Berkeley Energy Assurance Transformation Project

Designing a solar-powered, clean energy microgrid in downtown Berkeley

Project Description

The Berkeley Energy Assurance Transformation (BEAT) project explores how to develop a clean energy microgrid to increase community resilience in a dense urban city center. The BEAT project analyzed the feasibility of designing a Clean Energy Microgrid Community (CEMC) that uses solar and energy storage to share power between existing buildings. A microgrid system can better regulate day-to-day energy supply, and in the case of a power outage, can "island" itself from the main utility and provide clean back-up power for critical buildings.

The BEAT microgrid's primary objective is to utilize solar and battery storage for back-up power at critical facilities and minimize diesel generator use for up to a 7-day outage caused by a major natural disaster.

The BEAT team conducted a series of coordinated regulatory, technical and financial analyses to determine the feasibility of building a multi-facility CEMC in downtown Berkeley. These analyses informed site feasibility, optimal configurations, operation criteria, financing strategies, and lessons learned. The BEAT project team then developed three shovel-ready prototypes that range in scope, cost, ownership-model, and complexity to help advance the adoption of CEMCs. These scalable prototypes will serve as replicable models for other communities.

The City of Berkeley will pursue grant and other funding opportunities to build a resilient back-up power solution for downtown Berkeley.

Anticipated Benefits for California

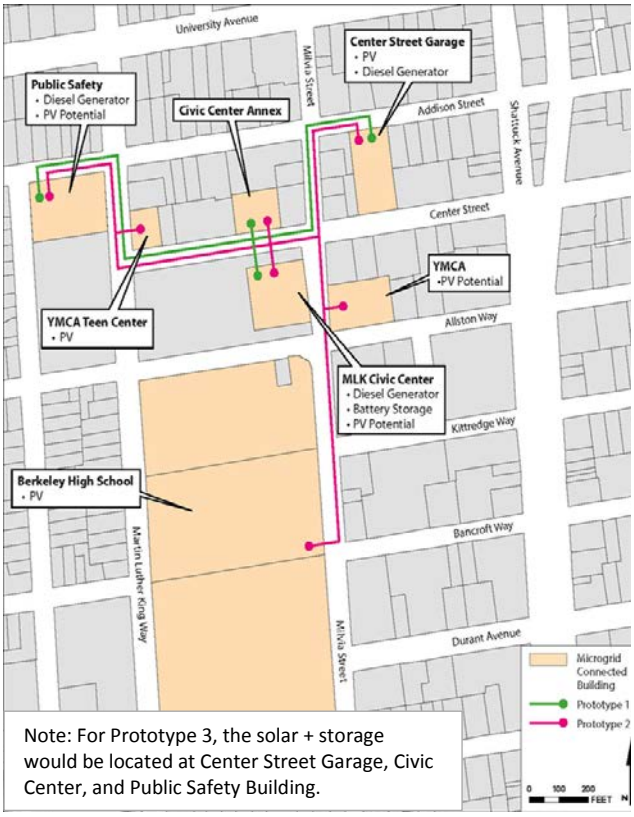
The BEAT project is designed to achieve multiple environmental, economic, and resilience benefits for California. Anticipated project benefits include increased energy reliability and local clean power generation, reduced greenhouse gas emissions and peak power demand, potential electricity cost savings through energy efficiency, and grid stabilization. These benefits help ratepayers and reduce the need for investment in additional power production, distribution, and transmission.

The Issue: Microgrids for Cities

Cities are responsible for serving the community even when power is disrupted. Yet, there are few viable or replicable microgrid demonstration projects serving existing buildings in a dense urban setting. Both CEMCs and islandable solar + storage systems present an opportunity for cities to provide clean back-up power to critical facilities in the case of an emergency without having to rely on dirty diesel generators.

These resilient solutions achieve goals related to renewable energy, energy reliability, energy demand optimization, and grid stabilization. New demonstration projects, such as BEAT, are needed to showcase how cities can benefit from clean energy microgrids that advance community resilience and energy assurance while also reducing greenhouse gas emissions.

Microgrid Connections (Prototypes 1 & 2)



Note: For Prototype 3, the solar + storage would be located at Center Street Garage, Civic Center, and Public Safety Building.

BEAT Grant Specifics

Electric Program Investment Charge (EPIC) Grant

Project Lead: City of Berkeley, CA

Subcontractors: Association of Bay Area Governments (ABAG), Center for Sustainable Energy (CSE), Interface Engineering, Lawrence Berkeley National Laboratory (LBNL), NHA Advisors, URS Corporation (URS), and West Coast Code Consultants, Inc. (WC^3)

California Energy Commission Funds: $1,499,214

Local Utility: Pacific Gas and Electric (PG&E)

Grant Term: September 2016 – June 2018

Microgrid Prototype Designs

The BEAT project developed three designs for Berkeley. All are intended to be scalable to include additional facilities in the future.

Prototype 1, a fully-connected multi-facility microgrid design, includes four City-owned buildings (Center Street Garage, Civic Center, Civic Center Annex, and the Public Safety Building) that could provide critical services to the public during an emergency. The buildings would be connected through new underground distribution lines. Prototype 1 could be expanded to Prototype 2.

Prototype 2, a future microgrid design option, consists of the four city-owned buildings in Prototype 1 plus three additional community-serving facilities (Berkeley High School, the YMCA, and the YMCA Teen Center). These buildings add additional solar generation and could serve as critical care shelters. Prototype 2 involves multiple building owners and additional regulatory and contractual challenges.

Prototype 3, a design for an islandable solar + storage system, includes the Center Street Garage, Civic Center and the Public Safety Building. It does not require new distribution lines and therefore is a simpler and more affordable option. This is a stand-alone solution for individual buildings and could be expanded to include additional critical facilities that have space for solar and storage. It does not, however, allow buildings to connect together to aggregate and share power.

Results of Analyses

Technical Design:

- The technical viability of a fully-connected microgrid depends on the physical proximity of buildings, solar potential, and the number of other non-microgrid customers on the distribution lines.
- Given the number of non-microgrid customers on existing distribution lines and inability to isolate microgrid customers during an outage, the BEAT CEMC would need new dedicated distribution lines.
- A large battery would help maintain operations for a multiple day outage. Utility rate structures play a significant role in defining the optimal battery size.
- Including building energy efficiency upgrades and maximizing solar generation increases benefits and financial pay-back.

Regulatory Analysis:

- The California Public Utilities Commission (CPUC) code prohibits non-utilities from distributing power across the public right-of-way (per Rule 218(b)). Therefore the local utility would need to own and operate the distribution lines for the BEAT CEMC.
- New microgrid distribution lines are considered special facilities under PG&E Rule 2, and therefore a monthly cost of ownership charge based on the estimated installed cost of the infrastructure applies.
- Any new distribution lines would need to be dedicated solely for microgrid customers through an exception filed by the utility with the CPUC.
- A single master meter or virtual meter at the point of interconnection would allow multiple facilities to balance power generation and demand. A single meter arrangement is at the discretion of the utility.

Financial Analysis:

- New distribution lines are very expensive. In addition, a utility may charge for the operation and maintenance of the line. There is also a transfer tax (ITCC) to deed the equipment to the utility.
- Current tariffs do not allow buildings to aggregate power, and no tariff exists for microgrids during an outage. New tariff development would require utility partnership and CPUC approval.
- An islandable solar + storage system is a more cost effective solution because it does not require constructing new distribution lines. However, it does not allow buildings to aggregate power.