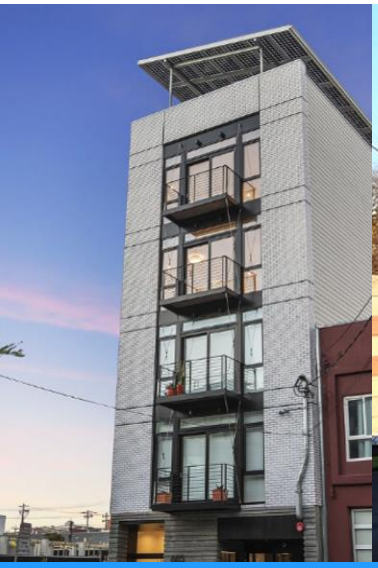
Clean Coalition

Making Clean Local Energy Accessible Now

Building and Community Microgrids: Designing for resilience



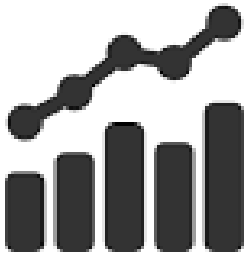
John Sarter

Program Manager, NBCRI

Clean Coalition

415-342-7199 mobile

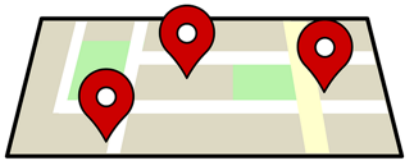
Clean Coalition: Areas of expertise



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

Clean Coalition (501c3 nonprofit): Mission

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

Reaction vs. resilience

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.

North Bay Community Resilience Initiative: Aims

- 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

Clean Coalition

Sonoma Clean Power

MCE

PG&E

Minerva Ventures
Charting a Resilient Path

Bay Area Air Quality Management District

County of Sonoma
Energy and Sustainability

biraenergy

rcpa
Regional Climate Protection Authority

Stone Edge Farm Microgrid

Rebuild NorthBay
Foundation

Ann V Edminster
AVE Design AVEnues LLC

Off the Grid Design
Creating a Sustainable Future

center for climate protection

Berkeley Lab

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

Clean Coalition

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.

Sonoma Clean Power

PG&E®

Bay Area Air Quality Management District

MCE

Aim 2: Model Structures: Advanced Energy Rebuild homes

Clean Coalition

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 esidence

Mini-split heat pump

H.P water heater

L.G. Chem energy storage

Induction cooking

Aim 3: Model structures

Clean Coalition

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 databas
  - Passive House Institute US
  - USGBC / New Buildings Institute “Grid-Optimal”
  - Net Zero Energy Coalition
  - Rocky Mountain Institute

ZERO ENERGY READY HOME U.S. DEPARTMENT OF ENERGY

PHIUS Passive House Institute US

nbi new buildings institute

U.S. GREEN BUILDING COUNCIL USGBC

Net-Zero ENERGY COALITION

ROCKY MOUNTAIN INSTITUTE

Electrification & Community Microgrid–Ready (ECMR) specifications document

Clean Coalition

- Developed by the Clean Coalition and a team of industry experts, as a guideline for homeowners and trades installers to easily 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

Resolution for Resilient Cities

- Drafted and intended as a statement of intention by a city, municipality, or region 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;

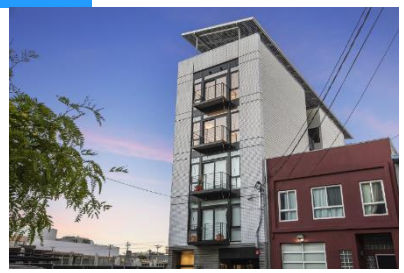
NOW THEREFORE, BE IT RESOLVED That the Council of the City of [_____] commits to actively support the goals of the North Bay Community Resilience Initiative (NBCRI) to:

- 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.

Nanogrids, Microgrids, and Community Microgrids

Clean Coalition

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 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

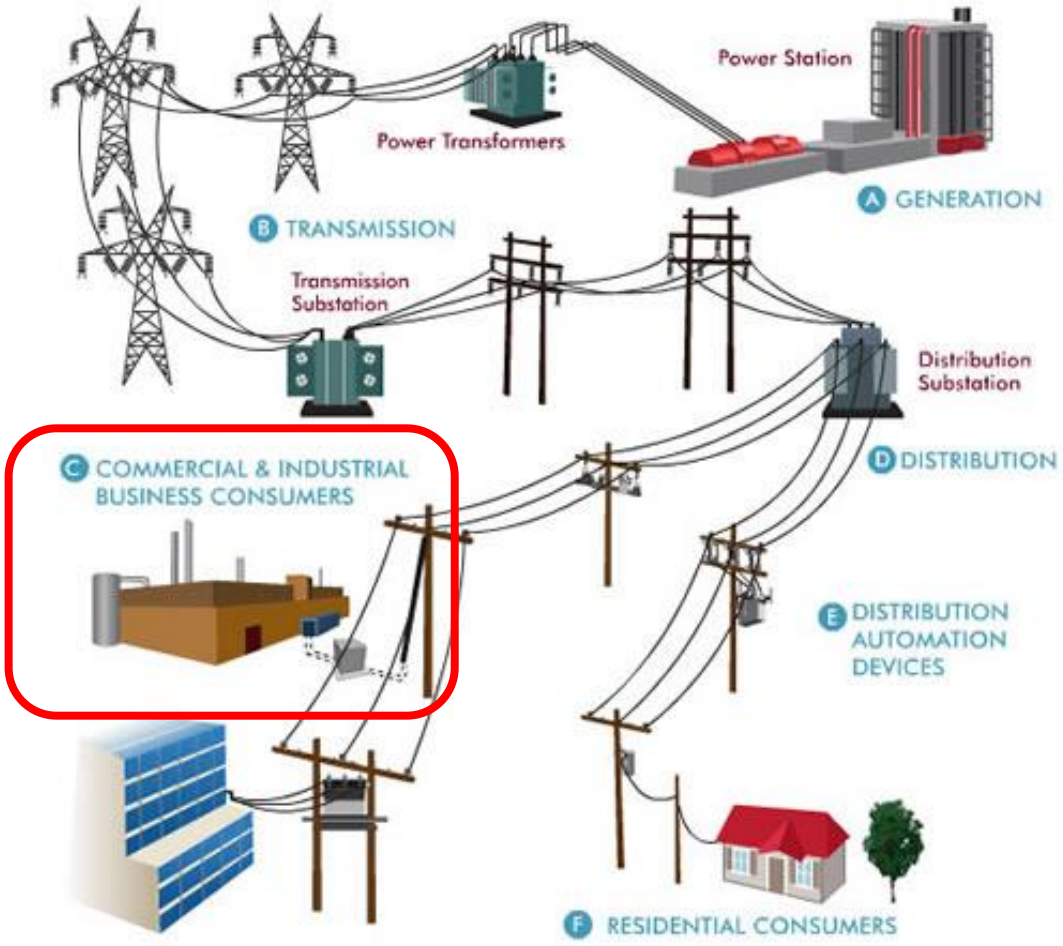
Kaiser Permanente Richmond Microgrid

Freemont Fire Station MIcrogrid

Seattle Community Center Microgrid

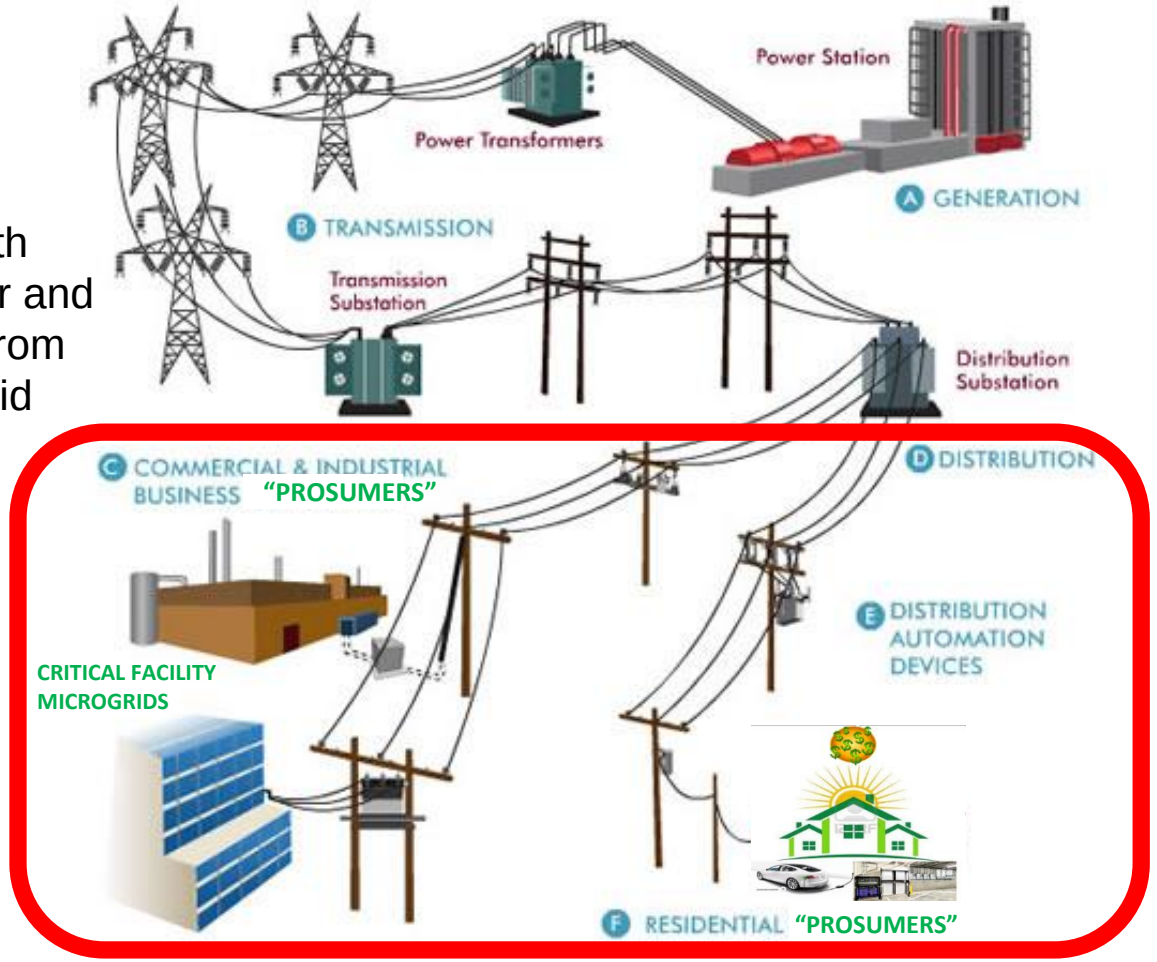
Stone Edge Farm Microgrid

Critical-facility microgrids focus on single customers



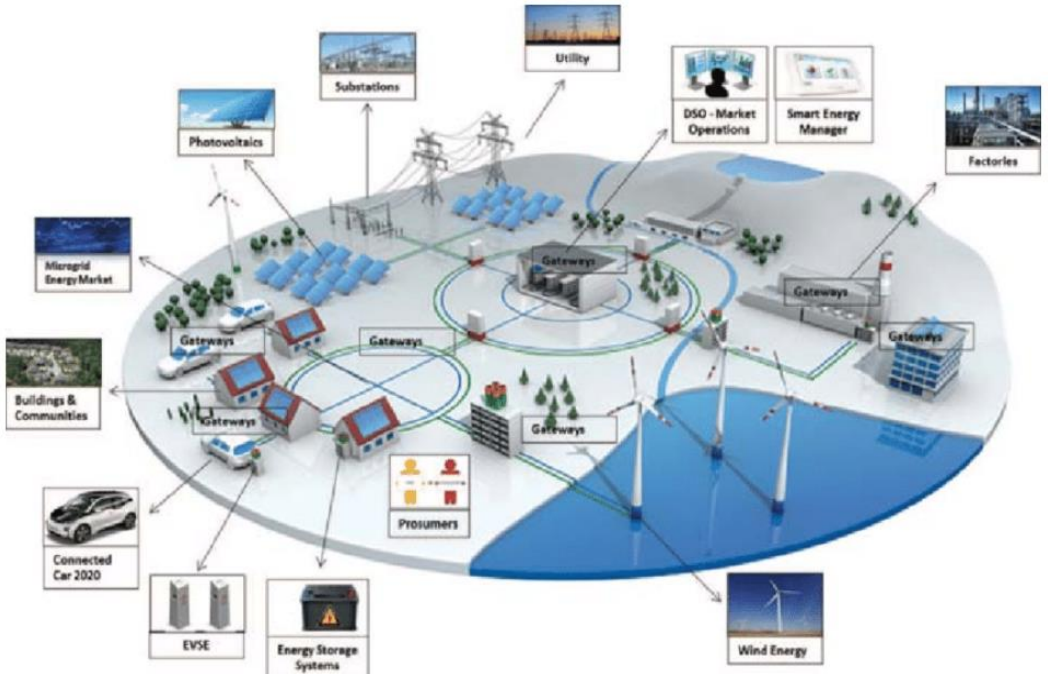
Community Microgrids can serve up to thousands of "prosumer" and "consumer" utility customers

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 microgid roadmap

Building-scale microgrids, aka “nanogrids,” and Community Microgrids for resilience and revenue

Clean Coalition

www.solluxalpha.com

Panasonic Microgrid Smart City, Japan

Sol Lux Alpha

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**

ZERO ENERGY READY HOME
U.S. DEPARTMENT OF ENERGY
HOUSING INNOVATION AWARD
WINNER 2018
US DOE ZNERH recog

PHIUS

PHIUS+
The Passive House Institute US (PHIus), maintains and certifies the highest standards for site energy efficiency in the world today.

ENERGY STAR

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

EPA WaterSense PARTNER

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.

ZERO ENERGY READY HOME

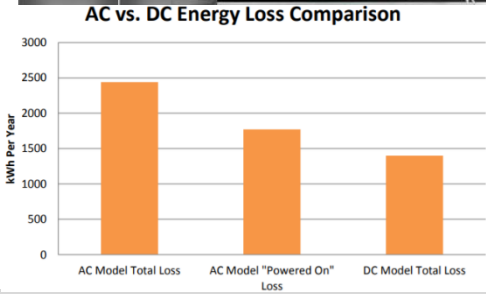
Department of Energy
The United States Department of Energy has developed a partner program dedicated to the building of, the science behind and the energy generation for Zero Net Energy and Net Positive Energy homes in the US. Sol Lux Alpha was built to exceed even the DOE program's highest standards,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

Clean Coalition

Net Positive Energy: How do you get there?

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

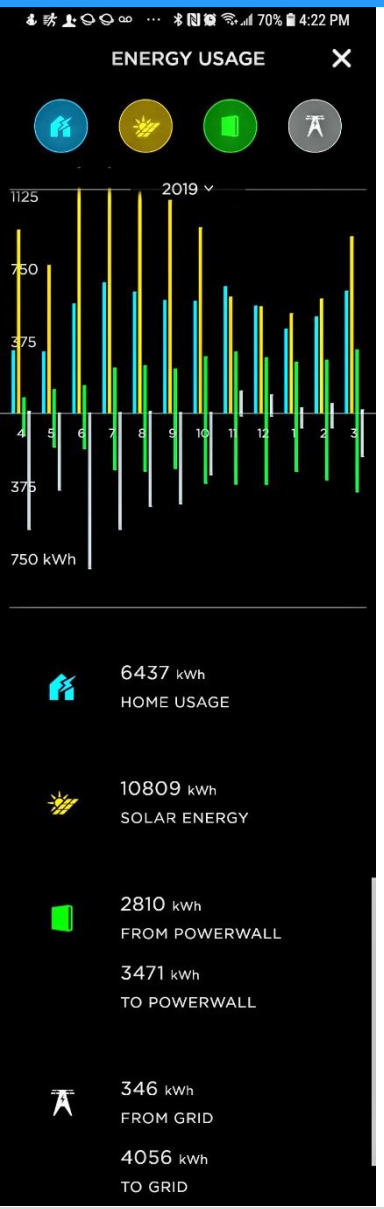
- Passive Solar design
- Air source heat pumps for HVAC, DHW, Clothes drying
- 100% L.E.D. lighting
- Automatic occupancy and vacancy sensors
- AEK – High efficiency Induction cooktops and Bosch "Benchmark" Appliances
- Next Gen projects - Moving to DC Appliances and systems



Sol Lux Alpha Nanogrid systems

- **Sunpreme** 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)
- **SCP Excess Generation Tariff** – 4056 kWh X Retail rate + $.01
  (up to $5000 maximum annually)
- If retail rate is avg of $.10/kWh - $.11 x 4056 = **$446.16 check**
- Excess energy for approx 15,000 miles EV driving per unit (15,000 mi. / 30mpg = 500 gallons fuel x $3.50 = **$1,750.00**
- **Add Energy Storage** – "Load shift"; charge from solar and during low TOU rate periods, **use** and **sell energy** back at **PEAK** TOU rates !

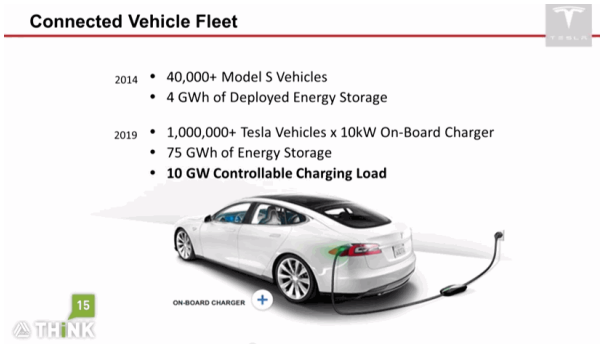
HIGHLY RESILIENT MICROGRID STRUCTURES = PROSUMER NETWORK

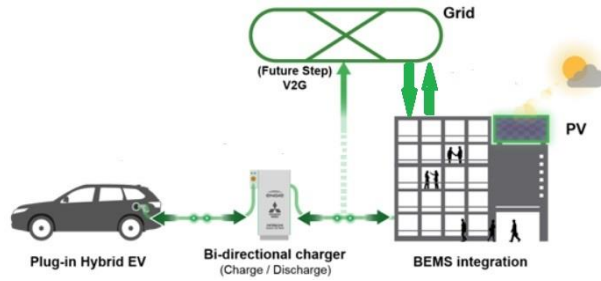
V2B and V2G technologies

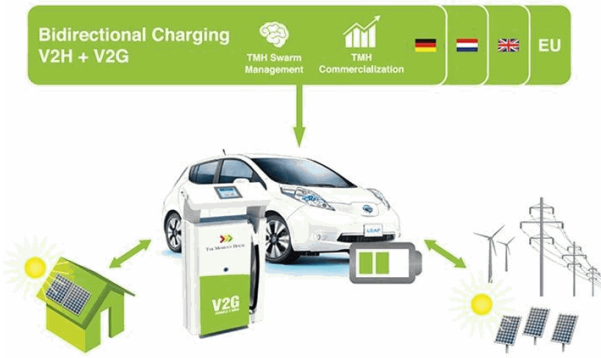
V2B

(Vehicle to building energy transfer)

- Enables V2G
- Extends **energy** beyond the building
- **Reduces** need for site based ESS
- **Mobile energy assets** for community resilience





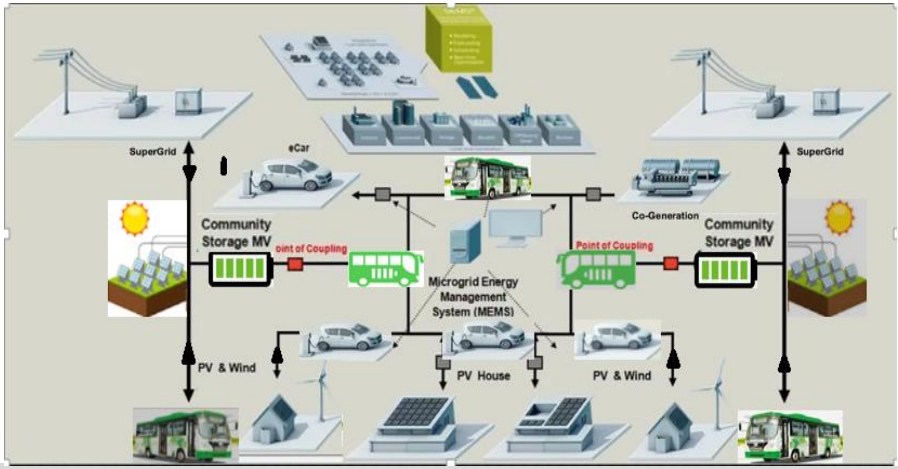


Future trends: “Mobile energy” microgrids

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

Volkswagen Announces: “Elli”



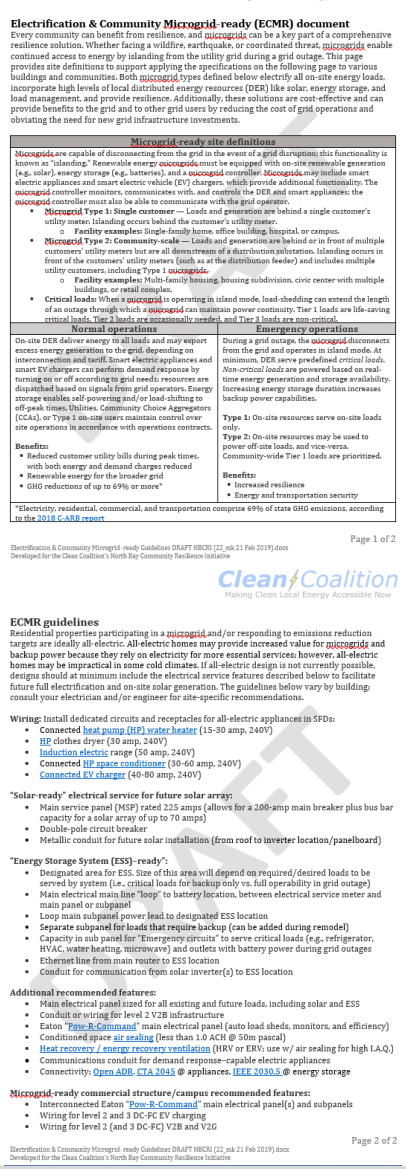
Thank you for your time!

Clean Coalition

Questions?

Electrification & Community Microgrid–Ready (ECMR) Document

- Developed with a team of microgrid industry experts: EPRI, LBNL, General Microgrids, former CAISO commissioner
- Guideline for owners, installers, electricians, and electrical engineers
- Template for necessary and suggested wiring, components, and communication protocol to be Community Microgrid–ready
- Best practice to install components at time of building, rebuilding, remodeling, for optimal financing or refinancing



Electrification & Community Microgrid-ready (ECMR) document

Every community can benefit from resilience, and microgrids can be a key part of a comprehensive resilience solution. Whether facing a wildfire, earthquake, or coordinated threat, microgrids enable continued access to energy by islanding from the utility grid during a grid outage. This page provides site definitions to support applying the specifications on the following page to various buildings and communities. Both microgrid types defined below electrify all on-site energy loads, incorporate high levels of local distributed energy resources (DER) like solar, energy storage, and load management, and provide resilience. Additionally, these solutions are cost-effective and can provide benefits to the grid and to other grid users by reducing the cost of grid operations and obviating the need for new grid infrastructure investments.

Microgrid-ready site definitions

Microgrids are capable of disconnecting from the grid in the event of a grid disruption; this functionality is known as "islanding." Renewable energy microgrids must be equipped with on-site renewable generation (e.g., solar), energy storage (e.g., batteries), and a microgrid controller. Microgrids may include smart electric appliances and smart electric vehicle (EV) chargers, which provide additional functionality. The microgrid controller monitors, communicates with, and controls the DER and smart appliances; the microgrid controller must also be able to communicate with the grid operator.

- Microgrid **Type 1: Single customer** — Loads and generation are behind a single customer's utility meter. Islanding occurs behind the customer's utility meter.
  - **Facility examples:** Single-family home, office building, hospital, or campus.
- Microgrid **Type 2: Community-scale** — Loads and generation are behind or in front of multiple customers' utility meters but are all downstream of a distribution substation. Islanding occurs in front of the customers' utility meters (such as at the distribution feeder) and includes multiple utility customers, including Type 1 microgrids.
  - **Facility examples:** Multi-family housing, housing subdivision, civic center with multiple buildings, or retail complex.
- **Critical loads:** When a microgrid is operating in island mode, load-shedding can extend the length of an outage through which a microgrid can maintain power continuity. Tier 1 loads are life-saving critical loads; Tier 2 loads are occasionally needed; and Tier 3 loads are non-critical.

Normal operations	Emergency operations
On-site DER deliver energy to all loads and may export excess energy generation to the grid, depending on interconnection and tariff. Smart electric appliances and smart EV chargers can perform demand response by turning on or off according to grid needs; resources are dispatched based on signals from grid operators. Energy storage enables self-powering and/or load-shifting to off-peak times. Utilities, Community Choice Aggregators (CCAs), or Type 1 on-site users maintain control over site operations in accordance with operations contracts. **Benefits:** • Reduced customer utility bills during peak times, with both energy and demand charges reduced • Renewable energy for the broader grid • GHG reductions of up to 69% or more*	During a grid outage, the microgrid disconnects from the grid and operates in island mode. At minimum, DER serve predefined *critical loads*. *Non-critical loads* are powered based on real-time energy generation and storage availability. Increasing energy storage duration increases backup power capabilities. **Type 1:** On-site resources serve on-site loads only. **Type 2:** On-site resources may be used to power off-site loads, and vice-versa. Community-wide Tier 1 loads are prioritized. **Benefits:** • Increased resilience • Energy and transportation security

*Electricity, residential, commercial, and transportation comprise 69% of state GHG emissions, according to the 2018 C-ARB report

Page 1 of 2

Electrification & Community Microgrid -ready Guidelines DRAFT NBCRI (22_mk 21 Feb 2019).docx
Developed for the Clean Coalition's North Bay Community Resilience Initiative

ECMR guidelines

Residential properties participating in a microgrid and/or responding to emissions reduction targets are ideally all-electric. All-electric homes may provide increased value for microgrids and backup power because they rely on electricity for more essential services; however, all-electric homes may be impractical in some cold climates. If all-electric design is not currently possible, designs should at minimum include the electrical service features described below to facilitate future full electrification and on-site solar generation. The guidelines below vary by building; consult your electrician and/or engineer for site-specific recommendations.

Wiring: Install dedicated circuits and receptacles for all-electric appliances in SFDs:

- Connected heat pump (HP) water heater (15-30 amp, 240V)
- HP clothes dryer (30 amp, 240V)
- Induction electric range (50 amp, 240V)
- Connected HP space conditioner (30-60 amp, 240V)
- Connected EV charger (40-80 amp, 240V)

"Solar-ready" electrical service for future solar array:

- Main service panel (MSP) rated 225 amps (allows for a 200-amp main breaker plus bus bar capacity for a solar array of up to 70 amps)
- Double-pole circuit breaker
- Metallic conduit for future solar installation (from roof to inverter location/panelboard)

"Energy Storage System (ESS)-ready":

- Designated area for ESS. Size of this area will depend on required/desired loads to be served by system (i.e., critical loads for backup only vs. full operability in grid outage)
- Main electrical main line "loop" to battery location, between electrical service meter and main panel or subpanel
- Loop main subpanel power lead to designated ESS location
- Separate subpanel for loads that require backup (can be added during remodel)
- Capacity in sub panel for "Emergency circuits" to serve critical loads (e.g., refrigerator, HVAC, water heating, microwave) and outlets with battery power during grid outages
- Ethernet line from main router to ESS location
- Conduit for communication from solar inverter(s) to ESS location

Additional recommended features:

- Main electrical panel sized for all existing and future loads, including solar and ESS
- Conduit or wiring for level 2 V2B infrastructure
- Eaton "Pow-R-Command" main electrical panel (auto load sheds, monitors, and efficiency)
- Conditioned space air sealing (less than 1.0 ACH @ 50m pascal)
- Heat recovery / energy recovery ventilation (HRV or ERV; use w/ air sealing for high I.A.Q.)
- Communications conduit for demand response–capable electric appliances
- Connectivity: Open ADR, CTA 2045 @ appliances, IEEE 2030.5 @ energy storage

Microgrid-ready commercial structure/campus recommended features:

- Interconnected Eaton "Pow-R-Command" main electrical panel(s) and subpanels
- Wiring for level 2 and 3 DC-FC EV charging
- Wiring for level 2 (and 3 DC-FC) V2B and V2G

Page 2 of 2

Electrification & Community Microgrid -ready Guidelines DRAFT NBCRI (22_mk 21 Feb 2019).docx
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