Clean Coalition

Making Clean Local Energy Accessible Now

PAEC Technical Advisory Committee Meeting #2

PAEC Master Community Design and Case Study

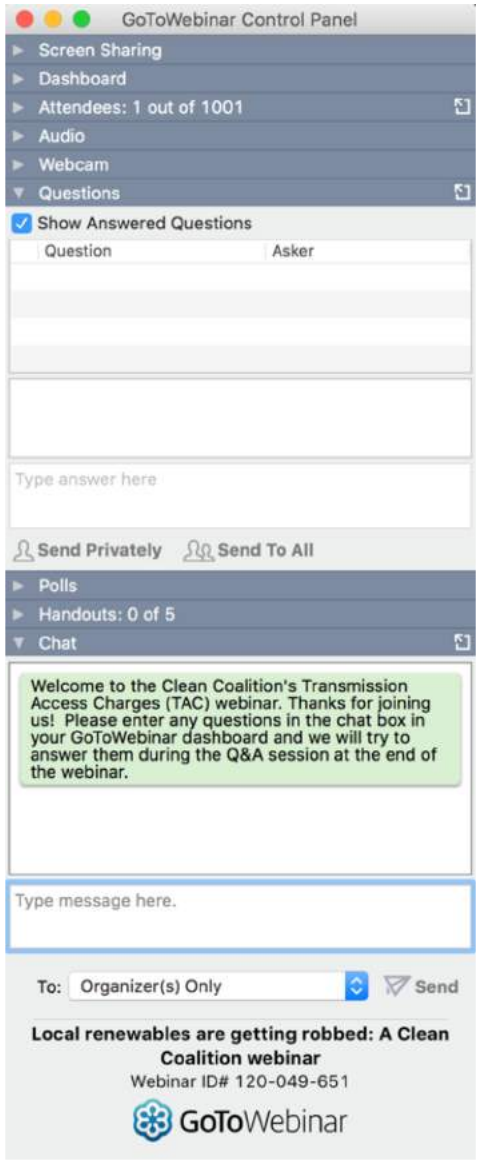
Clean Coalition
Dr. Frank Wasko, Program Director
Wendy Boyle, Grants & Contract Manager
Malini Kannan, Program Engineer,

Appraccel
Justine Burt, Founder

Kristin Kuntz Duriseti, Ph.D.

GoToWebinar FAQ

- Webinar recording and slides will be sent to registered attendees within two business days
- All webinars are archived on www.clean-coalition.org and the Clean Coalition's YouTube channel
- Submit questions in the Questions window at any time (window view varies by operating system and browser)
- Questions will be answered during the Q&A portion of the event
- Contact Josh Valentine for webinar questions: josh@clean-coalition.org



PAEC collaborators to date

Clean Coalition

Congresswoman
Anna G. Eshoo
California's 18th Congressional District

Menlo Park Fire Protection District

Carbon-Free Palo Alto
Advocates of carbon-free energy for Palo Alto, California

PAEC Reports

Task 2.2 - Best Practices report (Menlo Spark)

Task 2.4 - Gap Analysis (Menlo Spark)

Task 2.6 – Benefit-Cost Analysis Report of Potential Ordinances (DNV GL)

Task 2.8 - Interview with Public Agencies, Installers, and Vendors (Sovereign Energy)

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Task 12.2 – Initial Fact Sheet (Clean Coalition)

Task 12.9 – Final Technology/Knowledge Transfer Plan (Clean Coalition)

PAEC Media Releases (Blogs and News Article)

Blog Posts:

Blog #1 - Peninsula Advanced Energy Community launches, will provide framework for the future of clean energy, posted
Blog #2 - Palo Alto is aiming high by going low… carbon
Blog #3 - (Task 2) - The reality of implementing 100% clean local energy
Blog #4 - Solar Siting Survey of the San Mateo County Region and Core PAEC Region
Blog #5 - Palo Alto's Jewish Community Center: Heating and cooling in newer, cleaner ways
Blog #6 - A pathway to zero net energy: Atherton, California
Blog #7 - Shaping electric vehicle charging infrastructure in Palo Alto
Blog #8 - Best practices encouraging clean local energy deployment in California
Blog #9 - Connecting renewables to the grid faster… much faster
Blog #10 - Collaborating and innovating to expand clean local energy in San Mateo County
Blog #11 - No heat molecule left behind: Stanford's district-level heat recovery system
Blog #12 - What Puerto Rico teaches us about power resilience for all communities
Blog #13 - Building owners may be losing money by not investing in energy efficiency
Blog #14 - Model ordinances: Showing the way to a clean energy future
Blog #15 - Energy storage is about to take off
Blog #16 - Keeping the lights on after natural disasters
Blog #17 - Splitting up with split incentives: How green leases remove barriers to energy efficiency in commercial buildings

News Article:

"*New solar siting survey identifies 65 megawatts of solar potential in southern San Mateo County, California*", posted May 17, 2017
"*Solutions for connecting local renewable energy to the grid more quickly*", posted 9/28/2017

Visit www.clean-coalition.org

PAEC Webinars

Webinar Title	Date
Economics for energy efficiency and fuel switching measures for commercial-scale buildings	January 2018
How Solar Siting Surveys identify the potential for local solar generation	February 2018
The Green Lease and other innovative approaches for energy efficiency	March 2018
Electric vehicle charging infrastructure master plan	April 2018
Best practices for streamlining interconnection	May 2018
Community Master Design for PAEC Phase 2	June 2018

PAEC Workshops

Event	Date
RICAPS Working Group Meeting	8/23/16
RICAPS Multi-City Working Group	2/28/17
Green Lease Language Round Table	5/22/17
RICAPS Multi-City Working Group	6/20/17
RICAPS Multi-City Working Group	7/25/17
RICAPS Multi-City Working Group	8/22/17
Integration Capacity Analysis presentation	8/22/17

Summary of PAEC Technology/Knowledge Transfer Activities (blogs, news articles, webinars, and workshops)

PAEC CEC Reports: approximately 200

Blog Posts:
Total of 17 to date; various topics supporting and promoting advanced energy communities activities.

News Articles:
Total of 3 to date: Solar Siting Survey, Solar Emergency Microgrid, and Solutions for connecting local renewable energy to the grid more quickly.

Webinars:
Total of 4 completed, with 2 upcoming webinar scheduled for May and June 2018.

Workshops:
Total of 7 (RICAPS workshops which include project updates, Solar Siting Survey, Interconnection best practices, recommended model ordinances for San Mateo County, energy efficiency and fuel switching measures on 5 prototypical buildings, Green Lease Language, Integration Capacity Analysis).

Agenda

9:00 AM **Welcome & Introductions** – Craig Lewis, Executive Director, Clean Coalition

9:10 AM **Agenda and PAEC Project Overview** – Dr. Frank Wasko, Program Director, Clean Coalition, and PAEC Project Manager

9:20 AM **Task 10, PAEC Master Community Design – Presenter:** Clean Coalition – Malini Kannan, Program Engineer and Task Lead:

- The development of the Clean Coalition's Master Community Design showcasing our proposed PAEC2 project

10:20 AM **Task 10 Q&A**

10:50 AM **Task 9, PAEC Case Study - Presenters**: Appraccel – Justine Burt, Founder & CEO and Task Lead, Kristin Kuntz Duriseti, Ph.D and Task Lead:

- Describing and analyzing the actions, challenges, and lessons learned in planning, designing, and obtaining approval for the PAEC
- How the development of the PAEC will impact savings on electrical distribution infrastructure

11:50 AM **Task 9 Q&A, Next Steps, and Closing Remarks**

1:00 PM **Adjourn**

Clean Coalition

Making Clean Local Energy Accessible Now

PAEC T10: Master Community Design

Redwood City Community Microgrid: Innovation and Resilience

Malini Kannan
Programs Engineer
Clean Coalition
650-533-8039 mobile
malini@clean-coalition.org

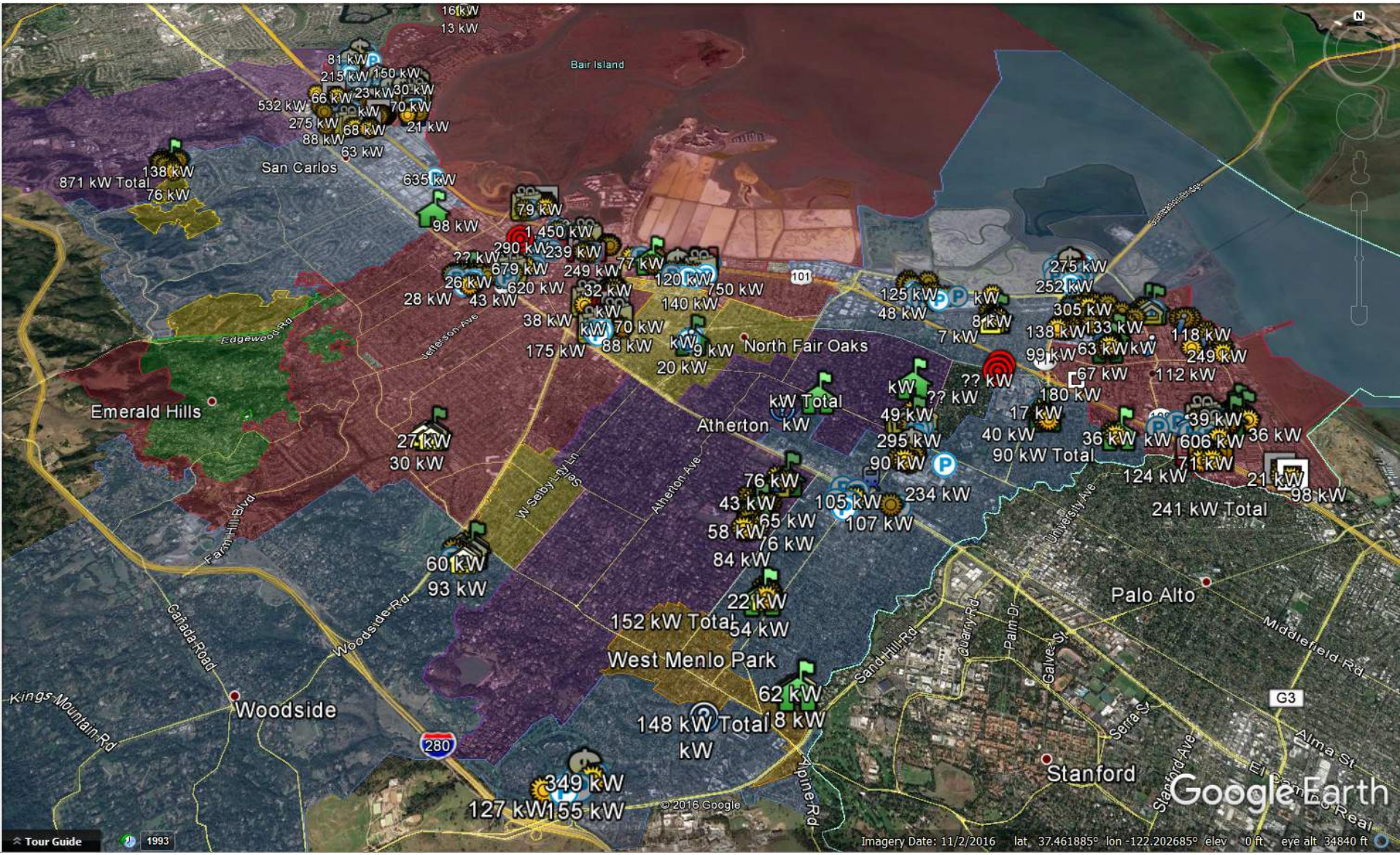
Meeting the T10 Goals and Objectives

- Goal: Develop a Master Community Design showcasing the Peninsula Advanced Energy Community.
  - Scoping and conceptual design have been successfully completed.
  - Design includes the deployment of model Solar Emergency Microgrids, Community Microgrids, and large scale EV charging deployments.
  - Designs span various use-cases and expected ownership models.
- Objective: Draft PAEC Design Report which will identify locations of the proposed PAEC elements, describe the synergistic AEC, and describe grid connection locations and methods.
  - Five sites in Redwood City have have completed scoping and conceptual design.
  - The PAEC elements will be connected behind the meter of each site, with several dedicated distributions lines used to connect sites during a grid outage.
  - Synergies include resilience through emergency backup power from microgrid configurations, lower project cost resulting from deploying DER together, and improving the bankability of certain DER by bundling financing.
- This scope of work is on track to be fully completed on time and within budget.

Summary of Key Findings

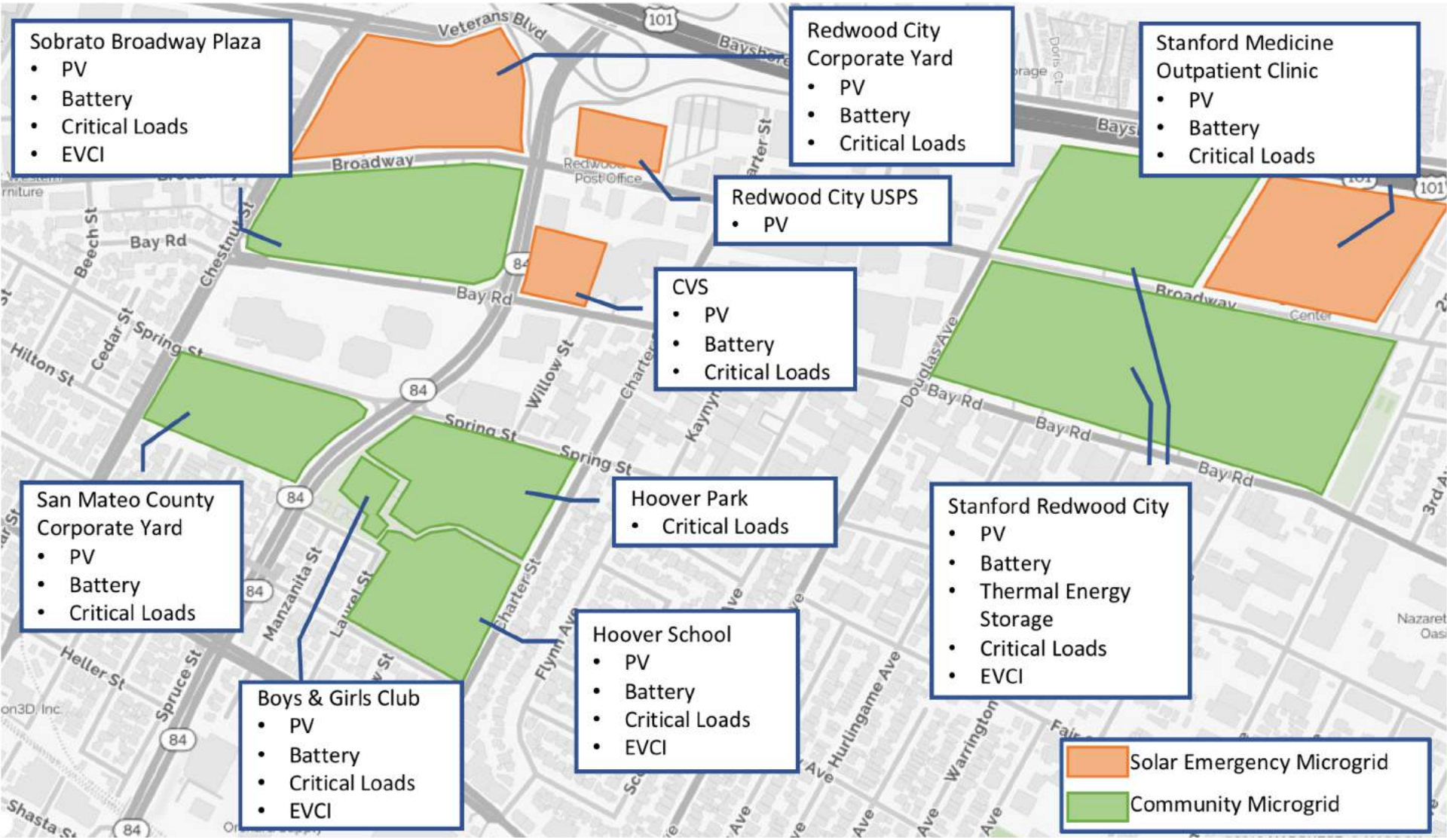
- Synergies:
  - Lower total project cost and improved bankability by bundling DER deployments.
  - Implementing Community Microgrids at critical facilities and for critical loads only ensures that communities can receive resilience, while the cost for this resilience is minimized.
  - Designing Community Microgrids for sites that have already implemented energy efficiency measures can save money.
  - Integrating a battery into a site with EV charging can reduce demand charges and reduce the impact of high-power charging on the grid
- Permitting: Redwood City Planning and Permitting Departments do not anticipate any roadblocks with permitting photovoltaics, lithium battery energy storage nor electric vehicle chargers.
- Interconnection: Proposed generating assets (solar and energy storage) can be interconnected within PG&E service territory under the NEM2 or NEM Multiple tariffs.

Core PAEC Region with Solar Siting Survey



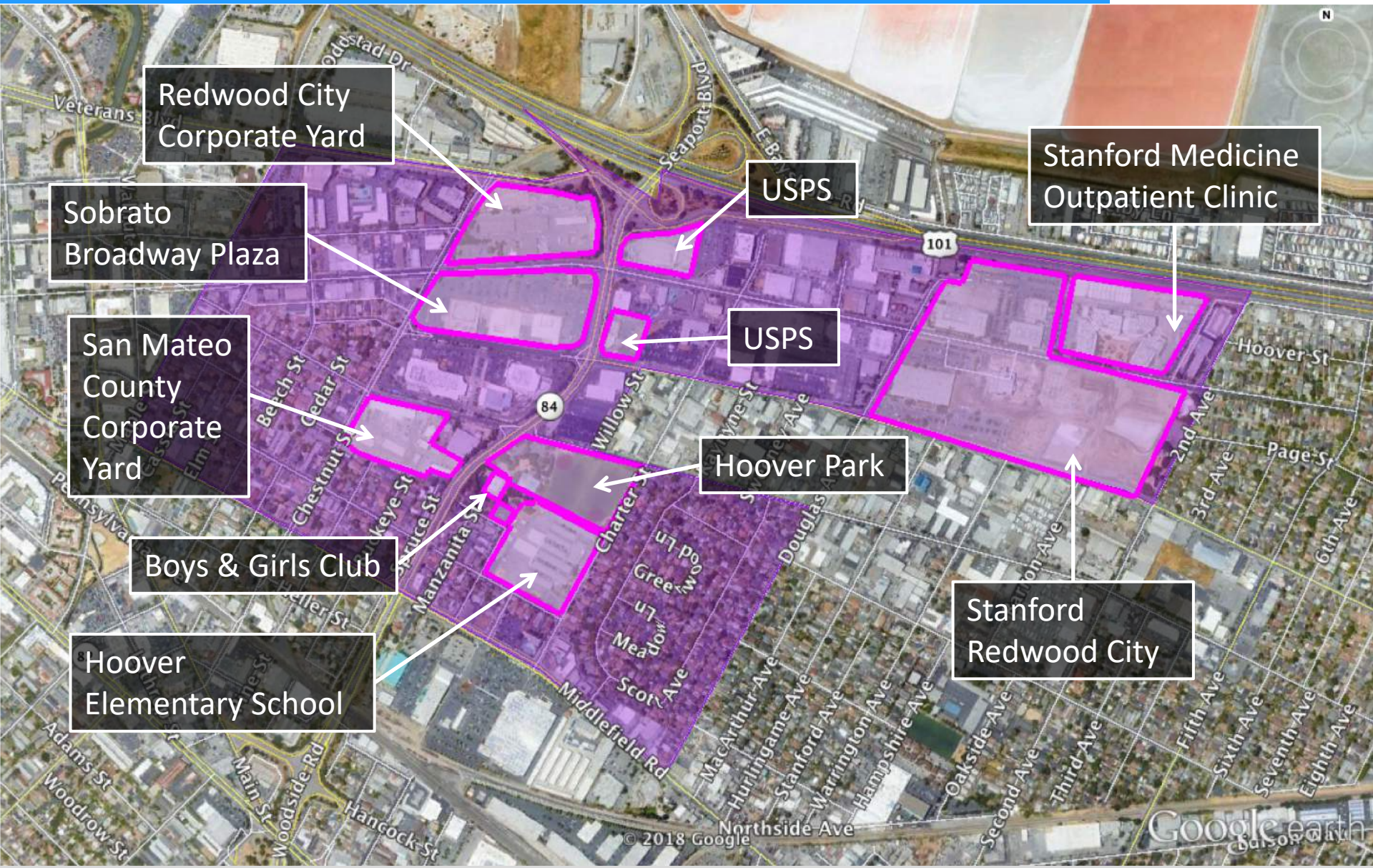
Redwood City Community Microgrid Conceptual Diagram

Clean Coalition



Redwood City Disadvantaged Community and Community Microgrid Sites

Clean Coalition



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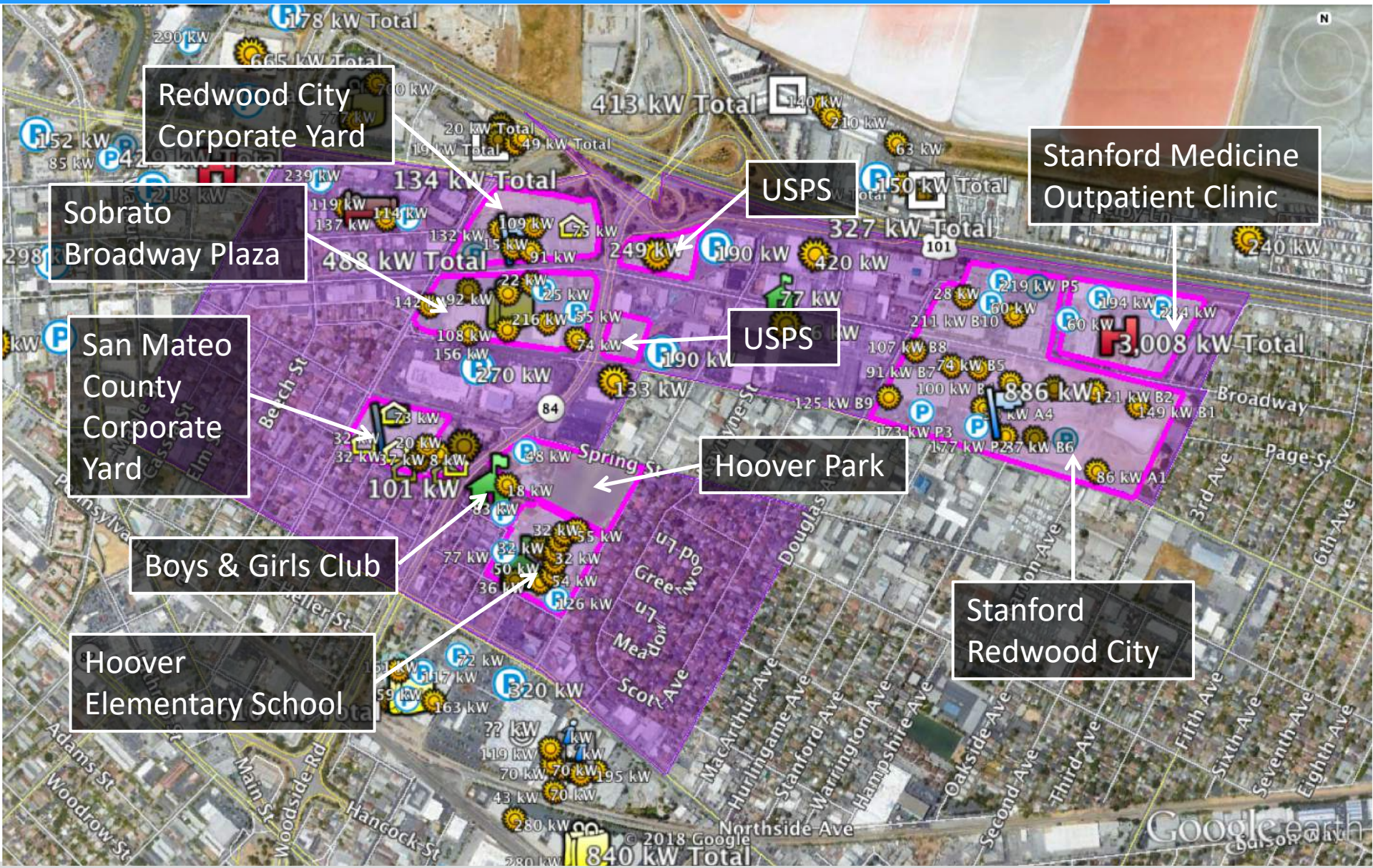


Deployment Summary

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.

Technical Approach
Step 1: Site walk

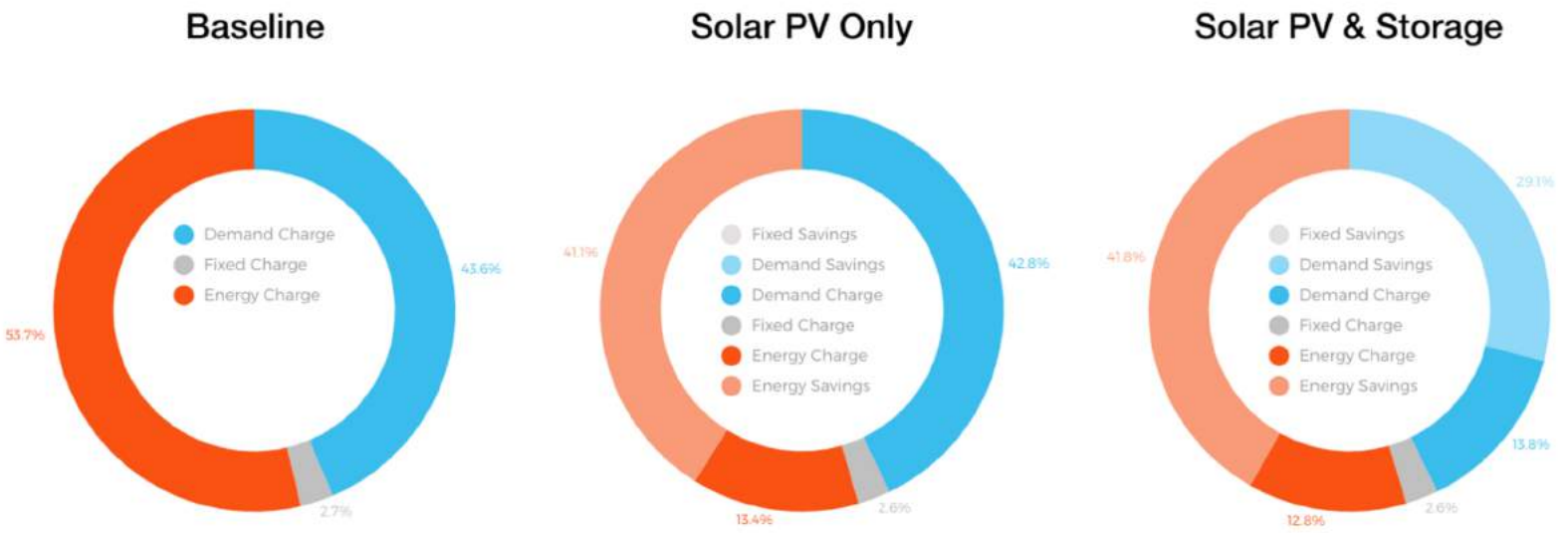
- Conduct site walk to determine solar siting potential, energy storage and EV charging locations, and details of existing electrical infrastructure (meters, AC bus sizing, etc.)
- Determine on-site load for each meter using 15 minute interval data where available.

Technical Approach
Step 2: PV system sizing

- Size and model multiple PV systems using PVwatts:
  - 1st system: **full-scale PV deployment**- use all feasible on-site rooftop and parking lot/ open space as defined in the Solar Siting Survey and site walk.
  - 2nd system: **net-metered PV system**- determine system size based on utility bills.
  - 3rd system: **net-metered PV system with EVCI load**- if the site is a candidate for EV charging, combine the existing load profile with the project load profile of additional EV chargers.
  - 4th system: **FIT PV system**- system size required to take full advantage of the available on-site space, but that exceeds the annual generation allowed by NEM2 interconnection.

Technical Approach
Step 3: Grid-connected Optimization with Esyst

- Used Geli's ESyst tool to determine the optimum energy storage size for a grid-connected system that takes advantage of peak shaving and demand charge management.
- The figure below shows the projected savings for one of the solutions for RWC Yard- 150 kW of PV, and 58kW 240kWh of energy storage.



Technical Approach
Step 4: Off-Grid Optimization with HomerPRO

- To properly size the system for grid-island mode and use of the Community Microgrid during emergency operations, the critical load profile was input into HomerPRO.
- Critical load is 10% of normal load. The on-site load was decreased by 10% proportionally.
- A ground-up energy budget would be more useful and reliable, however, we have not yet developed this type of load profile.
- Simulation inputs:
  - Critical load profile
  - Total on-site solar
  - Uptime required- 100%
- Simulation outputs:
  - Optimal energy storage system sizing, based on optimization of net present cost of the system

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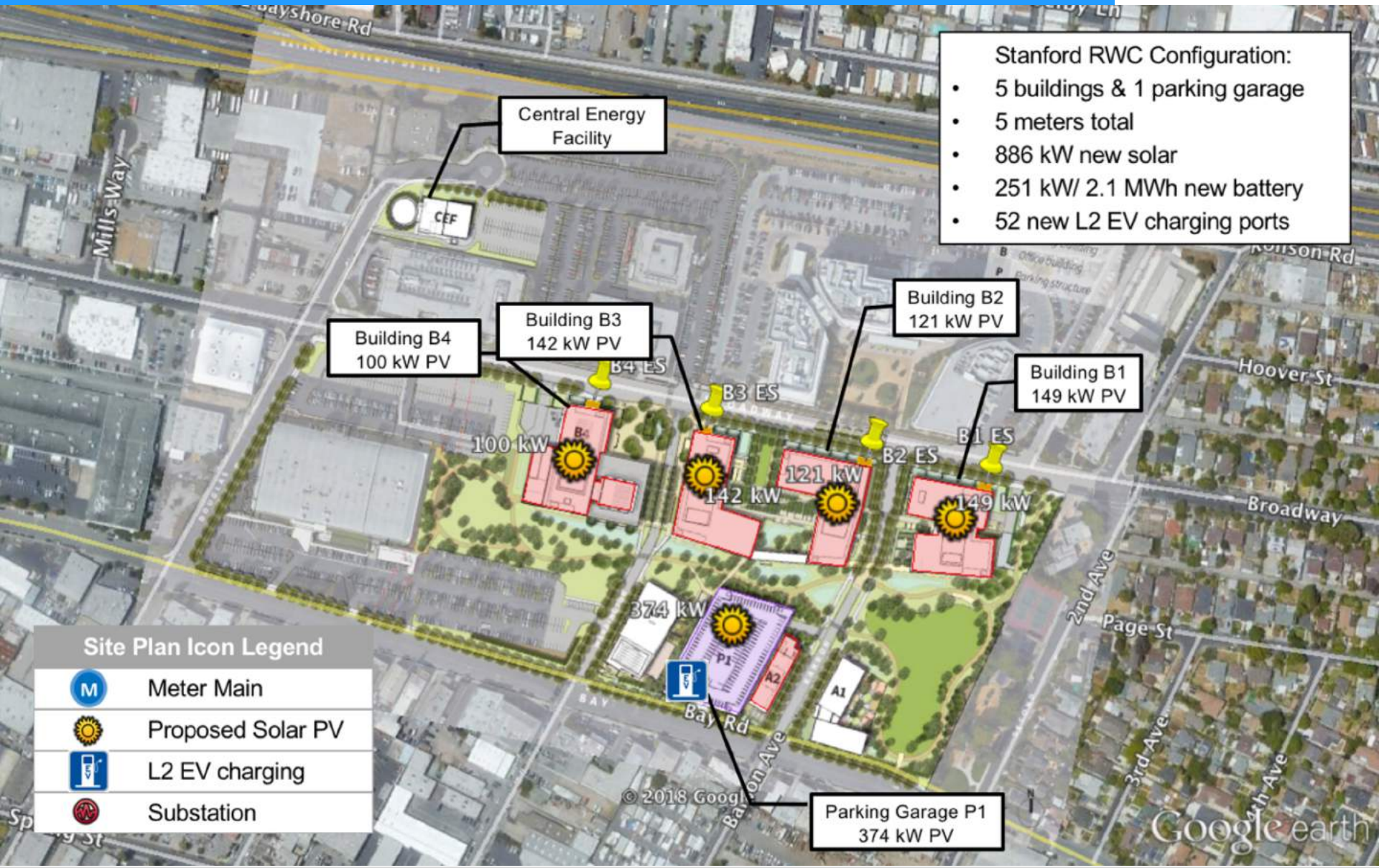
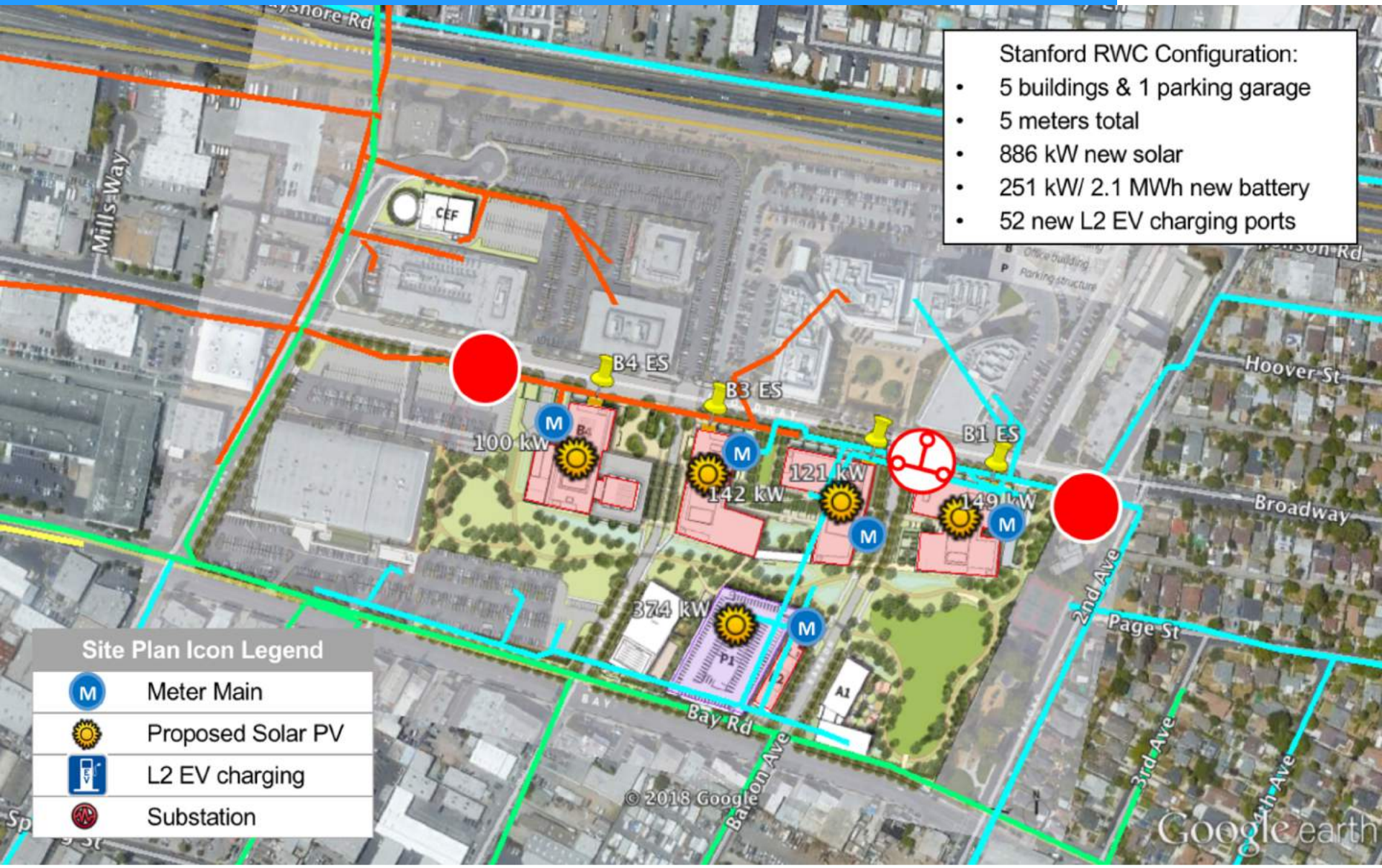
Stanford RWC Phase 1 and 2

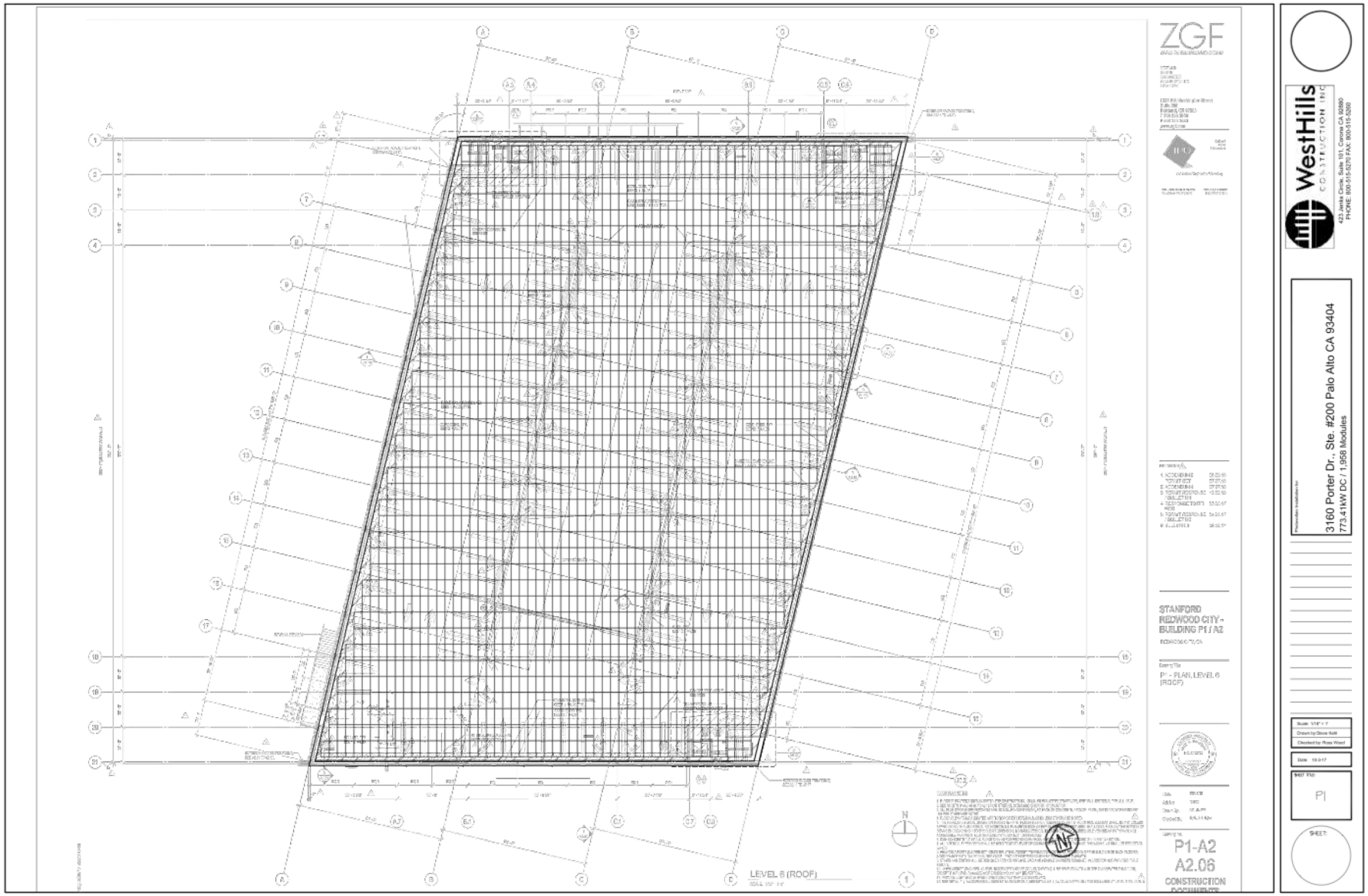
Stanford RWC Phase 1 Overview Map



Stanford RWC Phase 1 feeders & switching

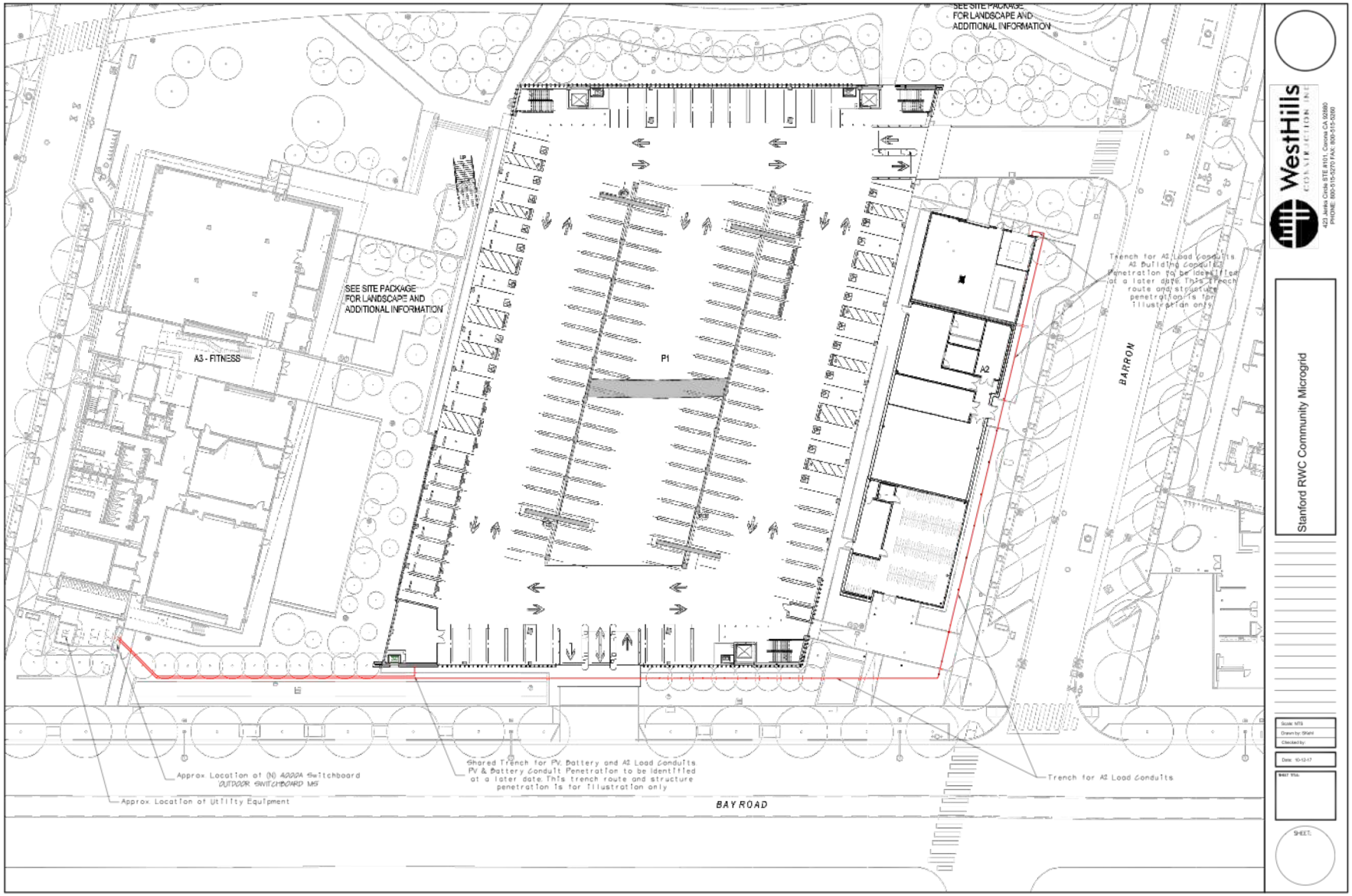


Stanford RWC Solar Layout and Sizing

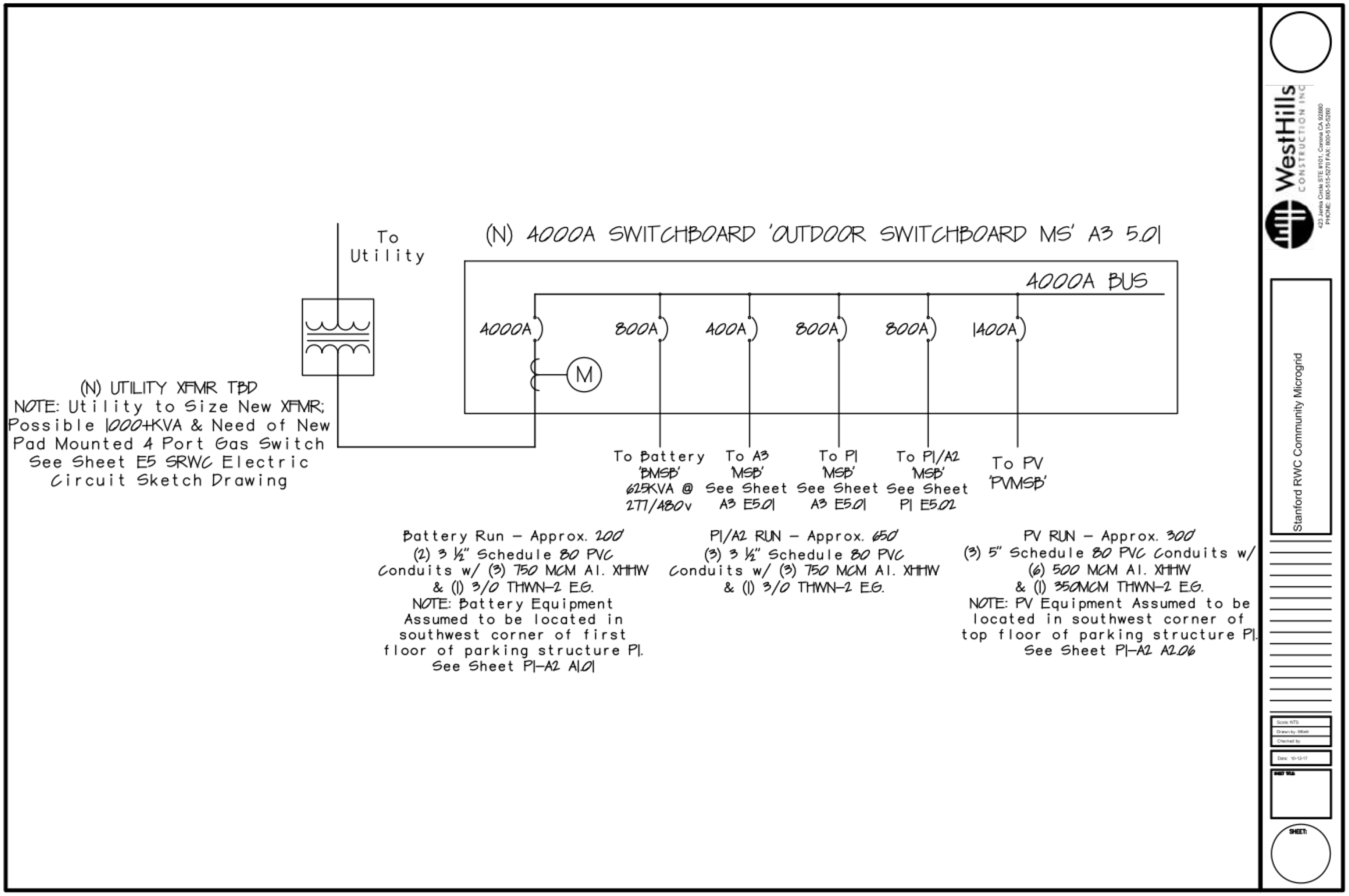


Stanford RWC Trenching Path CAD Drawing

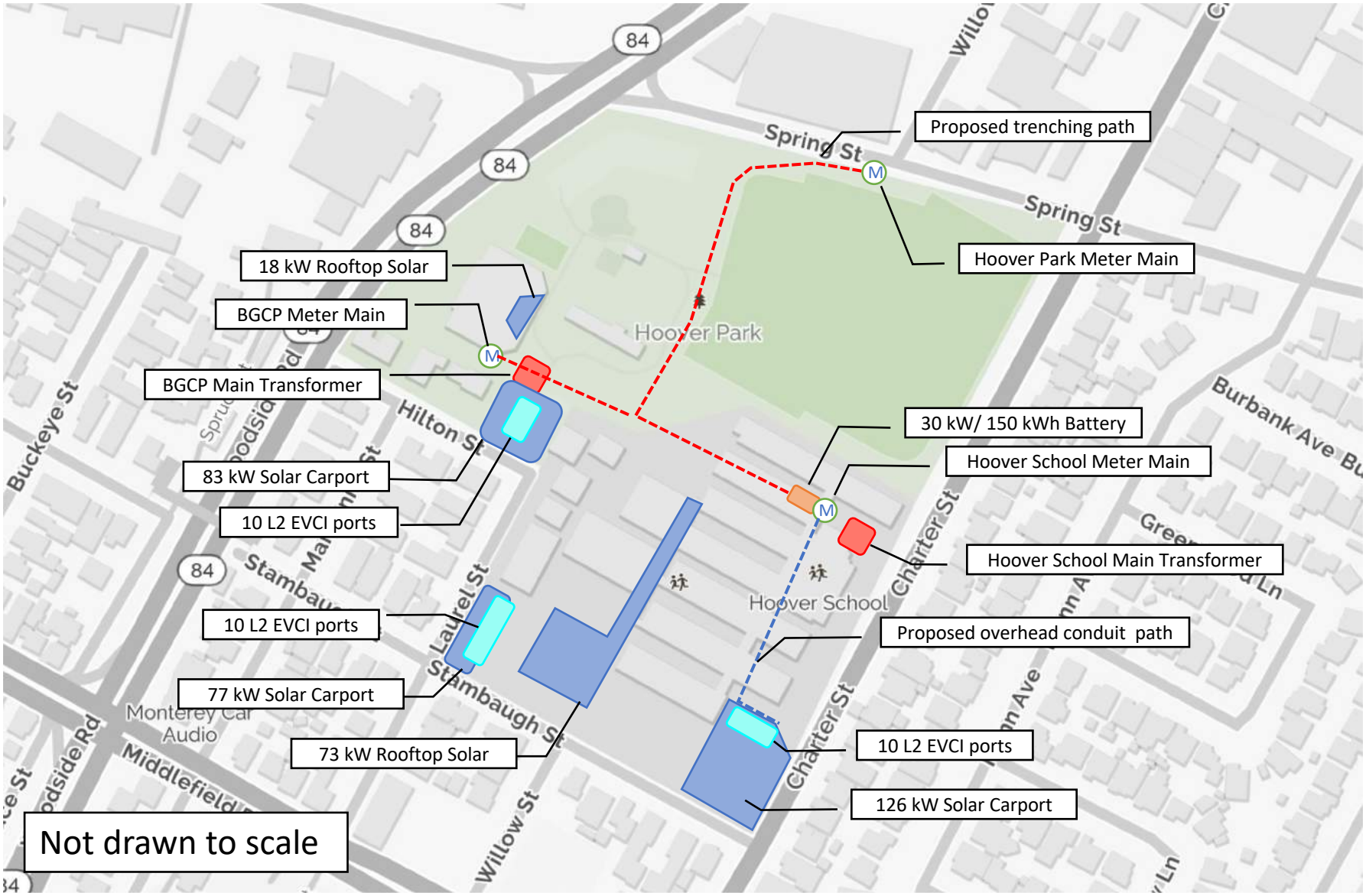
Clean Coalition



Stanford RWC Electrical Single Line Diagram

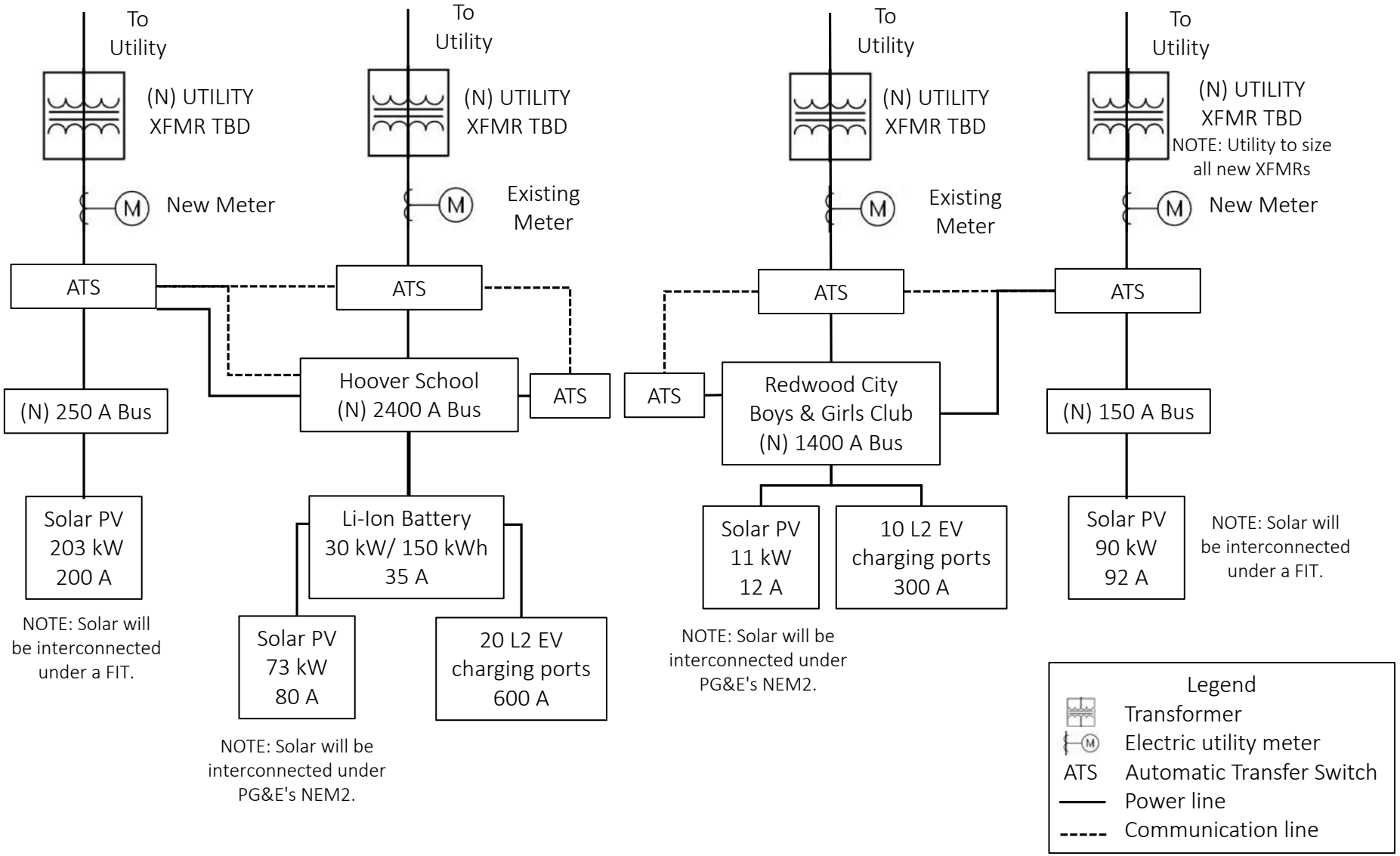


Hoover Cluster Conceptual Diagram



Hoover Cluster Detailed Map

Hoover Cluster
Single Line Drawing Block Diagram



Next Steps

- The Final Master Community Design Report will contain:
  - Finalized system sizes for solar and battery deployments
  - Engineering documents including up-to-date functional block diagrams or conceptual single line diagrams that show required site upgrades and new equipment and trenching and conduit path drawings for each site
  - Conceptual drawing and conceptual single line drawing demonstrating the design of the utility infrastructure that will connect each of the sites together for the full Redwood City Community Microgrid
  - Interconnection details for each new generating asset
  - Total project cost and economics for each site which will demonstrate the commercial viability of the project
  - Availability of funding and financing required to deploy the project at each site
- In addition to the above, the Final Master Community Design Report will address specific feedback from the CEC regarding the Draft report.

Thank You!

Malini Kannan

Programs Engineer

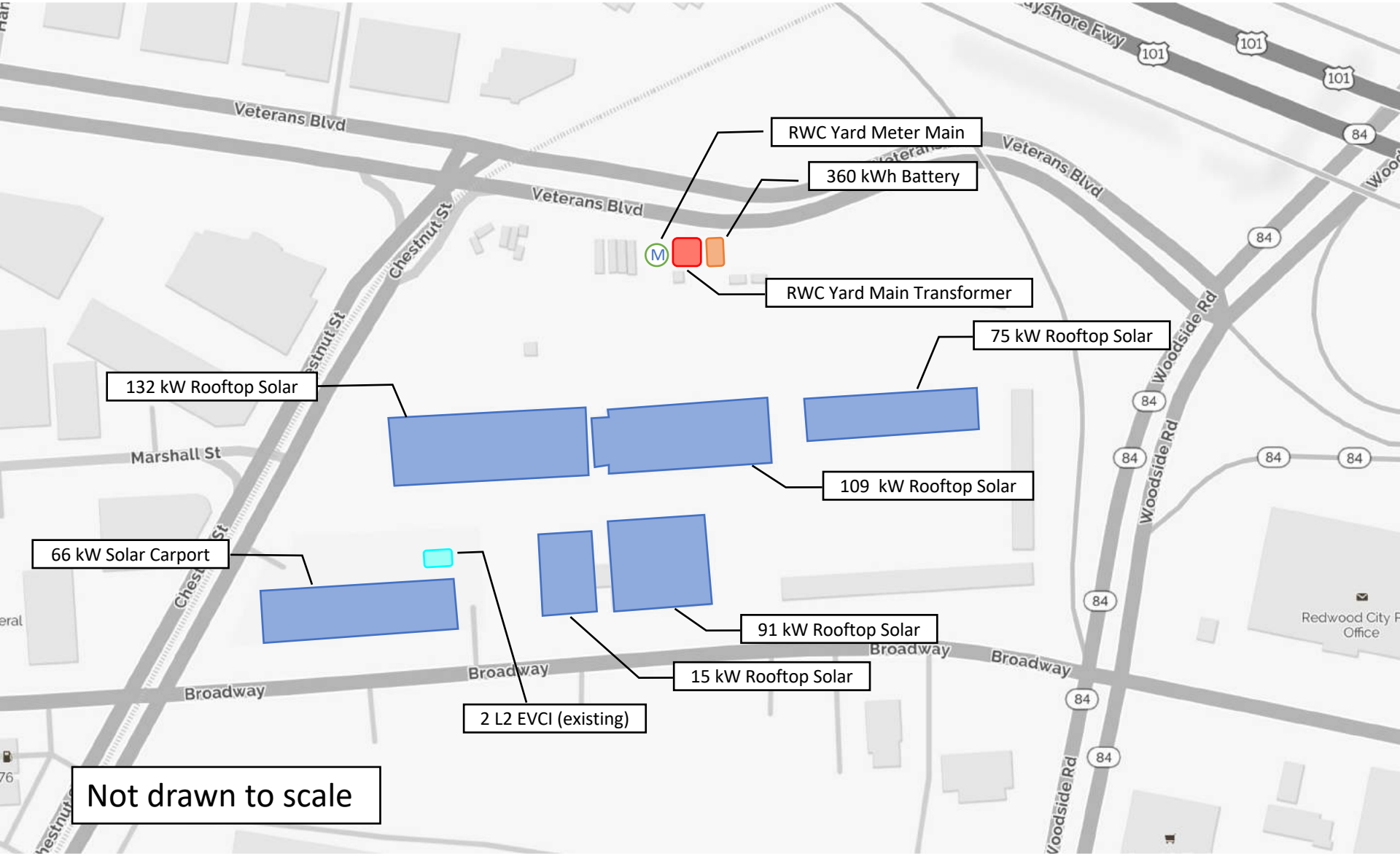
Clean Coalition

PAEC Task 10: Back up Slides

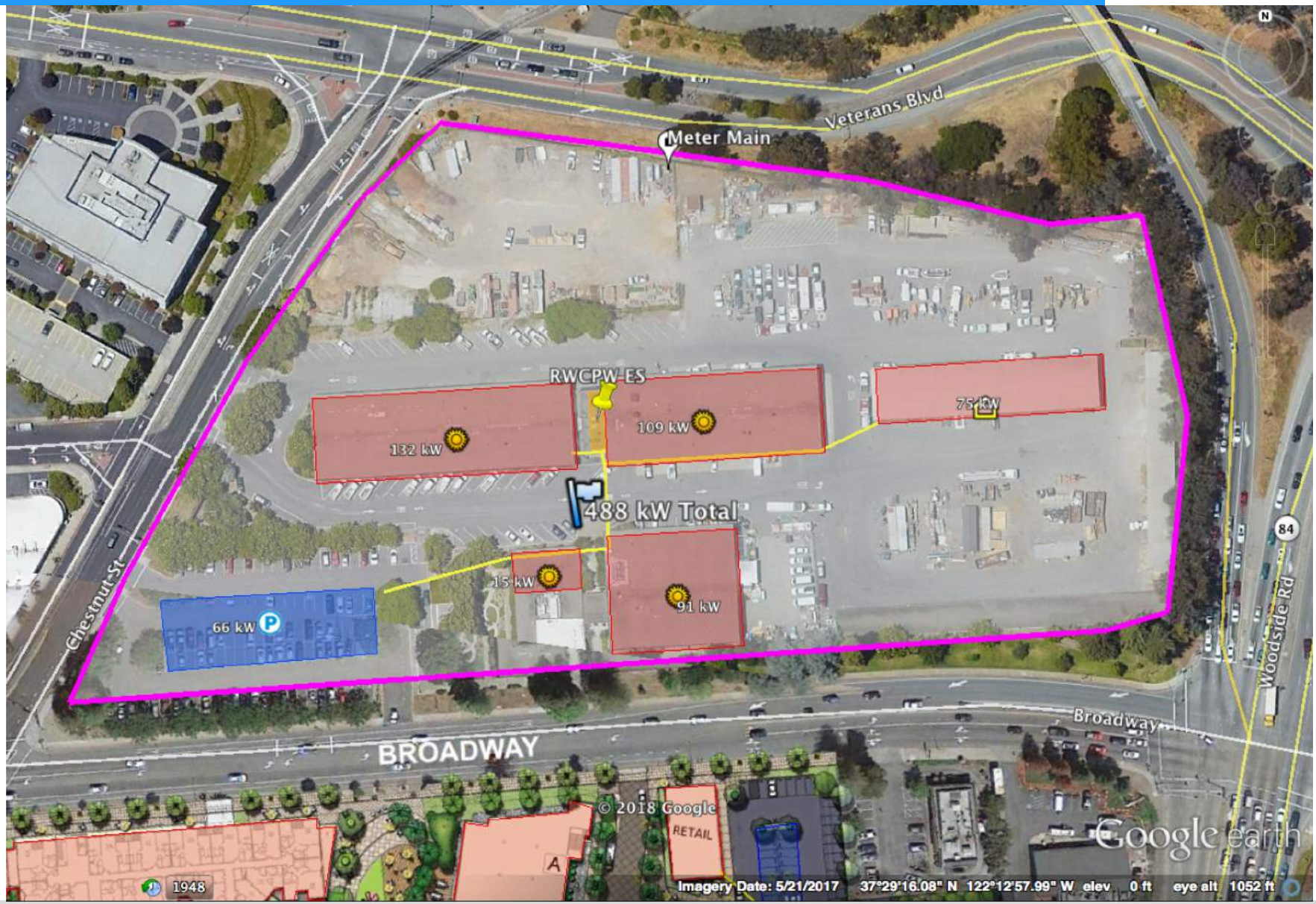
- BACK UP SLIDES

Redwood City Corporate Yard Conceptual Drawing

Clean Coalition



Redwood City Corporate Yard overview map



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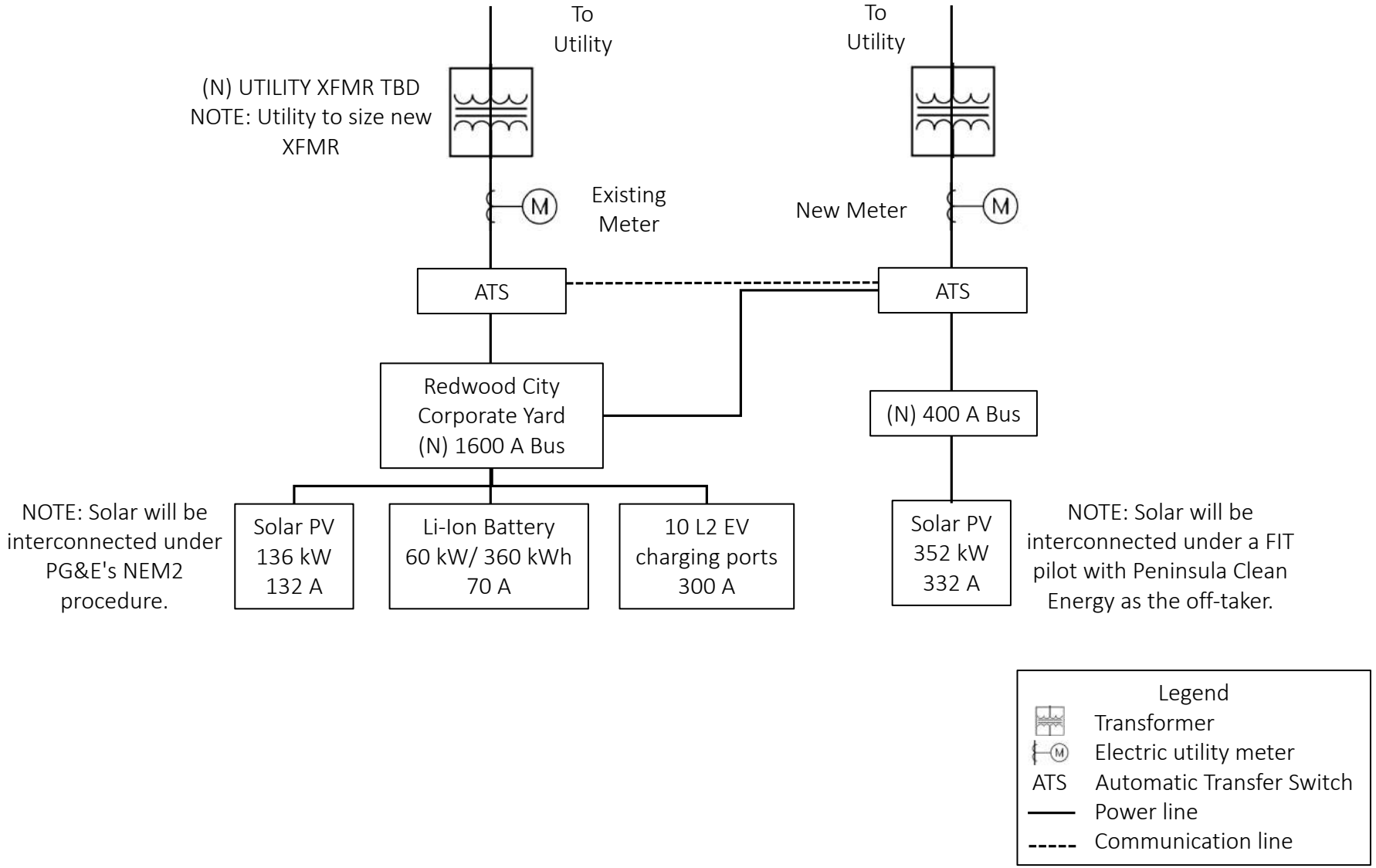

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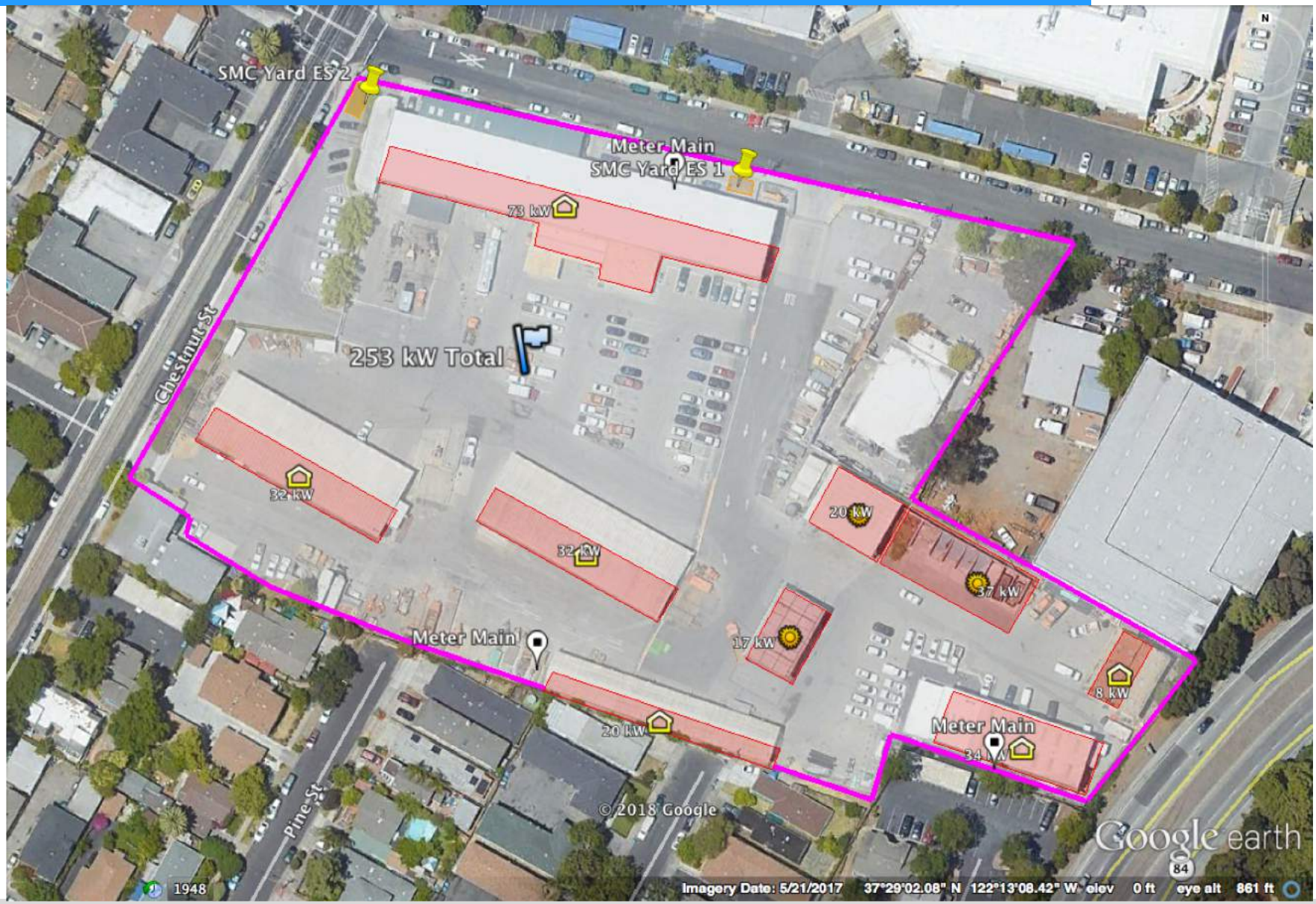

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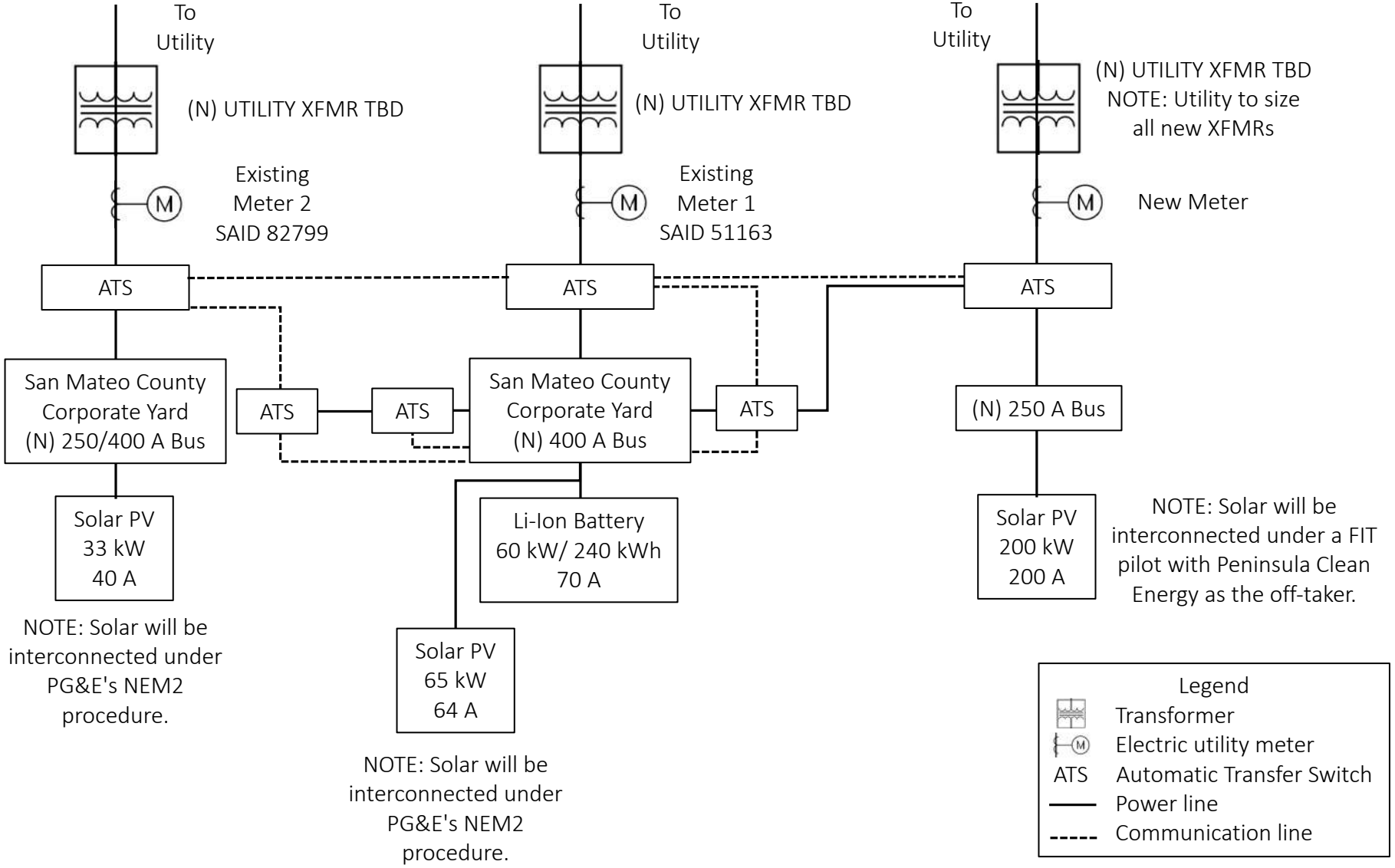
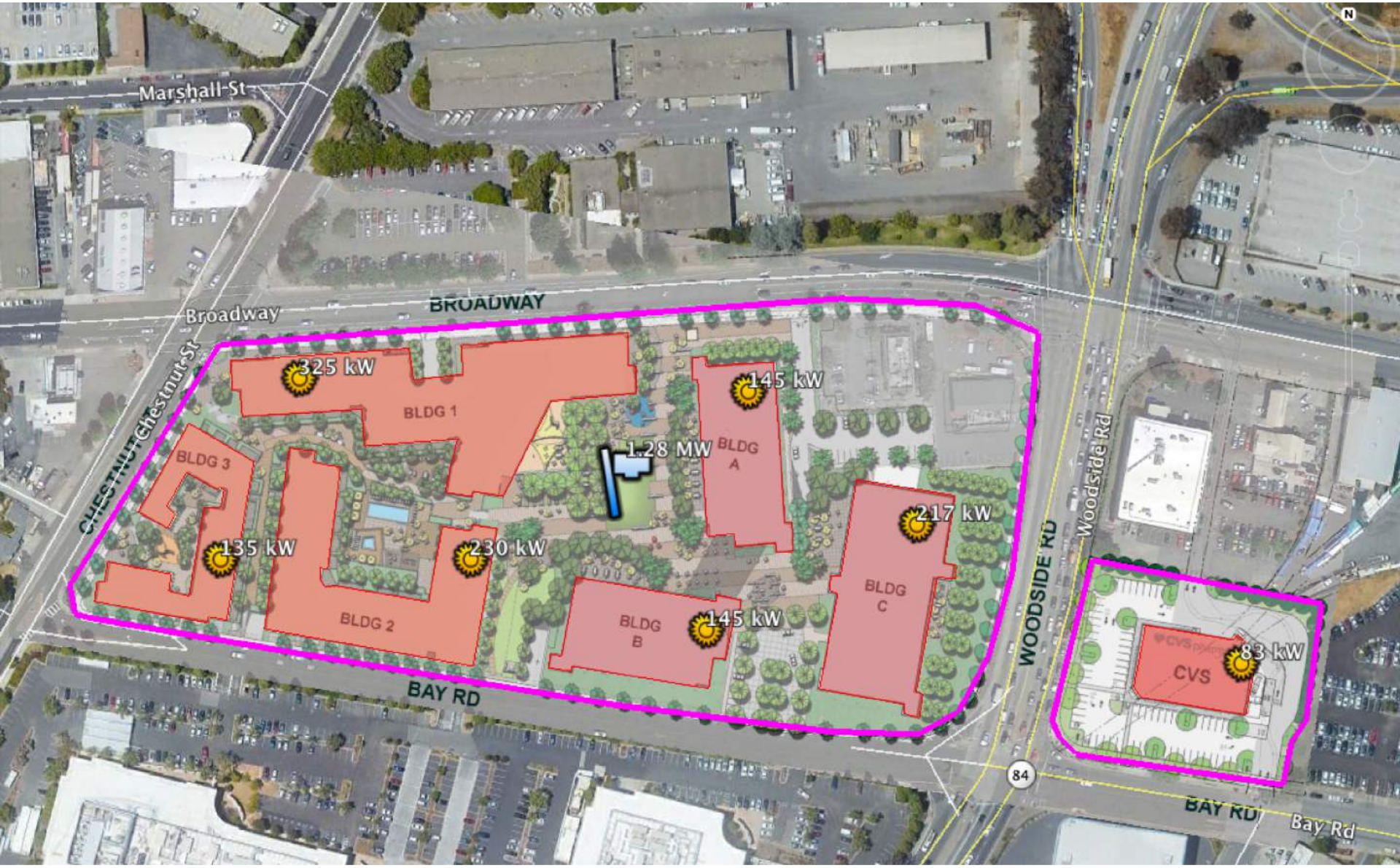


Sobrato Broadway Plaza and CVS overview map

Clean Coalition



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Task 9

PAEC Case Study

Justine Burt, Founder & CEO, Appraccel
Kristin Kuntz Duriseti, Ph.D.

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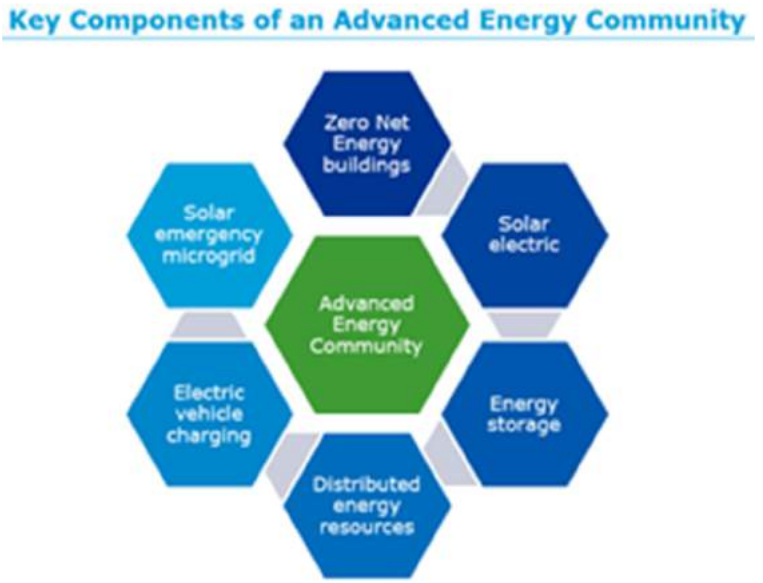
Overview: Chapters

V. Define AEC
VI. Policy goals and existing regulatory structure
VII. Key challenges
VIII. Best practices
IX. Key findings
X. Case studies
XI. Tools to accelerate to AECs
XII. Project benefits
XIII. Areas for future study
Appendix

Define Advanced Energy Communities

GFO-15-312

- Minimize need for new energy infrastructure
- Energy savings thru ZNE
- Grid reliability and resiliency
- Easier grid integration
- Replicable and scalable
- Affordable access through DER and EE for all electric ratepayers



Policy Goals and Existing Regulatory Structure

State goals

- AB 32 (greenhouse gas emissions)
- Title 24 and CalGreen (energy efficiency)
- CPUC Long-Term EE Strategic Plan (ZNE)
- CPUC Integrated Resource Plan and Long-Term Procurement Plan

- AB 117: Community Choice Aggregation
- AB 2565: EVCI in rental properties
- AB 2514: Energy Storage

Local jurisdictions

- San Mateo County
- Redwood City
- Atherton
- Menlo Park
- East Palo Alto

Key Challenges

Clean Coalition

Economic

- Life cycle cost assessments
- Capital v operating costs
- Split incentives
- Falling prices not fallen far enough
- Economies of scale
- Limited financing programs
- Who should fund AECs?

Policy

- Inconsistent permitting requirements
  - Streamlining interconnection
- Insufficient staffing
  - Review increasing number of EE upgrades, DG, EV charging, microgrids, storage
  - Budgets, planning, permitting, staffing

Best Practices

- Renewables
- Energy efficiency
- Zero net energy
- EV charging infrastructure
- Energy storage

- Economics (CCA, on-bill financing, fees)
- Policy (ZNE, retrofits)
- Technical

Renewable Energy (RE)	Energy Efficiency (EE)	Zero Net Energy (ZNE)	Electric Vehicle Charging Infrastructure (EVCI)	Additional Clean Energy Measures
Model Municipal Ordinance Options				
Solar Rooftops [RE1] (mandatory ordinances) could also include solar water heaters, cool roofs, or other alternatives, e.g., San Mateo **Solar Carports [RE2]** over parking, could be coupled with energy storage and/or EV charging, e.g., Palo Alto or Green Charge **Zoning or Building Codes [RE3]** requiring 100% Renewable Energy, e.g., Menlo Park, covering electricity & gas **Solar or Zero Carbon Water Heaters [RE4]** requiring new or replacement water heaters to be solar (e.g., Hawaii) or a non-fossil fuel alternative such as heat pumps	**Reach Codes for New Construction [EE1]** Palo Alto & Santa Monica (e.g., 15% efficiency improvement over title 24) **Point of Sale [EE2]** energy audits and disclosure, e.g., Berkeley and Austin **ECBO: Existing Commercial Building Benchmarking Ordinance [EE3]**, e.g., San Francisco Buildings report energy use + audit each year *or* retro-commissioning every 5 years **Other Mandatory Requirements** Higher efficiency equipment, etc.	**Reach Codes [ZNE1]** for CA ZNE, e.g., Santa Monica **Financial Incentives [Fees2]:** New Climate Impact Fee, fully refunded for ZNE, e.g., Watsonville	**City Ordinance & Zoning [EVCI1]:** Minimum parking spaces required with pre-wiring or EV Chargers for **new** homes, multi-family, commercial or parking, e.g., City of San Francisco	**Fees [Fees1]** for Fossil Fuel Use or Carbon, e.g., Palo Alto Natural Gas offset fees
Additional Measures				
Financing: Rebates, PACE, on-bill financing, etc. **New technology** – in-pipe hydro, Pressure Relieving Valve (PRV)/Turbine technology, e.g., Portland – Lucid project **Permitting** improvements	**Audit programs** – NYC Retrofit Accelerator, Green @ Home, Green House Calls, PG&E audits **Incentives**, e.g., Energy Upgrade CA **Permitting**, e.g., fees waived and/or expedited, e.g. Encinitas **Building Electrification** / Natural Gas Replacement, Boulder	**District Approaches** (e.g., 2030 Districts, Fort ZED, Cambridge) **RFP & Lease Language** **Existing Building Retrofits** Energiesprong, ZNE overhauls with modular components	**City Charging Stations** (for city fleets and public use) **Incentives** (preferred parking, free charging or low/no cost charging) **Streamlined Permitting** **City EV "First" purchasing policy**, Palo Alto	**Innovations through CCEs** (aggregated solar, EV deployment) **Solar Emergency Microgrids** **Energy Storage**

Key PAEC Findings

Economics

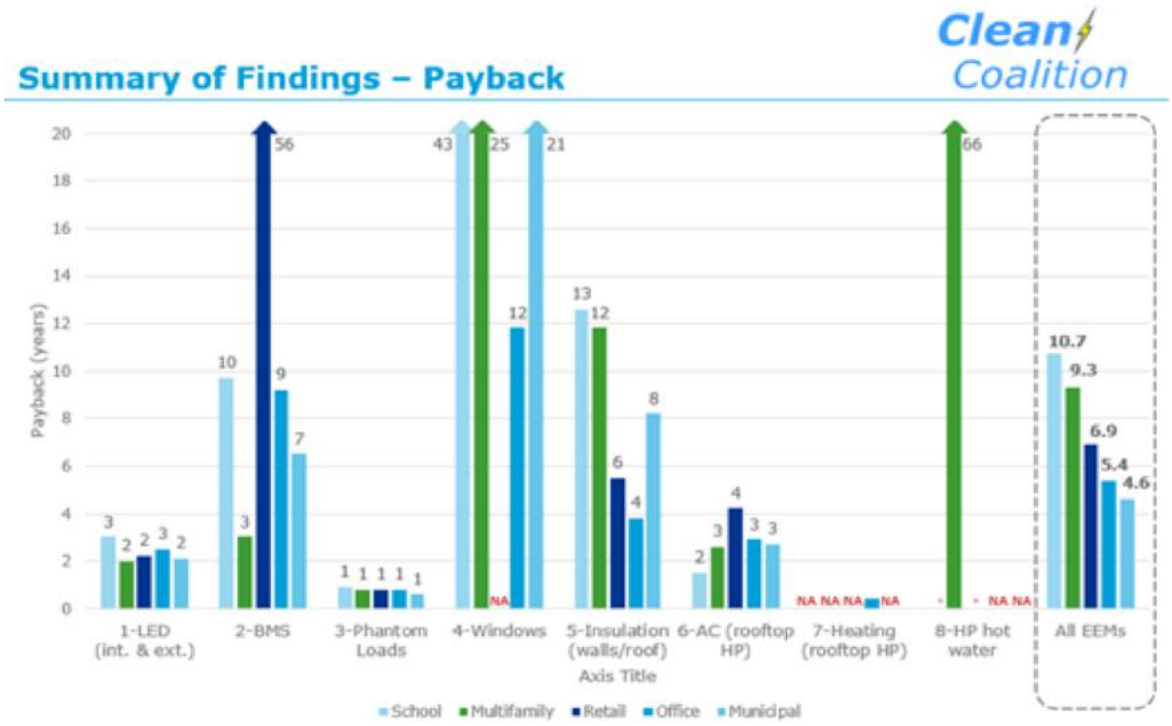
- Future financial viability of energy storage
- Bundling energy efficiency
- Model ordinances
- Inconsistent financial tools (on-bill financing)

Policy

- Focus on deep energy retrofits - Atherton
- Streamline interconnection
- Streamline permitting

Technical

- Solar siting survey - 65 MW WDG, minimum project size 100 kW ac
- EVCI master plan



Solar Emergency Micro-grid Case Studies

Solar Emergency Microgrid (SEM)

- Renewable back-up energy supply
- Community resilience
- Economic benefits (DER)

Case 1: Stanford RWC Community Microgrid

Solar Emergency Micro-grid Case Studies

Case 2: Hoover Cluster

- Three scenarios
  - Solar+storage
  - Solar+storage, plus EV charging
  - 21% of load for emergency community shelter
- What benefits larger community?

Solar Emergency Micro-grid Case Studies

Case 3: Atherton Civic Center

SEM will provide backup power for:

- critical emergency response,
- limited administrative functioning, and
- shelter capacity in library.

The SEM system can:

- operate indefinitely under good weather conditions, and
- provide sufficient power to critical functions for at least four days under the worst weather condition scenarios.

Solar Emergency Micro-grid Case Studies

Case 3: Atherton Civic Center

- First ZNE civic center in the US
- Minimized EUI reduces size of PV system
- Load shifting of energy demand from combined heat pump and water thermal energy storage

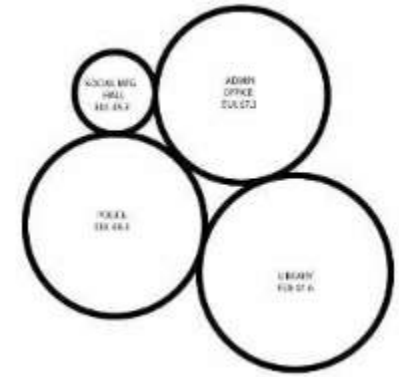
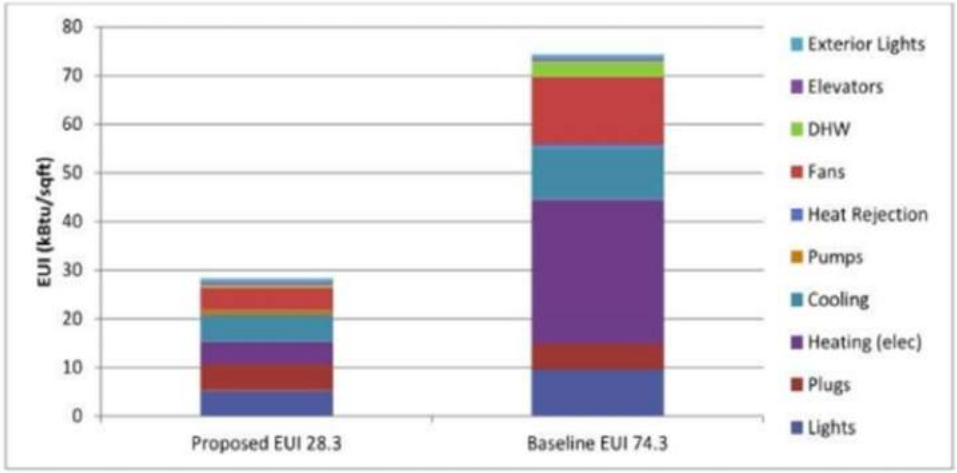


Table 1: Campus EUI Comparison



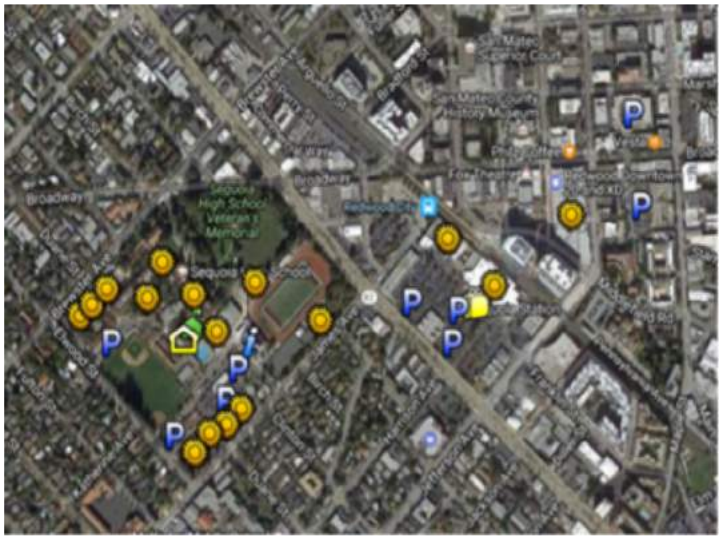
Tools to Accelerate AEC Deployment

Economic

- Standard tools - known benefits, disincentives, competing priorities
- Non-monetary benefits (qualitative metrics) - minimize fossil fuels, accelerate AECs, reduce GHGs
- Scenario analysis (especially resilience)

Policy

- Streamlined permitting guidelines
- Model ordinances
- Model interconnection process checklist
- Green lease language



Technical

- Solar siting survey
- Building management systems

Project Benefits

General benefits for California

- Help meet clean energy policy goals
- Enhance grid resilience and security
- Obviate expense of new power plants
- Help modernize the grid
- Increase % of renewables for RPS
- Improve interconnection policies
- Create green jobs

Specific benefits

- Energy consumers
  - Reduce cost of clean local energy
  - Bill payers save money
  - Solar essentially pre-pays electricity bills for next 25 years

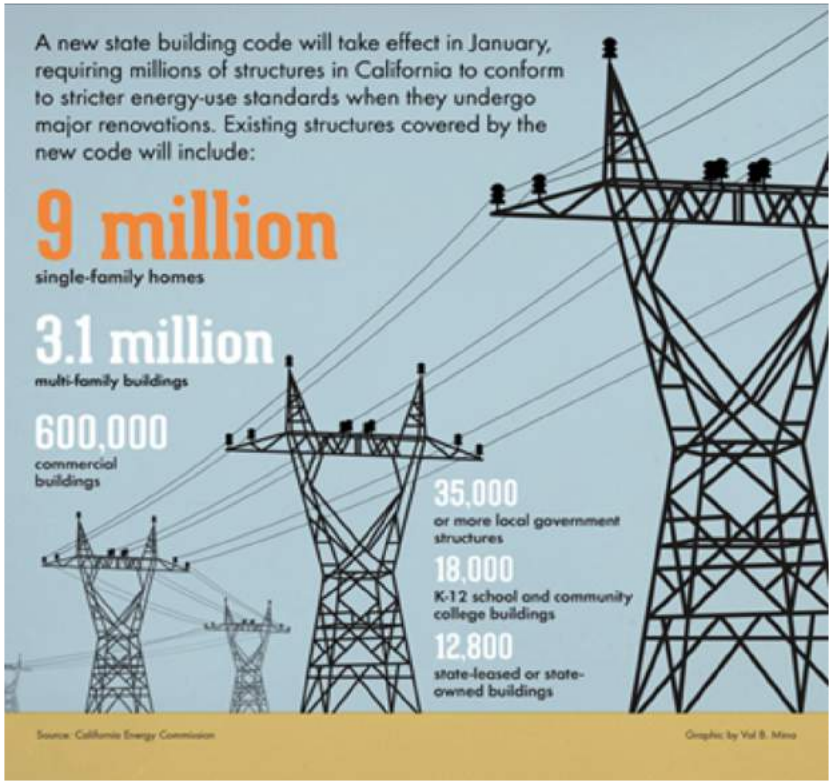
Project Benefits

- PAEC community
  - SEMs provide power for critical facilities
  - Accelerated development of local solar generation
  - Economic stimulus
  - Reduce GHGs
  - Avoided loss costs from outages – reliability

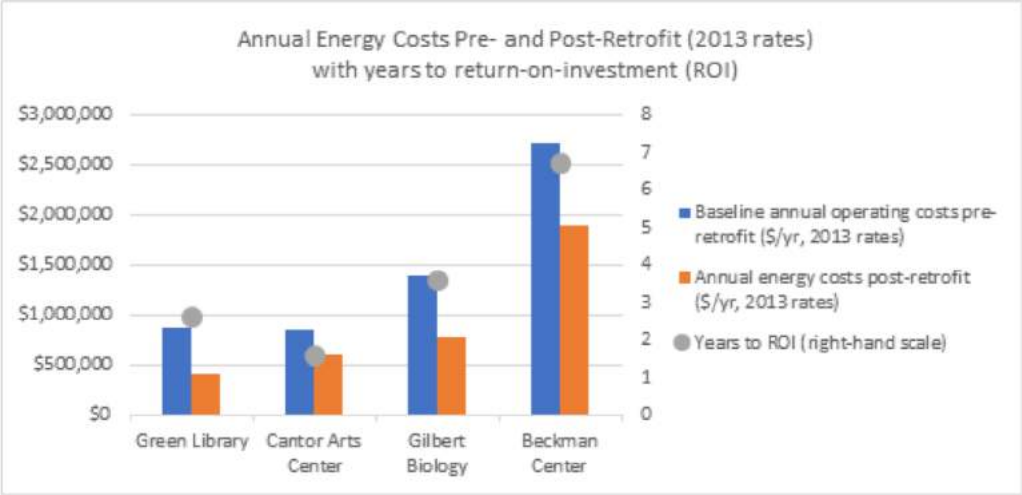
- Ratepayers
  - Energy consumers will save on peak capacity costs, avoided transmission losses,
  - Energy storage bridges the gap (duck curve)

Conclusion: Areas for Future Study

- Need additional financing tools and incentives to implement AEC components
- Train more planning and building inspection staff to incorporate AEC component requirements into permitting and inspection checklists
- Accelerate reach codes and deep energy retrofits
- Additional revenue streams for energy storage
- New rates and tariffs for virtual microgrids
- Integrated technology solution providers



Appendix: Mini-Case Studies



- Stanford University: district energy, retrofits
- Jewish Community Center: proven technology
- Kaiser Permanente Hospitals: full-cost accounting, PPA procurement of PV
- Palo Alto parking garage PV + EVCI: Feed-In-Tariff
- Redwood City Corporate Yard: community microgrid (public benefit) with 3rd party ownership
- Facebook: LEED, PV, EVCI, water-energy, data centers

Infographic (page 1)

Peninsula Advanced Energy Community

Advanced Energy Community Components

1. Energy efficiency
2. Renewable energy
3. Zero net energy
4. Electric vehicle charging infrastructure
5. Energy storage

Planned Atherton Civic Center

Benefits

1. Reduces need for new energy transmission + distribution infrastructure
2. Promotes grid reliability + resilience
3. Financially attractive
4. Replicable + scalable

PAEC Report Highlights

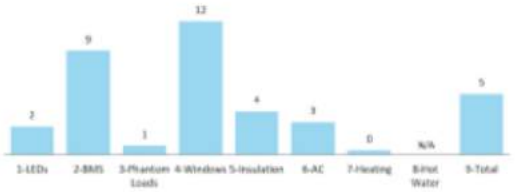
Challenges

- Inconsistent permitting processes (documentation requirements, costs, reviews, timelines) at municipalities and utilities
- Inconsistent financial instruments available to fund investments for AECs in commercial, residential, and public sectors
- Split incentives between building owners + tenants
- Tension between capital expenses + operating expenses
- Tendency to favor initial cost over life cycle costs
- Range anxiety - Lack of EV fast chargers

Recommendations

- Implement bundles of energy efficiency measures. Average 5-year payback = 18% return, better than returns from most other investment options.

Energy efficiency ROI for office building



- Focus on the following in southern San Mateo County:
  - Deep energy retrofits for residential + commercial properties
  - Financial options that allow energy savings to fund capital investments
  - Zero net energy for new developments
  - Increasing EV charging infrastructure with battery storage
- Municipalities should develop EV-ready codes for multi-unit dwellings
- Continue subsidizing energy storage in the near term as the market brings the price down

Tools

- Streamlined permitting
- Model interconnection process checklist
- Model ordinances
- Green lease language
- Solar siting survey
- Electric vehicle charging infrastructure master plan

Infographic (page 2)

Benefits of AEC Projects

Customers

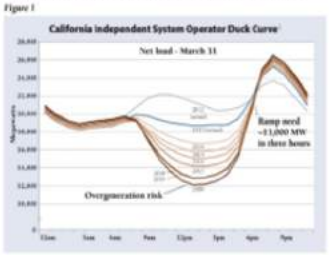
- Implementing energy efficiency means:
  - Customers save on their energy bill
  - Improved comfort, health + worker productivity
- Installing solar PV allows customers to prepay their electricity bill for the next 25 years, a hedge against future price increases

Community

- Provides clean local energy
- Creates clean energy jobs
- Obviates expense of new power plant construction
- Builds resilience
- Addresses climate change

Ratepayers

- Energy storage bridges the gap between overgeneration by solar PV during peak sunlight hours and peak energy demand later in the evening



AEC Leaders

Existing Projects with AEC Components

Palo Alto Bryant Street Garage (Improving feed-in tariff)
- Solar PV
- EV charging
- Energy storage

Facebook (including water treatment in energy footprint)
- On-site black water treatment
- Energy efficiency
- Solar PV
- EV charging
- Energy storage

Jewish Community Center (maximizing existing technologies)
- Energy efficiency
- Air-source heat pump
- Solar PV
- EV charging

Kaiser Permanente (life-cycle cost solution to split incentive problem)
- Energy efficiency retrofits
- Solar PV power purchase agreement
- EV charging

Redwood City Corp Yard (solar emergency microgrid)
- Solar PV
- EV charging
- Energy storage

Stanford University (district-level projects)
- Energy efficiency
- District-scale heat exchange system
- Solar PV
- EV charging

Thank You!

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