Clean Coalition

Making Clean Local Energy Accessible Now

Siting solar in distribution grids

May 13, 2015

Our mission

Clean Coalition

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

Our 2020 objectives

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- From 2020 onward, all new electricity generated in the U.S. will come from at least:
  - **80% renewable sources**
  - **25% local renewable sources**

- By 2020, policies and programs will ensure the successful fulfillment of the above
  - Reflecting the full value of local renewable energy and a modern grid
  - Including economic, environmental, and resilience benefits

Our vision: a distributed, integrated grid

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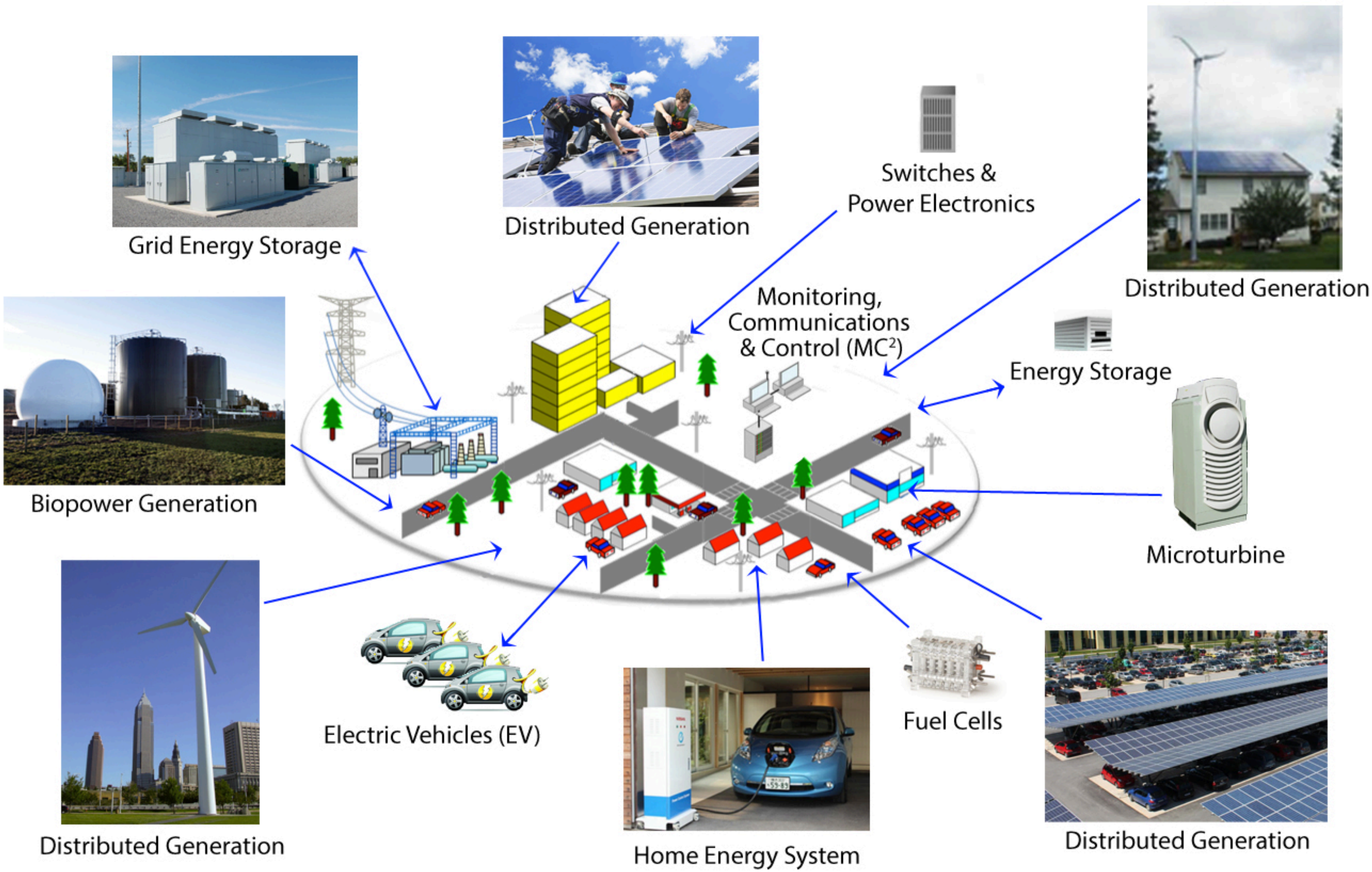

Our expertise areas in working with utilities

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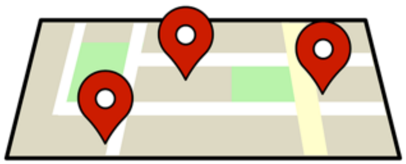
Analysis & Planning

DG siting surveys; full DER cost and value analysis

- PG&E
- PSEG
- SCE



Grid Modeling & Optimization

Powerflow modeling; DER optimization

- PG&E
- PSEG

Program Design

Procurement and interconnection

- LADWP, Fort Collins, PSEG
- City of Palo Alto (FIT and solar canopy RFP)
- RAM, ReMAT
- Rule 21 & FERC

Community Microgrid Projects

Design and implementation

- San Francisco, CA
- Long Island, NY
- U.S. Virgin Islands

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The Community Microgrid Initiative proves that high levels of local renewable energy provide a reliable and cost-effective foundation for the modern grid.

Objectives:

1. **Achieve 25% or more of total energy as local renewables**
   - While maintaining or improving grid reliability
2. **Prove technical & economic viability using a replicable model**
   - With cost-effective outcomes for communities
3. **Accelerate and scale deployments**
   - Through strong partnerships with utilities and vendors
4. **Strengthen local economies**
   - Via local investment, stable energy prices, less system cost

Result: A smarter distribution grid featuring more clean energy now, improved grid performance, and stronger long-term economics

What is a Community Microgrid?

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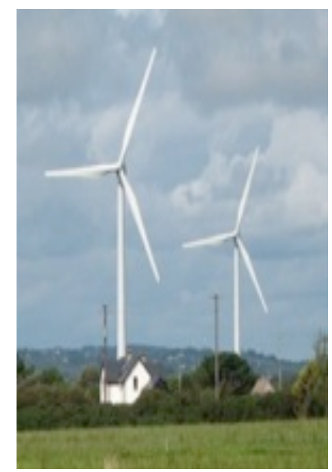
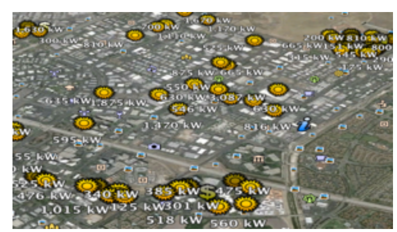
A Community Microgrid is a coordinated local grid area served by one or more distribution substations and supported by high penetrations of local renewables and other distributed energy resources.

Community Microgrids reflect a new approach for grid operations that achieve a more sustainable, secure, and cost-effective energy system while generally providing long-term power backup for prioritized loads.



The substation-level foundation of a Community Microgrid facilitates cost-effective replication for optimizing grid operations and customer satisfaction across utility service territories.



Community Microgrids achieve scale, lower costs

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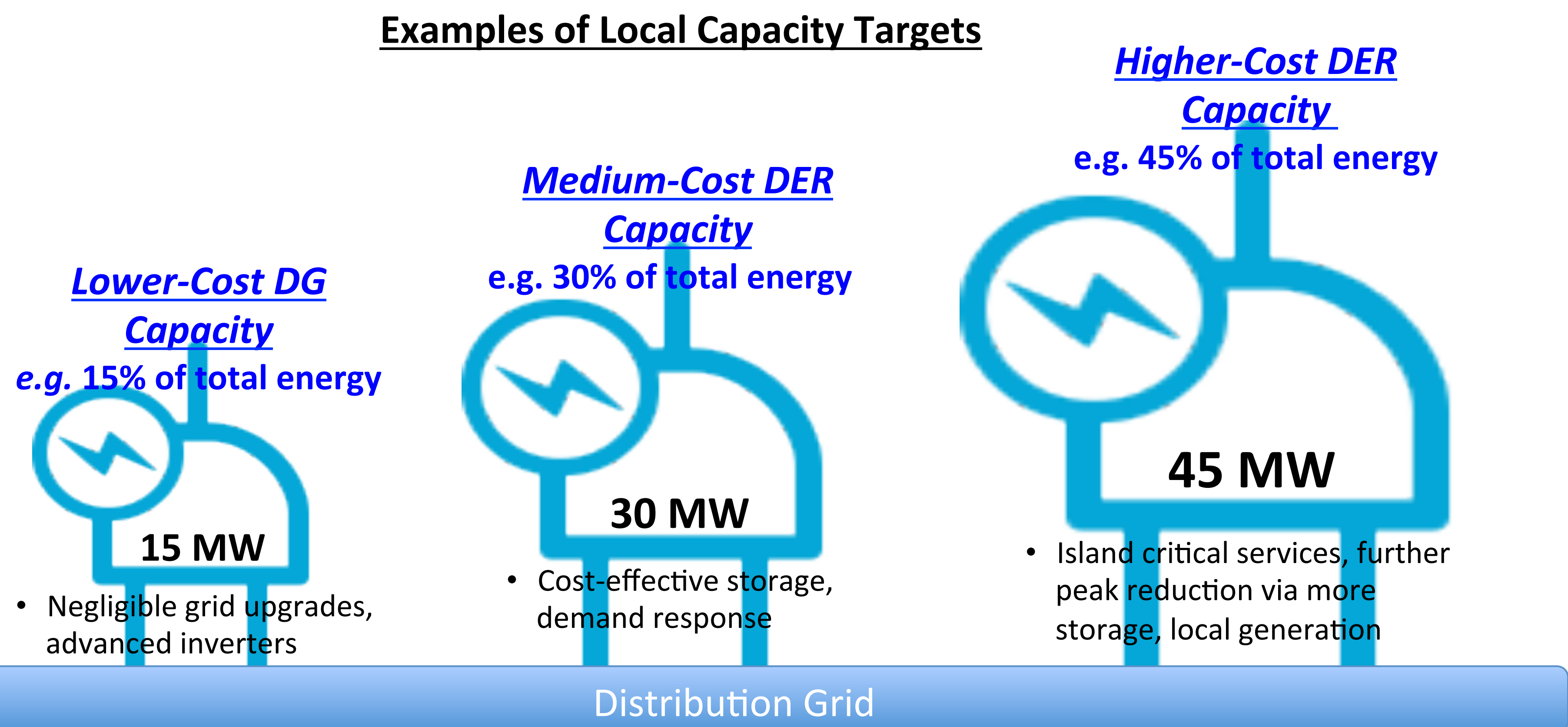
- Today's "one-rooftop-at-a-time" approach is slow, costly and disruptive to the grid
- Local Capacity Targets achieve scale, lower costs, and operational stability
- This "Plug-n-Play" method also enables apples-to-apples cost comparisons with centralized generation, which is already at scale



A Community Microgrid in four steps

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1. DG Survey

Methodical and complete survey of the DG potential within a target grid area, specific to actual site characteristics.

Quantifies the realistic DG potential plus helps define other requirements such as energy storage and control systems.

2. DER Optimization Modeling

Defines the optimal and most cost-effective portfolios of DER across a target grid area using utility-validated advanced modeling.

Combines local grid characteristics such as power flow, connected feeder capacity, and customer load shapes.

3. DER Financial Analysis

Full analysis of the cost- benefits and net value including reductions in T&D investments.

Includes bulk procurement and interconnection that achieve additional efficiencies in scale – delivering a "plug-and-play" model that further reduces costs.

4. Design & Deployment Plan

System design, architecture, and operational plan for the Community Microgrid.

Includes specific technology vendor recommendations appropriate to the design criteria and operational requirements.

Result: Distributed Energy Resources can deploy at scale in months rather than years. A massive acceleration of "one rooftop at a time…"

Solar Siting Survey for Community MIcrogrids

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Objectives:

- Provide an estimate of the solar generation potential in a target grid area served by a substation or substation(s)
- Identify the larger solar opportunities such as sites that can generate 250 kW (AC) of power or greater

Deliverables:

- Overview/summary documents: Word, PowerPoint
- Data: Excel file that provides the detailed data per site as well as summaries overall and per site categories
- Map: Google Earth file (.kml) that displays the target grid area using sun icons for the surveyed sites. Clicking on each sun icon provides more information.

Solar Siting Survey: Methodology

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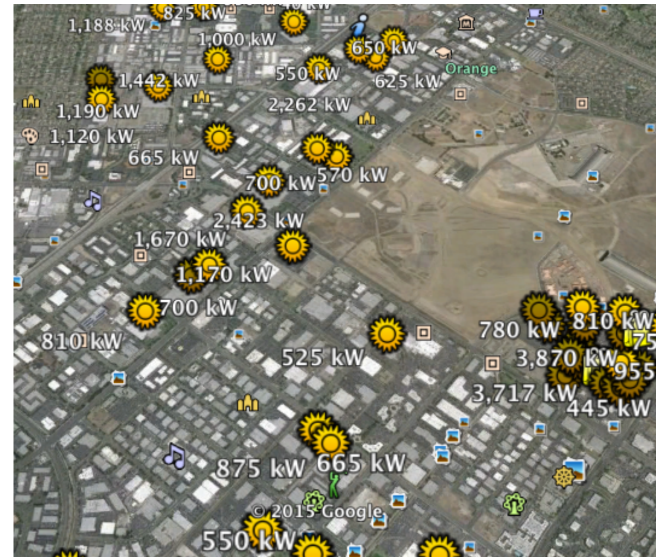
1. Identify appropriate sites, in both size and position, including rooftops, parking lots, and parking garages

2. Narrow down candidate sites to the most feasible locations, using estimates that exclude difficult, cluttered, or overly shaded areas

3. Measure the most feasible rooftop square footage per candidate site

4. Calculate the solar potential in kW AC per site

5. Include logical groupings where applicable such as office parks, shopping centers



Street address	City and ZIP code	Latitude of structure	Longitude of structure	Surface area in sqft	Structure type	PV power density assesment	Estimated PV potential [W, AC]	Total PV potential at this address [W, AC]
Address	City_ZIP	Lati	Longi	Area_ft2	PV_Type	PV_Rating	W_AC	Site_W_AC
3201 S Susan St	Santa Ana, CA 92704	33.704927	-117.910982	165,000	Roof_Flat	High	1,155,000	1,155,000
3441 W MacArthur Blvd	Santa Ana, CA 92704	33.704258	-117.914180	120,000	Roof_Flat	Medium	720,000	720,000
3320 S Fairview St	Santa Ana, CA 92704	33.702076	-117.908998	170,000	Roof_Flat	Medium	1,020,000	1,020,000
3300 S Bristol St	Santa Ana, CA 92704	33.702816	-117.887707	95,000	Roof_Flat	Medium	570,000	845,000
3300 S Bristol St	Santa Ana, CA 92704	33.702979	-117.886707	55,000	Pkg_Lot	Medium	275,000	-
3900 S Bristol St	Santa Ana, CA 92704	33.695739	-117.887860	157,700	Roof_Flat	Medium	946,200	946,200
2001 E Dyer Rd	Santa Ana, CA 92705	33.707939	-117.844428	346,100	Roof_Flat	High	2,422,700	2,422,700
2040 E Dyer Rd	Santa Ana, CA 92705	33.705920	-117.845644	238,600	Roof_Flat	High	1,670,200	1,670,200
2001 Carnegie Ave	Santa Ana, CA 92705	33.709638	-117.840411	100,000	Roof_Flat	High	700,000	700,000
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1800 E St Andrew Pl	Santa Ana, CA 92705	33.720475	-117.843203	200,000	Roof_Flat	Low	1,000,000	1,000,000
2400 S Grand Ave	Santa Ana, CA 92705	33.714956	-117.851856	170,000	Roof_Flat	High	1,190,000	1,190,000
1505 E Warner Ave	Santa Ana, CA 92705	33.717200	-117.848189	206,000	Roof_Flat	High	1,442,000	1,442,000
1224 E Warner Ave	Santa Ana, CA 92705	33.715521	-117.855663	115,000	Roof_Flat	Low	575,000	1,695,000
1224 E Warner Ave	Santa Ana, CA 92705	33.713926	-117.855369	160,000	Roof_Flat	High	1,120,000	-
1928 S Grand Ave	Santa Ana, CA 92705	33.721782	-117.852348	198,000	Roof_Flat	Medium	1,188,000	1,188,000
1856 Park Ct Pl	Santa Ana, CA 92705	33.748842	-117.841434	300,000	Brown_Fld	Medium	1,800,000	1,800,000
1395 S Lyon St	Santa Ana, CA 92705	33.730134	-117.844042	99,000	Roof_Flat	Medium	594,000	594,000

C&I customers are a good match

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C&I Match with Solar:

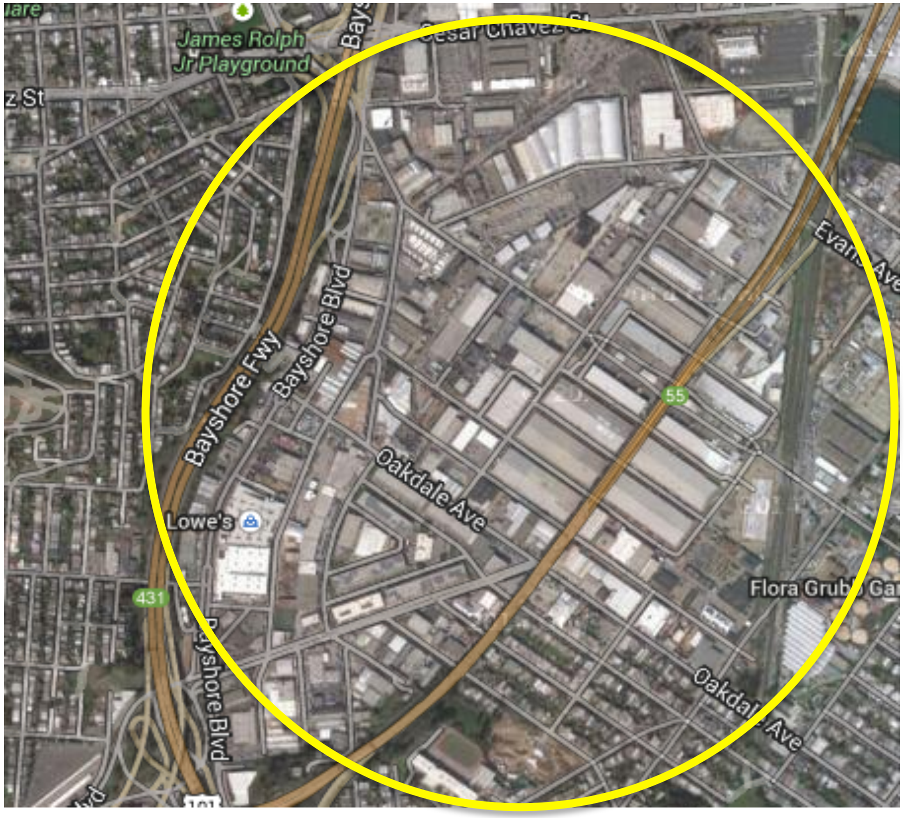
1. Most Generation
Larger rooftop spaces generate more energy

2. Lowest System Costs
Larger systems reduce overall costs

3. Best Grid Locations
Large loads served by robust feeder segments

4. Matching Load Profiles
Larger daytime loads match solar generation

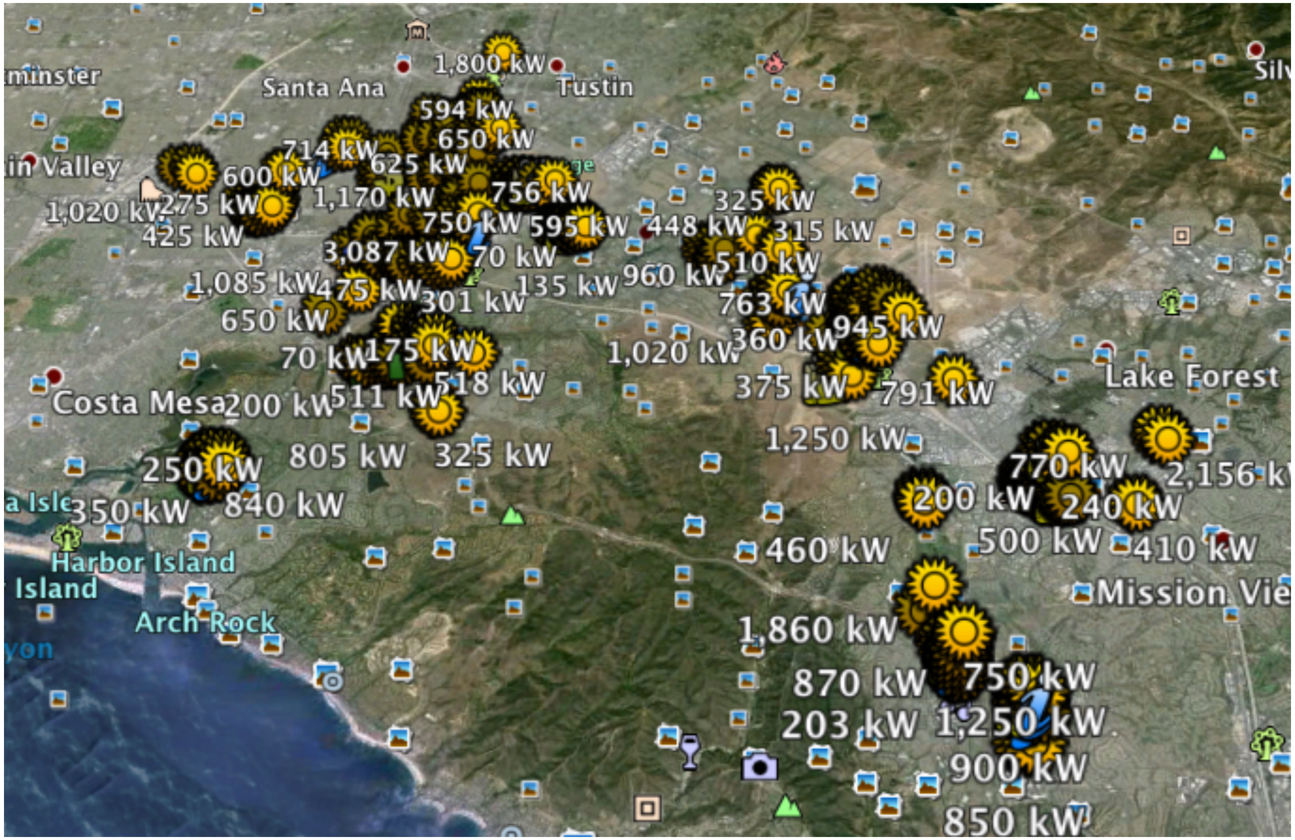
5. Financially Motivated
Larger bills including demand charges, plus rooftop leasing opportunity



Solar Siting Survey for SCE

Objective: Conduct a Solar Siting Survey across Southern California Edison's Preferred Resources Pilot (PRP) area for sites 500 kW or greater

The PRP area is approximately 120 square miles in Orange County, CA, bordered roughly by Santa Ana in the north and Laguna Niguel in the south.



Preferred Resources Pilot (PRP) overview

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Southern California Edison's (SCE's) Preferred Resources Pilot (PRP) is focused on meeting customers' electricity needs reliably and safely, using clean-energy resources.

"SCE is conducting a significant-scale, multi-year pilot to investigate and demonstrate how the integrated use of clean energy resources, including energy efficiency, demand response, renewable distributed generation, and energy storage — collectively referred to as "preferred resources" — may simultaneously meet demands for electricity and reduce the needs for incremental conventional power plants to serve customer needs in the PRP target region."

"SCE seeks to assess the capabilities of preferred resources, while informing the development of the grid of the future and contributing toward California's progressive environmental and renewable energy goals. "

"The PRP is focused on a transmission-constrained area of SCE's service territory served by the Johanna and Santiago substations in Central Orange County. More than any other part of the SCE territory, the future power supply needs of this region have been directly influenced by the closure of the San Onofre Nuclear Generating Station (SONGS) in 2013, which resulted in a loss of 2,200 megawatts (MW) of reliable power to the region."

SCE files

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SCE provided the following two files:

- Preferred Resources Pilot Map (.kmz)
  - Defines boundaries of PRP areas 24 & 59
  - Version available with transparency on polygon fill color so rooftops are visible
- PRP RFO Interconnection Map (.kmz)
  - Identifies substations and feeders
  - Allows identifying closest possible feeders to sites

SCE PRP Solar Siting Survey summary

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Summary: over 160 MW of new solar PV technical potential exists in the PRP area across rooftops, parking lots, and parking garages

PRP Solar Potential by PV size: totals per sites greater than 1 MW, sites greater then 500 kW but less than 1 MW, and sites less than 500 kW. The sites that are less than 500 kW are included as part of logical groupings such as office parks or shopping centers.

		Summary by PV Size							
		Num_Sites	kW_Total	PV W_AC >	1,000 kW	> PV W_AC >	500 kW	Less than	500 kW
PRP Area:	24	110	69,964 kW	26	36,599 kW	34	22,118 kW	50	11,246 kW
PRP Area:	59	221	105,437 kW	16	26,371 kW	68	48,031 kW	137	31,035 kW
PRP Area Overlap:		22	11,023 kW	4	6,673 kW	4	2,564 kW	14	1,786 kW
Totals:		309	164,378 kW	38	56,297 kW	98	67,585 kW	173	40,495 kW

PRP Solar Potential by site type: totals for rooftops, parking garages (multi-story parking structures that would enable rooftop-style mounting), parking lots (e.g. ground mount), and brown fields

		Summary by Site Type							
		Roof_Flat	kW_Total	Pkg_Garage	kW_Total	Pkg_Lot	kW_Total	Brown_Fld	kW_Total
PRP Area:	24	48	40,728 kW	18	12,831 kW	43	14,605 kW	1	1,800 kW
PRP Area:	59	113	58,125 kW	15	11,081 kW	93	36,232 kW	-	- kW
PRP Area Overlap:		15	9,599 kW	1	504 kW	6	920 kW	-	- kW
Totals:		146	89,253 kW	32	23,408 kW	130	49,917 kW	1	1,800 kW

SCE PRP Solar Siting Survey observations

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Observations:

1. More opportunities are available from structures less than 1 MW vs. greater than 1 MW due to common commercial and industrial building sizes

2. Parking Lots and Parking Garages represent a potential that is about 75% of the rooftop potential. Most of the large commercial buildings have adjoining large parking lots, and solar PV in parking lots provides an additional benefit: shade for cars (PV covered parking lots at schools and colleges are often the first to be occupied).

PV density examples: high

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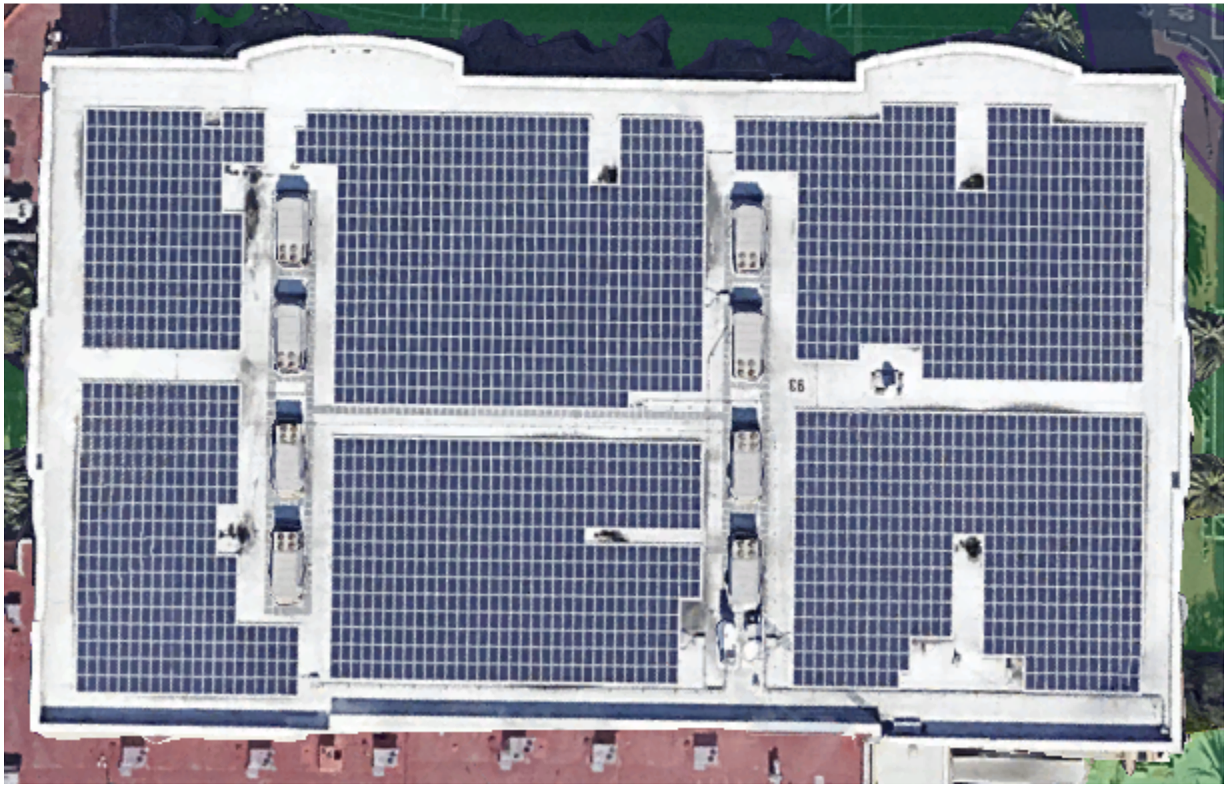

- Minimal roof clutter, grouped well
- Minimal setbacks and maintenance access

PV density examples: medium

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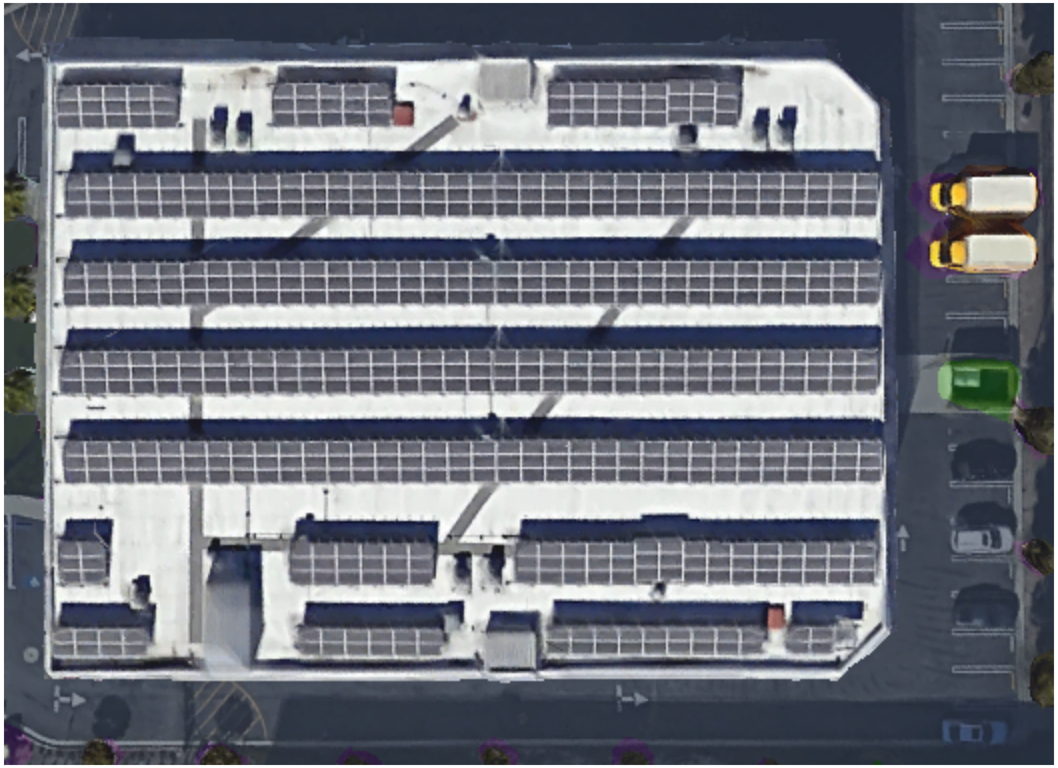

- Minimal roof clutter
- More setbacks and maintenance access than high density

PV density examples: low

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- Many skylights
- Much open space
- Looks like Tetris game

- Lots of unusable space
- More setbacks and maintenance access

PV density examples: shopping center

Marketplace at Laguna Niguel

PV density ratings

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Structure	High Density	Med. Density	Low Density	Notes
Roof, flat	7 W/sq. ft.	6 W/sq. ft.	5 W/sq. ft.	1, 2
Parking garage	7 W/sq. ft.	N/A	N/A	1, 2, 3
Parking lot	N/A	6 W/sq. ft.	N/A	2, 4, 5
Brown field	7 W sq. ft.	N/A	N/A	6

Notes:

1. Area calculated is normally corner-to-corner unless otherwise noted in the comments field in the spreadsheet. Edge clearance setbacks and panel maintenance access are assumed in these numbers.
2. May have areas restricted, notched or cut off as noted in the comments field in the spreadsheet.
3. High density due to no need for fire truck access between parking rows
4. Only includes central areas that have double row (nose-to-nose) parking. Single row parking around perimeter omitted. Impact on trees & planter boxes not included.
5. Medium density due to requirement for fire truck access clearance between parking rows.
6. Brown field was initially considered but dropped after project started. One potential site was left in database for reference.

Outputs: Excel file

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- Detailed data per site, including site address, site type, density rating, viable square feet, PV potential per site, distance to feeder(s), available feeder capacity, notes, etc.
- Summary tab: contains all summaries and breakdowns
- All data fields are explained within the file
- Can be easily filtered by city, zip code, type of structure, etc.

Street address	City and ZIP code	Latitude of structure	Longitude of structure	Surface area in sqft	Structure type	PV power density assesment	Estimated PV potential [W, AC]	Total PV potential at this address [W, AC]
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Outputs: Google Earth map file

- Sun icons mark each potential PV site in the PRP area
- Clicking on the sun icon provides more info (see picture)
- All data in the Google Earth file comes from the Excel spreadsheet