Clean Coalition

Making Clean Local Energy Accessible Now

Community Microgrid Initiative

Overview

Greg Thomson
Director of Programs
Clean Coalition
415-845-3872 mobile
greg@clean-coalition.org

Today's Agenda

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- **Community Microgrids: an opportunity for scale and cost-effectiveness**
- Community Microgrid methodology and examples
- Existing projects as case studies

The Modern Grid: Local Renewables @ 25% Minimum

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Community Microgrid Initiative

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Community Microgrids offer a more scalable, cost-effective, and modern solution for our electricity grid. Key benefits include:

1. **Scale, Sustainability:** local renewables reaching 25% - 50% of total annual energy – vs. solar at less than 2% today
2. **Cost-effectiveness:** lower long-term costs via technology vs. commodity advantage, plus peak & transmission reductions
3. **Local investment:** substantial energy dollars spent on local / regional jobs instead of remote / offshore
4. **Resilience & Security:** improved grid reliability, resilience, and security via a replicable model that extends across any area

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 new approach for designing and operating the electric grid, achieving a more sustainable and cost-effective energy system.

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.
- Ongoing renewables-driven power backup for critical and prioritized loads across the grid area.
- A solution that can be readily extended throughout a utility's service territory – and replicated across utilities.

Why Does a Systems Approach Matter?

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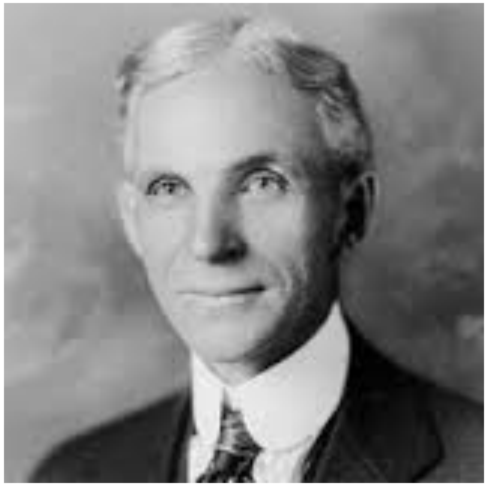
A systems approach is analogous to how Henry Ford's assembly line changed the economics and scale of the automobile industry



- Internal combustion engines, other car components, and cars existed before the assembly line, just as solar panels, inverters, and energy storage exist today.
- Rather than producing individual cars one at a time, Ford shifted the perspective to a higher-level systems solution that changed the world of manufacturing.
- Similarly, in the electrical system we have the opportunity to bring all the elements together into an "assembly line" approach that attaches renewable energy to the distribution grid in bulk amounts.
- Community Microgrids provide this systems-based solution and the resulting benefits across scale, innovations, and cost-effectiveness.

Community Microgrids Achieve Scale, Lower Costs

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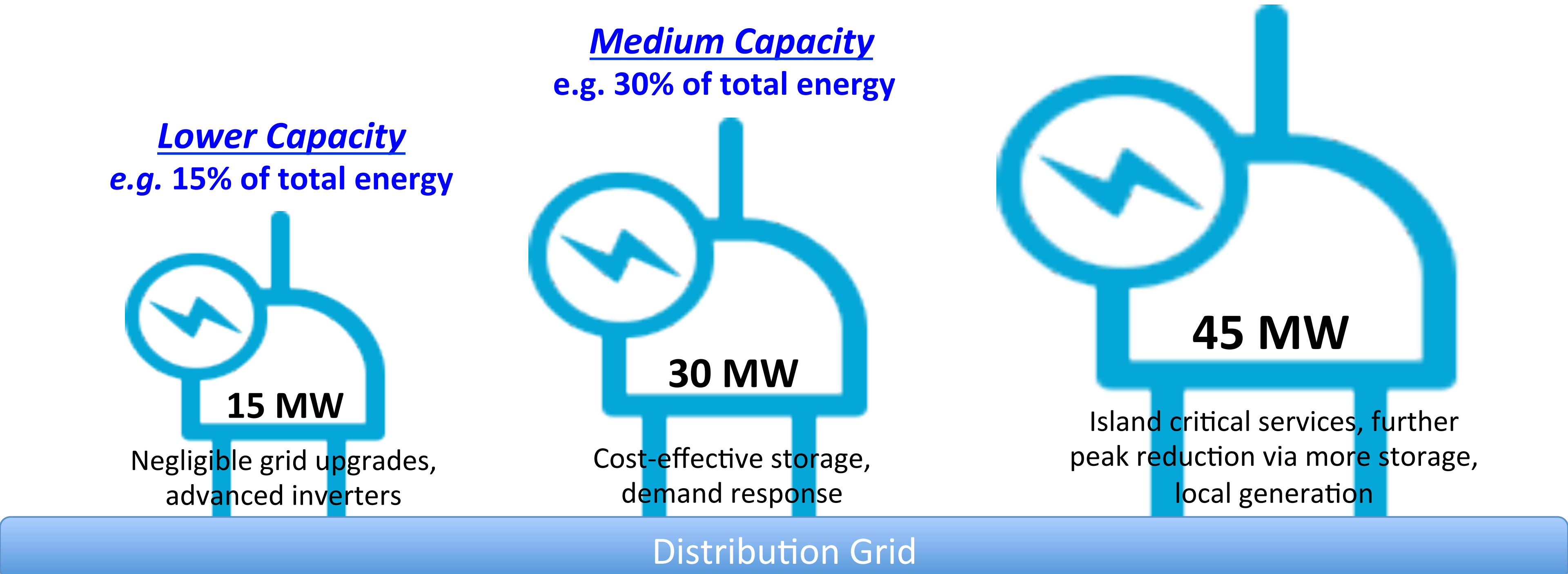
- Today's "one-rooftop-at-a-time" approach is slow, costly and disruptive to the grid
- The systems approach – a.k.a. "Local Capacity Targets" – achieves scale, lower costs, and grid stability
- This "Plug-n-Play" method also enables a more apples-to-apples cost comparison with centralized generation, which is already at scale

Examples

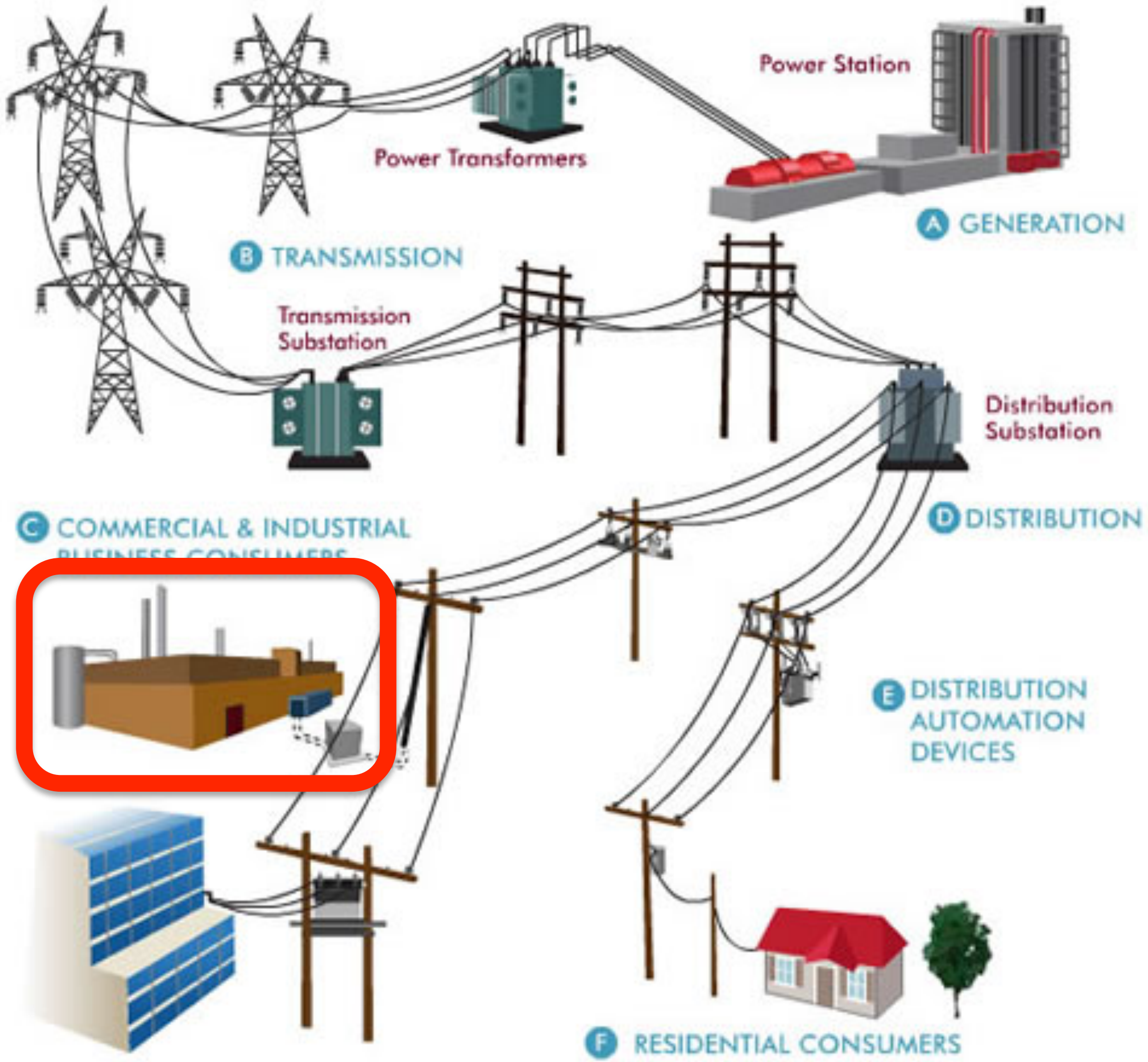
Higher Capacity
e.g. 45% of total energy

Medium Capacity
e.g. 30% of total energy

Lower Capacity
***e.g.* 15% of total energy**



Traditional Microgrids Focus on Single Customers



Source: Oncor Electric Delivery Company

Community Microgrids Serve Thousands of Customers

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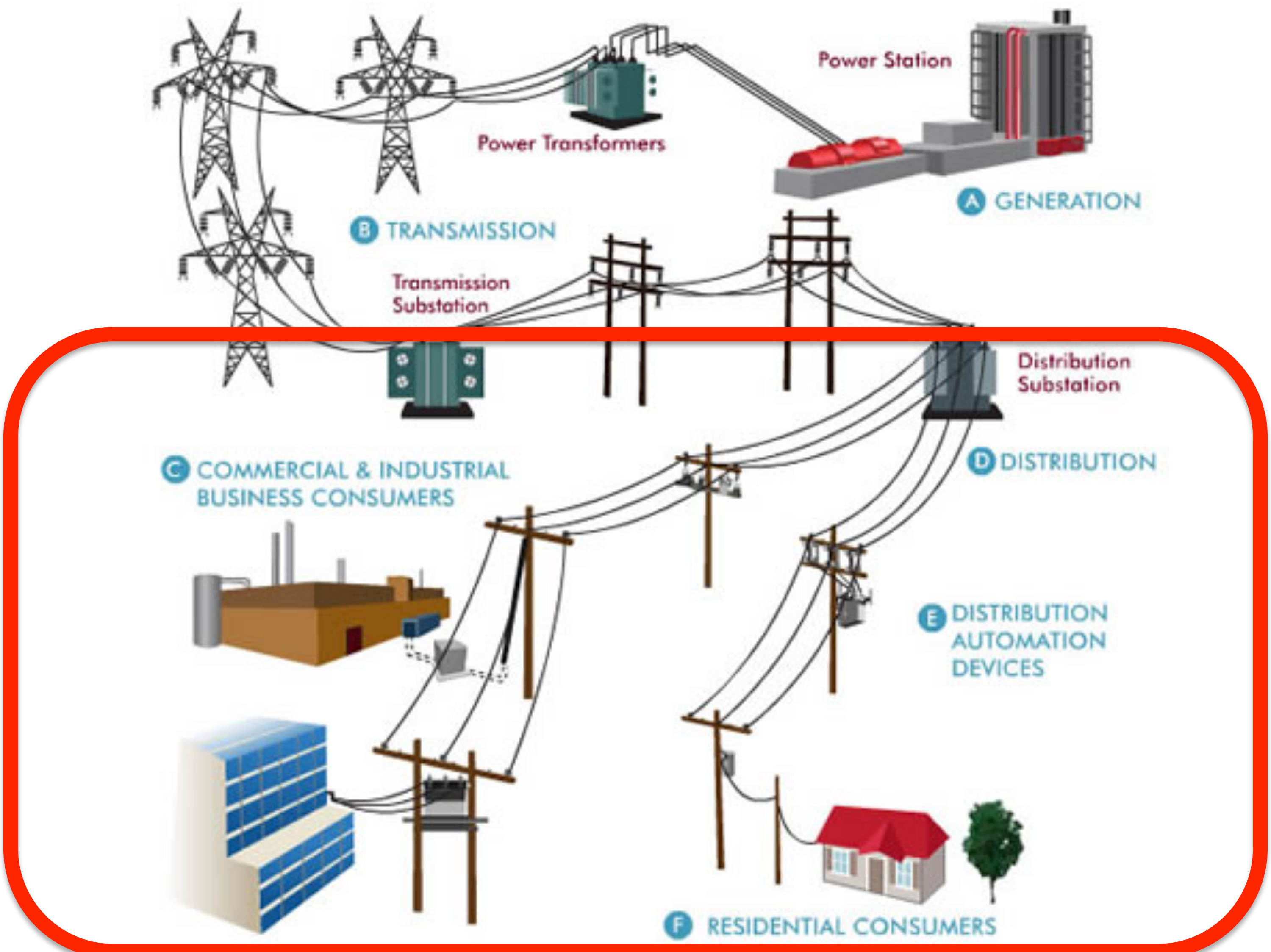

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A Community Microgrid in Six Steps

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1	2	3	4	5	6
Goals	**Baseline Grid Analysis**	**Renewable Siting Survey**	**DER Optimization**	**Economic Analysis**	**Deployment Plan**
Desired goals and performance metrics of the target grid area.	Inventory of the existing grid assets including load profiles, grid operations, and existing generation.	Survey of all viable renewable energy potential in the grid area.	Design of optimal DER portfolios including load management.	Analysis of the cost-benefits and net value.	Final system design, financial model and operational plan.
Includes goals for renewables, grid reliability, power backup, peak reductions, etc.	Includes identifying critical and prioritized loads.	Informs other requirements such as energy storage capacity and control system functionality.	Incorporates Baseline Grid Analysis and Renewables Survey.	Includes cost reductions in T&D, other ratepayer benefits, and local job creation.	Includes operational requirements and vendor analysis.

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

Step 1: Goals

Community Microgrid Goals, Example:

1. Achieve high penetrations of local renewables, targeting at least 25% of total electric energy consumed within the target grid area

2. Save ratepayers money by deferring substantial investments in Transmission & Distribution (T&D) infrastructure through local balancing, e.g. load shifting and peak shaving

3. Improve grid performance – quality, reliability, resilience, and security – by leveraging local renewable energy and energy storage to provide ongoing backup power to specific critical and prioritized loads in the area

4. Provide a cost-effective and accelerated path to modernizing grid operations and reaching the Distributed Energy Resources (DER) future

Step 2: Baseline Grid Analysis

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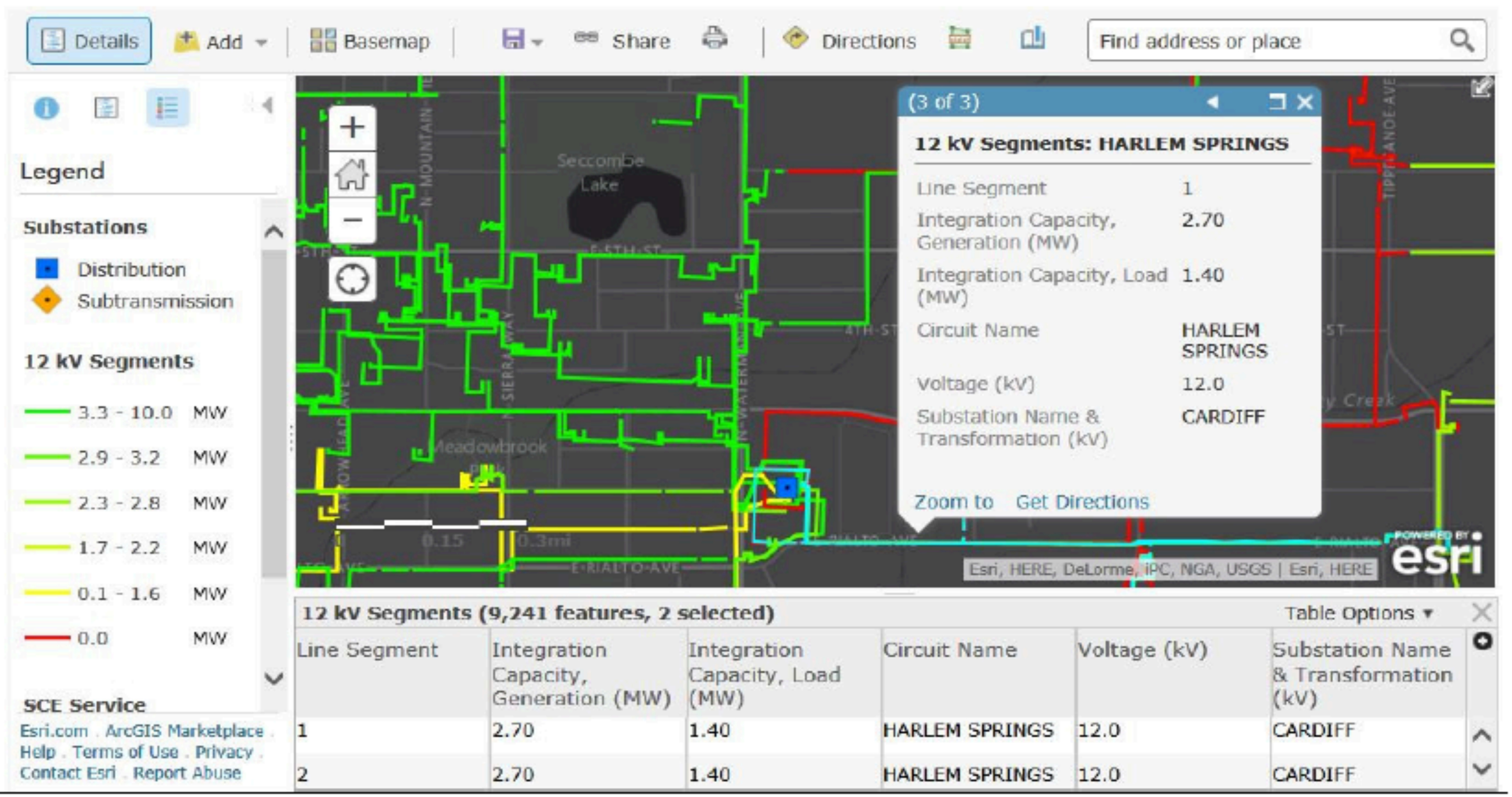
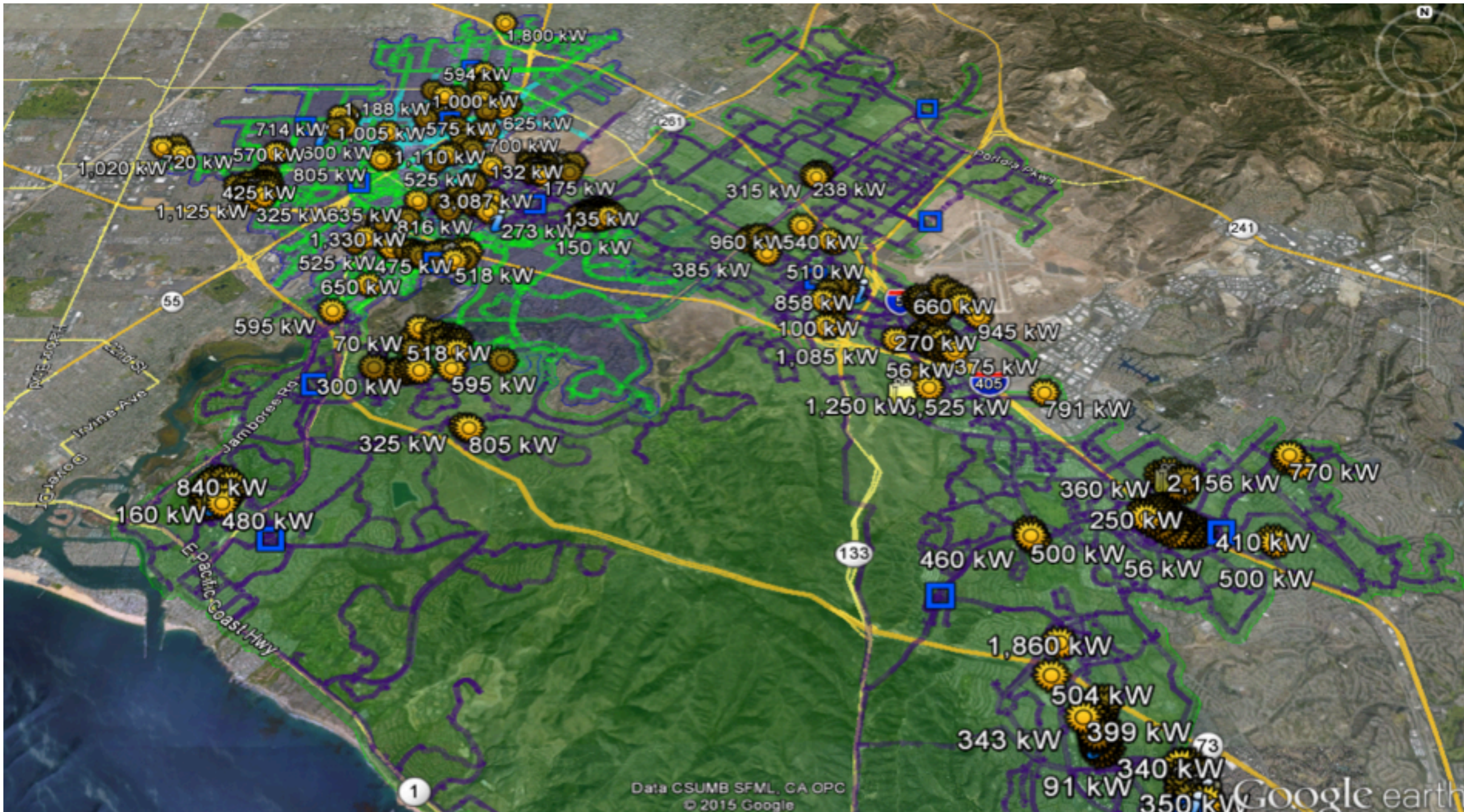
Determine the ability of the grid to accommodate new DER: Inventory of the existing grid assets including load profiles, voltage regulation, feeder and transformer capacities, and existing generation



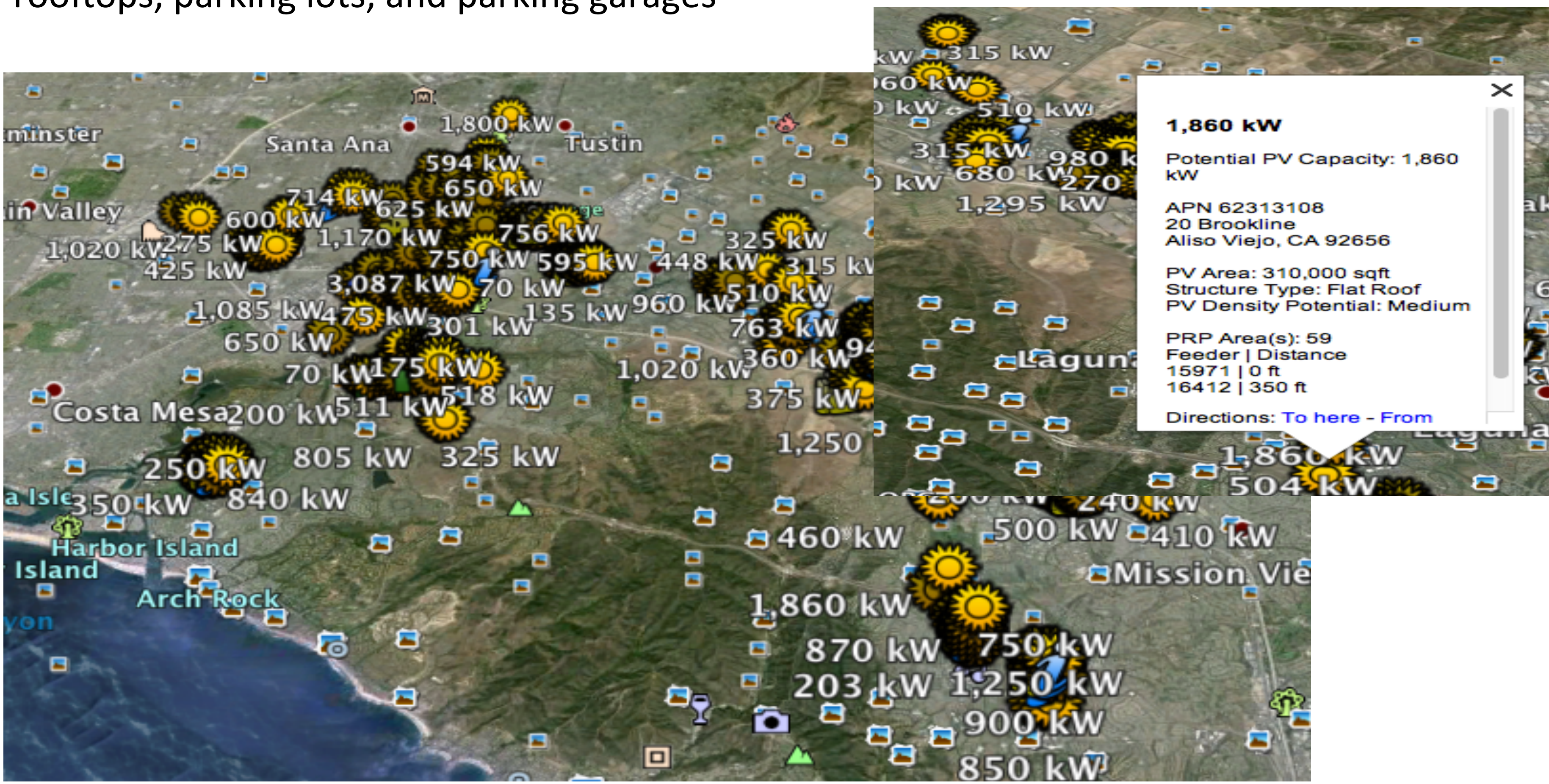
Comprehensive assessment of the local renewable energy generation potential in the target grid area, specific to local resources and site characteristics



Renewable Siting Survey Example: SCE

Example: Solar Siting Survey across Southern California Edison's Preferred Resources Pilot (PRP) area, approximately 120 square miles in Orange County, CA.

Result: over 160 MW of new solar PV technical potential exists in the PRP on large rooftops, parking lots, and parking garages



Step 4: DER Optimization Methodology

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Inputs

Data, existing grid:
- Loads, load forecasting
- Network model & circuit map
- Equipment list, upgrade plan, O&M schedule
- Transmission constraints

Data, DER solutions:
- DG survey
- Solar insolation
- Weather forecasting
- DER specs: advanced inverters, storage, DR, etc.

4. Higher Capacity

- **Higher DER level incl. storage & local generation (e.g. Fuel Cells, CHP) that further mitigate variability & peaks while islanding critical services**
- **Optimize via locations, sizes, types, costs, system deferrals**

3. Medium Capacity

- **Target DER level in context of net grid value that adds cost-effective storage & DR. May require moderate grid upgrades.**
- **Optimize via locations, sizes, types, costs, system deferrals**

2. Lower Capacity

- **Initial DG level that requires negligible grid upgrades and manages voltage w/existing equipment & advanced inverters**
- **Optimize via locations, sizes, types, costs, system deferrals**

1. Baseline Powerflow

- **Acquire all data sets, validate data accuracy**
- **Model existing grid area, including existing DG**

Outputs

- Scalable, cost-effective, operationally viable DER Optimization plan
- Results validated with utility & tech vendors
- Grid reliability & power quality maintained or improved

DER Optimization: Local is Fundamental

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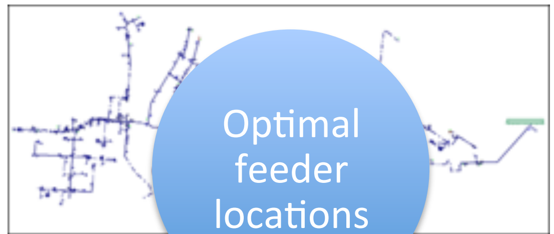
Local grid characteristics unlock optimal and cost-effective DER portfolios. The modern distribution grid becomes an asset that supports DER and its benefits.

More reliable, cost-predictable, cleaner

Local Market Value – e.g. Rates



Optimal feeder locations

In combination with the other characteristics

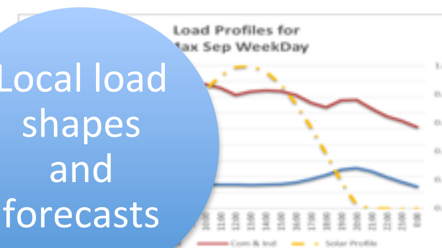
Locally connected feeders

Helps with local balance

Optimal DER Portfolio

Also extends to system-wide avoided costs

Local avoided grid upgrades



Local load shapes and forecasts

Differentiated customers, unique DER opportunities

DER Optimization: Advanced Inverters

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1. 6AM:
   - No PV impact
2. Noon:
   - 20MW PV causes overvoltage
3. Noon:
   - 20MW PV with advanced inverters set at 0.9 power factor stabilizes voltage

DER Optimization: Commercial & Industrial (C&I)

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C&I customers are typically the largest electricity users and emitters of GHG. Guess what? They also match well with solar.

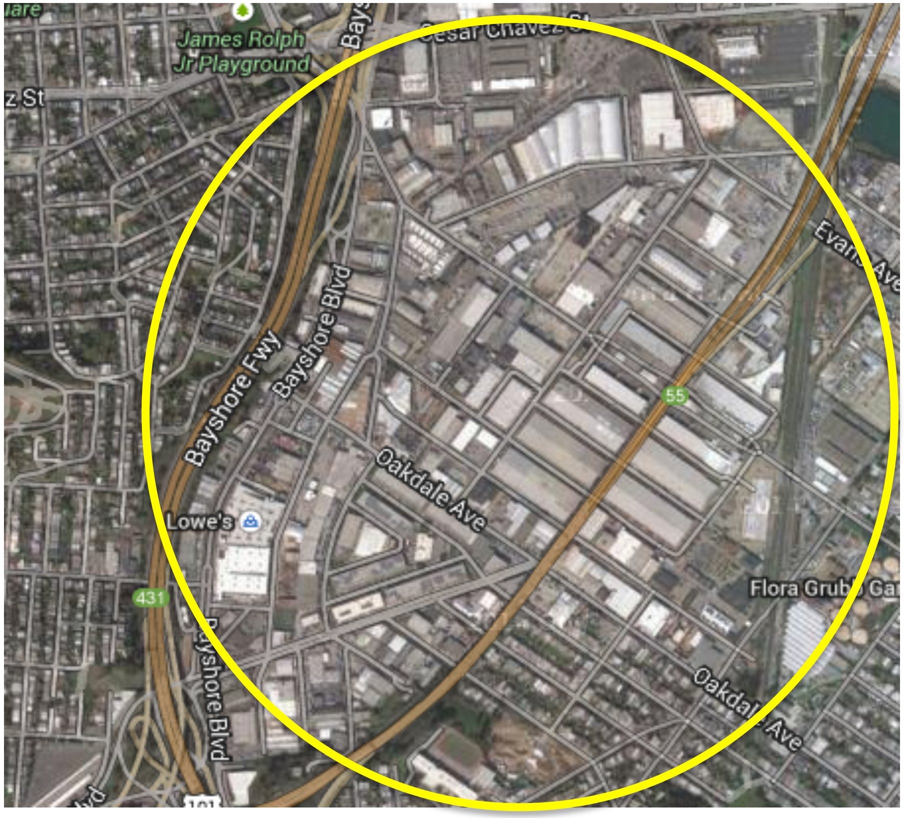
1. **Most Generation**
Larger rooftop spaces generate more energy

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



Step 5: Economic and Benefits Analysis

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Hunters Point Example: Benefits from 50 MW New PV Over 20 Years

Energy

Cost Parity: Solar vs. NG, LCOE

$260M: Spent locally vs. remote

$80M: Avoided transmission costs

$30M: Avoided power interruptions

Economic

$200M: New regional impact

$100M: Added local wages

1,700 Job-Years: New near-term and ongoing employment

$10M: Site leasing income

Environmental

78M lbs.: Annual reductions in GHG emissions

15M Gallons: Annual water savings

375: Acres of land preserved

50 MW Total = Existing Structures @ 30 MW + Redev Zone @ 20 MW

Example: 180 Napolean St.
- PV Sq. Ft = 47,600
- System size = 714 kW

Commercial: 18 MW

Example: 1485 Bay Shore
- PV Sq. Ft = 37,800
- System size = 567 kW

Parking Lots: 2 MW

Example: 50 avg. rooftops
- Avg. PV Sq. Ft = 343
- Avg. system size = 5 kW

Residential & MDU: 10 MW

Step 6: Deployment Plan

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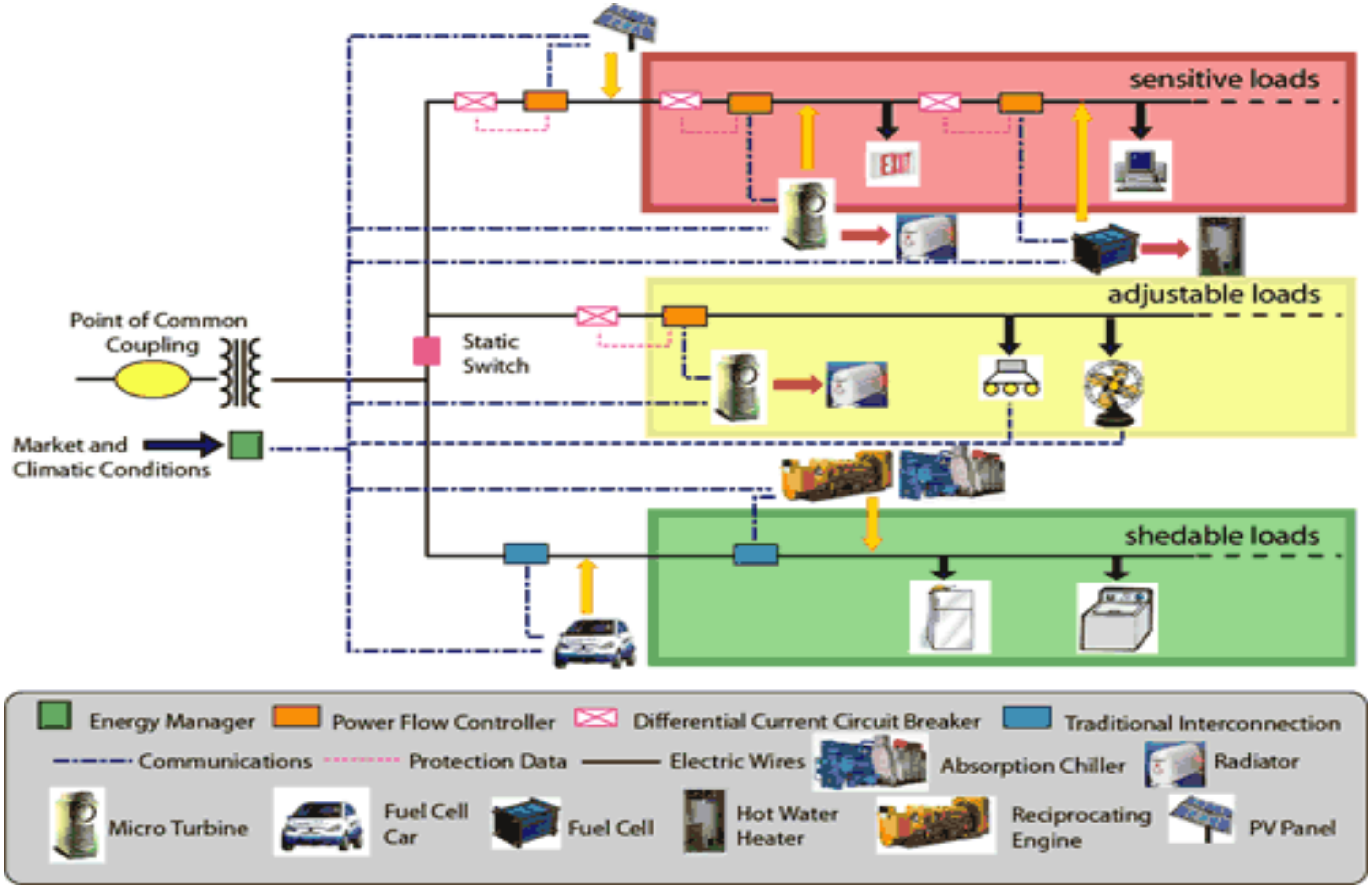
Final system design, financial model and operational plan for the Community Microgrid. Includes vendor analysis (e.g. RFIs, RFPs) appropriate to the final design criteria, financial model, and operational requirements.



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- **Existing projects as case studies**

Hunters Point Community Microgrid Project

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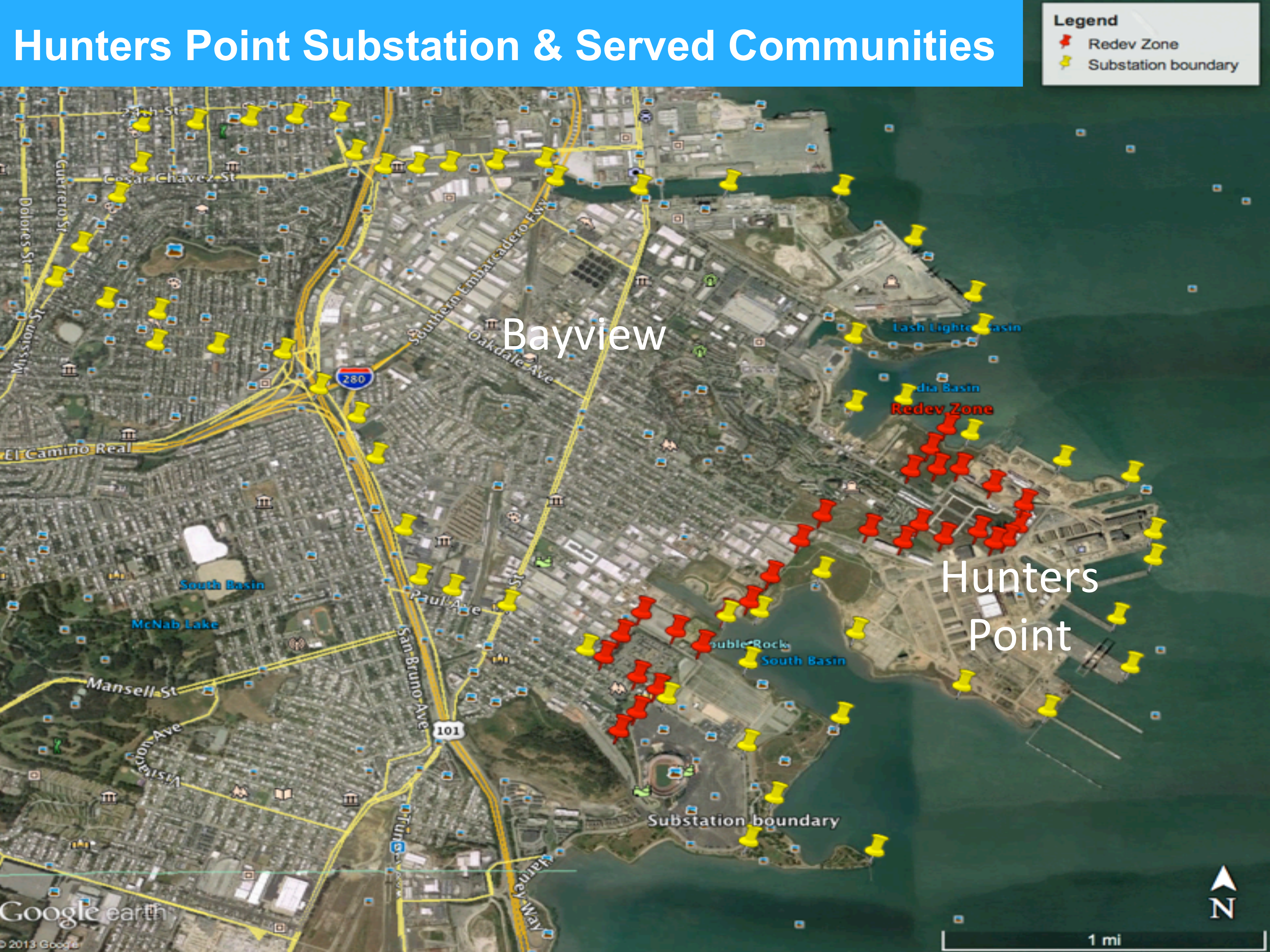
Overview

- Innovative project in the Bayview-Hunters Point area of San Francisco, in collaboration with PG&E
- Showcase location demonstrating the value of Community Microgrids
- DG / DER Optimization using existing tools that can be replicated easily by any utility, for any community area
- Methodology and results used as key input to the CPUC's final DRP ruling requiring "plug-and-play" model for DER

The Hunters Point substation serves ~20,000 customers (about 90% residential, 10% commercial & industrial)

Hunters Point Substation & Served Communities



Hunters Point Results to Date

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The Hunters Point substation area proves that high penetrations of DG are achievable at a very low cost to the grid. 30 MW of new PV added at optimal locations, equaling 25% of total annual energy, with no adverse impacts to distribution grid operations.

- 20 MW added to select Commercial & Industrial sites matching low resistance locations with higher daytime loads
- 10 MW added to select Residential sites (multiple dwelling units) matching more robust feeder locations
- No Out-of-Range voltages. Voltage regulation achieved using existing Load Tap Changers (advanced inverters not needed yet).
- No Backfeeding to Transmission. Some "Crossfeeding" between feeders.

2015 New York State Energy Plan

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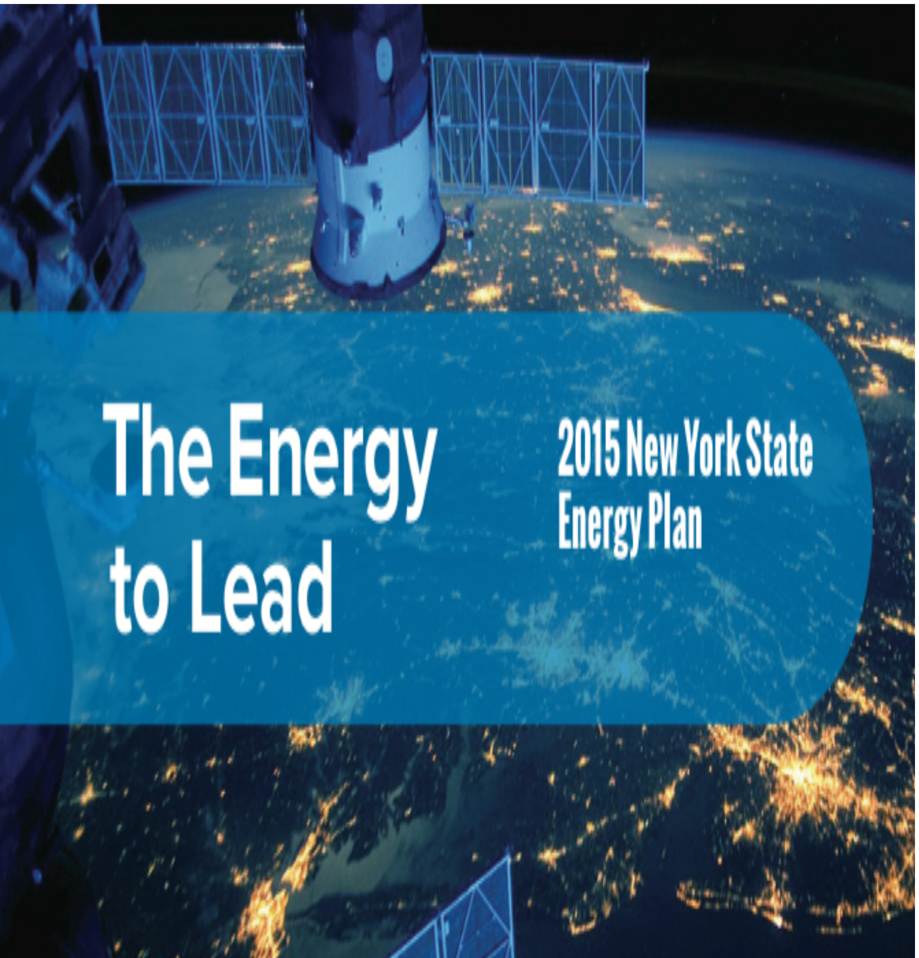
"Comprehensive roadmap to build a clean, resilient, and affordable energy system for New York… Relies on greater investment in distributed energy resources… Facilitates development of innovative community microgrids…"



2030 Targets

40% Reduction
in GHG emissions from 1990 levels

Reducing greenhouse gas (GHG) emissions from the energy sector—power generation, industry, buildings, and transportation—is critical to protecting the health and welfare of New Yorkers and reaching the longer term goal of decreasing total carbon emissions 80% by 2050.

50% Generation
of electricity from renewable energy sources

Renewable energy sources, including solar, wind, hydropower, and biomass, will play a vital role in reducing electricity price volatility and curbing carbon emissions.

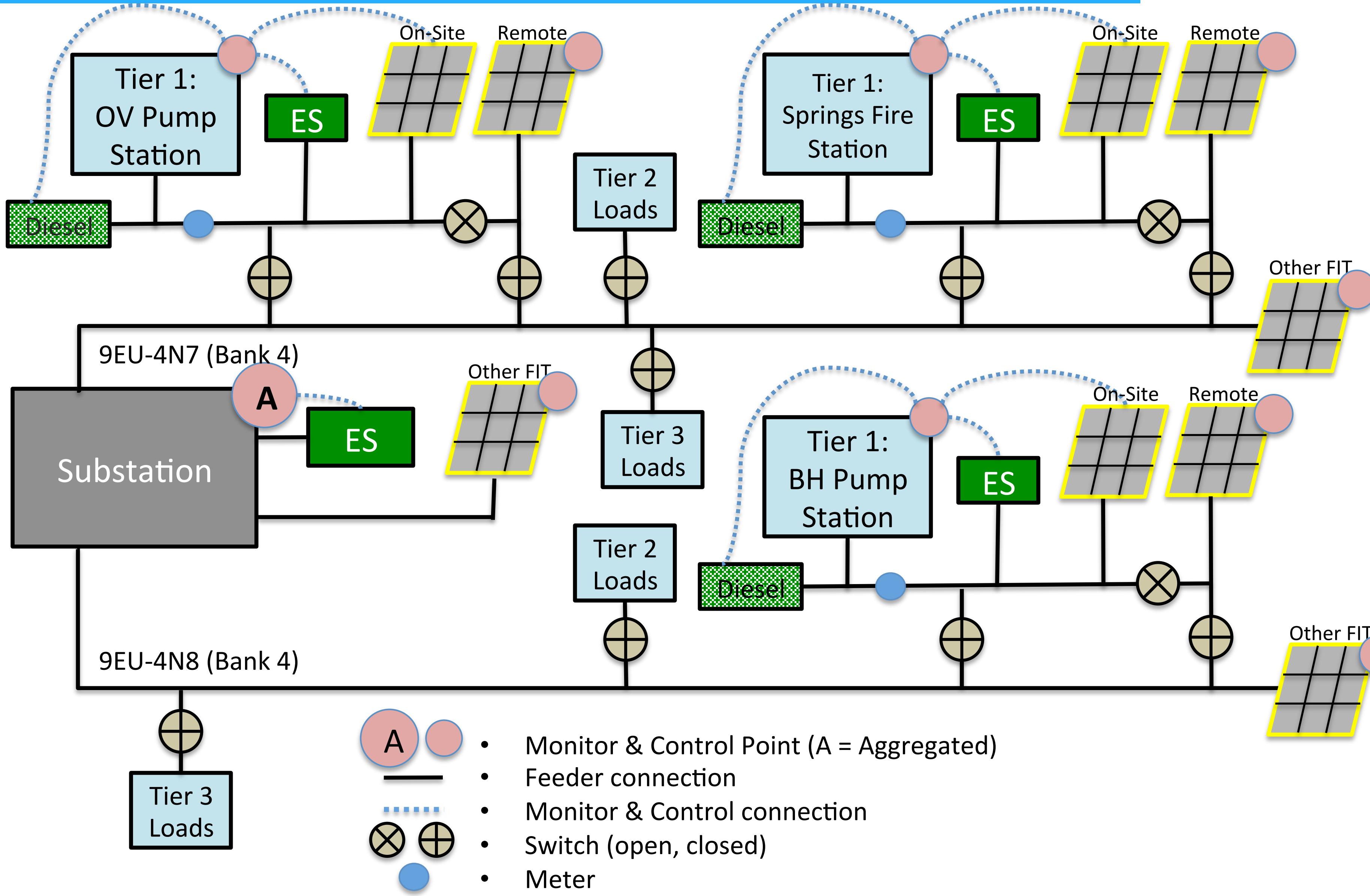
23% Decrease
in energy consumption in buildings from 2012 levels

Energy efficiency results in lower energy bills and is the single most cost-effective tool in achieving energy objectives. 600 trillion British thermal units (TBtu) in energy efficiency gains equates to 23% reduction in energy consumption by buildings.

Long Island Community Microgrid Project

- NY Prize Community Microgrids Competition grant award. Collaboration with PSEG Long Island, Long Island Power Authority (LIPA), and NYSERDA covering a substation in East Hampton, NY that serves thousands of customers.
- Combines 15 MW of local solar (via Feed-In Tariff) with a 5 MW / 25 MWh battery system and targeted load management
- Reaches almost 50% of total annual energy from local renewables. Minimizes the use of existing fossil generators including local diesel peakers and diesel backup generators.
- Provides ongoing power backup to multiple critical facilities as well as other priority loads across the area
- Sets the stage to preempt hundreds of millions of dollars in transmission and fossil generation investments

LICMP as a Design Template



A Peek at our Community Microgrid Future

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

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