Clean Coalition
Making Clean Local Energy Accessible Now

Community Microgrids: The Path to Resilience & Sustainability

Greg Thomson
Director, Community Microgrid Initiative
Clean Coalition
415-845-3872 mobile
greg@clean-coalition.org

Community Microgrids: The Path to Resiliency

Clean Coalition

Greg Thomson
Director, Community Microgrid Initiative
415-845-3872 mobile greg@clean-coalition.org

Analysis & Planning	Grid Modeling & Optimization	Program Design	Community Microgrid Projects

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

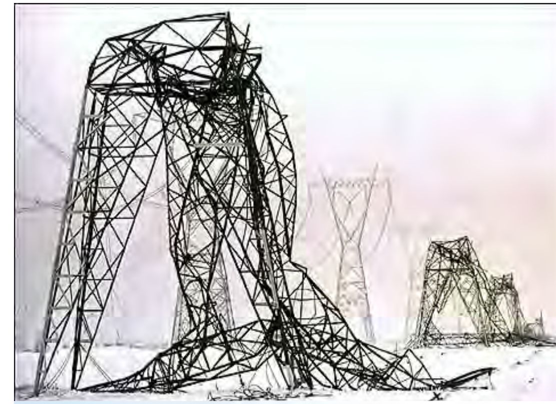
Clean Coalition

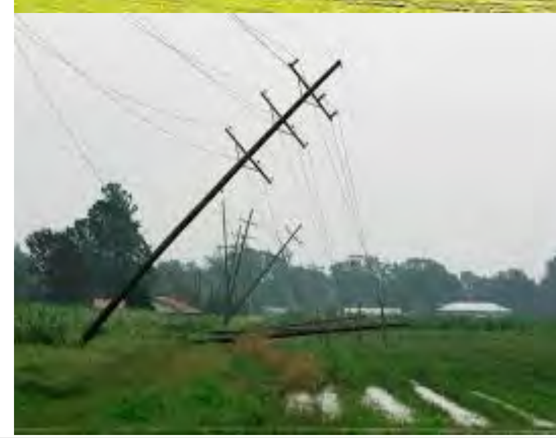
Energy is critical infrastructure.

And yet, our legacy, centralized energy architecture carries multiple <u>critical</u> <u>risks</u>.

- 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?

Clean Coalition

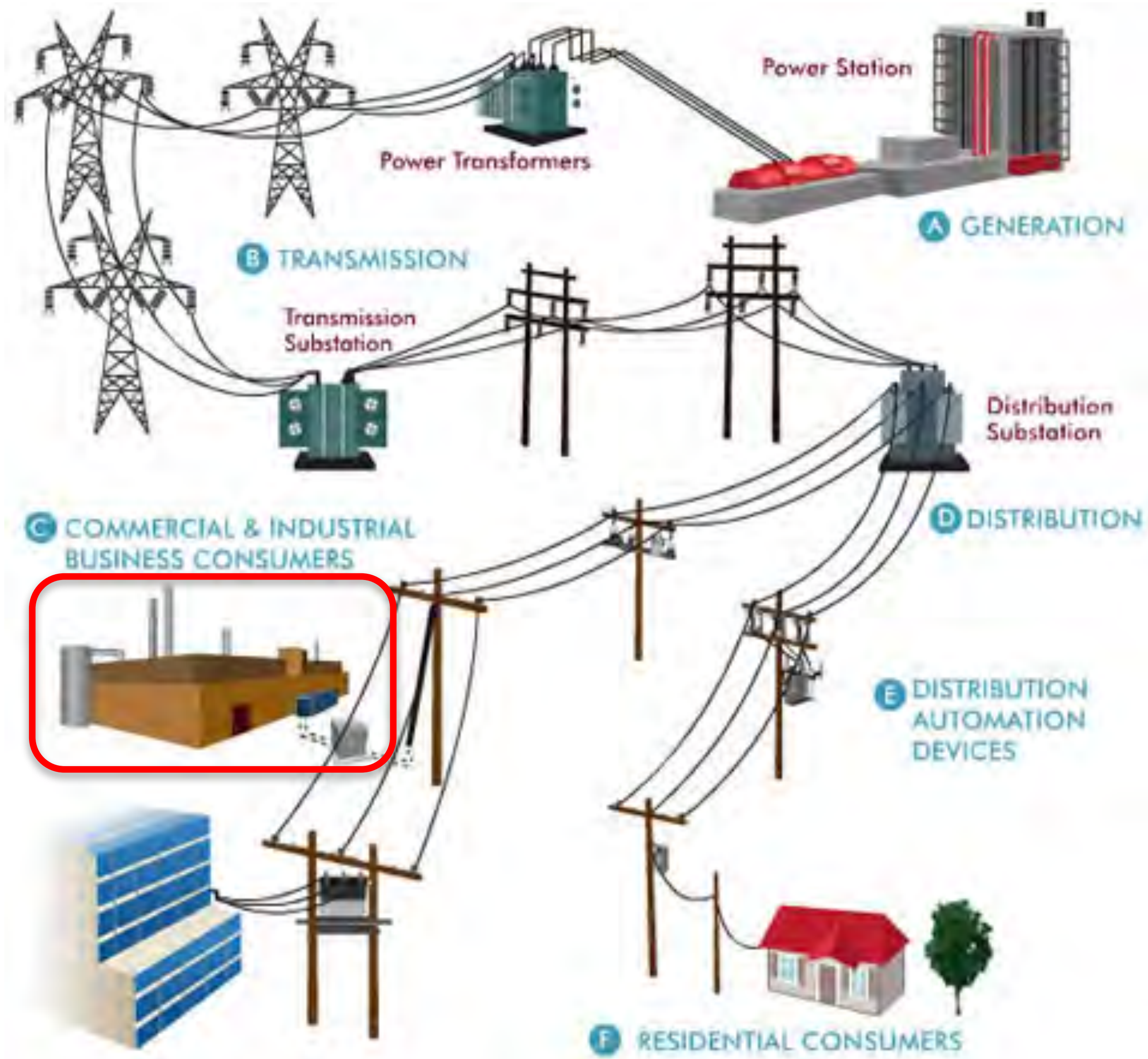
A Community Microgrid delivers four combined benefits to communities.

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

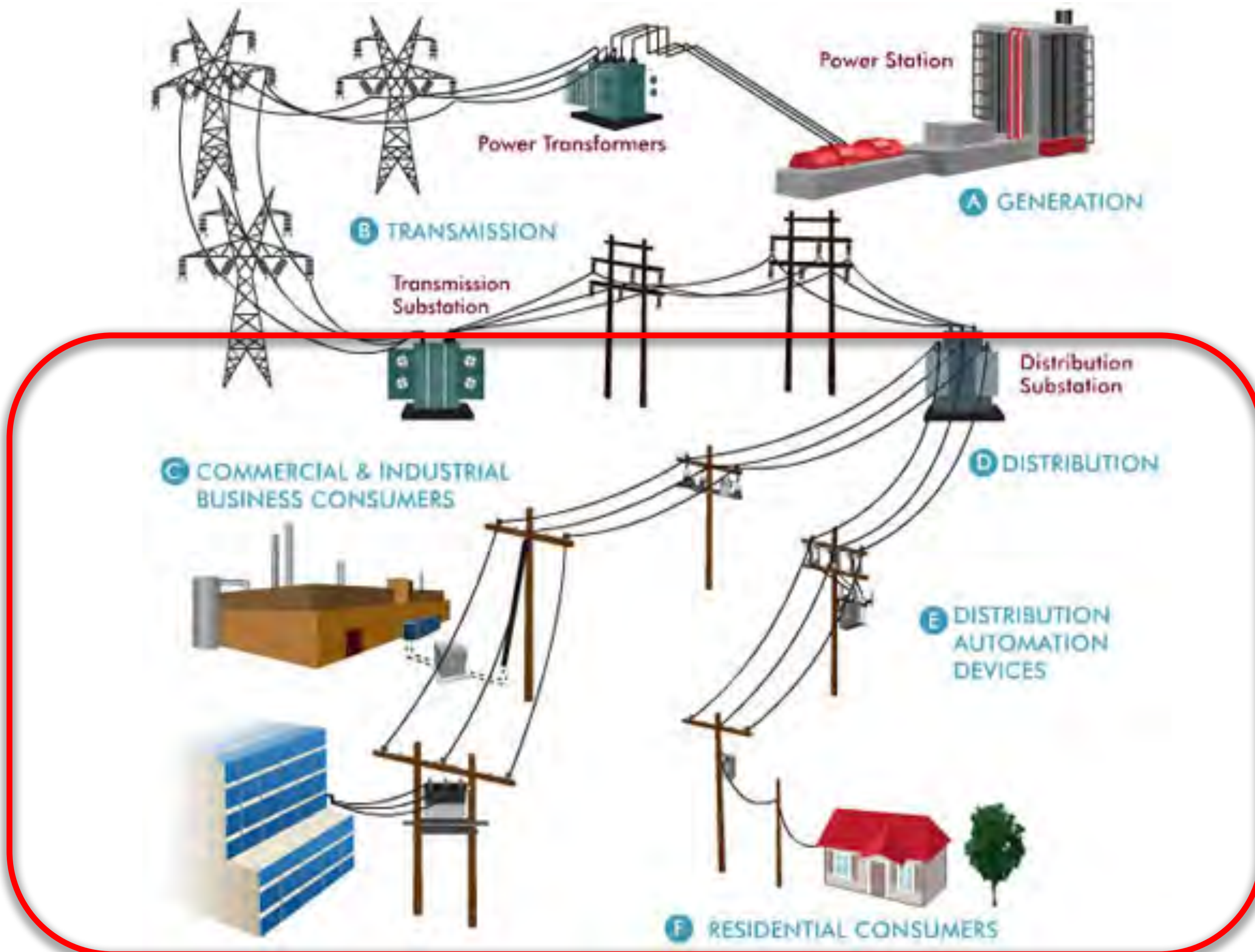
Traditional Microgrids focus on single customers

Clean Coalition



Source: Oncor Electric Delivery Company

Community Microgrids serve thousands of customers



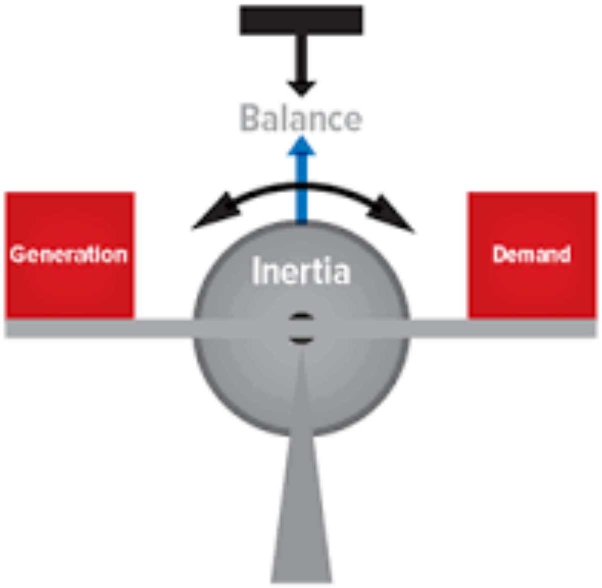
Source: Oncor Electric Delivery Company

Community Microgrids feature "Local Balancing"

Clean Coalition

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

Clean Coalition

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

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

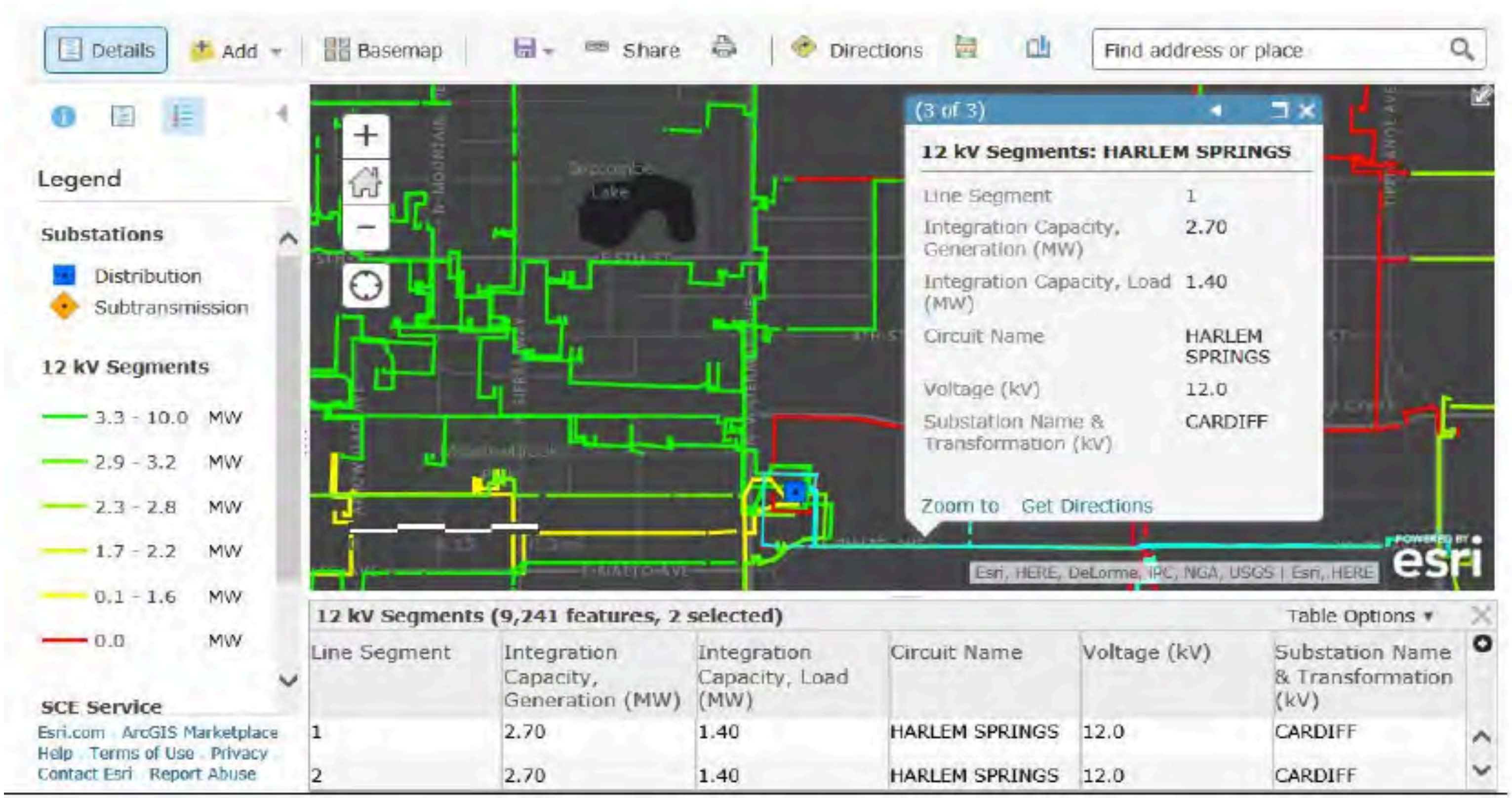
3. **Modernize grid operations** to support and automate the above, helping enable utilities to take a much-needed step forward

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

Clean Coalition

Step 2: Baseline Grid Analysis

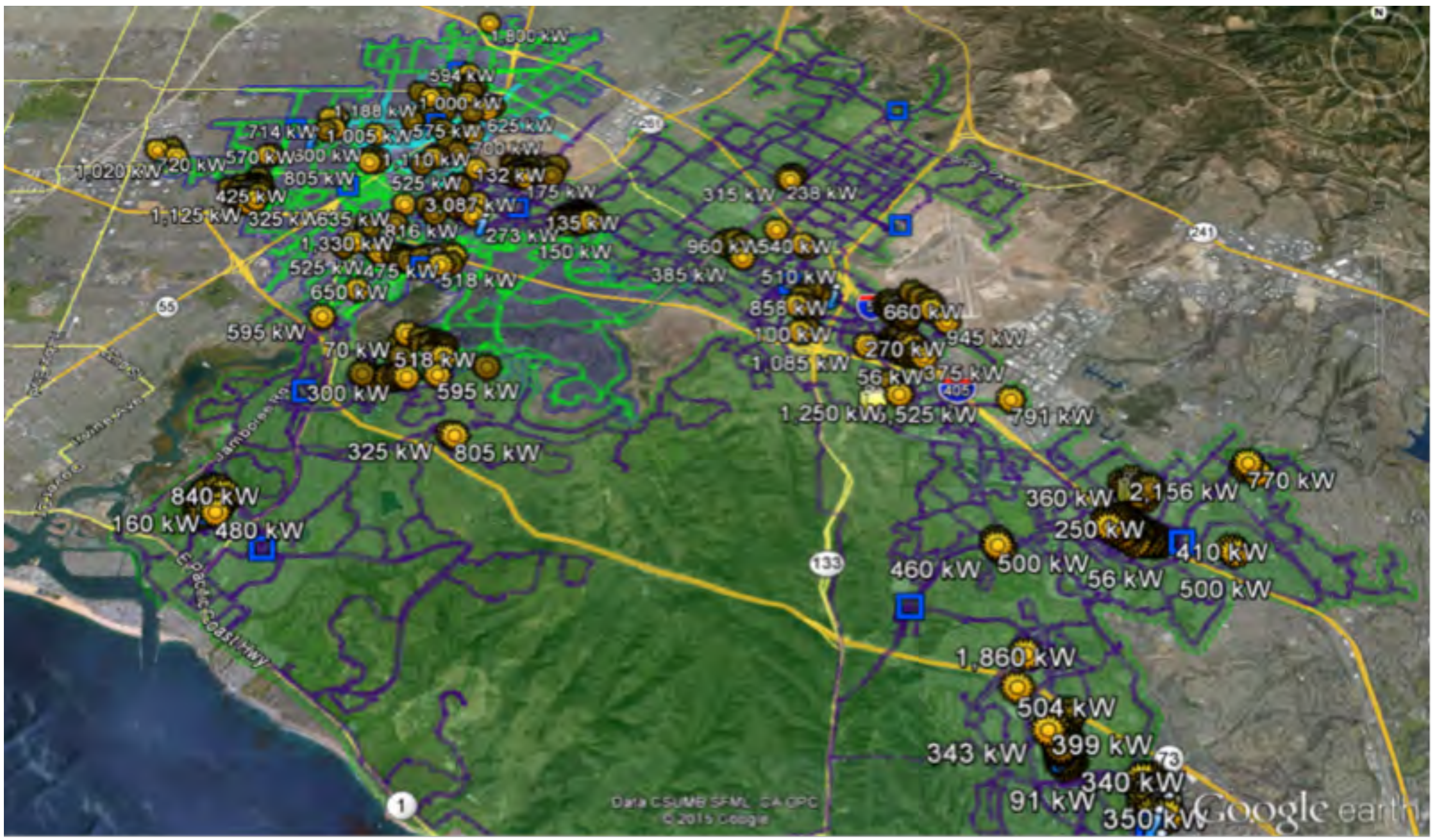
Determine the ability of the grid to accommodate new DER: Inventory of the existing grid including load profiles, voltage regulation, feeder and transformer capacities, and existing generation



Clean Coalition

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

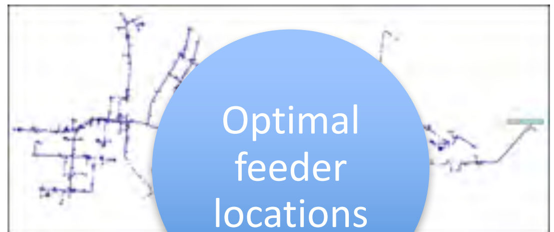
Clean Coalition

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

Locally connected feeders

Helps achieve local balance

Optimal DER Portfolio

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

Clean Coalition

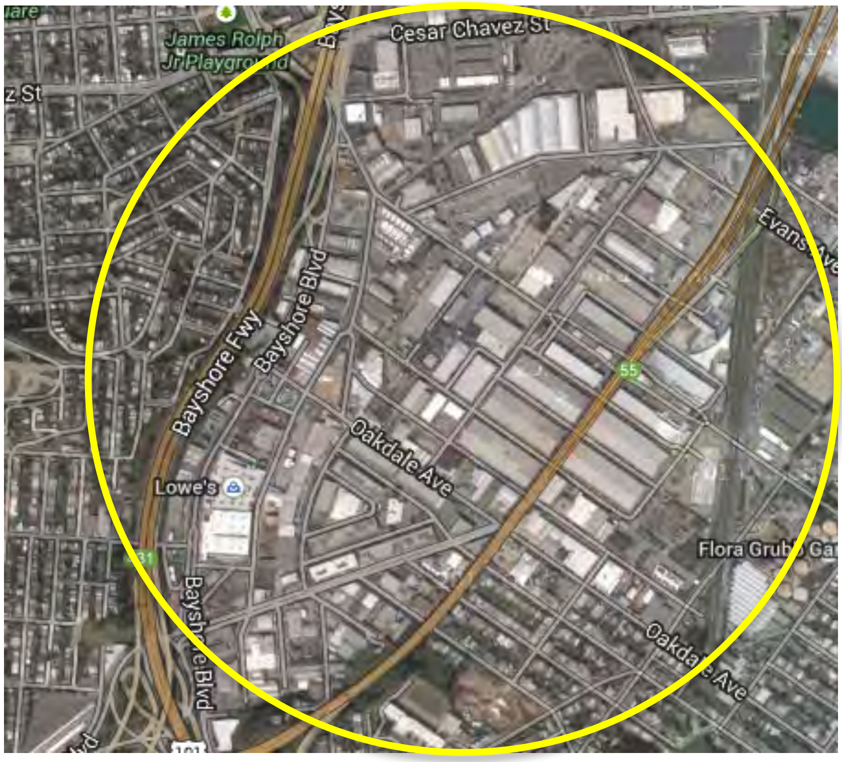
1. 6AM:
   - No PV impact
2. Noon:
   - 20MW PV causes overvoltage
3. Noon:
   - 20MW PV with advanced inverters set at 0.9 power factor stabilizes voltage

DER Optimization: Commercial & Industrial (C&I)

Clean Coalition

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 roof & parking spaces generate more energy
2. **Lowest System Costs:** Larger PV 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 roof and parking lease opportunities



Community Microgrid design steps

Clean Coalition

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

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

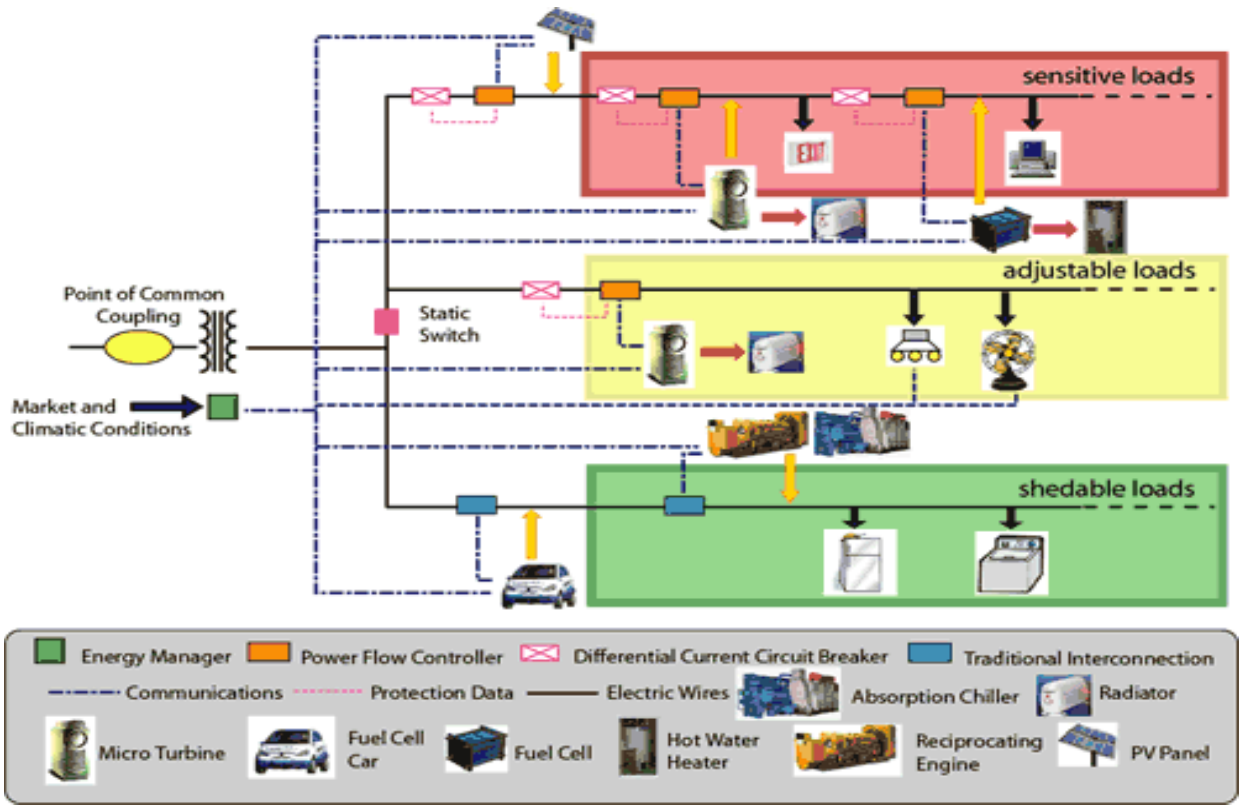
Example: 50 avg. rooftops
- Avg. PV Sq. Ft = 343
- Avg. system size = 5 kW

Residential & MDU: 10 MW

Clean Coalition

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.



Examples: New York – inefficiencies

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

- The bulk power system, designed to meet a peak demand 75 percent higher than most of America, is **underutilized most of the day**
- New Yorkers have been paying some of the **highest electrical bills** in the nation, so that their air conditioners can have power during the hottest summer days
- New York's **antiquated infrastructure** was in trouble long before hurricane Sandy
- Hurricane Sandy revealed the **vulnerabilities** of the low-lying Atlantic state's grid

Source: Renewable Energy World.com, June 2015

Examples: NY – new initiative

Clean Coalition

On Jan 2, 2018, New York Gov. Andrew Cuomo announced that the state is launching an initiative to deploy 1,500 MW of energy storage by 2025.

- State energy agencies and authorities will generate a **pipeline of storage projects**
- NY Green Bank to **commit at least $200 million** for storage-related investments
- The New York State Energy Research and Development Authority will **invest at least $60M** in storage pilots
- Includes utility procurements, changes in utility rates and wholesale energy markets, and storage for **large scale renewable** procurements

Examples: NY – project

Clean Coalition

The Marcus Garvey affordable housing complex in Brooklyn, NY uses a solar+storage microgrid system to cut costs, improve grid reliability, and provide resilient backup power for tenants

- Leverages the **Brooklyn Queens Demand Management** program, a commission-approved $200M fund that helps defer a substation upgrade estimated at costing approximately $1.2B
- Also provides a framework for **future, market-based**, "non wires alternatives" such as microgrids

Source: https://www.cleanegroup.org/ceg-projects/resilient-power-project/featured-installations/marcus-garvey-apartments/

Examples: NY – financing

The Marcus Garvey project is financed by the New York City Energy Efficiency Corporation (NYCEEC), a non-profit, specialty finance company for clean energy

- Develops **financing solutions** to enable projects that save energy or reduce greenhouse gases
- Their custom-tailored solutions **close financing gaps** for buildings and clean energy project developers
- Originally focused only on the state of NY, the organization is now looking to **finance projects up and down the East Cost** – from Maryland to Maine

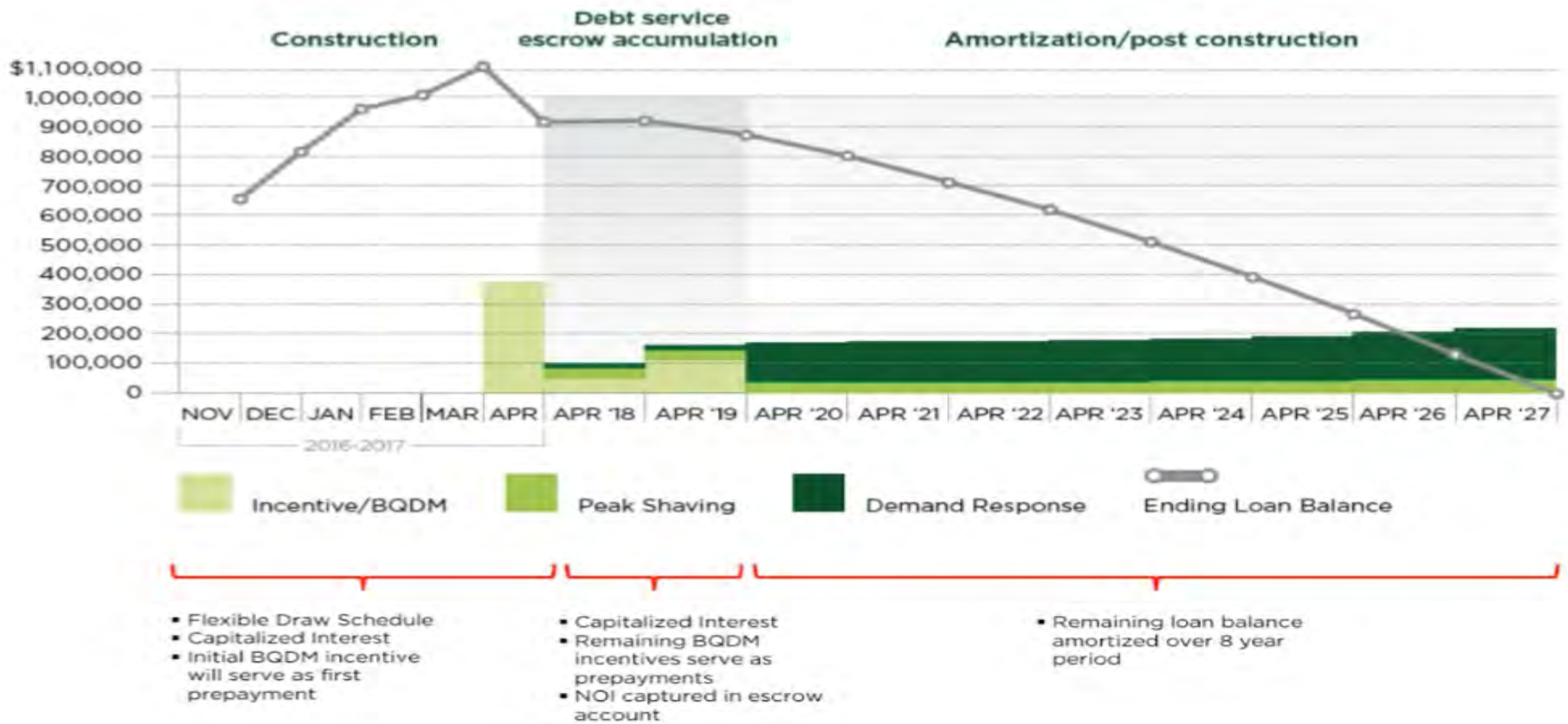
NYCEEC
BUILDING FINANCIAL SOLUTIONS

Source: https://www.cleanegroup.org/ceg-projects/resilient-power-project/featured-installations/marcus-garvey-apartments/

Examples: NY – template

NYCEEC's successful financing at Marcus Garvey serves as a template

- Payoff is in approximately 10.5 years, based on the three revenue streams: BQDM incentives, Peak Shaving, and Demand Response



Source: https://www.cleanegroup.org/ceg-projects/resilient-power-project/featured-installations/marcus-garvey-apartments/

Examples: Long Island Community Microgrid Project

Clean Coalition

"NY Prize" Community Microgrid 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

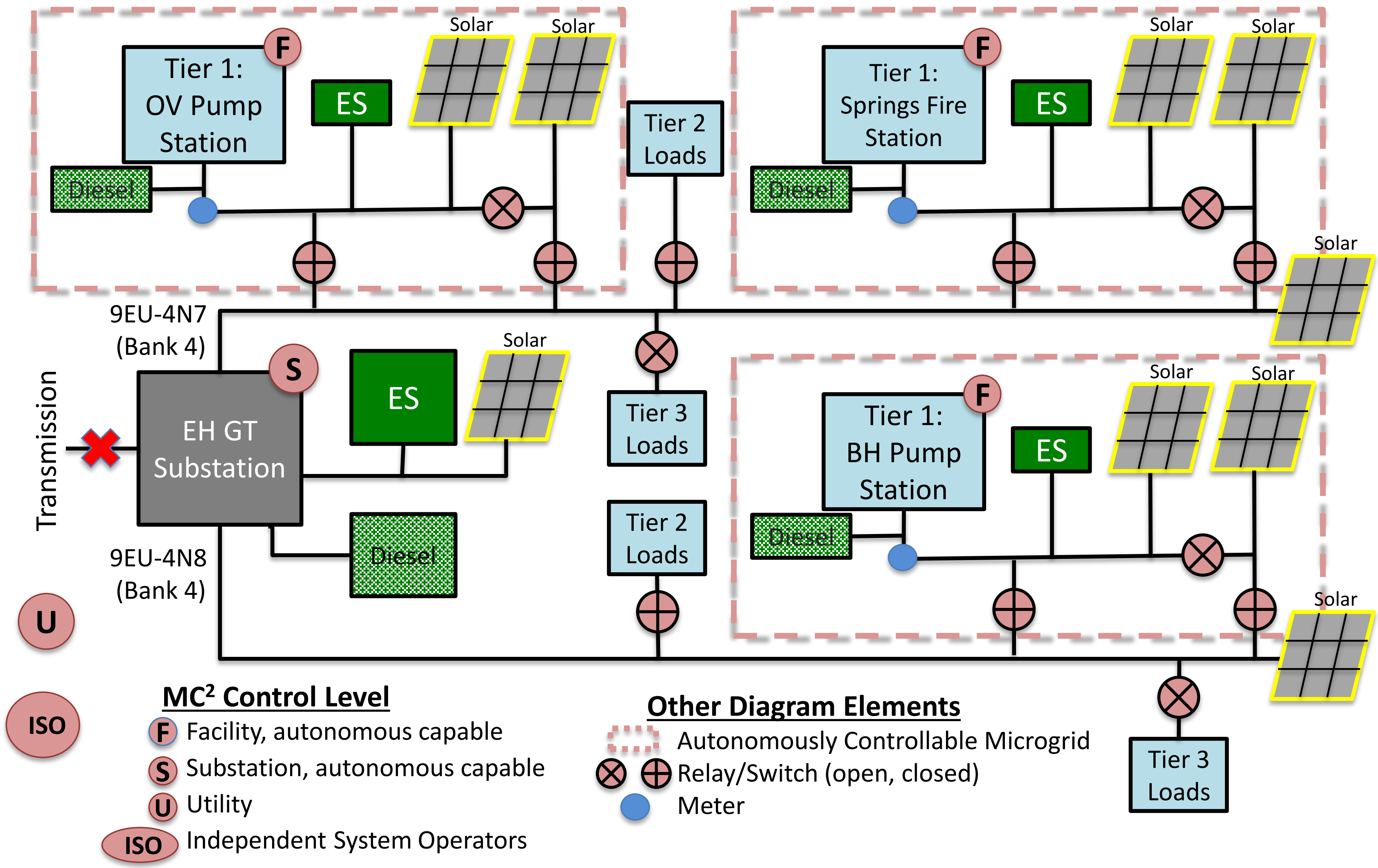
NEW YORK STATE OF OPPORTUNITY. | NYSERDA

PSEG LONG ISLAND
We make things work for you.

LICMP Economic Analysis highlights

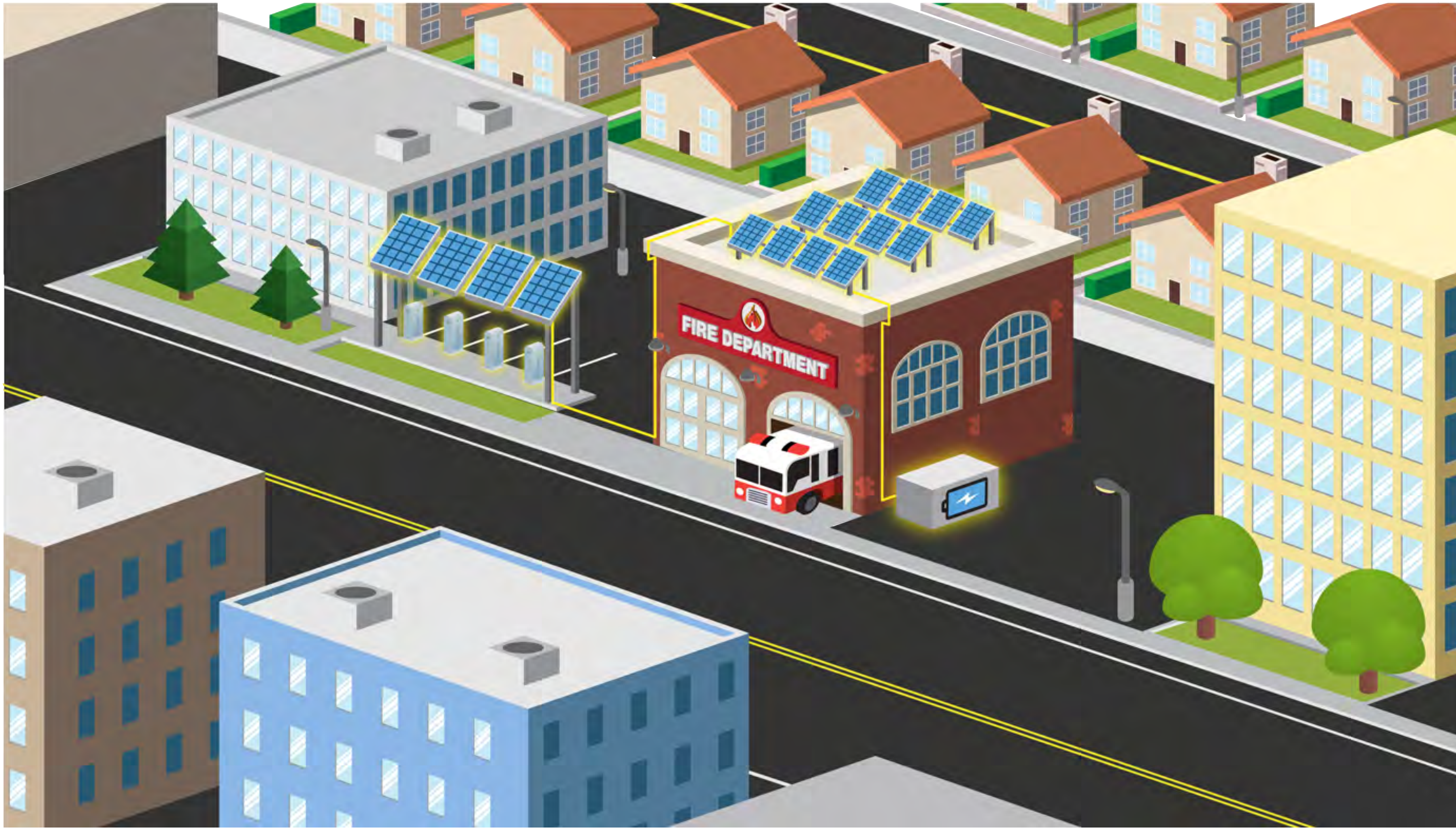
- The LICMP would avoid $29-38 Million of new transmission capacity resulting in a net cost benefit for all PSEG-LI utility ratepayers.
- The local generation capacity provided by the LICMP PV and storage facilities will also reduce NYISO capacity charges by $6 Million through 2022, and at a rate exceeding $1 Million annually thereafter.
- In addition, the energy storage will allow the utility to shift wholesale power purchases from daily peak pricing periods to off peak periods, realizing net savings in energy purchases of $2.5 Million by 2022 and more than $500,000 annually thereafter.
- These savings would be reflected in lower electric rates for all PSEG-LI utility customers.

Long Island Community Microgrid Configuration



Community Microgrids provide resilience

Clean Coalition

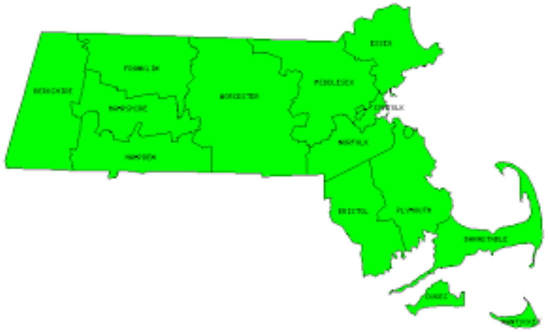


Examples: Massachusetts

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

DOER
Massachusetts Department of Energy Resources

- **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

Examples: Vermont

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**.

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

Examples: 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

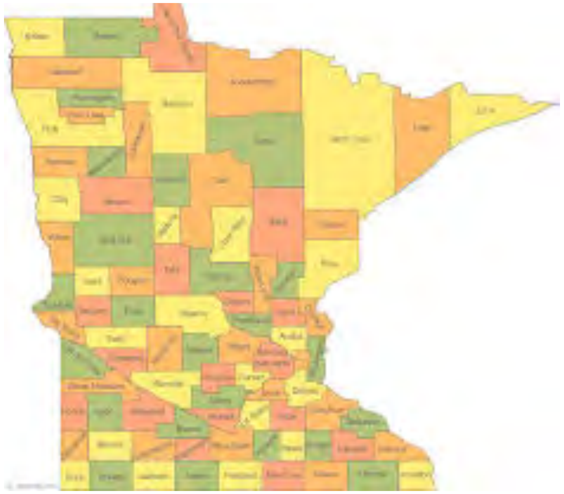
Examples: Minnesota

Clean Coalition

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.

Xcel Energy®



Is Community Storage next? Yes – Community Microgrids…

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

Examples: 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

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

Examples: California

Clean Coalition

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

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

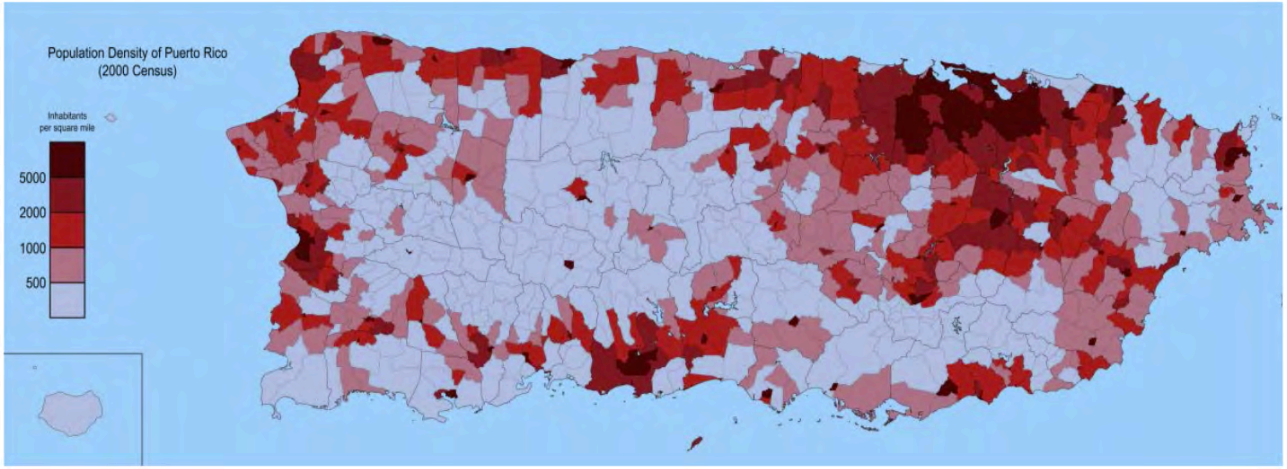
Residential PV arrays in a community microgrid
can be sized for optimum contribution and fair compensation to owners regardless of their site-specific demand through a CCA + PPA approach

Moving Forward: Puerto Rico

Clean Coalition

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.

NewYork 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

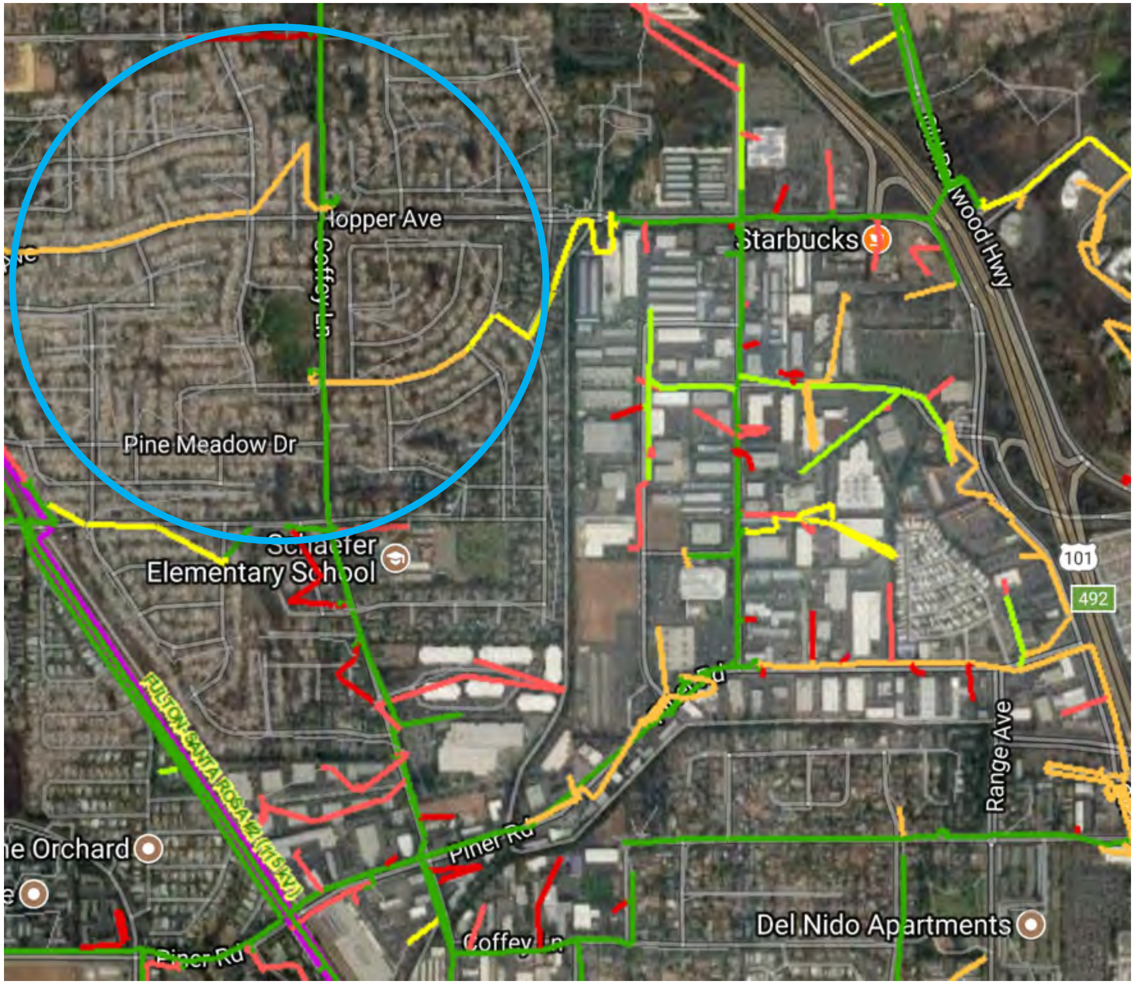
Moving Forward: Sonoma Initiative

Coffey Park area of Santa Rosa – before and after fires

Moving Forward: Sonoma Initiative

PG&E Feeder Map – Coffey Park and adjacent C&I area – ideal for Community Microgrid

Fire-damaged area



Sonoma Community Microgrid Initiative

Clean Coalition

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.