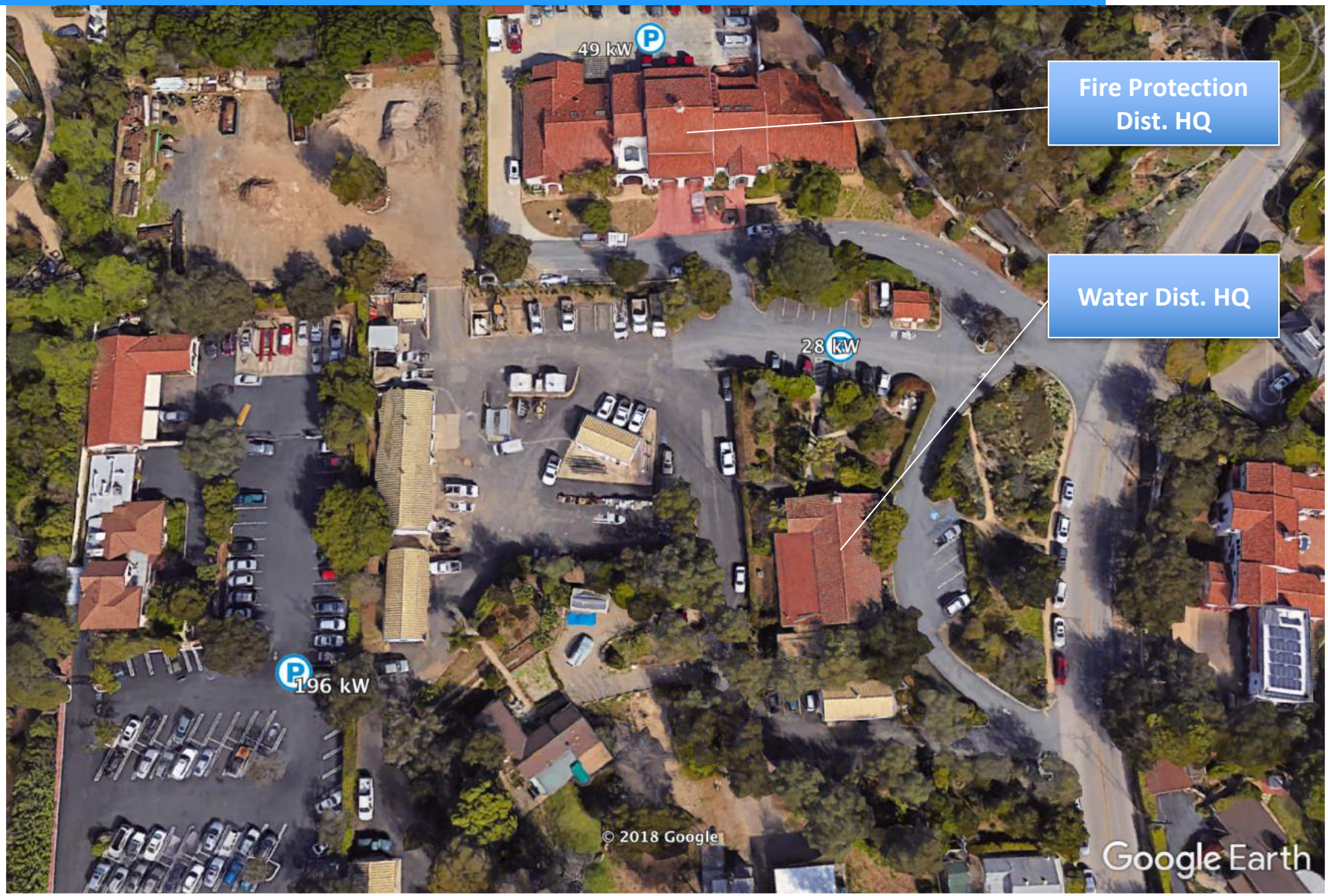
Montecito Association HQ

Upper Village Community Microgrid block diagram

Clean Coalition



Upper Village northern portion



Montecito Community Microgrids use of funds

Clean Coalition

1. $300k - $600k to take each comprehensive Community Microgrid from an idea to being ready for deployment
   - 30% - Project Staging.
   - 45% - Project Planning & Engineering.
   - 25% - Deployment Preparation.
2. $7.5 million to deploy Upper Village Community Microgrid
   - $2 million for 500 kWac of solar at $4k/kWac (mostly smallish solar carports and rooftop arrays).
   - $2 million for 500 kW / 500 kWh of energy storage at $1k/kWh.
   - $2 million for grid upgrades like the addition of grid isolation switches etc.
   - $1.5 million for Monitoring, Communications, and Control (MC^2).
3. $22.5 million to deploy Lower Village Community Microgrid
   - Economies of scale from more than 5 times the levels of solar and energy storage; and larger individual project sizes.
   - Leverage grid upgrade and MC^2 learning from Upper Village efforts.

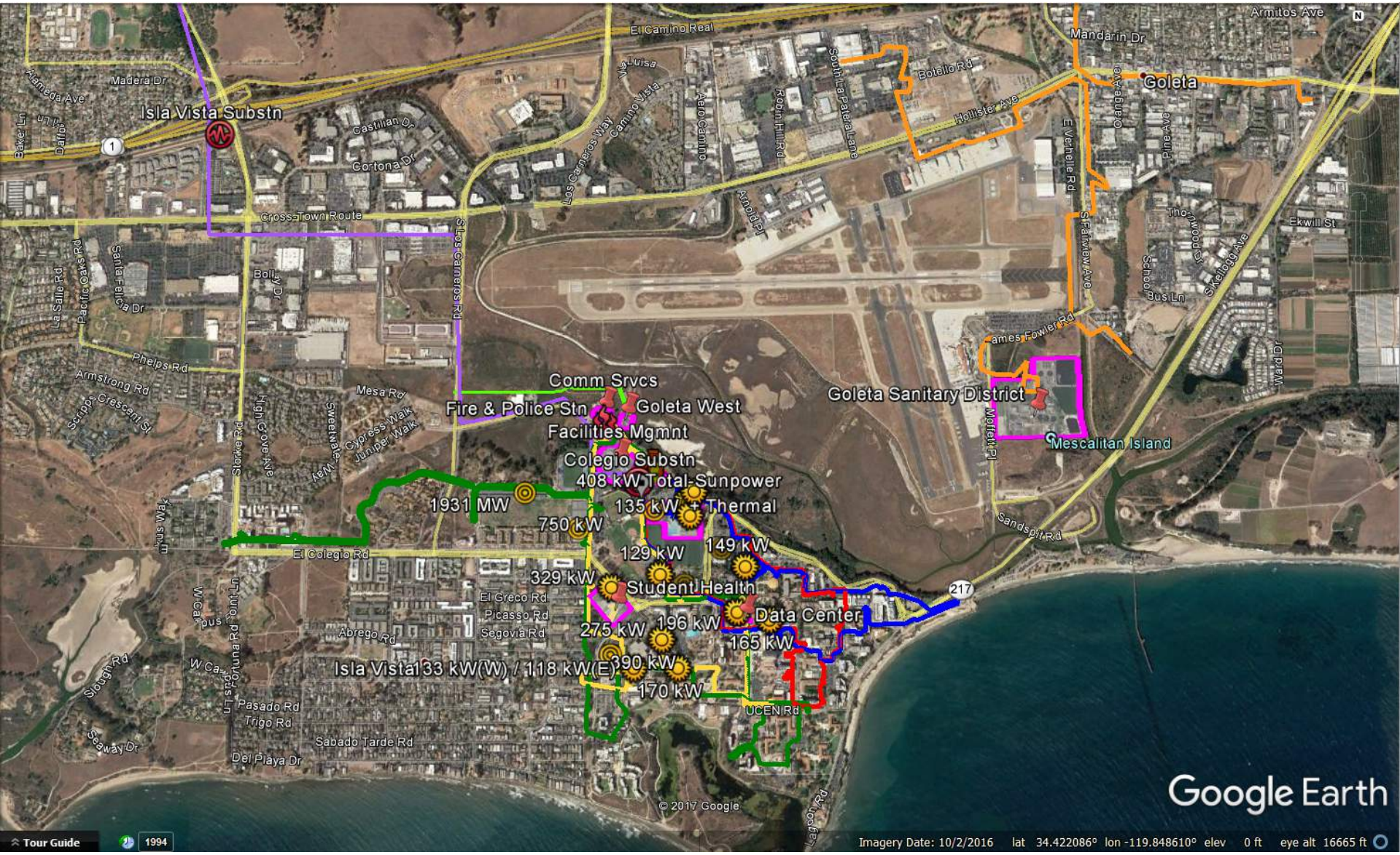
Montecito Community Microgrids source of funds

Clean Coalition

1. $300k - $600k to take a Community Microgrid from an idea to being ready for deployment
   - Philanthropic funding.
2. $7.5 million to deploy Upper Village Community Microgrid
   - About half pays for itself (most of the solar and about half the energy storage and MC^2).
   - Other half (about $3.75 million) needs to be paid by grants and philanthropic funding; and possibly via SCE ratebasing.
3. $22.5 million to deploy Lower Village Community Microgrid
   - Will require about 25% to be paid by grants and philanthropic funding; and possibly via SCE ratebasing.

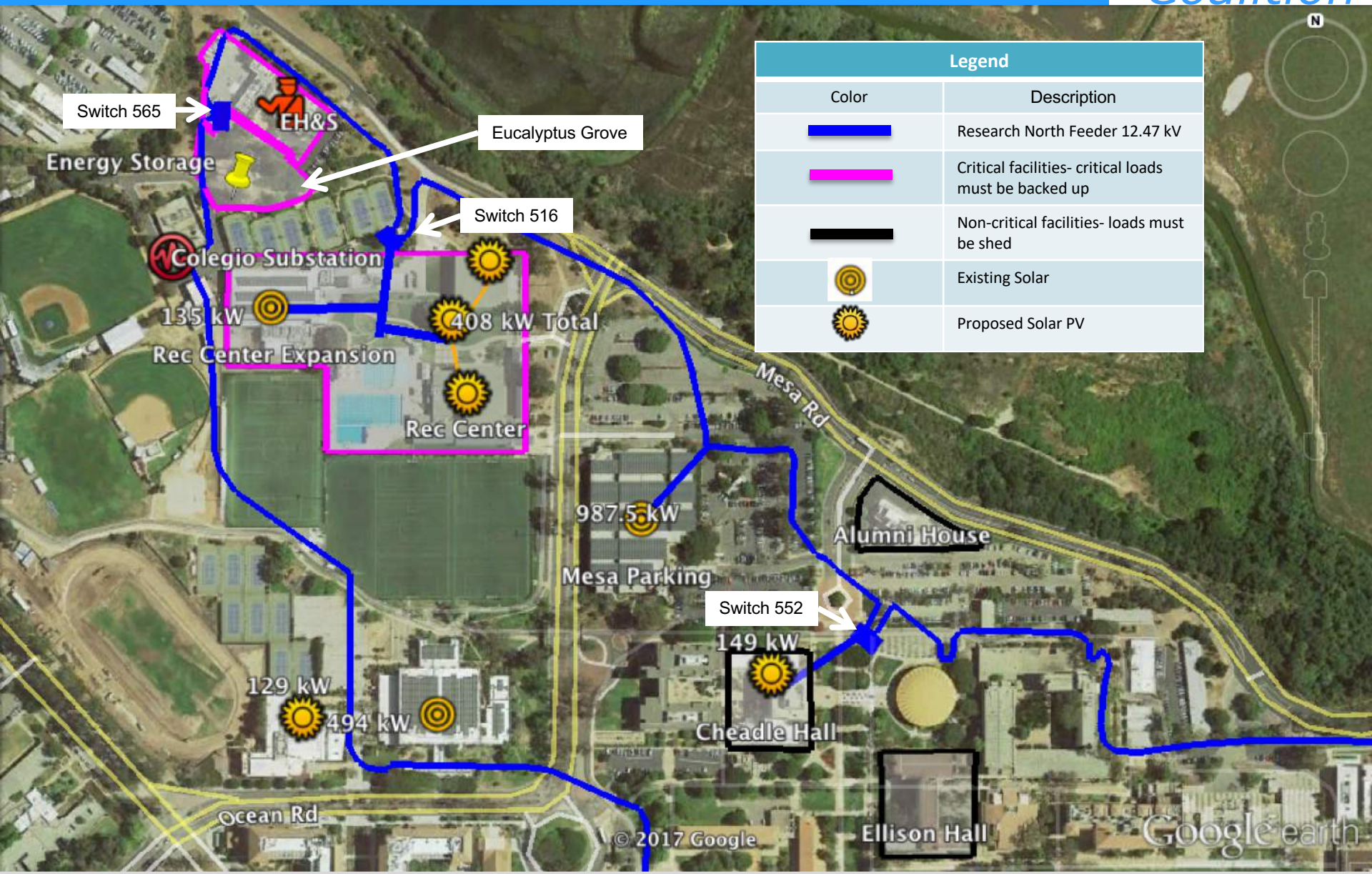
UCSB Community Microgrid – Area Map

Clean Coalition



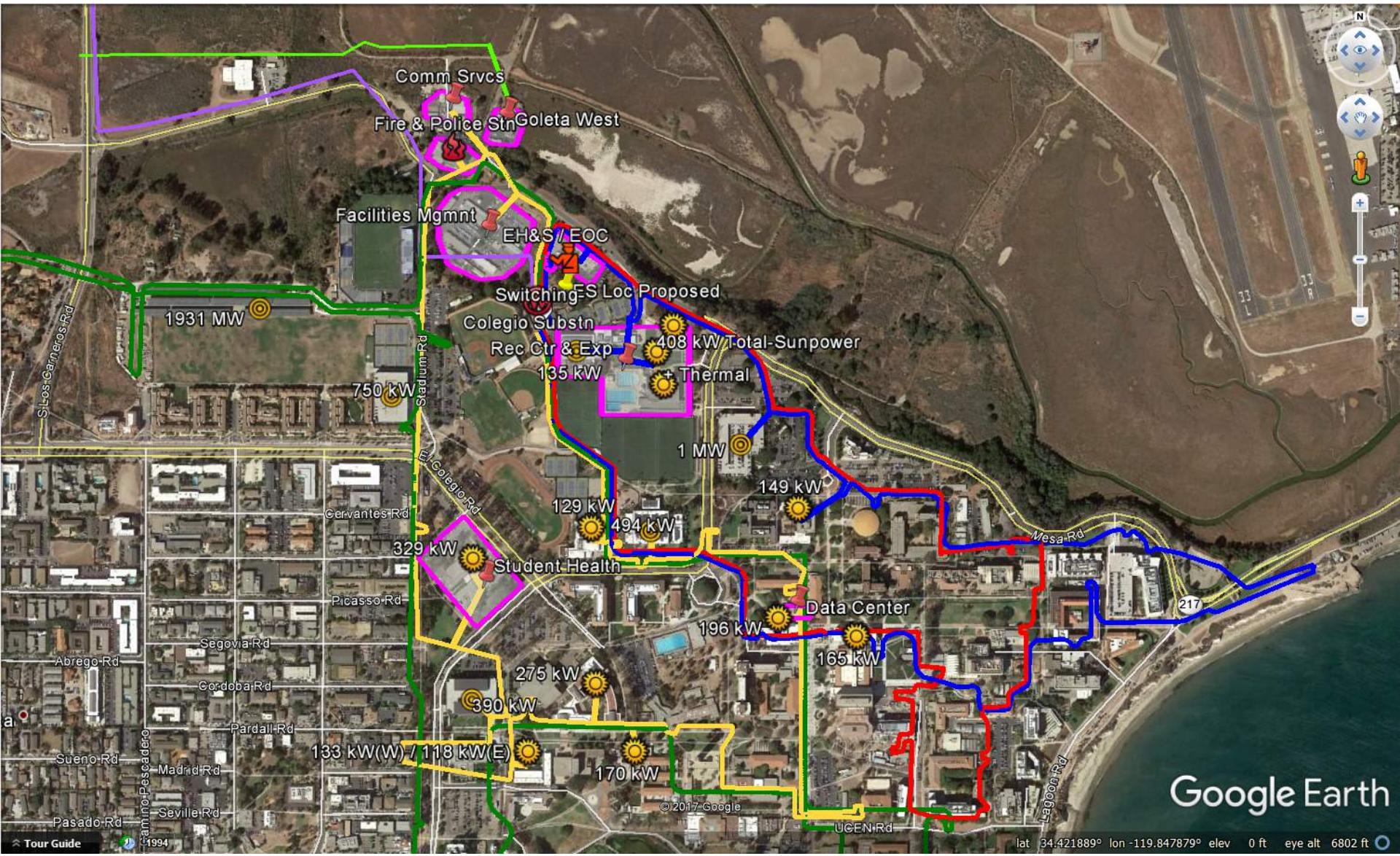
UCSB Community Microgrid – Phase 1

Clean Coalition



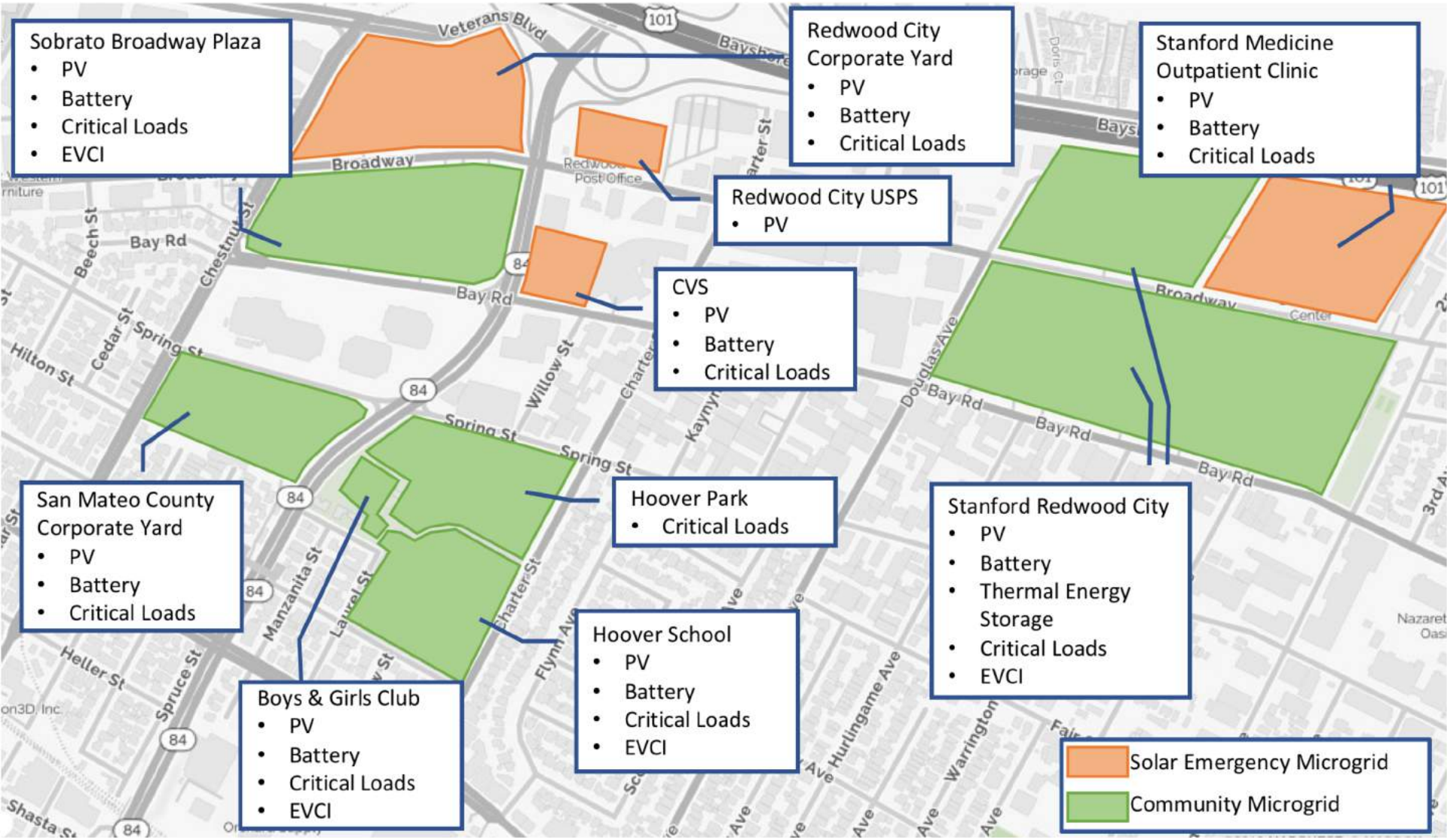
UCSB Community Microgrid – Phase 1 + 2

Clean Coalition



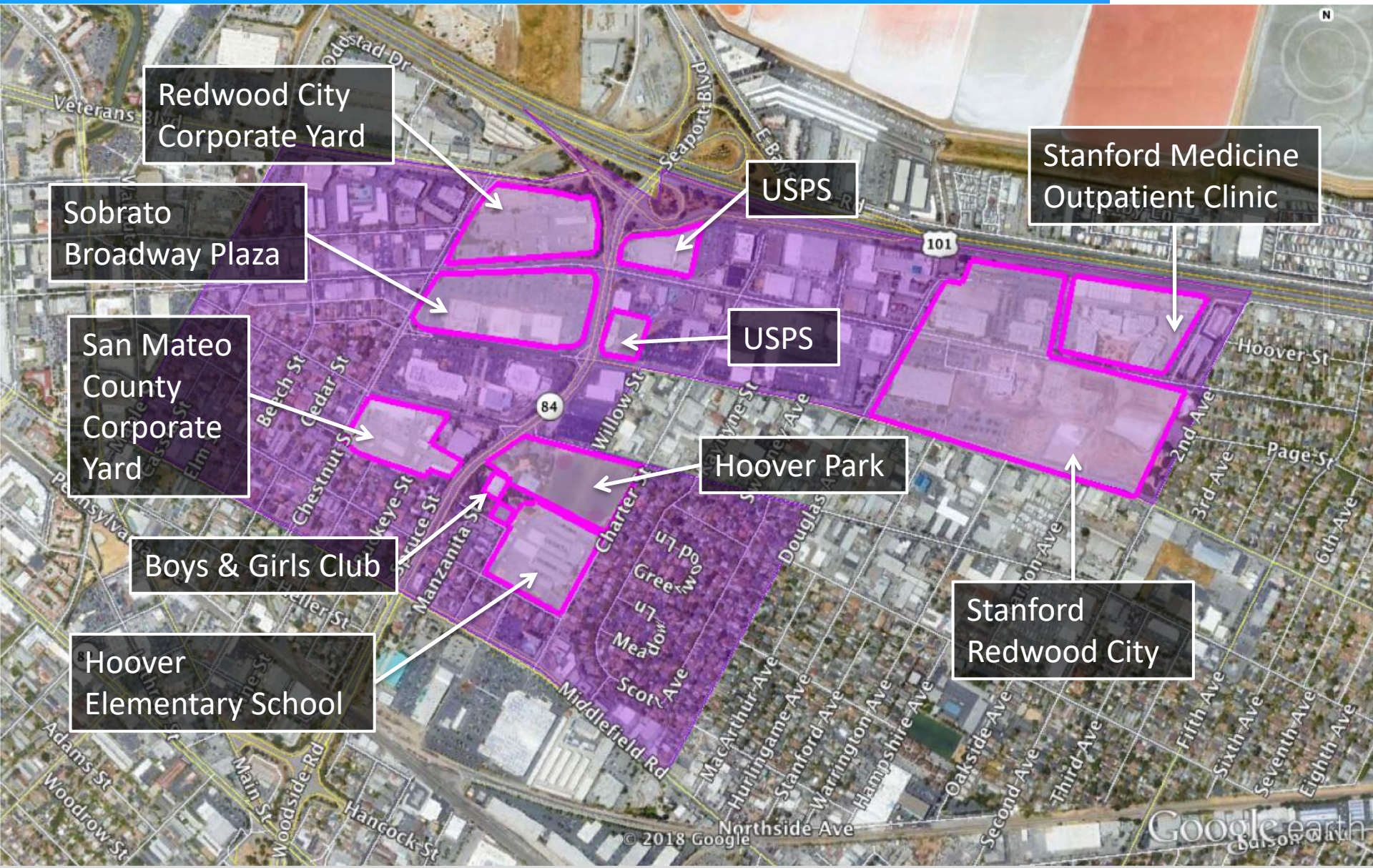
Redwood City Community Microgrid Conceptual Diagram

Clean Coalition



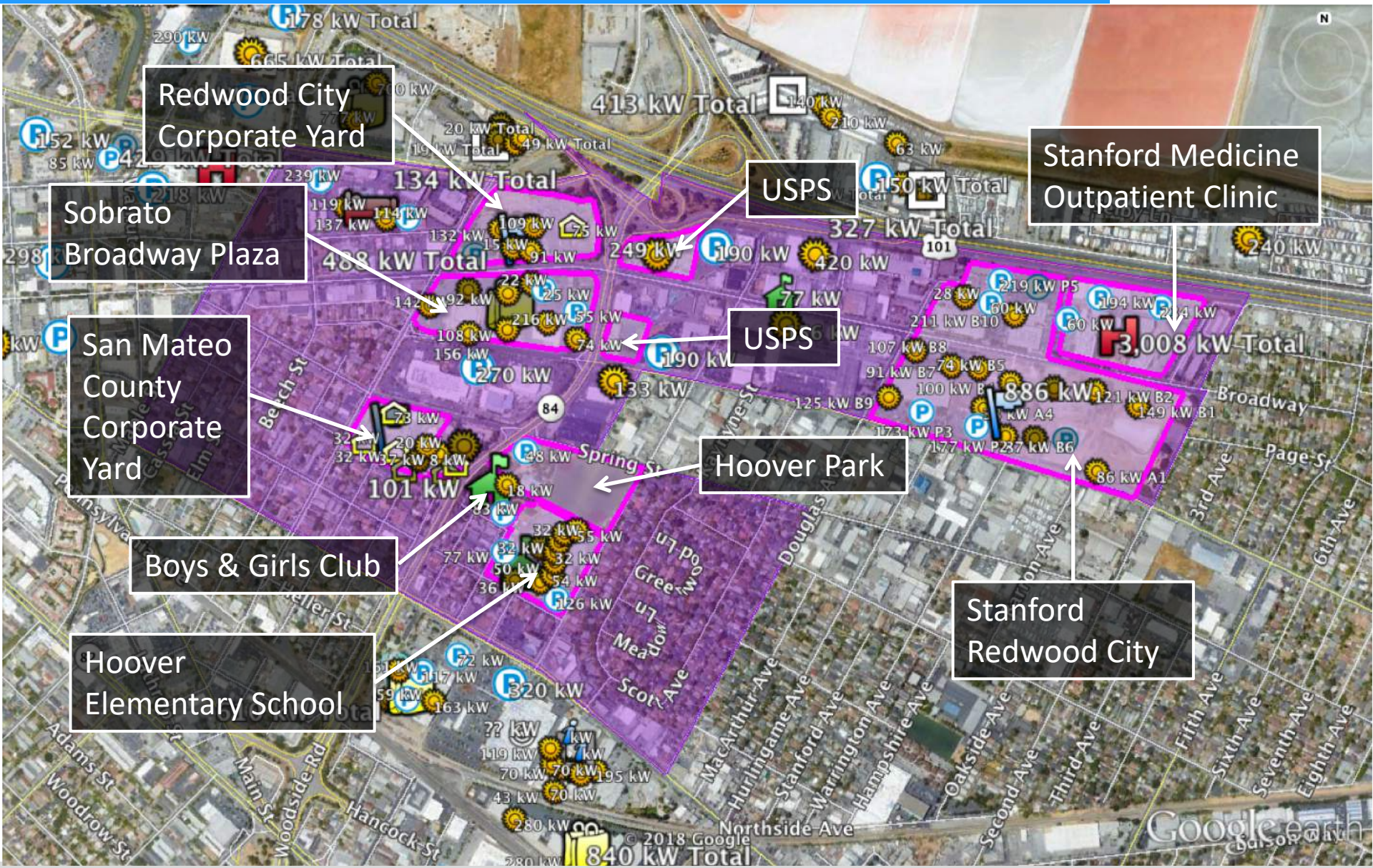
Redwood City Disadvantaged Community and Community Microgrid Sites

Clean Coalition



Redwood City Disadvantaged Community and Community Microgrid Sites

Clean Coalition



Deployment Summary

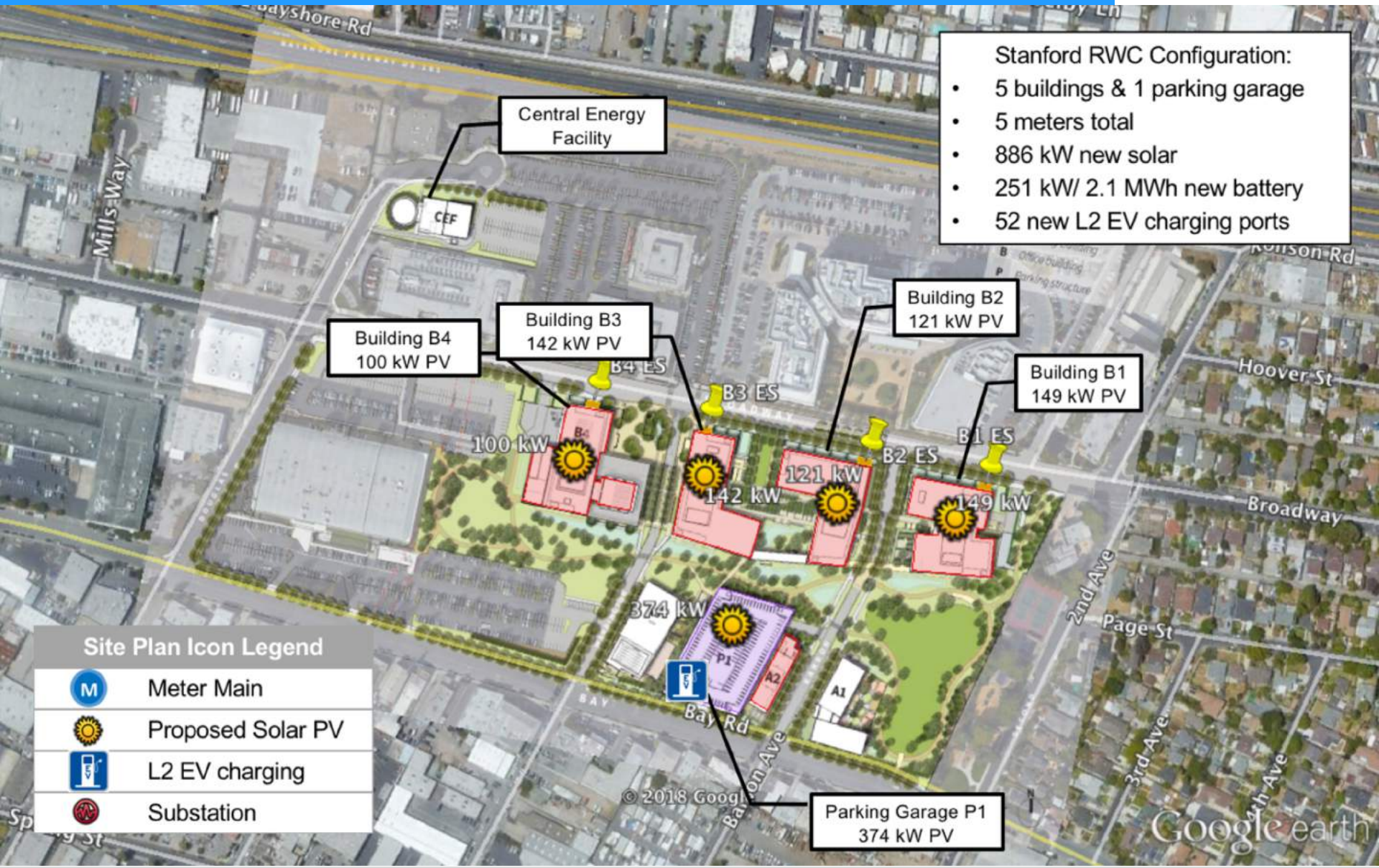
Site Name	Meters or Buildings	Critical Loads	NEM Solar [kW AC]	FIT Solar [kW AC]	Total Solar [kW AC]	Battery [kW]	Battery [kWh]	EVCI (Level 2)
Stanford Redwood City Phase 1	P1, B1-B4	Campus emergency response	886	0	886	251	2,100	52
Hoover Cluster	Hoover School	Shelter & food service	73	203	276	29	150	20
	Boys & Girls Club	Shelter & food service	11	90	101	0	0	10
	Hoover Park	Equipment staging	0	0	0	0	0	0
Redwood City Corporate Yard	Redwood City Corporate Yard	Road and public facility maintenance and repair	136	352	488	58	360	*4
San Mateo County Corporate Yard (SMC Yard)	SMC Yard Meter 1	Road and public facility maintenance and repair	65	0	65	58	240	0
	SMC Yard Meter 2		33	121	154	0	0	*4
	SMC Yard Meter 3		0	79	79	0	0	0
Sobrato Broadway Plaza	Sobrato Broadway Plaza (multiple meters)	Low income housing	0	1,197	1,197	TBD	TBD	TBD
	Sobrato CVS	Pharmacy & grocery	0	83	83	TBD	TBD	TBD
New Deployments TOTAL			**1,204**	**2,125**	**3,329**	**396**	**2,850**	**82**

With net metering, only 1.2 MW can be deployed.

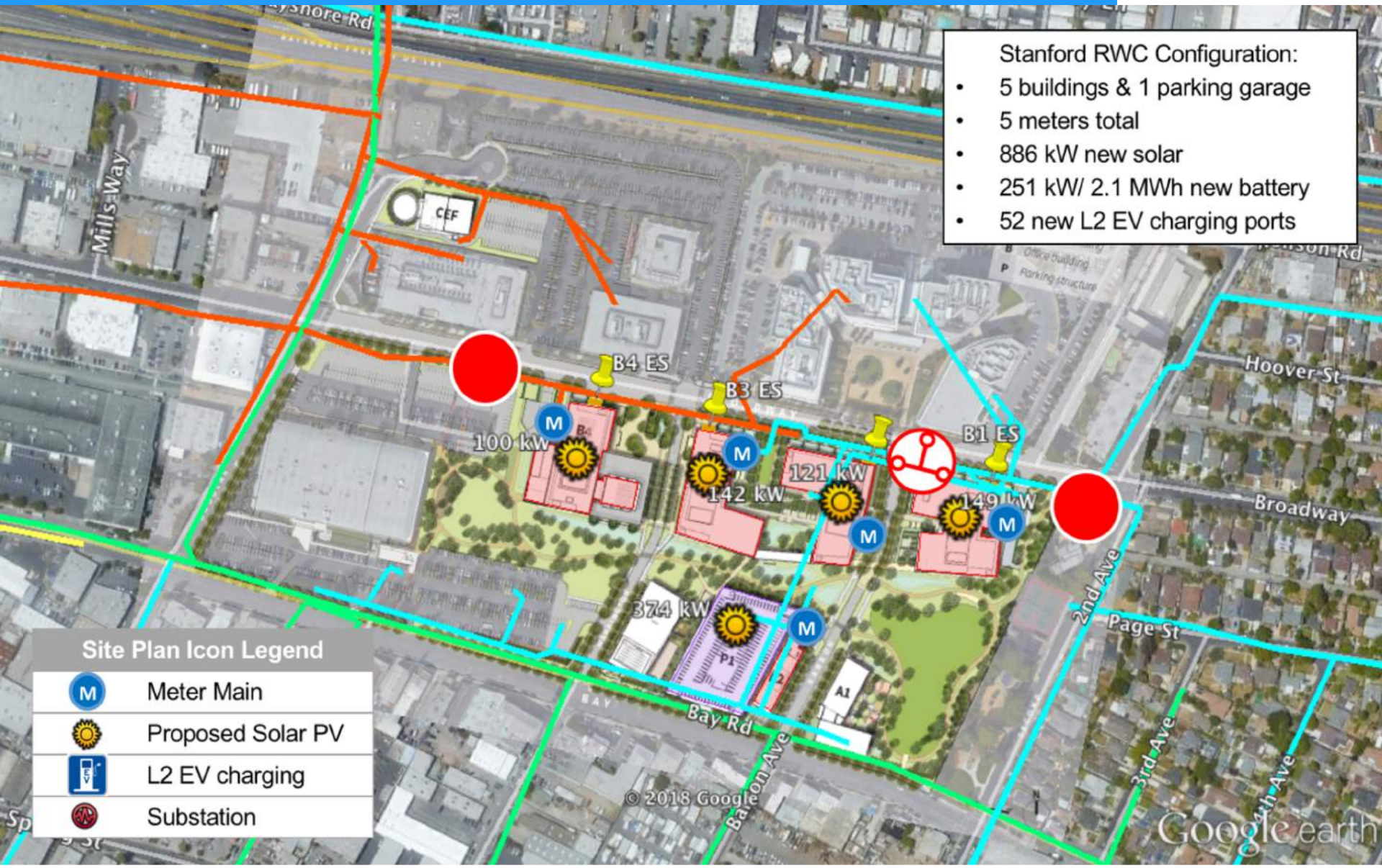
With a new FIT program, an **additional 2.1 MW** of local, renewable generation could be deployed in a disadvantaged community.

Stanford RWC Phase 1 and 2

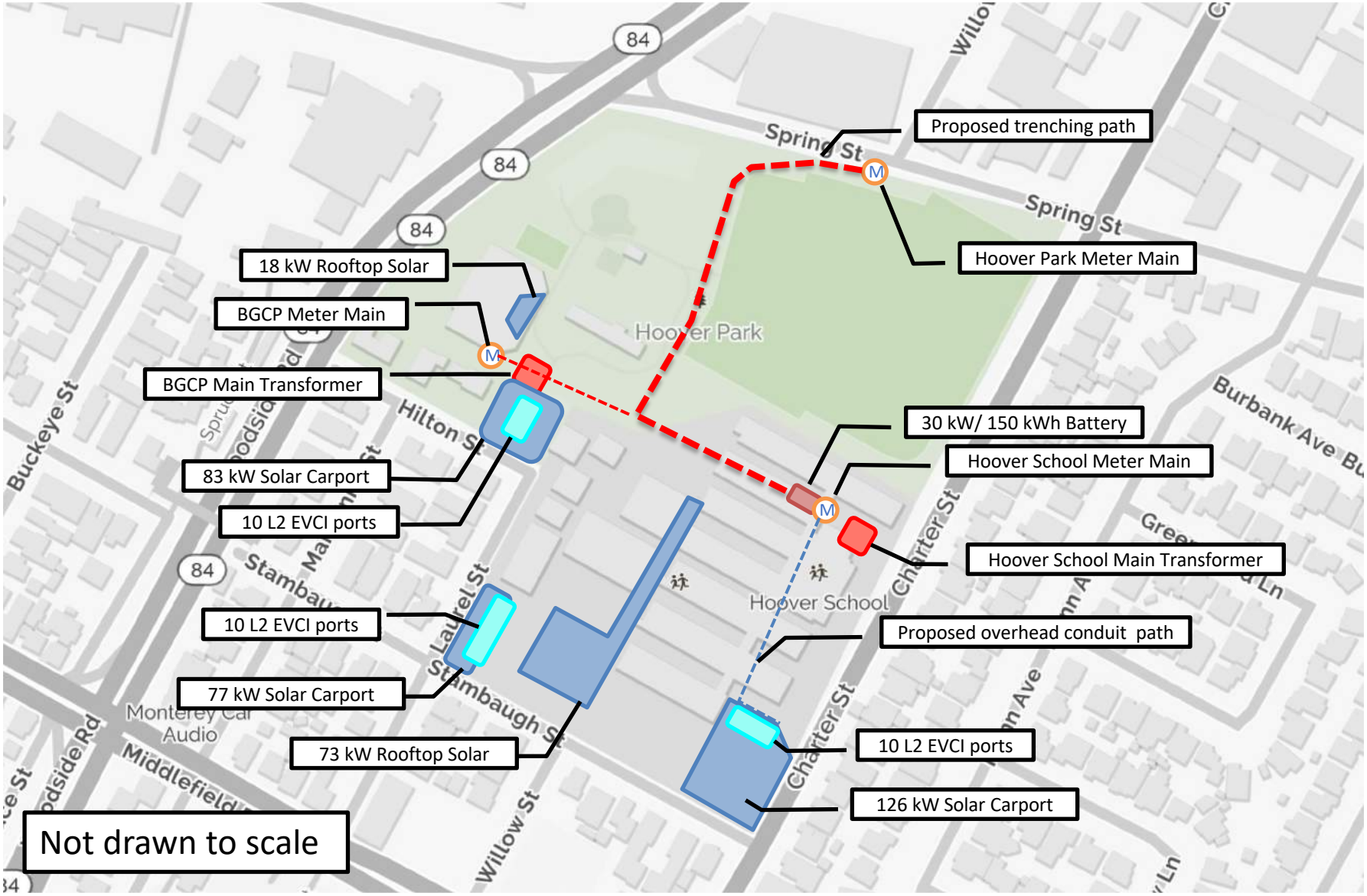
Stanford RWC Phase 1 Overview Map



Stanford RWC Phase 1 feeders & switching



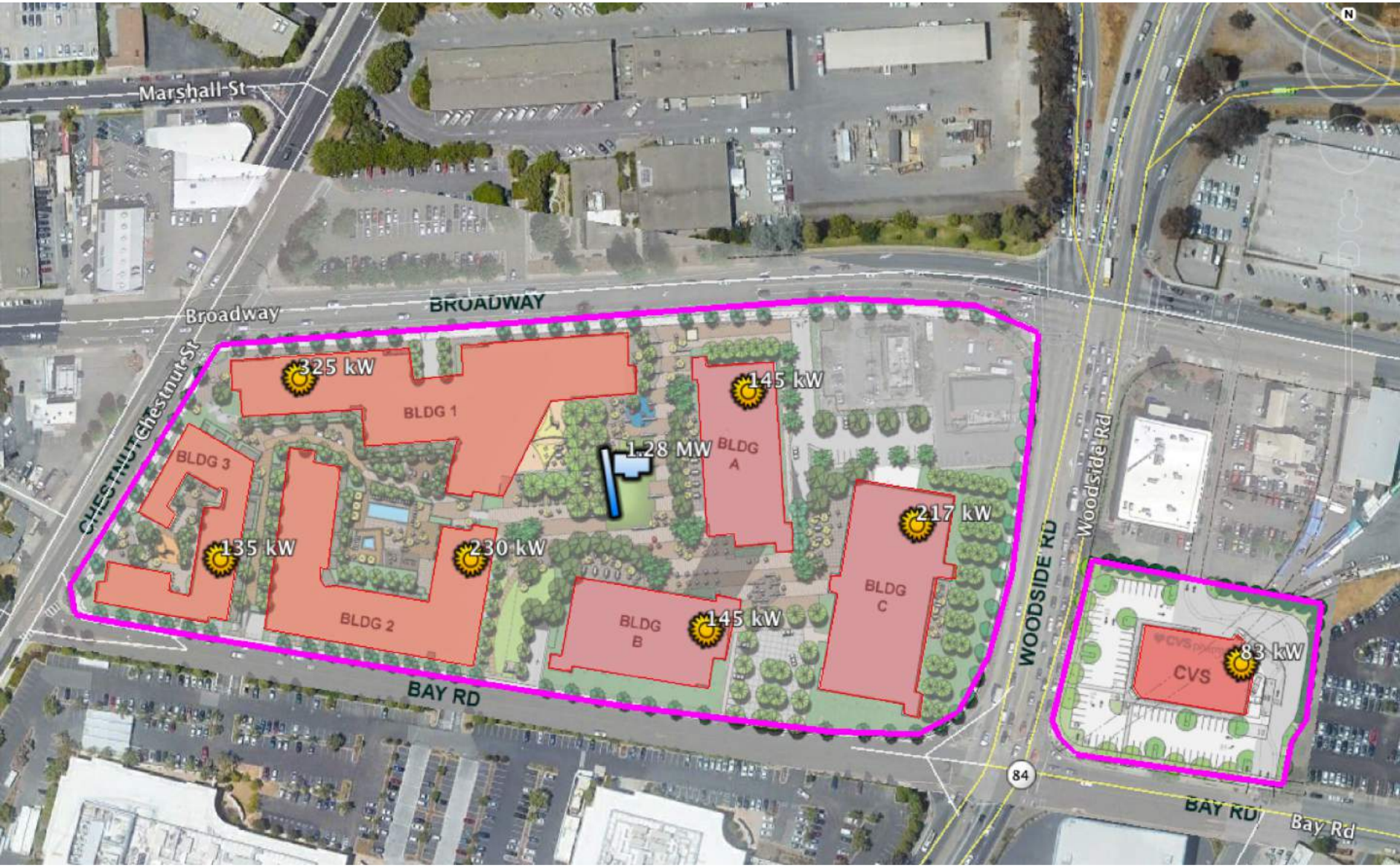
Hoover Cluster Conceptual Diagram



Hoover Cluster Detailed Map

Sobrato Broadway Plaza and CVS overview map

Clean Coalition



Peek at the Community Microgrid future

Clean Coalition

Ecoplexus project at the Valencia Gardens Apartments in SF. ~800 kW meeting ~80% of the total annual load.

Backup

Community Microgrids obviate gas peakers

- Thanks in part to our analysis, California regulators have rejected Ellwood and signaled their intent to reject Puente as well
- “Let’s take this opportunity to move the Oxnard community into the clean energy future — which is here already.” *Carmen Ramirez, Mayor of Oxnard*
- Significant opportunity to leverage this work to prevent future new gas plant proposals across the country

Community Microgrids cheaper than gas peakers

- Leveraging our technical and economic expertise, the Clean Coalition conducted an analysis to determine the viability of solar+storage as a better alternative