

Nanogrids, Microgrids, and Community Microgrids: Designing for resilience

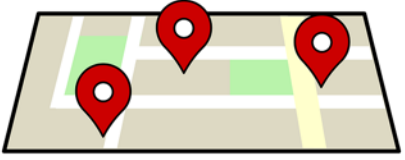


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Analysis & planning

- 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 and policy design

- Grid planning, 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
 - Montecito, CA
 - U.S. Virgin Islands

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

Reaction to disaster is how we have been operating, by declaring emergencies and implementing temporary emergency measures for rapid rebuilding after catastrophic events. This is *important*, however...



Resilience can be created by resolving to move forward proactively *for the long term* in ways that will increase our ability to strategize, rebuild in better ways, adapt, and better manage resources that stay powered and fully capable when catastrophe strikes again.

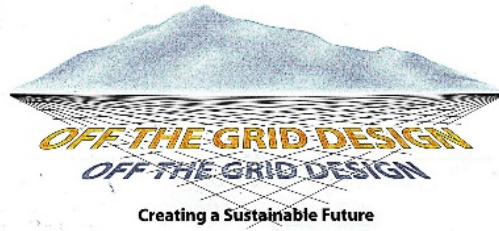
- Track, publicize, and support cutting-edge resilience-creating energy efficiency, electrification, and microgrid incentives, plus policy advancements by SCP, MCE, BayREN, BAAQMD, and others.
- Procure and develop a database of model structures with “Community Microgrid-ready” designs: For new and retrofit residential, commercial, and municipal bldgs.
 - Develop “Electrification & Community Microgrid-Ready” (ECMR) document for homeowners and installers
- Develop Community Microgrid roadmap beginning with critical facility microgrid pilots such as fire stations, hospitals, and places of refuge.
 - Position these pilots in areas that are conducive to expansion into Community Microgrids.
- Develop all as a model for resilience in rebuilding, and for **proactive resilience** and community modernization.



North Bay Community Resilience Initiative: Team



Stone
Edge Farm
Microgrid



Aim 1: Support and promote Advanced Energy Rebuild programs for homes and structures

Support for rebuilding with efficiency, electrification, and resilience

- Sonoma Clean Power (SCP) and MCE Advanced Energy Rebuild: SCP, MCE, Pacific Gas and Electric Company (PG&E), and Bay Area Air Quality Management District have joined efforts to help homeowners affected by the firestorms to rebuild energy-efficient, sustainable homes.
- The SCP program offers two incentive packages tailored to Sonoma and Mendocino Counties.
- Each package has a flexible performance pathway or a simple prescriptive menu. SCP offers up to \$17,500 in incentives to electrify, add solar + energy storage, Connected EV's, and upgrade to "connected" appliances
- MCE has similar "Advanced Energy Rebuild" program for the Napa fire rebuilding efforts.



Aim 2: Model Structures: Advanced Energy Rebuild homes

Showcase and provide case studies of homes being rebuilt utilizing the **Advanced Energy Rebuild** program. Up to \$17,500 incentives from Sonoma Clean Power and MCE, to go “all electric” and “microgrid ready”

Having a “microgrid” means when the power goes out, your power **stays ON**



Hirsch solar-powered residence



Mini-split heat pump



H.P water heater



L.G. Chem energy storage



Induction cooking

Developing a **design database** for model structures for new and retrofit residential, commercial, and municipal buildings

- In collaboration with high “performance based” building organizations in the USA:
 - US DOE Zero Energy Ready Home Program & US DOE “Solar Decathlon” homes database
 - Passive House Institute US
 - USGBC / New Buildings Institute “Grid-Optimal”
 - Net Zero Energy Coalition
 - Rocky Mountain Institute



- Developed by the Clean Coalition and a team of industry experts, as a guideline for homeowners, trades installers, and electrical engineers to easily plan and install necessary wiring to be all-electric and microgrid-ready.
- All-Electric benefits; Safer and healthier homes and communities;
 - Elimination of natural gas which is highly flammable, and produces formaldehyde and other toxic gases within the home and community
 - EV adoption = Reduction and eventual elimination of all fossil fuels
 - EV's can become “mobile energy” assets, saving *and making* money
 - Reduced reliance on outside fuel & energy sources
 - Reduction of greenhouse gases
 - REVENUE for homeowners by using your connected assets as grid assets
- Microgrid benefits; Energy resilient homes and communities
 - Ability to stay powered in grid outages = **Resilience and Security**
 - Ability to use behind the meter and community energy storage as “grid assets” = revenue stream
 - Energy produced by local renewable sources = local jobs

- Drafted to help cities and municipalities and regions make a statement of intention toward developing resilient infrastructure and buildings.
- Santa Rosa and Calistoga may be first adopters
- Open source and available to all civic and municipal bodies interested

RESOLUTION FOR COMMUNITY RESILIENCE [2019-01]

Resolution of the City Council of the City of [_____] endorsing a commitment to enabling community resilience and requesting regional collaboration stemming from the catastrophic wildfire events of 2017 and 2018, and the continued threat of wildfires and earthquakes to our communities.

WHEREAS, The City of [_____] is concerned about the well-being and safety of its residents and businesses, and seeks to create a sustainable, livable, and resilient community, where resilience is defined as a community's ability to withstand chronic stresses and acute shocks while still maintaining essential functions and recovering quickly and effectively; and

WHEREAS, Extreme weather events are occurring more frequently; in 2017 the U.S. experienced 16 weather and climate related events that cost \$1B or more, and collectively caused damage totaling a record breaking \$312 billion (National Oceanic and Atmospheric Administration) not including the loss of human life. The [North Bay region] and other regions of California have experienced deadly wildfires in the last two years, with damages exceeding \$30 billion, and affecting our community and neighboring communities; and

WHEREAS, Existing planning documentation such as the Climate Action Plan, Local Hazard Mitigation Plan, and/or Emergency Response Plan identify a range of strategies and policies designed to mitigate greenhouse gas (GHG) emissions and respond to emergency situations does not enable nor advance community resilience in the face of large-scale environmental threats; and

WHEREAS, Access to energy during and soon after a natural disaster can improve recovery timelines, and local renewable energy production and energy storage offers the single largest opportunity to reduce community wide GHG emissions and enable community energy resilience while also creating local jobs;

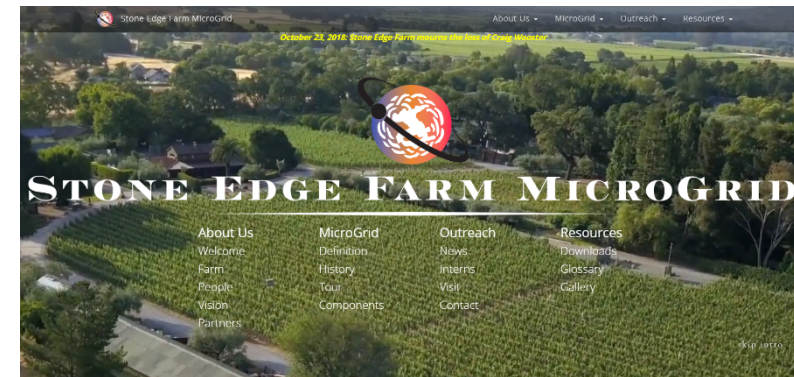
NOW THEREFORE, BE IT RESOLVED That the Council of the City of [_____] commits to actively support the goals of the North Bay Community Resilience Initiative (NBCRI) to:

- Track and publicize cutting-edge resilience-related energy efficiency and electrification incentives and policy advancements by government agencies to support Advanced Energy Rebuild and retrofits projects.
- Identify model structures (homes, commercial buildings and municipal buildings) with fully electrified and Community Microgrid-ready designs. Develop specifications for all-electric and Community Microgrid-ready buildings that are resilient to local environmental threats and that are compatible with near-term infrastructure advancements.

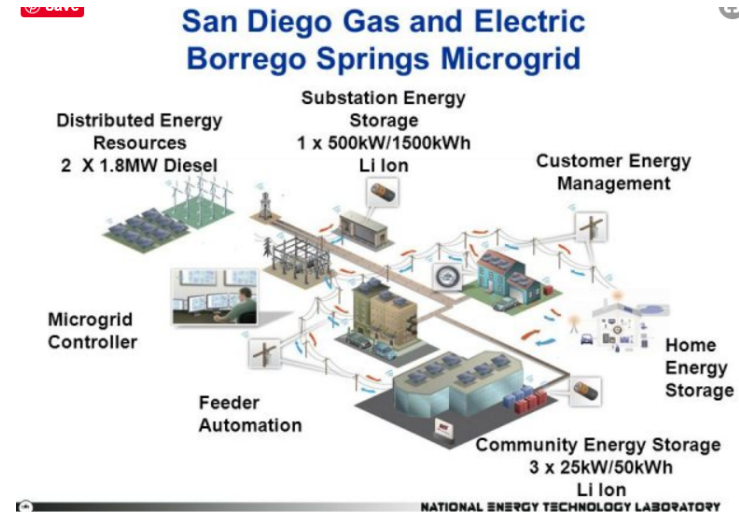
Nanogrid: A single site (residential) microgrid; single physical layer of power distribution with a localized energy control system, creating reliability, quality, and site based capacity. Coordinated behind-the-meter (BTM) site based renewable energy, and energy storage. It can be islanded (from the local grid) at the customer meter. The key attribute of a nanogrid is *simplicity*.



Microgrid: A coordinated set of behind-the-meter (BTM) local renewable energy, energy storage, and other Distributed Energy Resources (DER) *on a building or campus scale*, that can be islanded (from the local grid) at the customer meter.



Community Microgrid: A coordinated set of local renewables, energy storage, and other Distributed Energy Resources (DER) that can also be islanded, (from the larger grid) across a defined distribution grid area to provide indefinite renewables-driven resilience to critical community facilities, and other structures within the community.



Benefits of nanogrids

Financial impacts of building or unit-scale nanogrids

- Lower operation costs (near “0” energy bills)
 - Revenue from excess energy export (HOA **dividends**?)
 - Renewable transportation energy – (100% R.E. EV charging)
 - All electric and “tighter” buildings = better I.A.Q. = healthier homes
 - Energy “resilience”, and fire “resilience” (with fire resistive materials)
 - Home is a community resilience asset / and a grid asset
 - Elimination of fossil fuels (reduced GHG emissions)
 - Safer buildings and communities
- = Higher appraised property values**



Critical-facility microgrids

- **Critical-facility microgrids**; “Island” from the Grid in the event of grid outage or disruption to power critical loads for community services, safety, and security. They include renewable energy, and energy storage assets:
 - **Hospitals:** Kaiser Permanente Richmond Microgrid
 - **Fire Stations:** City of Fremont Fire Station Microgrid
 - **Emergency shelters:** Seattle Community Center Microgrid
 - **Campus microgrids:** Stone Edge Farm Microgrid



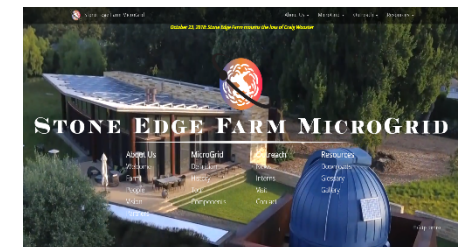
[Kaiser Permanente Richmond Microgrid](#)



[Fremont Fire Station Microgrid](#)

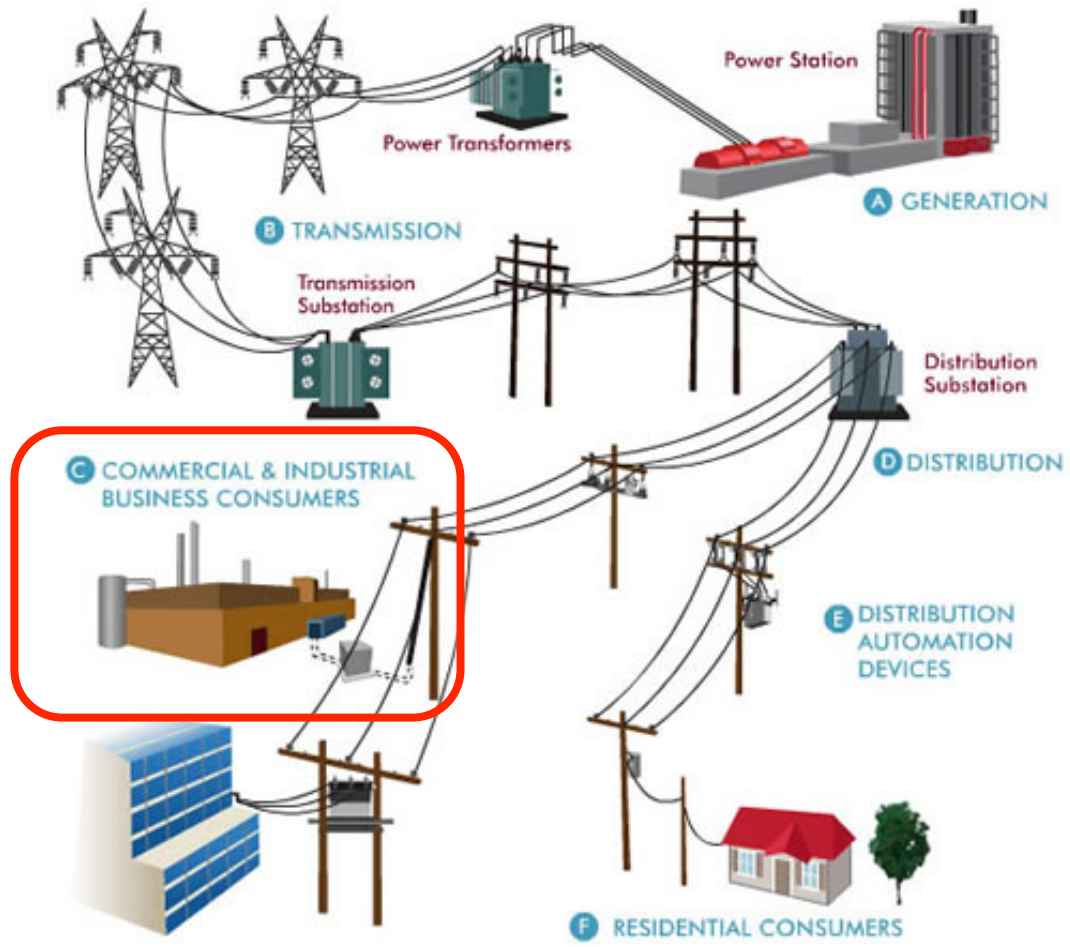


[Seattle Community Center Microgrid](#)



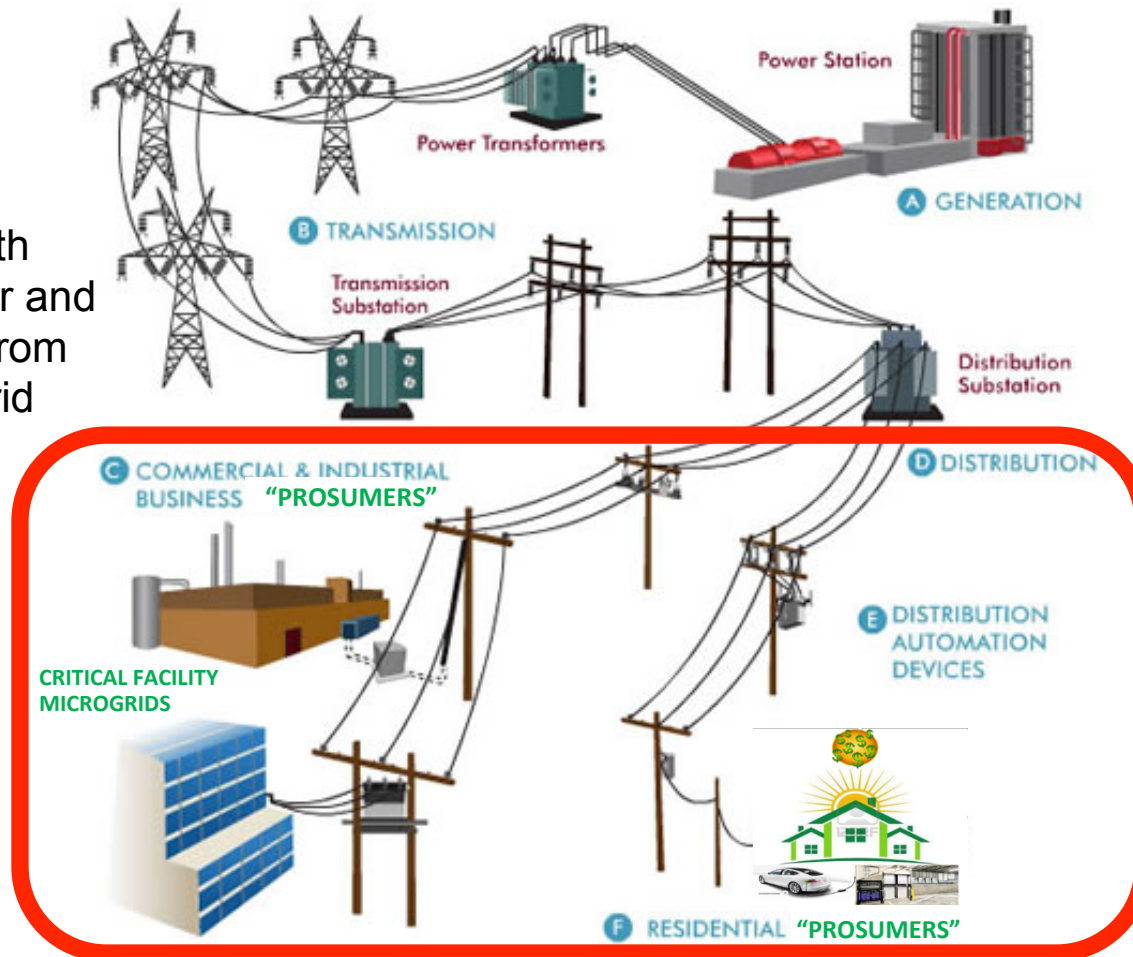
[Stone Edge Farm Microgrid](#)

Critical-facility microgrids focus on single customers



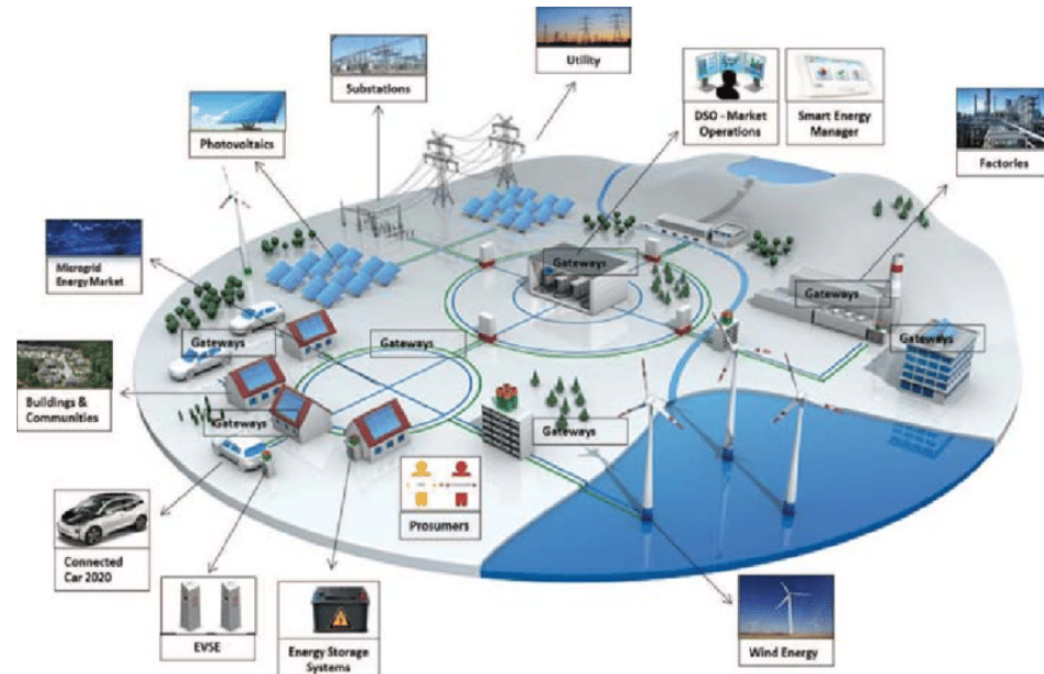
Community Microgrids can serve up to thousands of “prosumer” and “consumer” utility customers

Prosumer: Utility customers that both produce energy for and consume energy from the grid or microgrid



Community Microgrid benefits

- Reliability and power continuity
- Local control of energy
- Permanent local jobs in energy, installation, and maintenance
- Local energy for EV transportation systems
- Network of prosumers share the use, generation, and revenue of and from energy.
- No “peaker” power plants
- Reduced transmission losses
- Enhanced safety
- GHG reductions
- Resilience and energy security
- National security
- Reduced global conflicts
- Peacetime infrastructure spending



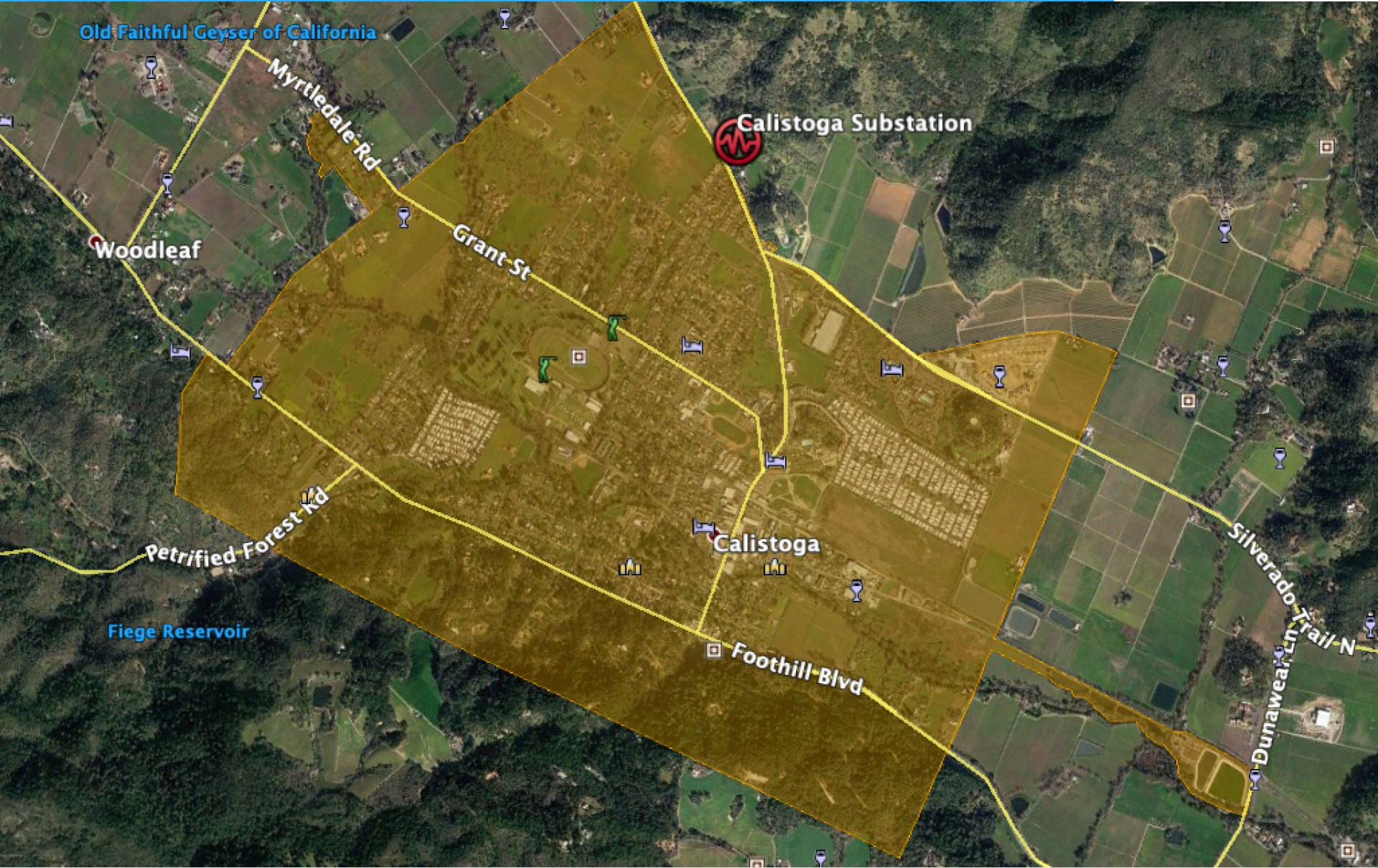
[CEC California microgrid roadmap](#)

- Well-designed and well-situated ZNE and N +E homes become valuable “prosumers” in the resource mix when combined with larger PV arrays on commercial and industrial structures.
- Load shifting and revenue from ancillary ESS assets pays dividends for all



- The California Public Utilities Commission (CPUC) recently [issued a decision](#) for new “multiple-use” applications for energy storage, which allow storage providers to “stack” various services.
- “Energy storage” can be either stationary or **mobile**, as in EV’s

Calistoga microgrid energy overview



Site	Annual Historic Use	Proposed Solar PV Capacity (DC)	Solar PV Annual Production
Fire District	103,623 kWh	70 kW	102,533 kWh
Pump House	21,415 kWh	14.5 kW	21,379 kWh
WD Office	28,716 kWh	19.5 kW	28,765 kWh
WD Mech Yard	14,933 kWh	10.2 kW	15,141 kWh
Sand Lot	NA	75.9 kW	112,069 kWh
Phase 1 Total	168,687 kWh	190.1 kW	279,887 kWh

Note that the 75.9 kW Solar PV system proposed for the Sand Lot would be used to offset electricity from other municipal electric accounts, such as the Water District accounts not located in this site, via the Renewable Energy Self-Generation Bill Credit Transfer (RES-BCT) program.



Nanogrids, Microgrids, & Community Microgrids for resilience and revenue

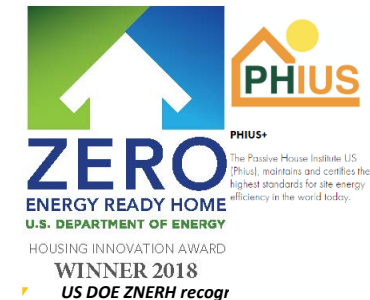


www.solluxalpha.com

[Panasonic Microgrid Smart City, Japan](#)

SOL LUX ALPHA – First PH Certified multi-unit nanogrid to US market

- 4 unit, 6 story, N+E using only PV within the building envelope
- All electric: Fossil-fuel free
- Passive House PHIUS + US DOE Zero Energy Ready Home program
- (Includes Energy Star, Indoor Air Plus, EPA “WaterSense”)
- **WINNER of the US DOE Housing Innovation Award for Multi-Family**
- **WINNER of 2018 PHIUS “Best overall Project” in North America**



Energy Star

The US Energy Star program guides builders and homeowners to the highest efficiency home appliances and other home energy products available in the USA today.



US EPA WaterSense

The US EPA WaterSense program helps save water and protects the environment by promoting WaterSense labeled products for homes, yards, and businesses, while taking various other simple steps to save water each day.



Department of Energy

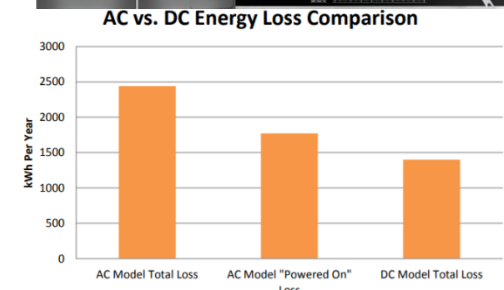
The United States Department of Energy has developed a partner program dedicated to the building of the science behind on the energy generation for Zero Net Energy and Net Positive Energy homes in the US. Sol Lux Alpha was built to exceed even the DOE program's highest standards, which is measured and recognized a year after occupancy.



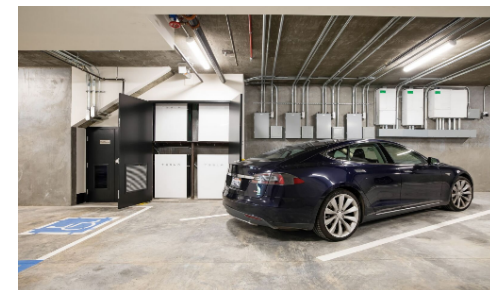
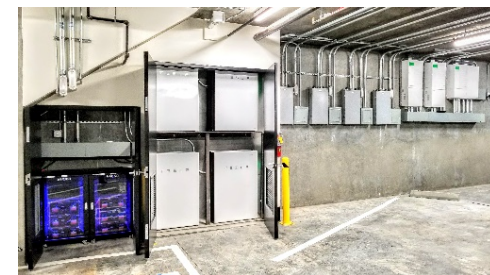
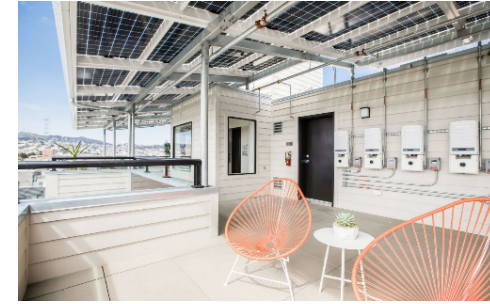
Net Positive Energy: How do you get there?

Passive House Baseline + industry best efficient systems
Passive House methodology reduces energy for HVAC by 80%

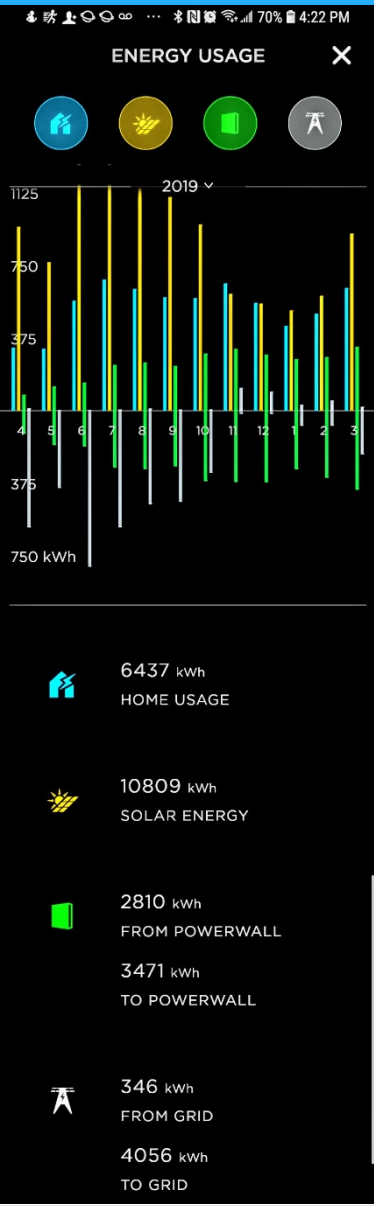
- Passive Solar design
- Air source heat pumps for HVAC, DHW, Clothes drying
- 100% L.E.D. lighting
- Automatic occupancy and vacancy sensors
- AEK – High efficiency Induction cooktops and Bosch “Benchmark” Appliances
- Next Gen projects - Moving to DC Appliances and systems



- **Sunprime GxB 380w Bifacial panels** (up to 25% boost) = 475w
- **Tesla Energy Powerwall x3** (triple redundancy, 2-3 days energy)
- **Blue Planet Energy “Blue Ion”** for 3 phase loads (elevator & commons)
- **VEHICLE-TO-BUILDING (V2B) ENERGY** enabled



Nanogrid to microgrid = resilience + revenue



Sol lux alpha N+E “nanogrid” condominium zero carbon living + transportation San Francisco, Ca

- **6 story 4 unit building** – generating approx. 2x energy required from solar PV completely within the building footprint
- Excess energy = **4056 kWh** (4 Megawatts – 1 of 4 units)
- **CleanPower SF Excess Generation Tariff** – \$.09 / kWh
- $$.09 \times 4056 \text{ kWh} = \underline{\$365.04 \text{ check at year's end}}$
- Excess energy for approx 14,000 miles EV driving per unit (14,000 mi. / 30mpg = 467 gallons fuel x \$4.00 = **\$1,868.00**)
- **Add Energy Storage** – “Load shift”; charge from solar and during low TOU rate periods, **use and sell energy back at PEAK TOU rates!**

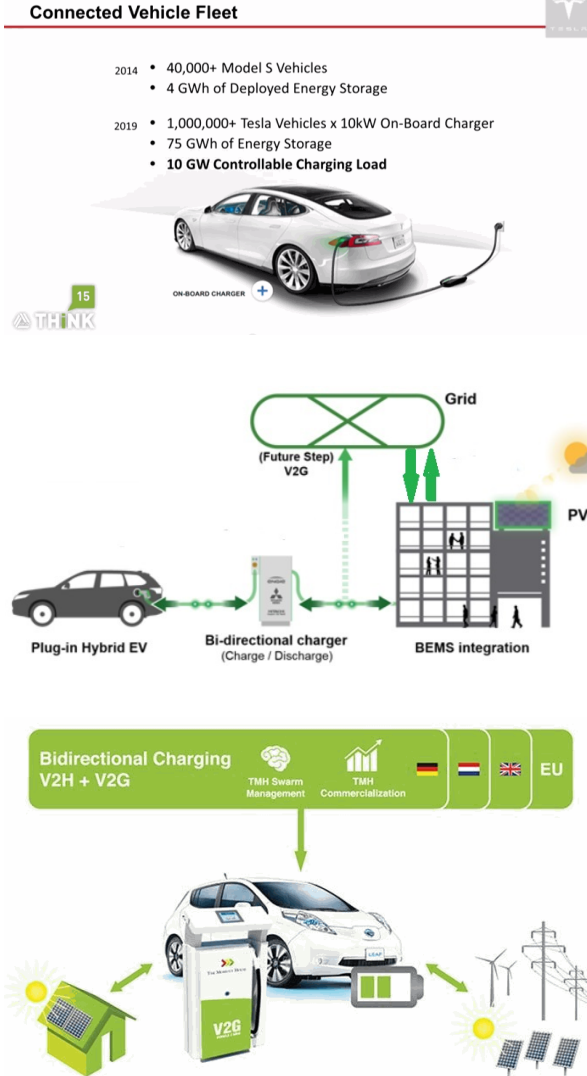
**HIGHLY RESILIENT MICROGRID STRUCTURES =
PROSUMER NETWORK**



V2B

(Vehicle to building energy transfer)

- Enables V2G
- Extends **energy** beyond the building
- **Reduces** need for site based Energy Storage System (ESS)
- **Mobile energy assets** for community resilience



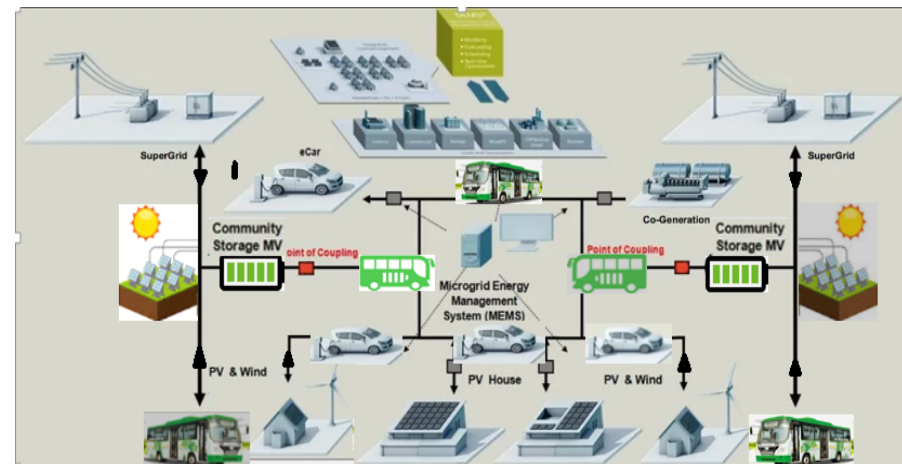
Future trends: “Mobile energy” microgrids

Microgrids + bi-directional EV’s = Aggregated “mobile” Community Microgrids

- Solar PV can export to grid or charge EV’s at daytime when solar energy is peaking
 - EV’s can bring that energy “home” and use for residential power at evening/night
- Charge EV’s when rates are low, and use in evening when rates are high (load shifting)
- Once stationary and mobile ancillary ESS grid services are enabled at scale, (and aggregated) fossil fuel peaker plants become unnecessary
- More behind meter ESS + mobile ESS assets results in reduced need for community scale solar / wind + ESS’s
- Greater resilience is created by virtue of distributed systems, and fewer single points of failure
- “Mobile energy” from bi-directional EV’s reduces need for site based ESS & transmission wires
- Add Community Scale R.E. & (mobile) storage at:
 - Points of grid connection to provide ancillary
 - Grid and microgrid services = revenue for the microgrid system



[Volkswagen Announces: “Eli”](#)



STATIONARY VS MOBILE

Which is better?



OR



OR



Thank you for your time!

Questions?