Clean Coalition

Making Clean Local Energy Accessible Now

Community Microgrids: The Path to Resilience & Sustainability

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Clean Coalition (non-profit) Mission

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

Community Microgrids: The Path to Resiliency

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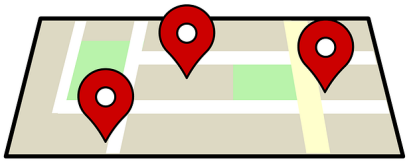
Analysis & Planning

Full cost and value accounting for DER; siting analysis

- PG&E
- PSEG
- SCE



Grid Modeling & Optimization

Powerflow modeling; DER optimization

- PG&E
- PSEG
- SCE

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

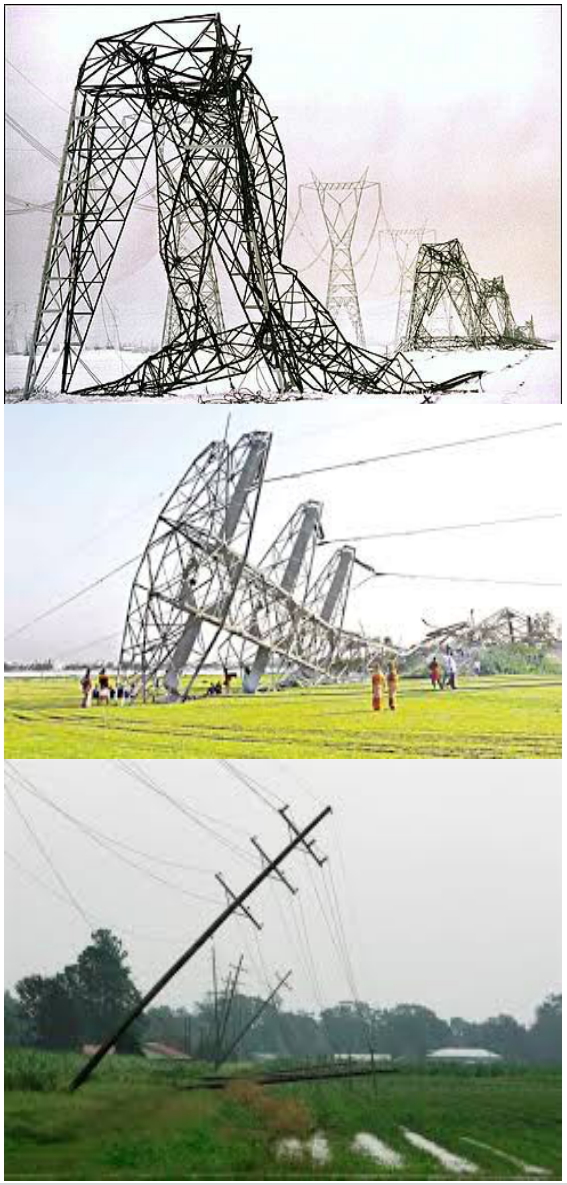
Introduction: Energy is critical infrastructure

Energy is critical infrastructure.

And yet, our legacy, centralized energy architecture carries multiple critical risks.

- This architecture is **costly, aging, inefficient,** and a **highly vulnerable security risk**
- **Extreme weather events** are occurring more frequently, further demonstrating the **vulnerability** and **high cost**
- **Cyber attacks** are a **growing risk,** and an attack on a centralized system can **affect millions**
- To accomplish both **local and national security,** we must move more quickly to a new solution

Community Microgrids:
Cleaner, More Reliable & Resilient, More Affordable



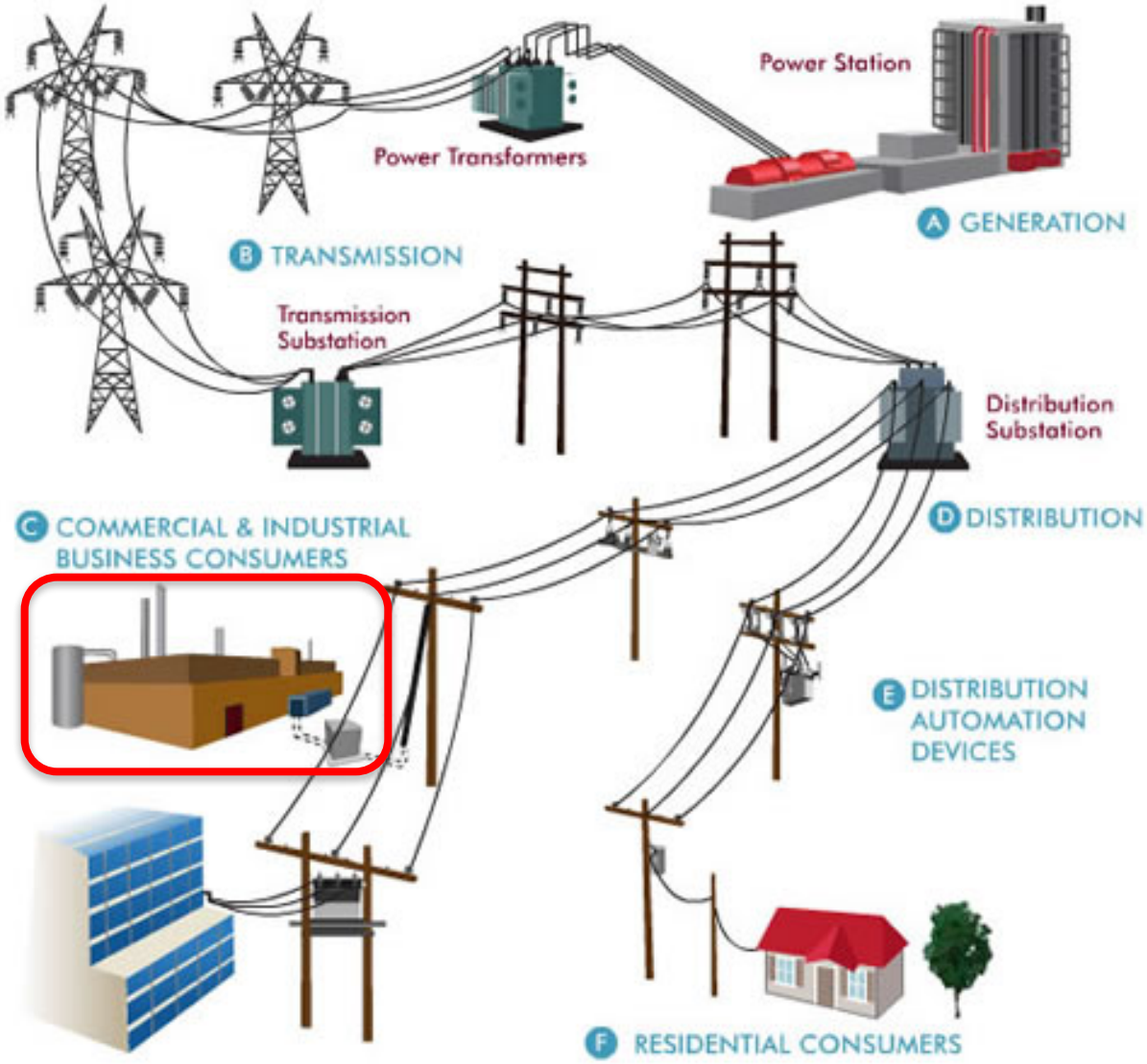
Why Community Microgrids?

A Community Microgrid delivers four combined benefits to communities.

These benefits are not provided by today's centralized energy system.

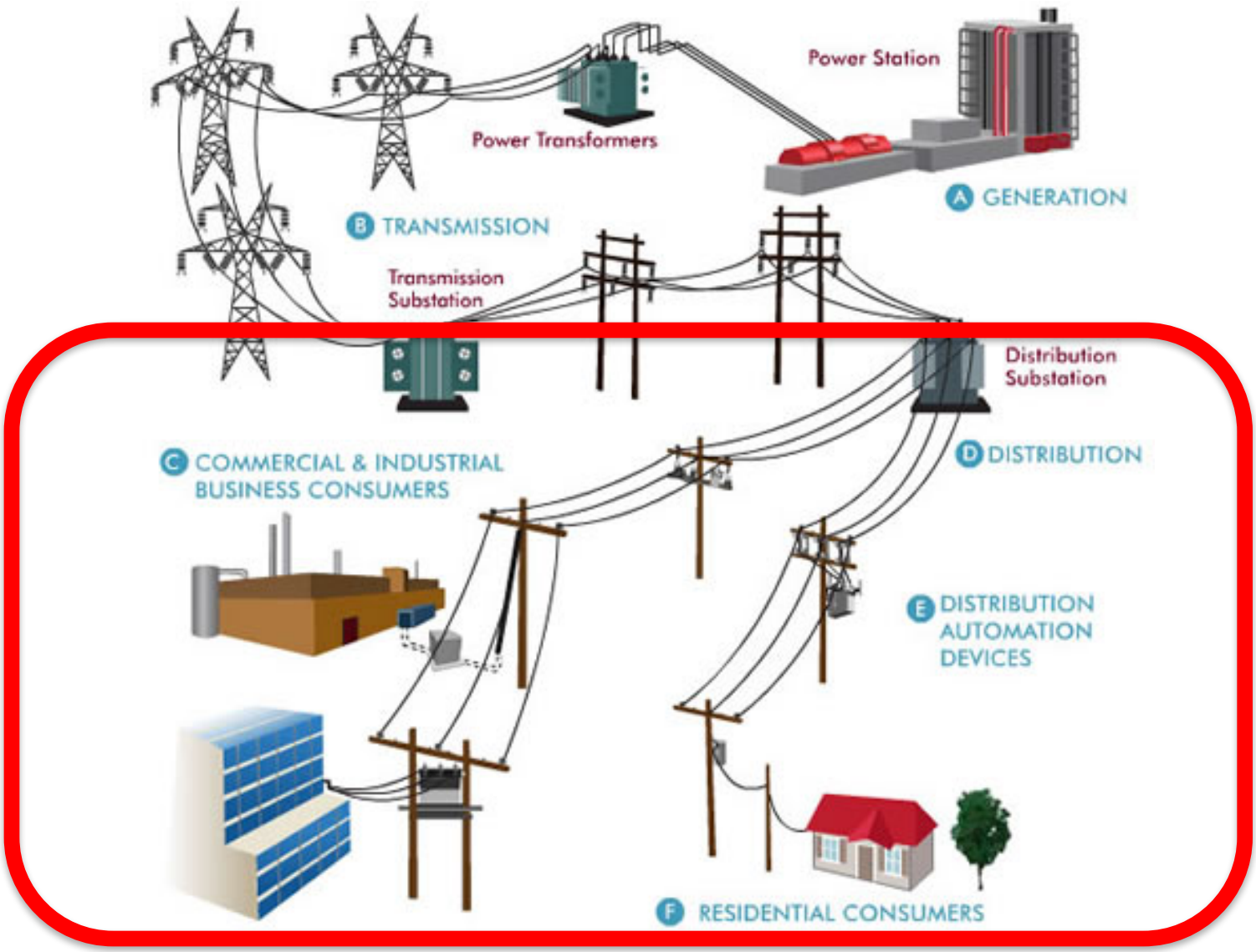
1. **Lower Costs**: By optimizing local clean energy, energy storage, and other DER, the cost of electricity is reduced by eliminating expensive peak periods and all associated costs
2. **Cleaner Energy**: High penetrations of local clean energy not only replaces fossil fuels, it also provides clean energy for local transportation – and at lower delivery costs
3. **Resilience & Security**: Delivering ongoing, clean power to critical & priority loads in communities, while able to withstand multiple disaster scenarios
4. **A Replicable Solution**: Covering an entire substation area, this solution can be deployed in any community around the world – and also increases local economic investment

Traditional Microgrids focus on single customers



Source: Oncor Electric Delivery Company

Community Microgrids serve thousands of customers



Source: Oncor Electric Delivery Company

Community Microgrids = the Grid of the Future

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Community Microgrids are a modern approach for designing and operating the electric grid.

Key features:

- A targeted and coordinated local grid area served by one or more distribution substations
- Optimal penetrations of local clean energy and other Distributed Energy Resources (DER) such as energy storage and demand response
- Ongoing, renewables-driven backup power 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 Microgrids feature "Local Balancing"

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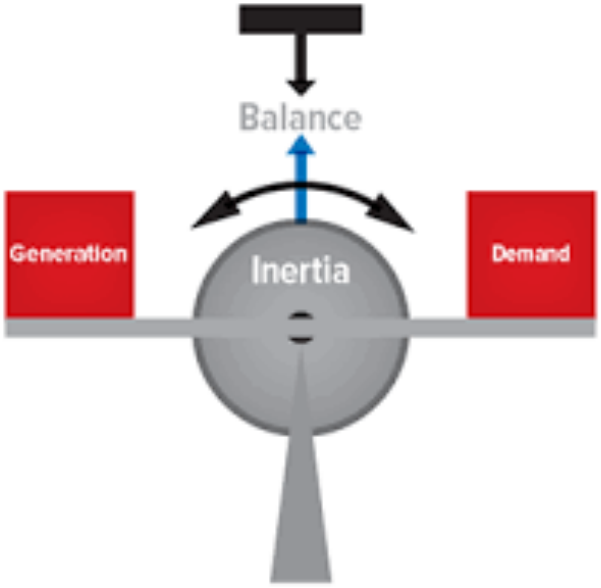
Local Balancing gives us a more efficient way to operate the grid

1. **Flattens and lowers load shapes** across entire community areas, thereby reducing system-wide peaks and thus the most costly energy and grid infrastructure
2. **Manages variability/volatility locally**, rather than exporting volatility as an aggregated issue up to the centralized system
3. **Provides energy resiliency & security** to cities and communities via power generated, delivered, and consumed locally



The distribution & transmission grids become equal partners in grid operations and efficiencies.

Local Balancing offers multiple economic benefits

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The six economic benefits of Local Balancing via Community Microgrids

1. **Cost Reductions Due to *Peak* Management**: Protection against the high cost of peak energy
2. **Cost Reductions Due to *Demand Charges*:** Protection against additional fees charged by utilities for peaks
3. **Cost Reductions Due to *Rate* Management:** Protection against future rate changes, e.g. evening ramp
4. **Cost Reductions Due to *Investment Deferrals***: Deferral of substantial costs for centralized infrastructure
5. **Cost Certainty**: Keeping rates and costs constant for consumers as well as grid operators.
6. **Increased Economic Investment in Communities**

These Cost Issues Are Caused by Our Mostly Centralized System

Community Microgrid design steps

Clean Coalition

Step 1 – Goals

1. **Save ratepayers money** by deferring substantial investments in centralized infrastructure through Local Balancing – local clean energy at optimal locations, energy storage for peak reduction and generation firming, and load shifting & shaping

2. **Improve grid reliability, resilience, and security** by utilizing local clean energy and energy storage to provide ongoing backup power to critical and prioritized loads in the area

3. **Modernize grid operations** to support and automate the above, helping enable utilities to take a much-needed step forward

4. **Feature energy efficiency and home improvements/ZNE**, as key additional cost, health, and energy performance improvements

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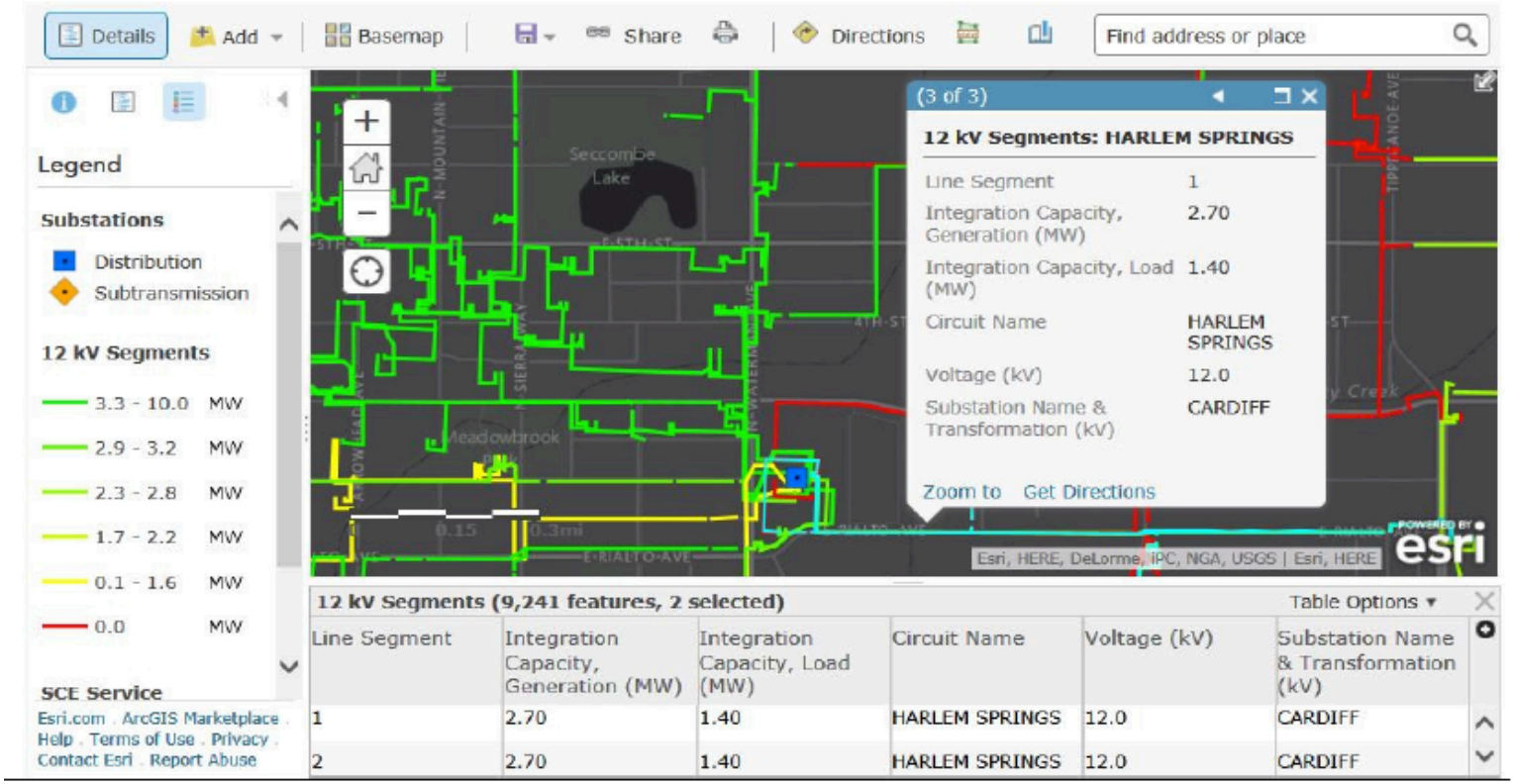
Step 2: Baseline Grid Analysis

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



Community Microgrid design steps

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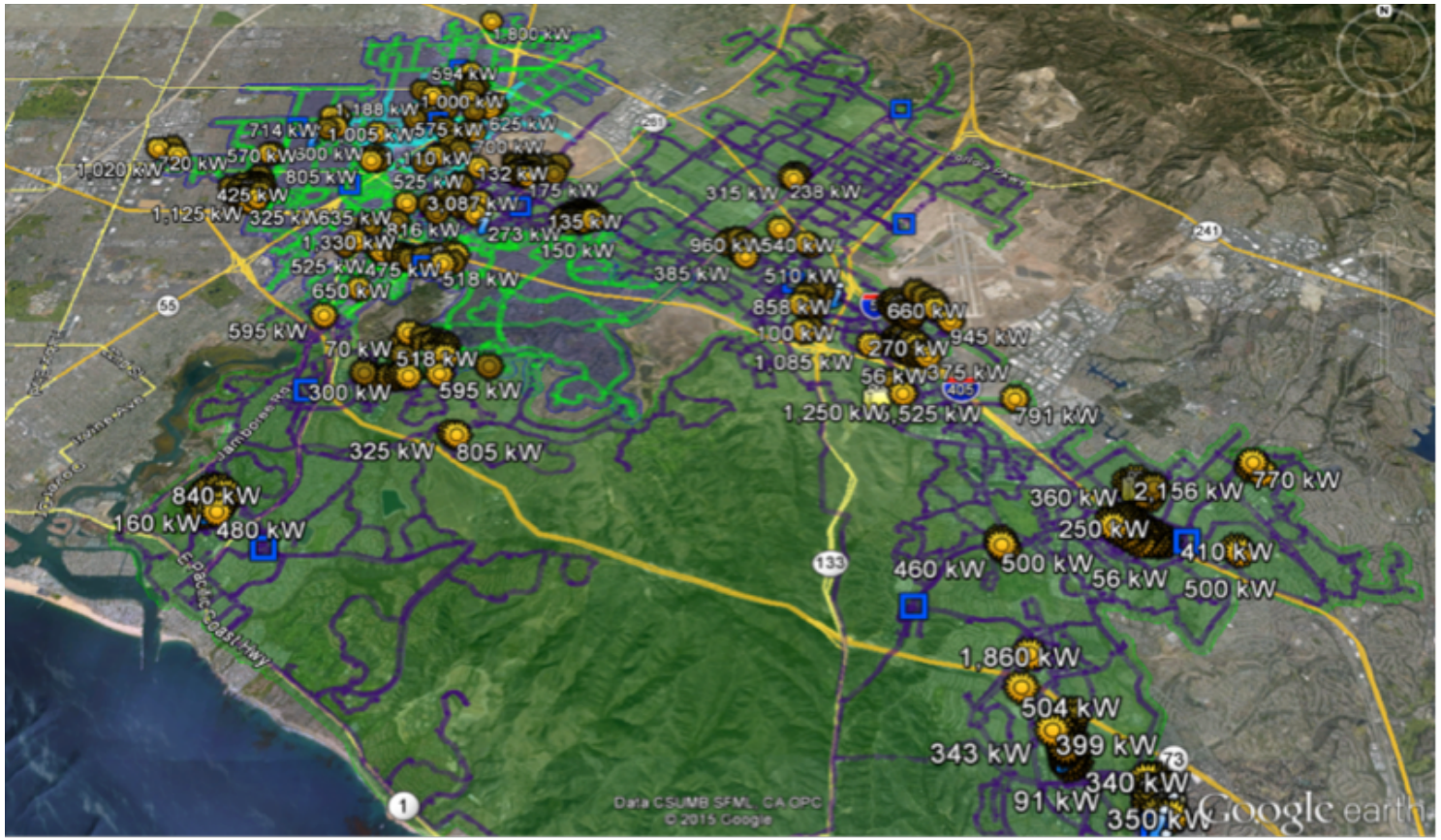
Step 3: Local Clean Energy Survey

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



Community Microgrid design steps

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Step 4: DER Optimization

The DER Wheel of Fortune! Unlocking optimal and most cost-effective DER portfolios.

More reliable, cost-predictable, cleaner

Local Market Value – e.g. Rates

Optimal feeder locations

Derived In combination with the other optimizations

Optimal DER Portfolio

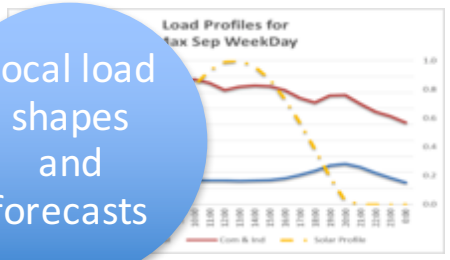
Locally connected feeders

Helps achieve local balance

Also extends to system-wide avoided costs

Local avoided grid upgrades

Local load shapes and forecasts



Unlocks optimal customers and DER

DER Optimization: advanced inverters

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

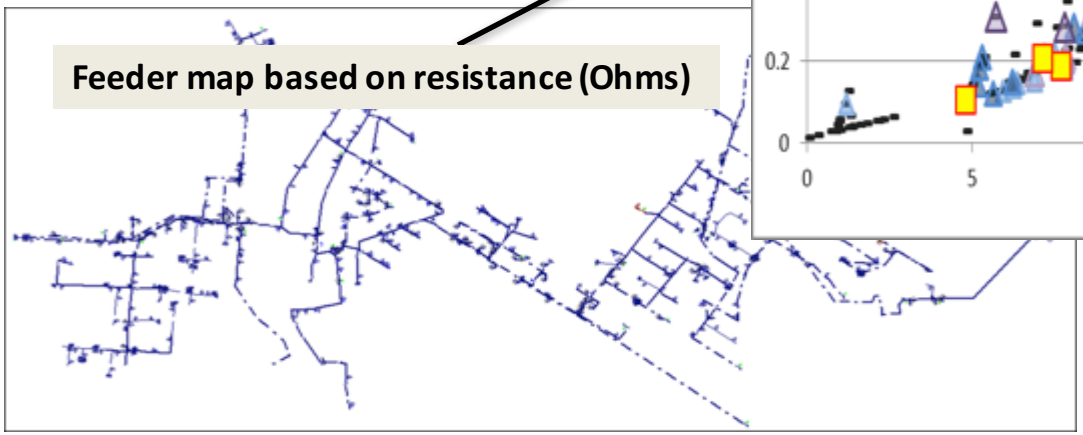
Local Balancing optimizations

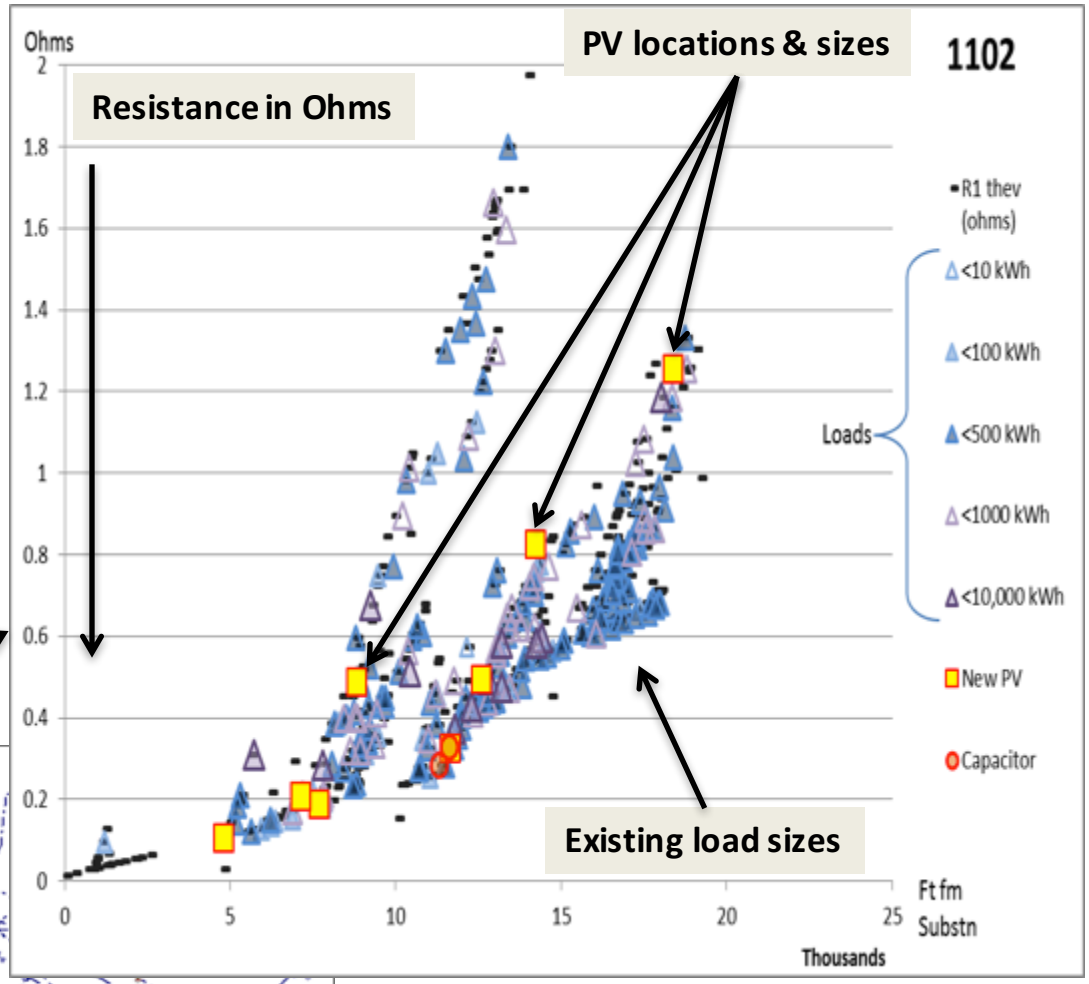
Optimal locations for PV, to help reduce daytime peaks across the system:

1. Matching load types: e.g. higher loads during daytime means better match for PV

2. Robust feeder locations: less resistance (lower Ohms) means more capacity for local generation

3. Avoided costs: service transformers, etc.





Source: The Clean Coalition's Hunters Point Community Microgrid Project

Local Balancing optimizations

Clean Coalition

Opportunity:
Vastly Untapped Commercial & Industrial Energy Assets

The formula for low carbon cities:

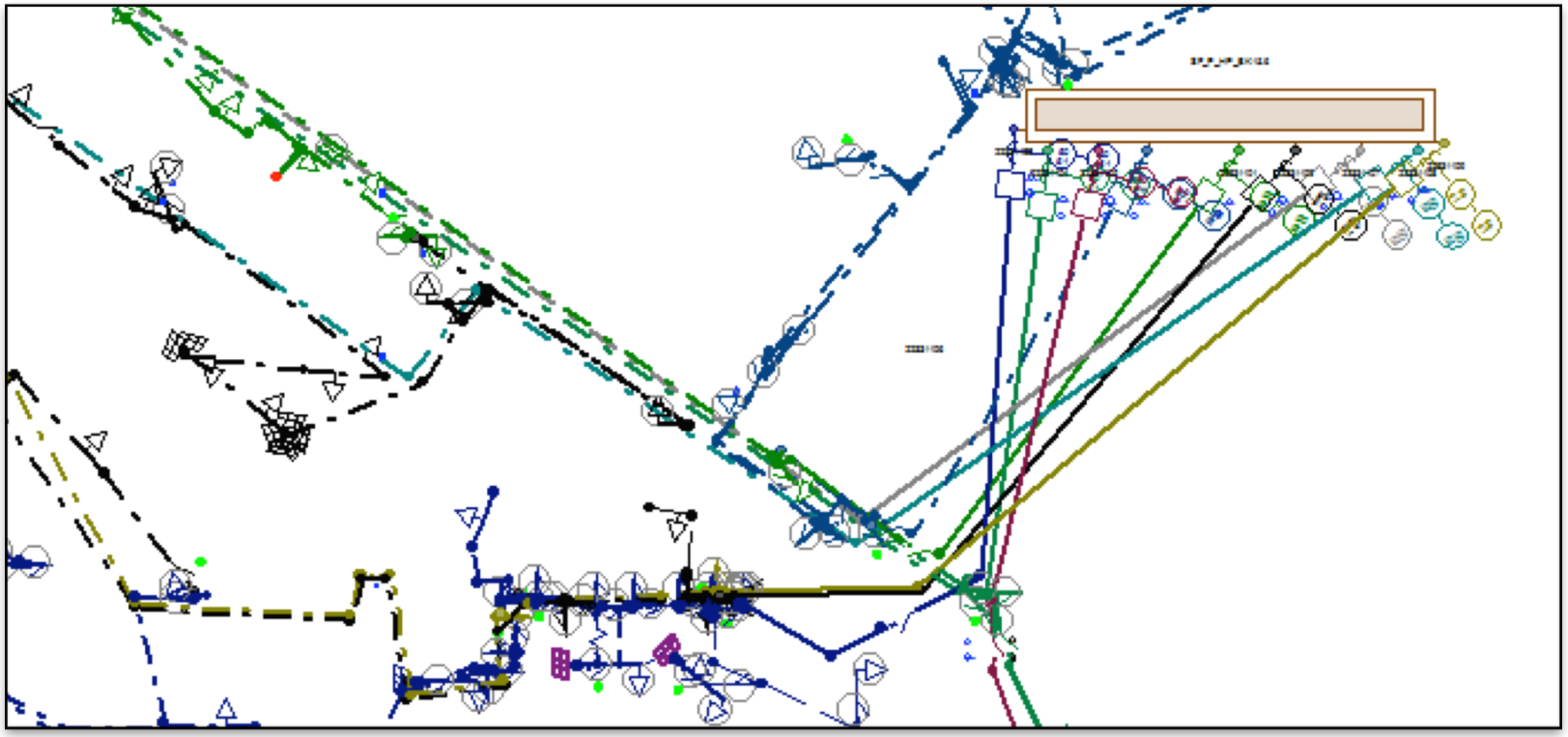
Example: solar on 25% of C&I rooftops = 25%+ local annual energy use

- ✓ Largest financial opportunity – largest DER systems
- ✓ Largest rooftops & parking lots – most generation
- ✓ Largest daytime loads – matching solar
- ✓ Largest utility bills incl. demand charges – motivated
- ✓ Best solution for grid – system peak reduction, strong feeders
- ✓ Most carbon emissions within cities

Local Balancing optimizations

Connected feeders enables substation-wide optimizations and balancing across a substation, such as:

1. "Crossfeeding," e.g. over-generation on certain feeders consumed by load on other feeders within the substation area
2. Optimizing DER such as storage and demand response across the substation feeders
3. Optimizing settings, e.g. load tap changers, across the substation feeders



Community Microgrid design steps

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Step 5: Benefits Analysis

Hunters Point Example – 50 MW PV over 20 yrs.

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

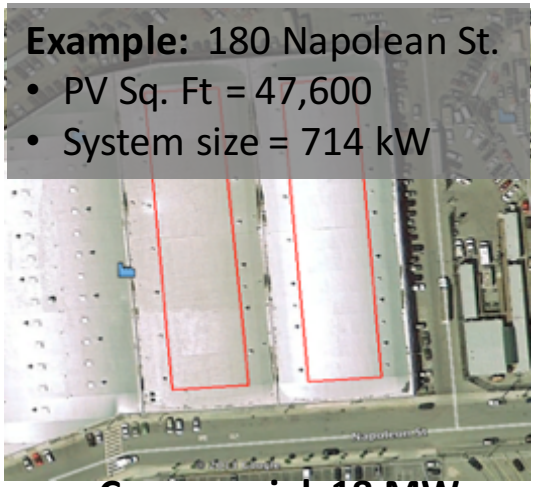
$10M: Site leasing income

Environmental

78M lbs.: Annual reductions in GHG emissions

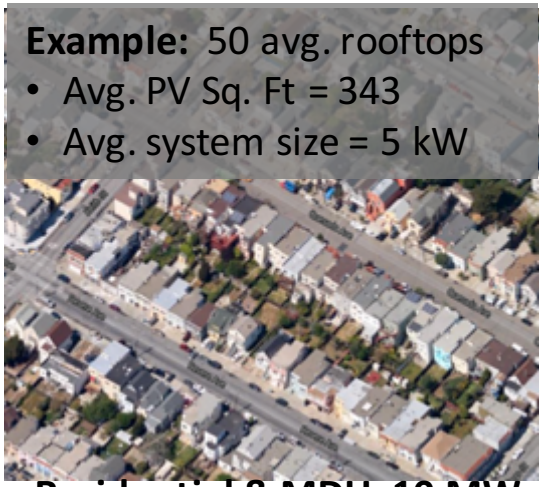
15M Gallons: Annual water savings

375: Acres of land preserved



Commercial: 18 MW

Parking Lots: 2 MW



Residential & MDU: 10 MW

Community Microgrid design steps

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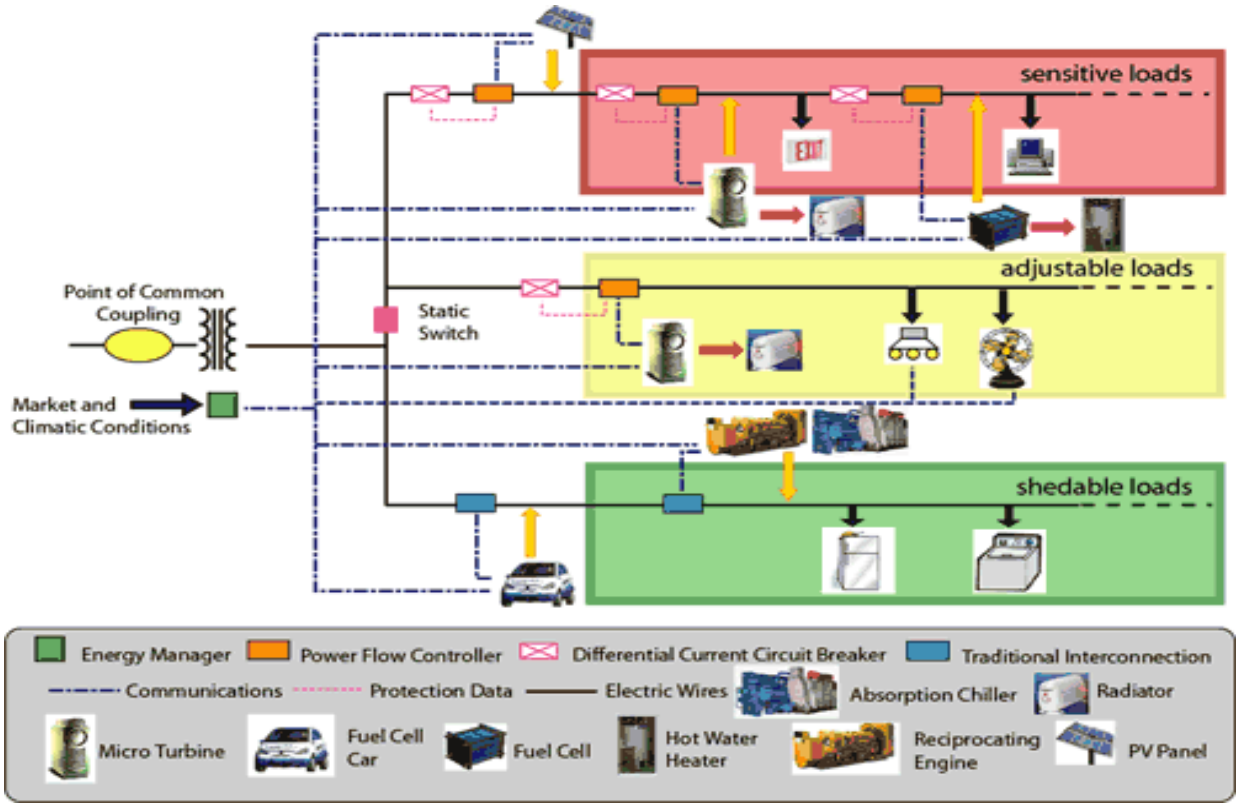
Step 6: Deployment Plan

Final system design and operational plan for the Community Microgrid. Includes sizing for energy storage based on local generation, overall loads, and critical load requirements. Also includes targeted EE, load shifting, EV charging, etc. Features financial model and streamlined/bulk deployment plan.



Example: New York

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New York State uses peak power only 100 hours each year – costing ratepayers $1.7 billion to serve less than 1% of the system's needs.

- In response, on Jan 2, 2018 Gov. Andrew Cuomo announced that the state is launching an initiative to **deploy 1,500 MW of energy storage** by 2025.
- Includes utility **procurements**, changes in utility **rates** and wholesale energy **markets**, and storage for large scale **renewable** procurements
- The Marcus Garvey affordable housing complex in Brooklyn, NY uses a new solar + storage microgrid system to **cut costs**, improve grid **reliability**, and provide **resilient** backup power
- NY Green Bank to commit **at least $200 million** for storage-related investments

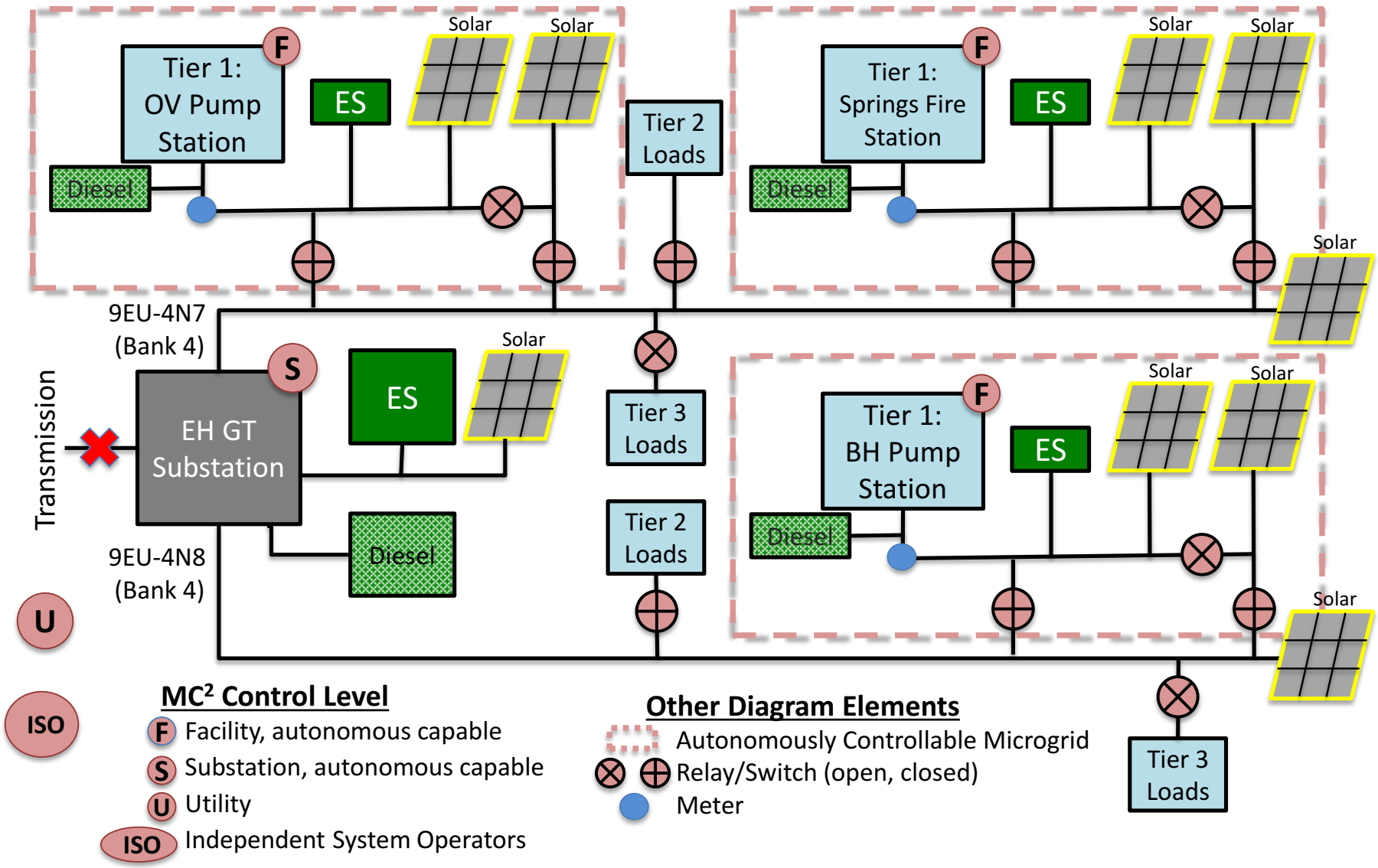
Example: New York

Long Island Community Microgrid Design

- The LICMP would **avoid $29-38 Million** of new transmission capacity resulting in a net cost benefit for all ratepayers.
- The combined Solar + Storage system would also **reduce NYISO capacity charges by $6 Million** through 2022, and at a rate exceeding $1 Million annually thereafter.
- The system would also shift wholesale power purchases from peak to off peak periods, realizing **net energy savings of $2.5 Million** by 2022 and more than $500,000 annually thereafter.
- Resiliency savings from avoided outages would **exceed $330,000** per outage day
- These savings would be reflected in **lower electric rates** for all PSEG-LI utility customers.

Long Island Community Microgrid Design

Clean Coalition



Example: California

Setting a precedent: Community Microgrids eliminate gas peakers

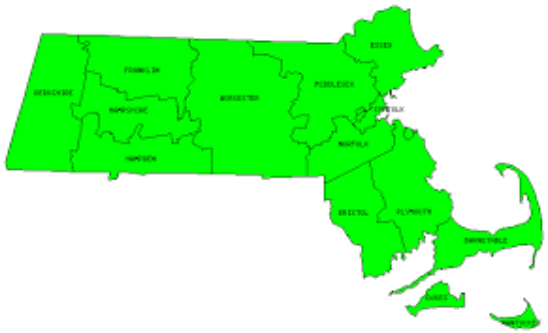
- Thanks in part to Clean Coalition cost analysis, the California Public Utility Commission is now rejecting new peaker plants, such as Puente in Oxnard, CA, in favor of solar + storage
- As part of this substantial change, in Jan 2018 the CPUC also announced that PG&E will be required to use renewables and storage instead of gas-fired plants run by Calpine
- This appears to be "the first time a utility will procure energy storage to replace existing gas plants for local capacity needs."
- Leveraging this important analysis can prevent future new gas plants across the country

Source: https://www.greentechmedia.com/articles/read/pge-must-solicit-energy-storage-ders-to-replace-three-existing-gas-plants?utm_source=Daily&utm_medium=email&utm_campaign=GTMDaily#gs.biWkmDY

Example: Massachusetts

Similarly, Massachusetts has announced a new model for community-scale energy systems called SMART (Solar Massachusetts Renewable Target).

- **Fully compensates solar PV** for the total output of a system rather than relying on net metering, which only accounts for net bill savings
- Thus, a large warehouse roof or shopping center parking lot can be **fully compensated** for all the solar generated on that site, regardless of the amount of electricity used onsite
- As an example specific to the Commercial & Industrial sector, 250kW – 1,000kW solar systems would receive an **incentives** of $0.16 - $0.18/kWh over a term of 20 years.
- This method is commonly referred to as a **Feed-In-Tariff** – or **CLEAN** program – and has been deployed successfully in other locations such as Germany to deploy more local clean energy systems.



Source: http://www.qatargreenleaders.com/news/sustainability-news/1668-unlocking-the-distributed-grid-with-flexibility-management-software

Example: Vermont

Clean Coalition

Vermont utility Green Mountain Power now pays customers a little over $30 per month to utilize their battery systems as a load-offsetting capacity resource.

- Makes investments in battery-based backup systems **more attractive** for customers.
- For Green Mountain Power, access to the batteries helps address the **steep transmission access charge** assessed by ISO New England. That charge **more than doubled** from $3 per kilowatt per month in 2016 to over $7 in 2017. The charge is **expected to increase** to over $9 in 2018.
- And, as more solar is installed on the distribution grid, **access to that local solar** at times when electricity from transmission is the most expensive is a **grid benefit** that can **save a utility money**.

GREEN MOUNTAIN POWER

Source: http://www.qatargreenleaders.com/news/sustainability-news/1668-unlocking-the-distributed-grid-with-flexibility-management-software

Example: Connecticut

A new group of microgrids has been proposed to help support Connecticut's critical facilities in the event of emergencies

- Funding opportunities under the state's Department of Energy and Environmental Protection (DEEP) **microgrid program**
- New focus on the growing movement to provide **resilient power** to essential buildings during emergency situations
- Includes a proposal for Westbrook, CT middle school and high schools, which have recently been designated as **emergency/evacuation shelter** and support areas
- Another proposal for Coventry, CT would island a circuit loop for **nine critical facilities** in the town, including schools, a communication tower, and a senior care center

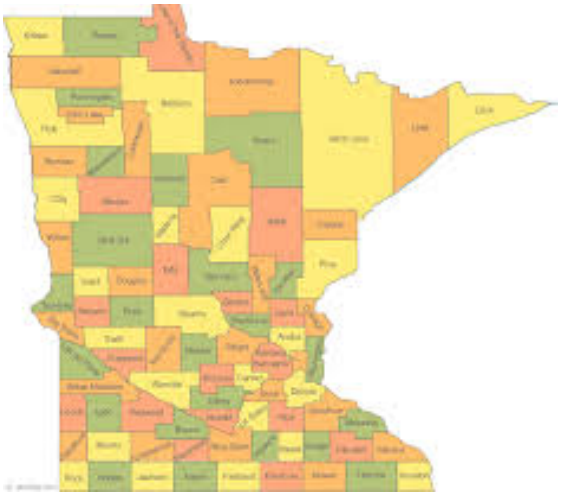
Connecticut Department of ENERGY & ENVIRONMENTAL PROTECTION

Source: http://www.renewableenergyworld.com/articles/2018/01/this-is-what-microgrids-for-resilience-in-emergencies-look-like.html

Example: Minnesota

Largest Community Solar program in the country; helping double the solar generation across the state.

- More than **doubled** the community **solar capacity** in 2017, now to **211 megawatts in operation** today, demonstrating the awareness and accelerating success
- Provides monthly bill credits to those who subscribe. **Any customer** can participate.
- Beginning to offer **predictability** and **transparency** due to a mature process and the experience and hard work from all stakeholders
- The need for **grid transparency** has been heard by the commission and Xcel Energy, the utility. The most effective program strides have been made in **access to interconnection** information.



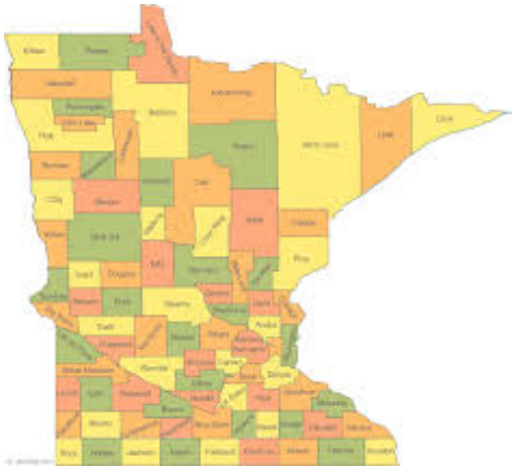
Is Community Storage next? Yes – Community Microgrids…

source: https://www.greentechmedia.com/articles/read/xcel-energy-community-solar-program-turns-three#gs.rPWCafg

Example: Minnesota

This program has been transformative to the Minnesota energy market.

- Starting point for a **major overhaul** of the state interconnection standards
- Brought about city and county **solar ordinances** and **permitting advancements**, thereby **reducing costs**
- Encouraged customers to think about their energy mix and ask for better options from their utilities
- Giving customers the option of subscribing to clean, local energy has been **incredibly popular** – with individuals and organizations
- One pilot project will pair **energy-efficiency improvements** with **community solar**, and there is now a push for this model to be **expanded** across Xcel's service territory



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Homes & buildings are grid partners

Clean Coalition

Ann V Edminster
DESIGN AVEnues LLC

Well-designed and well-situated ZNE homes
are a valuable part of the DER resource mix in combination with larger PV arrays on commercial & industrial structures

Homes & buildings are grid partners

Clean Coalition

Ann V Edminster
DESIGN AVEnues LLC

Residential PV arrays in a community microgrid

can be sized for optimum contribution and fair compensation to owners regardless of their site-specific demand through a CCA + PPA approach

Moving Forward: Puerto Rico

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Puerto Rico Re-build Highlights – the "Build Back Better" Plan

Puerto Rico is a unique opportunity to rebuild and update the power system to 21st century technologies and best practices, enabling the rethinking of how power is generated and distributed.

- Hurricanes Maria and Irma decimated T&D lines across the island and caused widespread wind and flooding damage to substations, generation, and distribution facilities
- Damage from the hurricanes resulted in the longest duration power outage in US history

Moving Forward: Puerto Rico

Clean Coalition

Puerto Rico Re-build Highlights – the "Build Back Better" Plan

- **Team**: Features major grid and energy experts including: NY Power Authority, Con Ed, Edison International, EPRI, PSE&G Long Island, DOE, SEPA, Puerto Rico Electric Power Authority, Navigant Consulting, NREL, PNNL, Grid Modernization Lab Consortium
- **Goal**: Implement resiliency and hardening measures that are designed to increase the capability of Puerto Rico's electric power grid to withstand future storms
- **Recommendation**: use modern grid technologies and control systems, renewable energy resources, and new technologies such as energy storage and microgrids to enable energy to become abundant, affordable, resilient, and sustainable. Ensures continuity of service while lowering PREPA's dependence on large central generating stations.

New York Power Authority

EDISON INTERNATIONAL

conEdison

U.S. DEPARTMENT OF ENERGY

EPRI ELECTRIC POWER RESEARCH INSTITUTE

NREL NATIONAL RENEWABLE ENERGY LABORATORY

This modern power system design will set a model for the industry while promoting private investments in the use of clean energy for a low carbon future

Sonoma Community Microgrid Initiative

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Objective: make energy abundant, affordable, resilient, and sustainable

1) **Re-build fire-destroyed areas with high levels of resilience and sustainability** in both the building stock and the grid, enabling a modern, distributed, and carbon free system that delivers substantial economic, environmental, and resilience benefits.

2) **Establish a blueprint for re-building disaster-destroyed areas** in a timely and cost-effective manner that also maximizes the economic and resilience value of energy as a critical resource to ratepayers, property owners, and municipalities.

3) **Provide a model for operating a modern distribution grid** covering an entire substation area that incorporates optimal distributed energy resources, cost-effective local balancing, full interaction with the transmission system, and local energy markets – with resulting benefits across both grid operations and economics.

4) **Ensure that building codes are advanced** to achieve more resilient, safer, and cleaner building stock and communities.

Moving Forward: Sonoma Initiative

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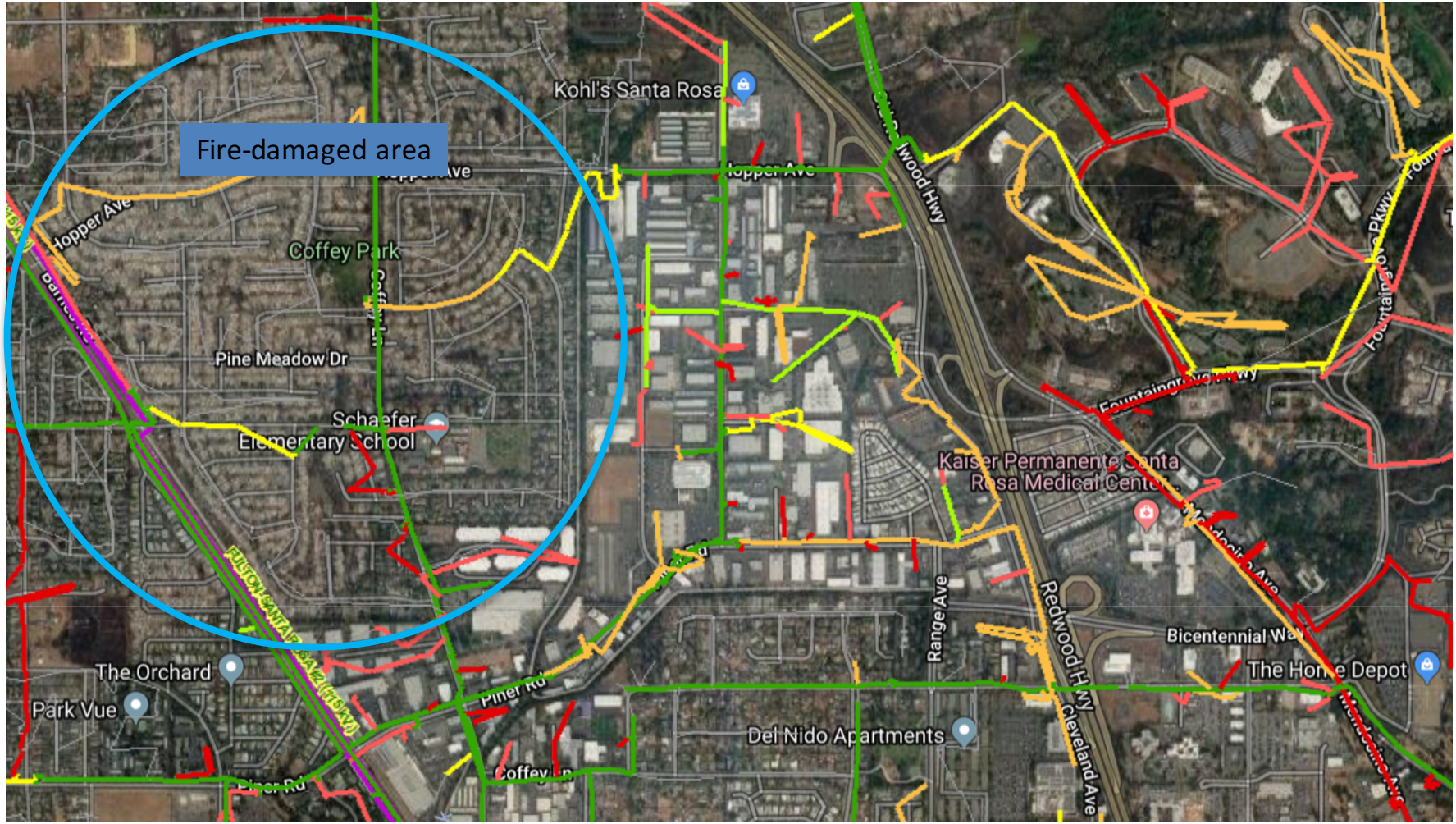
Area 1: Coffey Park and the Bicentennial Corridor – ideal for Community Microgrid



Moving Forward: Sonoma Initiative

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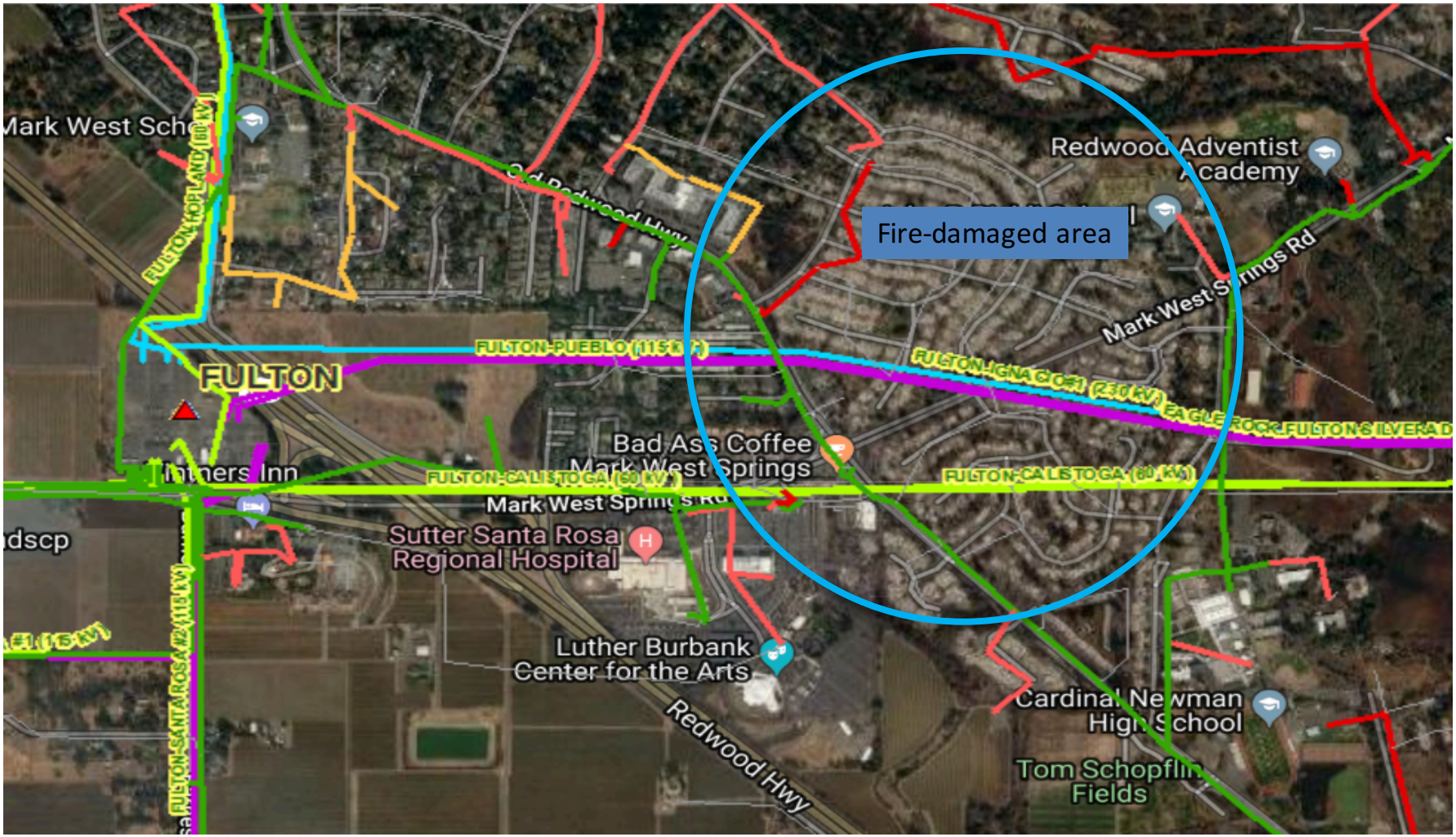
Area 2: Larkfield and the Old Redwood Highway Corridor – ideal for Community Microgrid



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Key Locations: Critical, Priority, Large Roofs & Parking, etc.

Area 1 – Coffey Park and the Bicentennial Corridor

- Kaiser Permanente Santa Rosa Medical Center
- Kaiser Permanente Santa Rosa Hearing Center
- Sonoma County Sheriff's Office
- Superior Court of California
- Sonoma County Clerk Recorder
- Sutter Urgent Care
- Security Public Storage
- Schaefer Elementary School
- Solstice Senior Living Center
- And dozens of Commercial & Industrial roof and parking lot locations including Vertex Climbing Center, Trader Joe's, Epicenter, Walgreens, Pepsi Bottling Group, etc.

Key Locations: Critical, Priority, Large Roofs & Parking, etc.

Area 2 – Larkfield and the Old Redwood Highway Corridor

- Sutter Santa Rosa Regional Hospital
- Mark West School
- Molsberry Markets
- Larkfield Shopping Center
- John B Riebli School
- Luther Burbank Center for the Arts
- Cardinal Newman High School
- St. Rose School

Sonoma Initiative Core Team

- Clean Coalition
- Sonoma Clean Power
- PG&E
- CAISO
- Rebuild North Bay
- Center for Climate Protection
- County of Sonoma, Energy & Sustainability Division
- Regional Climate Protection Authority
- Design Avenues -- EE/ZNE expert

Advanced Energy Rebuild for Homes

Led by Sonoma Clean Power with PG&E support:

Option 1:

- 20% above code requirements including high performance walls or attics and advanced windows
- WaterSense efficient plumbing
- Water efficient landscaping
- 220V outlet at stove/range and clothes dryer
- EV charging station (equipment free from SCP)
- Desired target, per SCP: $10,000

In addition, a homeowner can choose to add solar to either Option

- Solar panels or solar subscription via PG&E/SCP "all green" option
- Desired target per SCP: $20,000

Advanced Energy Rebuild for Homes

Led by Sonoma Clean Power with PG&E support:

Option 2: Bundle 1 plus -

- Higher performance walls and attics
- "Cool" roof
- Verified enclosure sealing
- Electric heat pump hot water heater
- Smart thermostat
- Compact plumbing design
- Induction cooking
- Electric or heat pump clothes dryer
- Desired target per SCP: $15,000

In addition, a homeowner can choose to add solar to either Option

- Solar panels or solar subscription via PG&E/SCP "all green" option
- Desired target per SCP: $20,000