



# *Energy Resiliency through Microgrids*

Colorado Resiliency Office's  
Adaptations and Futures Webinar Series

May 05, 2021  
12 P.M. - 1 P.M.



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Resiliency Office  
Department of Local Affairs

# *Climate Adaptations & Futures Webinar Series*

- First Wednesdays from 12pm - 1pm
- Recordings & upcoming webinars are available here:  
[www.coresiliency.com/webinars](http://www.coresiliency.com/webinars)



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# Welcome

Please use the **chat** to communicate any questions or comments to all attendees.

Please use the **Q&A** to ask any questions to the panelists only.

Your microphone is on mute.

This webinar is being recorded and will be posted on the Colorado Resiliency Office's website: [coresiliency.com/webinars](https://coresiliency.com/webinars)



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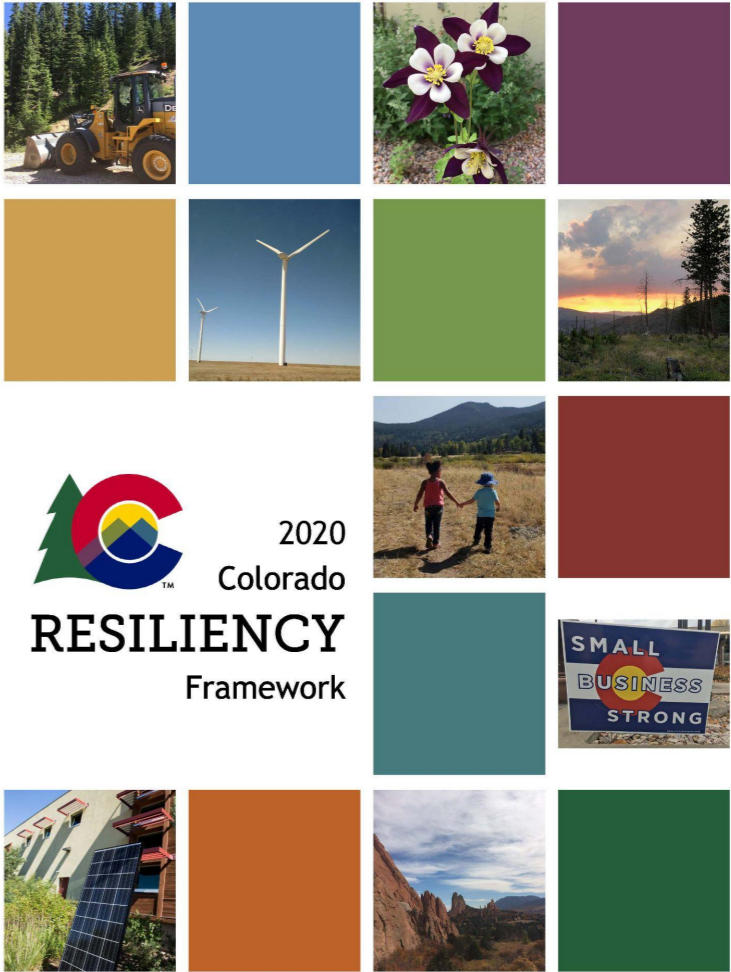
**Resiliency Office**

Department of Local Affairs

# Microgrids and Resiliency

**BI6. Grow a Network of Resiliency Hubs**

Support the development of regional state-of-the-art resiliency hubs that serve as community centers for education, services, and community capacity. Provide access to food, shelter, power, and other critical services during emergencies.





**Greg Martin**  
Engineering Manager  
National Renewable  
Energy Laboratory



**Zach Hendrix**  
Climate Action Manager  
Pitkin County



**Matt Arsenault**  
Mitigation Projects  
Team Supervisor  
Division of Homeland  
Security & Emergency  
Management

Moderator: Rob Pressly, Colorado Resiliency Office





# Microgrids Today

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Greg Martin

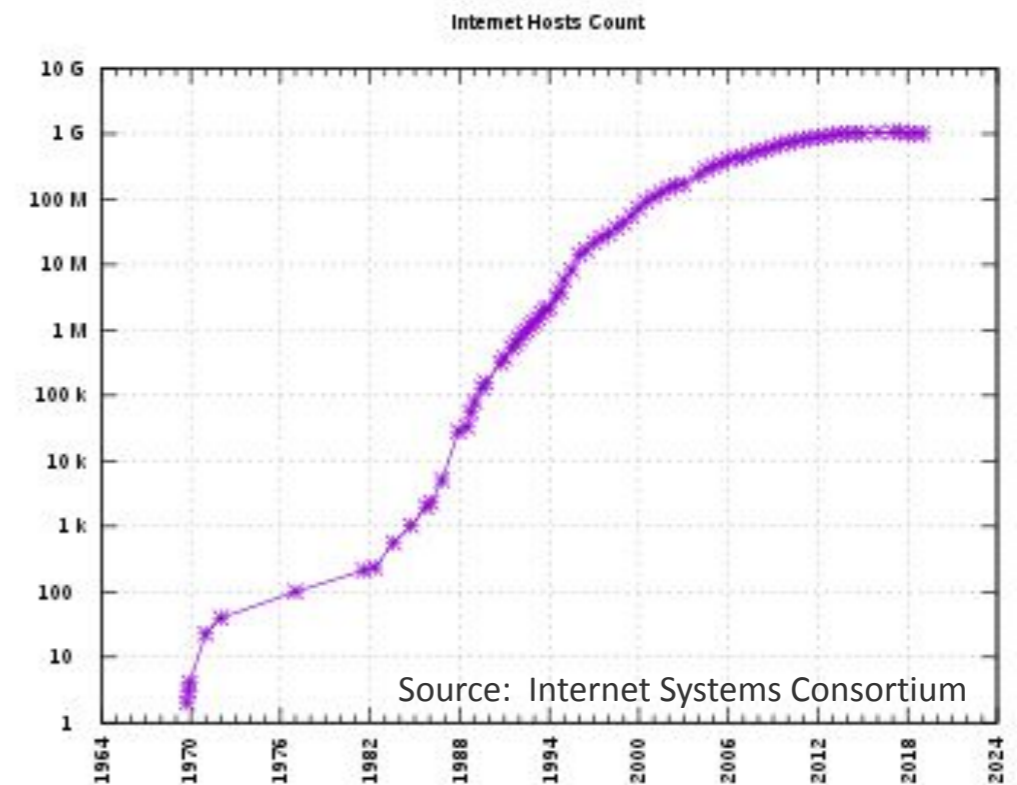
Engineering Manager, NREL

May 5, 2021

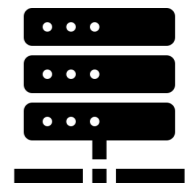
# Opening Remark

**Microgrids are not new, but the concept is enduring while the opportunity is growing.**

- Can provide resilience, security, safety
- Can help access to energy and possibly costs
- Gateway for clean energy and efficiency
- Positive economics or cost/benefit
- Create foundation for innovation

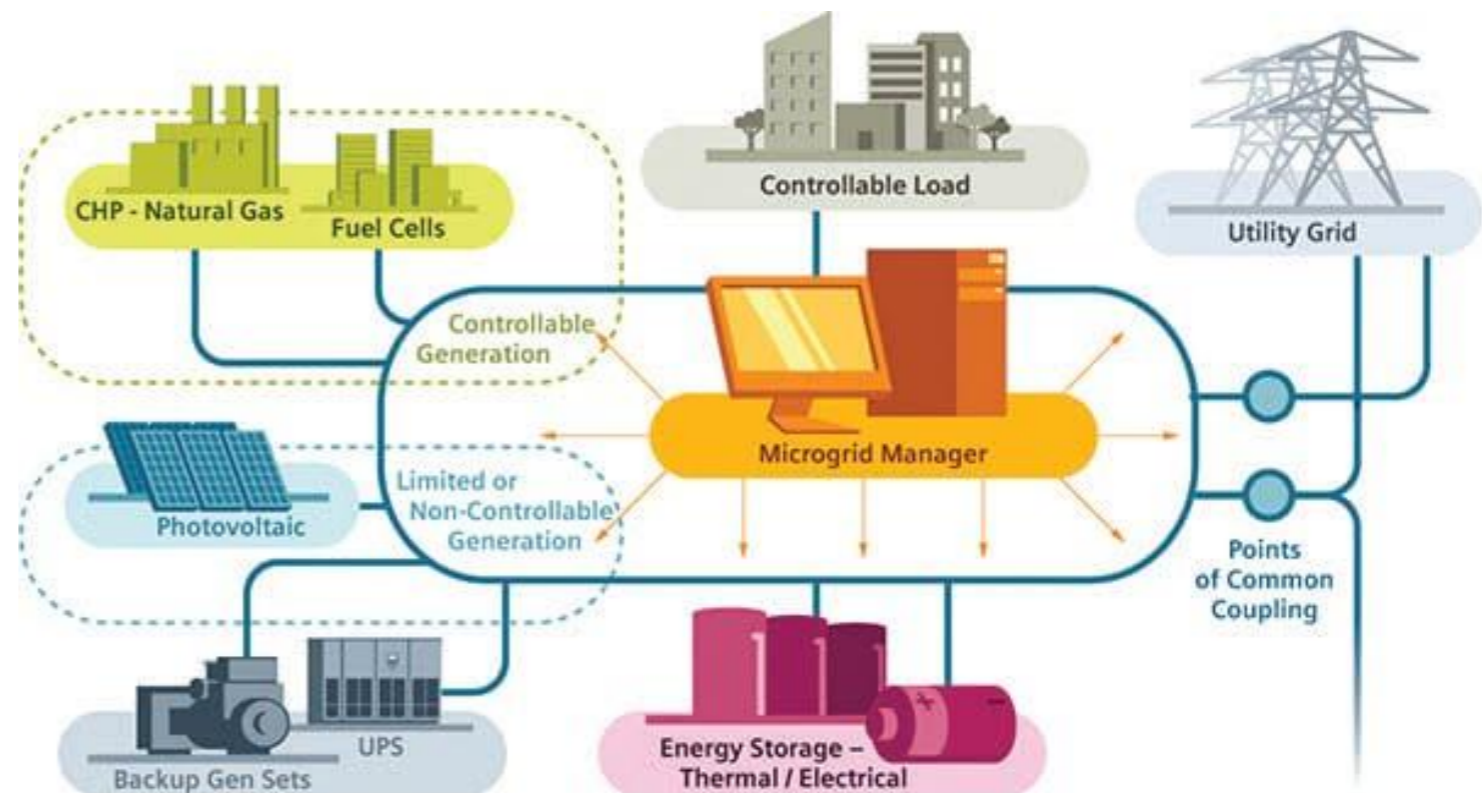


**If we are building the internet for energy, microgrids are akin to data servers**



# Single Microgrid

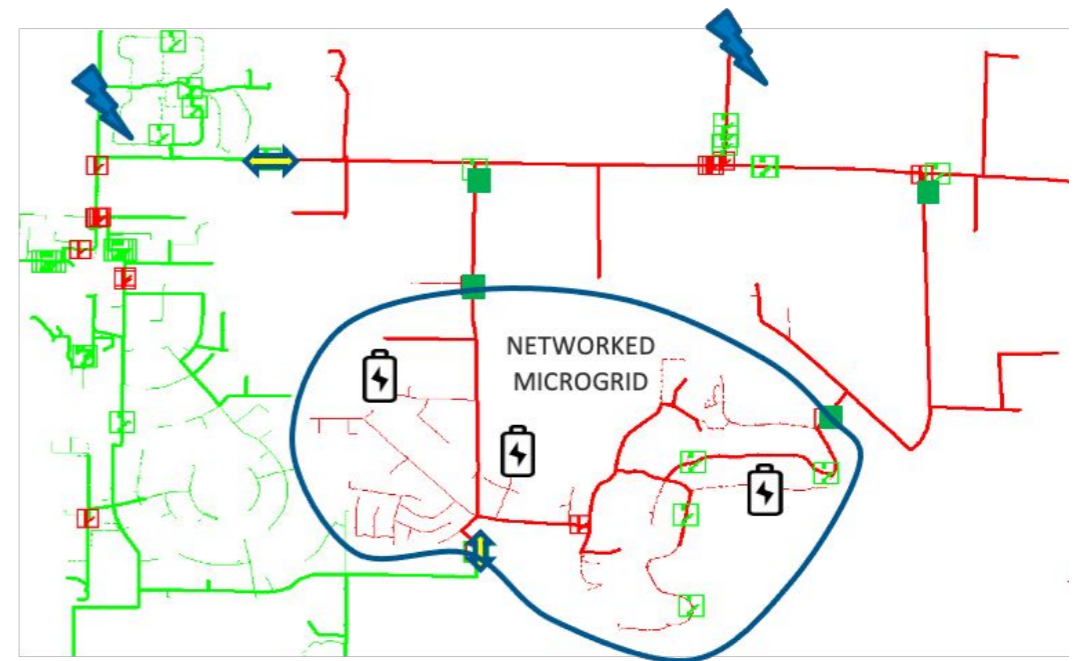
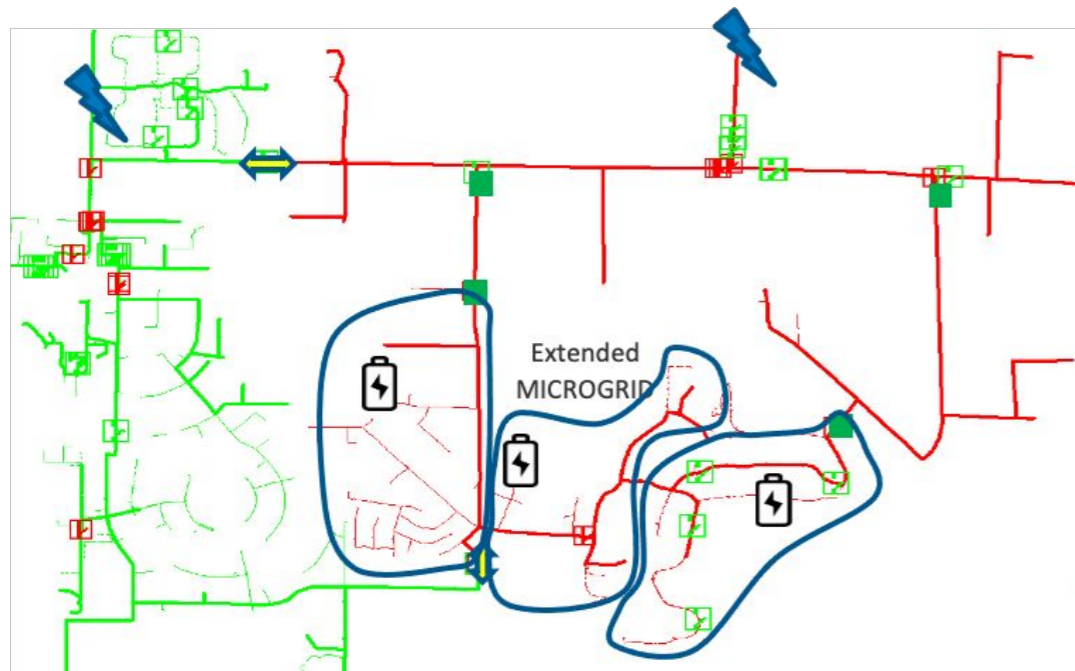
- Control of local assets
- Operates with or without grid
- Incorporates renewable energy and storage
- Provides interface with utility operator for offering grid services valuation of services
- Tailor to local needs, funding and benefits



Source: Power Magazine



# Multi-Microgrid



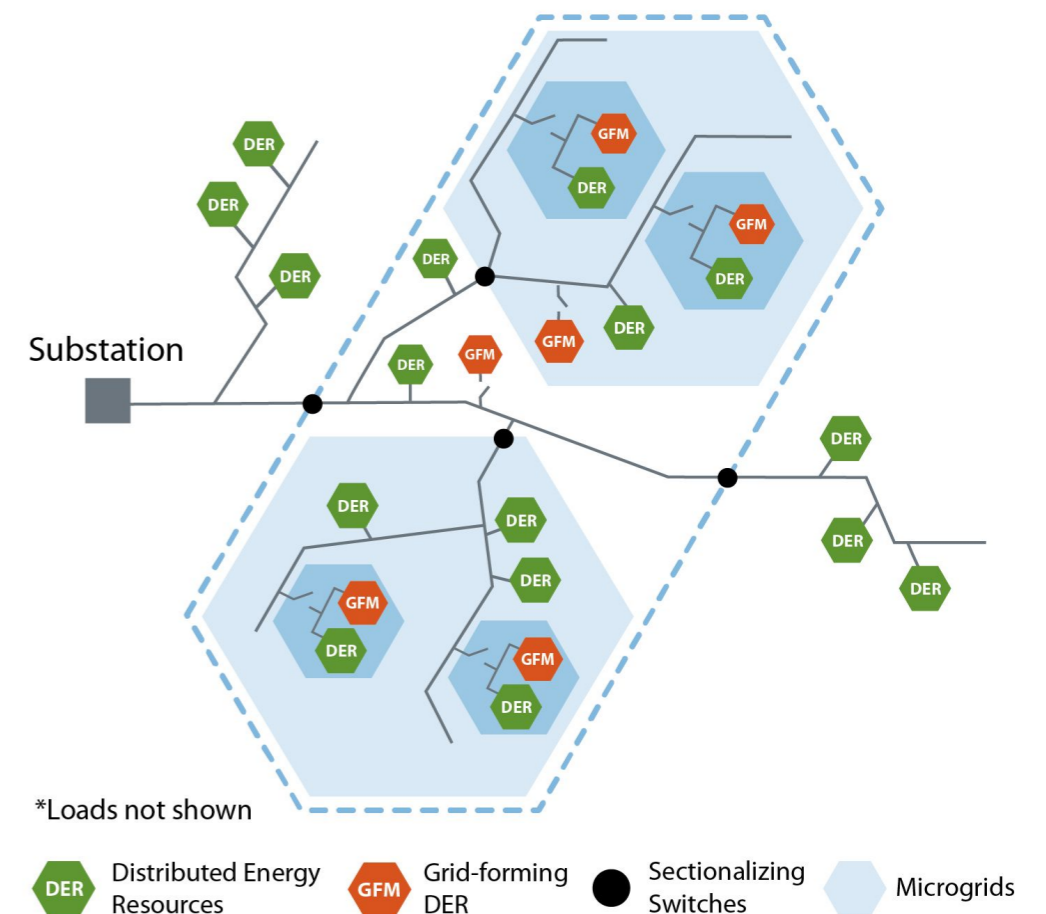
- ✓ Shared operational parameters among 2+ microgrids
- ✓ Multiple microgrid responses are coordinated
- ✓ MEMS, communications and standardization are key; much of this is in development
- ✓ IEEE 2030.7 addresses microgrid standardization, needs to continue to evolve

## Multi-Microgrid Sub-types:

- Extended
- Nested
- Clustered
- Networked  
(zone controlled)  
(mini-grid / remote)

# System Restoration with Networked Microgrids

- Individual microgrids have proven their ability to increase reliability and resilience, but at a high cost
- Networked microgrids can further increase reliability and resilience and mitigate the high costs by sharing technology investment
- Networked microgrids provide the following:
  - Resilience (to extreme events)
  - Reliability and security (normal/single failures, e.g., N-1)
  - Economics (combined investment and operations)
  - Efficiency (operating at efficiency points)
- Networked microgrids can exist in many variations



# Microgrid Technology Development

- **Fast load shed**
- **Seamless transition**
- **Black start**
- **Synthetic inertia**
- **Cell – based, networked or building block architecture approaches**
- **Autonomous devices, distributed intelligence coordination**
- **Communications and cyber security (5G...)**
- **Interface and operating requirements standardization (IEEE 2030.7)**



# Modern/Advanced Case Study Examples

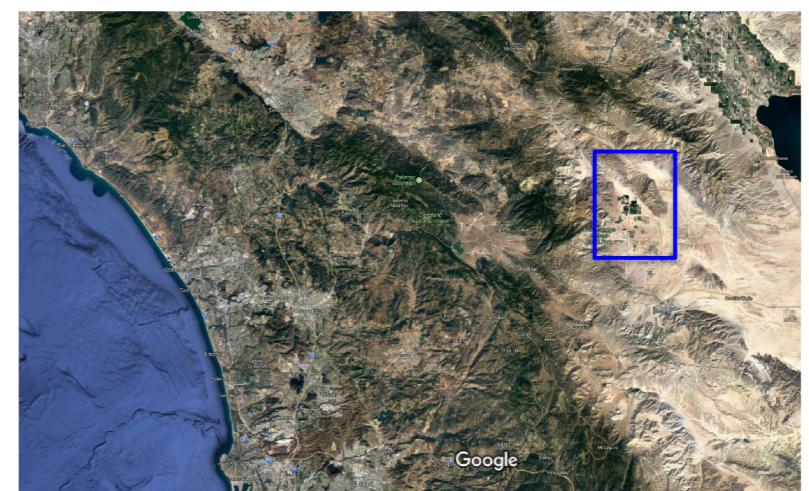
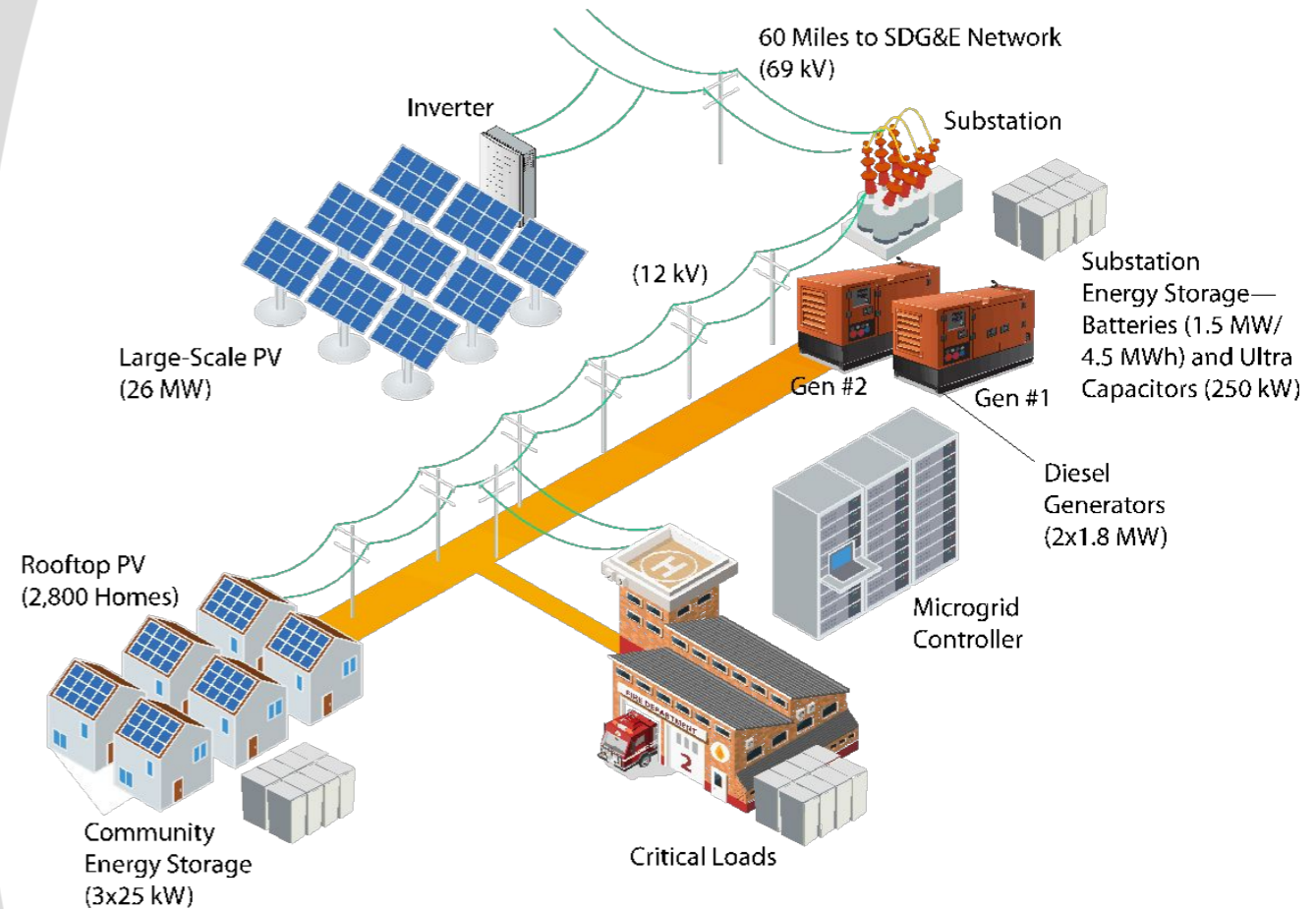
- Borrego Springs – San Diego Gas & Electric
- Pacific Missile Range Facility – Navy
- Buffalo Niagara Medical Center – Electric Power Research Institute
- Joint Base Cape Cod – Air National Guard
- Miramar – Marines
- Bronzeville, IL – Commonwealth Edison, IIT

# High-Penetration Microgrid: SDG&E Borrego Springs

- High concentration of customer-owned solar generation
- Potential for reliability enhancements
- Transmission line thermal limit below maximum net export
- Opportunity to balance supply and demand to be more self-sufficient.

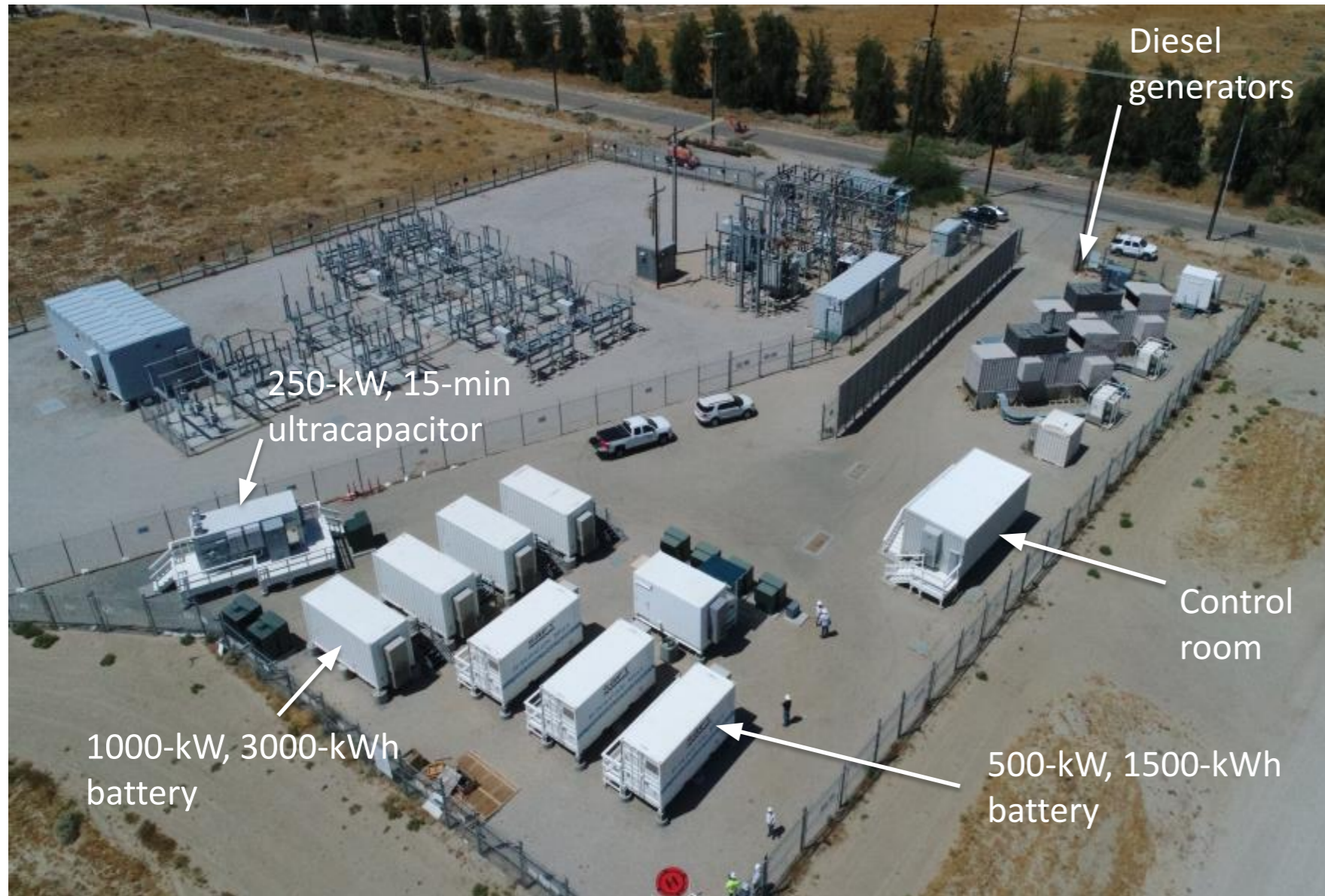


Photo by  
SDG&E



Imagery ©2017 Landsat / Copernicus, Data SIO, NOAA, U.S. Navy, NGA, GEBCO, Data USGS, Data LDEO-Columbia, NSF, NOAA, Map data ©2017 Google, INEGI United States

# Borrego Springs Microgrid Assets



- ~14-MW native load
- 26-MW photovoltaics (PV)
- 4.5-MW rooftop PV
- 6.5-MW concentrating PV (CPV)
- 1.5-MW/3-h battery energy storage system (BESS)
- 250-kW ultracapacitor
- 3.6-MW diesel gensets.

*Photo by  
SDG&E*

# Microgrid Research and Development at NREL's Energy Systems Integration Facility



*Photos by NREL*

- The Energy Systems Integration Facility (ESIF) is a national user facility located in Golden, Colorado, on the campus of the National Renewable Energy Laboratory (NREL) (<http://www.nrel.gov/esif>).
- Megawatt-scale controller- and power-hardware-in-the-loop (CHIL/PHIL) capability
- Allows testing of energy technologies at full power in real-time grid simulations to safely evaluate performance.
- Major growth at NREL is happening in integrated energy system research under ARIES; expansion to the Flatirons campus.

<https://www.nrel.gov/news/features/2020/an-unexpected-debut-aries-microgrid-infrastructure-powers-nrel-campus-through-outage.html>

# Summary

- Microgrid deployments continue to increase driven by resilience and clean energy, and requirements.
- Increased penetration of inverter-based resources results in challenging low-inertia environments.
- Multi-microgrids (networked) hold promise but will require new tools.
- Regulatory, policy, and technical advances need to support the overall environment for market incentivized microgrid growth.
- Time to build the energy internet 😊



# Thank You

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[www.nrel.gov](http://www.nrel.gov)

[gregory.martin@nrel.gov](mailto:gregory.martin@nrel.gov)

This work was authored in part by the National Renewable Energy Laboratory, operated by Alliance for Sustainable Energy, LLC, for the U.S. Department of Energy (DOE) under Contract No. DE-AC36-08GO28308. Funding provided by Department of Energy, Office of Energy Efficiency and Renewable Energy, Solar Energy Technologies Office and Office of Electricity, Microgrids Program. The views expressed in the article do not necessarily represent the views of the DOE or the U.S. Government. The U.S. Government retains and the publisher, by accepting the article for publication, acknowledges that the U.S. Government retains a nonexclusive, paid-up, irrevocable, worldwide license to publish or reproduce the published form of this work, or allow others to do so, for U.S. Government purposes.





PITKIN  
COUNTY

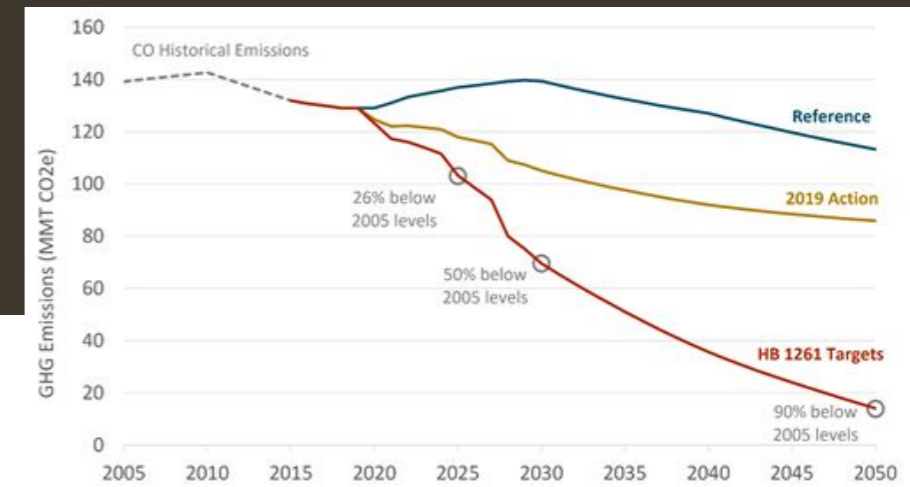
# Integrated Clean Energy System at the Aspen Airport Business Center

A Micro-Grid and Heating District System for Public Facilities



# A DOLA Funded Feasibility Study

- Assess conservation measures and the electrification of public facilities
- Investigate and plan the implementation of a Micro-Grid and Heating District linking the facilities
- Create an administrative framework for operation of the system and analyze the cost of implementation and maintenance

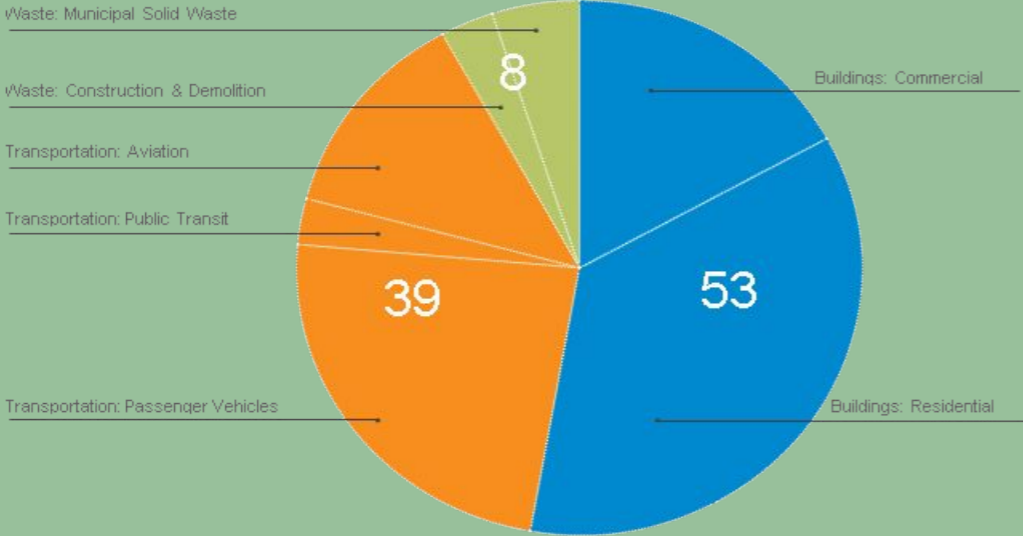


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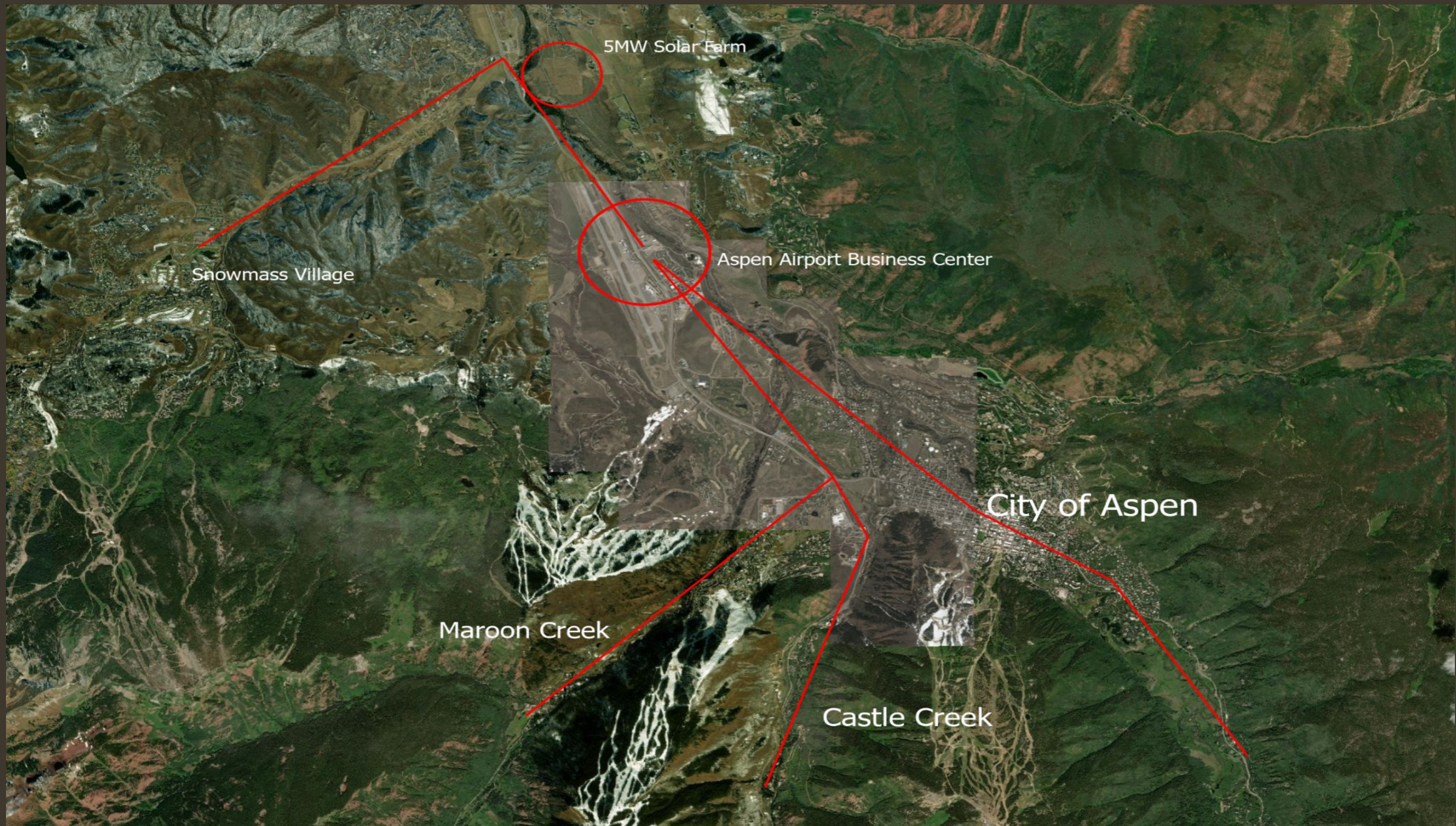
# The Lake Christine Fire



# Climate Action



<https://www.holycross.com/powerplus/>



5MW Solar Farm

Snowmass Village

Aspen Airport Business Center

City of Aspen

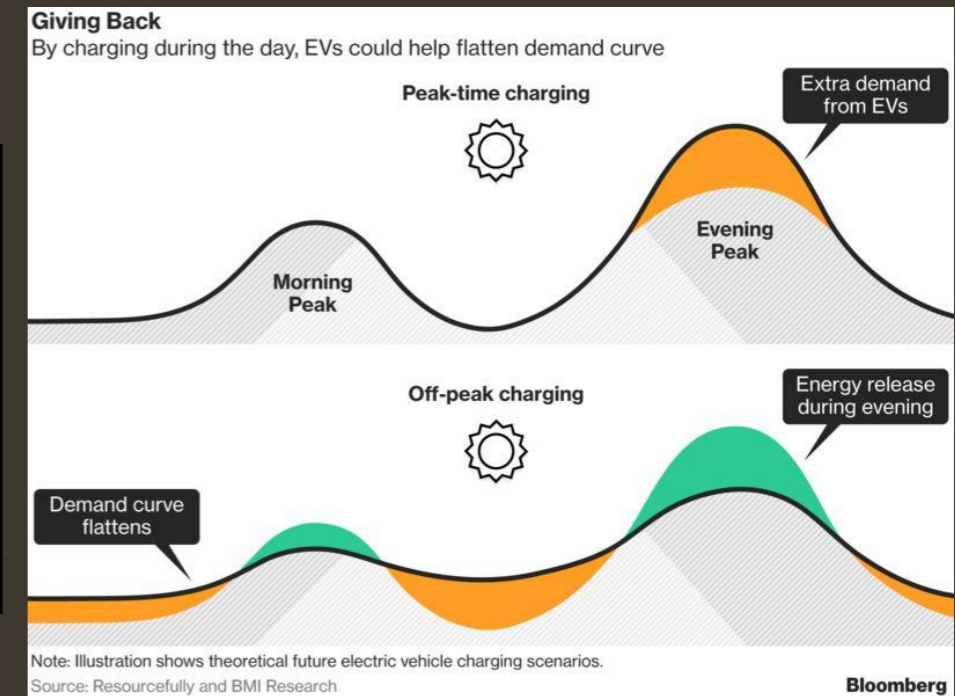
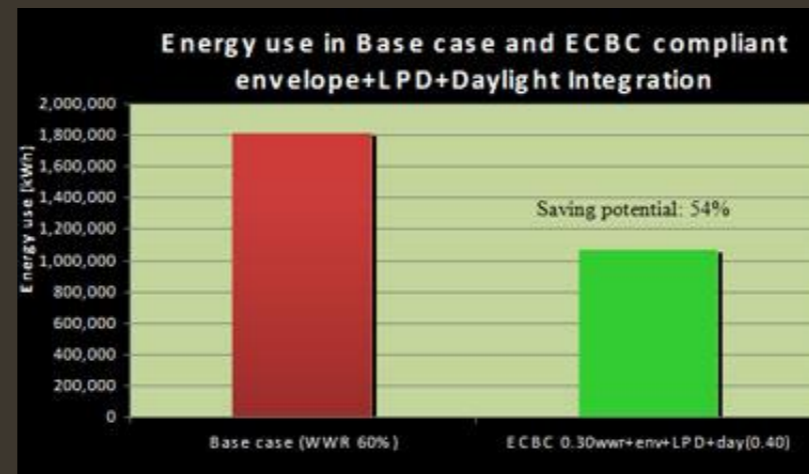
Maroon Creek

Castle Creek



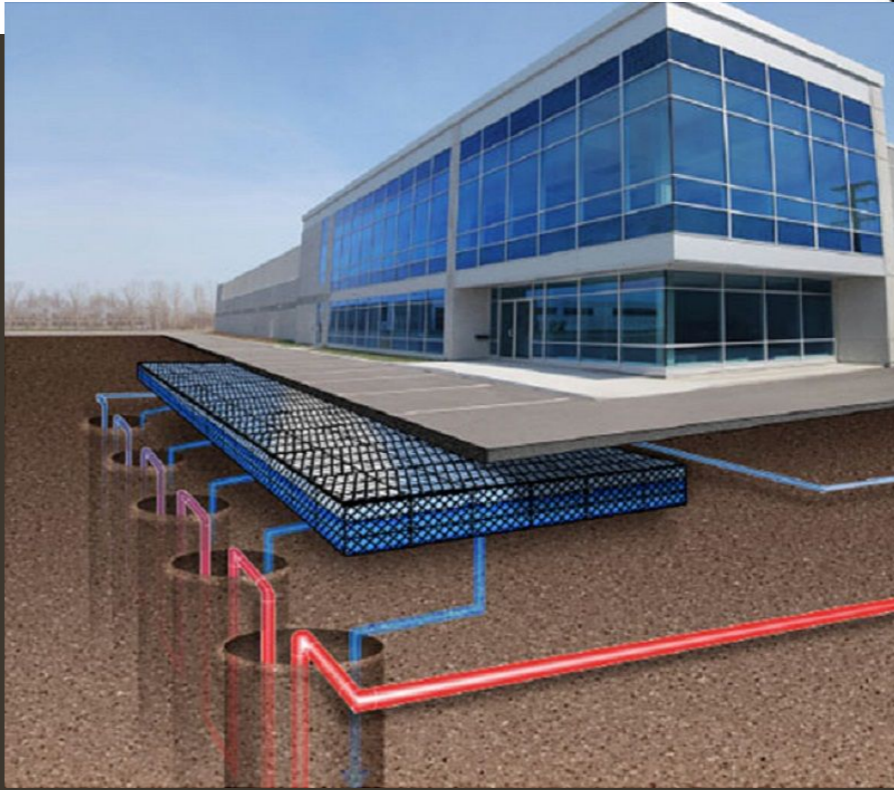
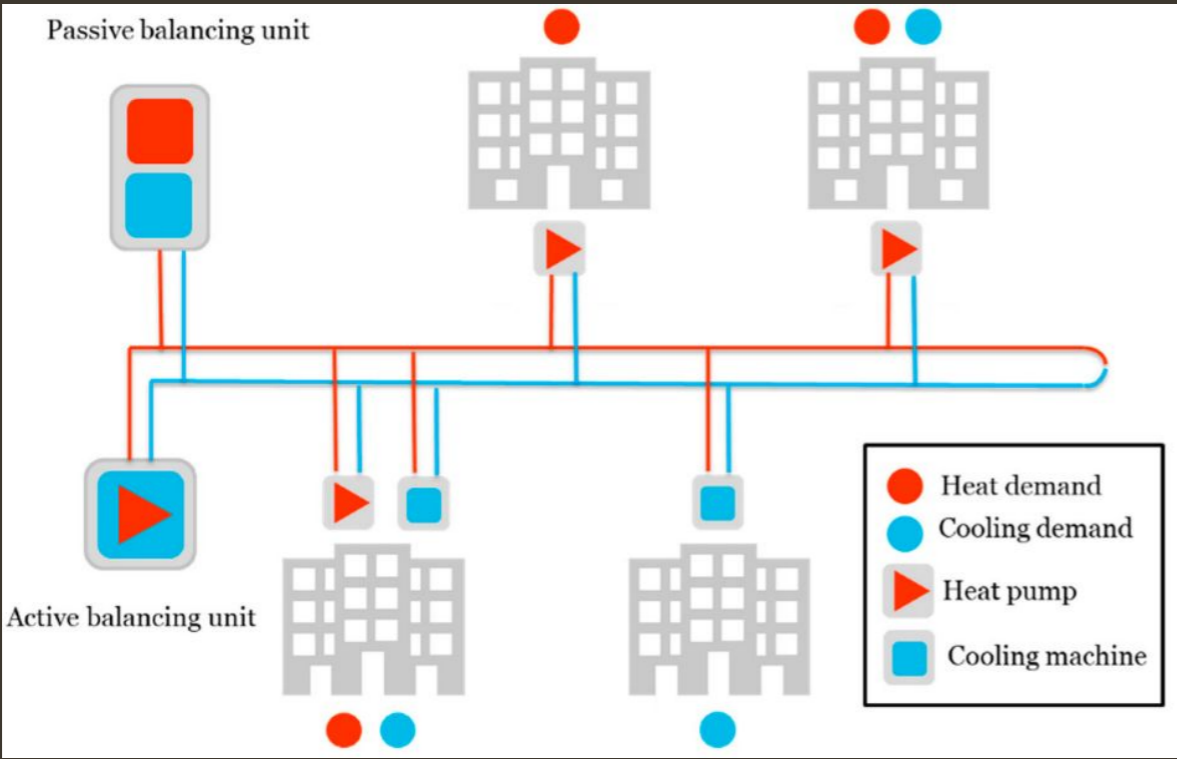
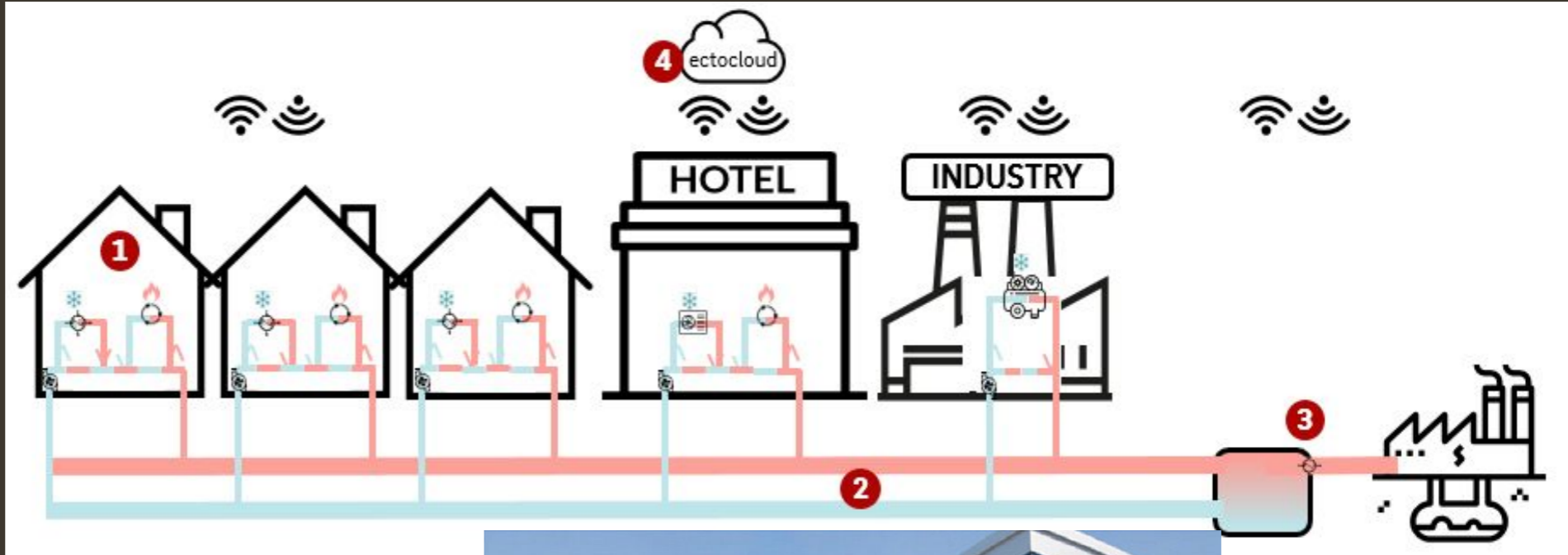
## Comprehensive Assessment of Conservation and Electrification Measures

- Renewable installation potential
- Electrification of all natural gas appliances
- Tightening of thermal envelopes
- Replacement of existing equipment with new high efficiency equipment
- Air heat pumps
- EV charging points
- Time of day operations





# Heating District



## Micro-Grid & Administrative Framework

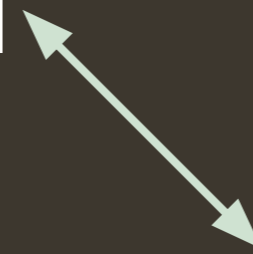
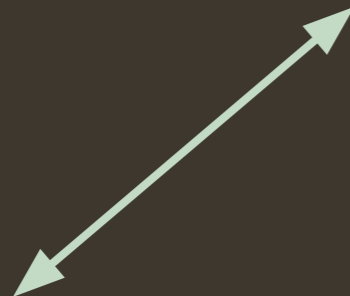
- Who has rights to a produced electron?
- How do we ensure continuity of operations in the event of an outage?
- Where can battery storage be located? (Red Circles)
- What new utility infrastructure is needed?
- How is the maintenance of the system managed and the costs distributed?
- What is the process for distributing electricity outside of the micro-grid?



Image from Anesco

# Unforeseen Difficulties

- Bureaucratic
- Ownership
- FAA
- Underpass Snowmelt
- COVID



# Microgrids

## *Building Resilient Infrastructure and Communities (BRIC) grant program*

### **Funding Caps**

The funding caps (federal share) for the BRIC program are as follows:

- **State/Territory Maximum Allocation and Activity Caps:** \$600,000
  - Up to \$300,000 may be used for mitigation planning and planning-related activities per applicant
- **Tribal Set-Aside Activity Caps:** The combined cost of the applicant's capability- and- capacity building activities under the Tribal Set-Aside must not exceed \$600,000 per applicant.
- **National Competition Cap:** \$50 million per subapplication

For additional information on funding caps, visit [FEMA.gov](https://www.fema.gov).

*Generally, the cost share for this program is 75 percent federal/25 percent non-federal.*



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# Microgrids

## Blue Lake Rancheria Tribe Microgrid



Humboldt Bay, CA  
FEMA Region IX

The Blue Lake Rancheria (BLR) is a Native American reservation located in an area subject to heavy rainstorms, forest fires, and frequent power outages. The reservation constructed a low-carbon community microgrid in 2017 to bolster its resilience to these outages. It helps power government offices, economic enterprises, and several Red Cross safety shelter-in-place facilities. The BLR microgrid integrates a solar array, battery storage, and control systems to allow the Rancheria campus to operate in tandem with, or islanded from, the main utility grid. This provides resiliency to the community because if the main grid experiences a power outage, the microgrid will automatically disconnect and go into island mode.

The system prioritizes clean generation, but if needed it will bring a 1-megawatt isochronous backup generator online to support the photovoltaic (PV) array and battery. The solar array also generates renewable energy regardless of whether or not it is in island mode, providing both carbon emission and electricity cost savings. The microgrid is projected to save \$150,000 a year and reduce 150 tons of carbon dioxide emissions annually.

### Addressed Hazards



### Innovative Energy Solution Tested and Proven in 2019

When a nearby wildfire caused a power outage in October 2019, the microgrid successfully islanded and kept the facilities from experiencing a blackout. During the outage, the microgrid served 10,000 people, about 10 percent of the county's population, and is credited with saving four lives.

### Leveraging Partnerships for Tribal Lifeline Resilience

By leveraging public and private partnerships, this project utilizes the latest in microgrid technology to mitigate cascading impacts to an entire tribal community.



Workers installing the racking for the Blue Lake Rancheria's 500-kilowatt solar system in June 2016. The solar system is a cornerstone of the tribe's low-carbon community microgrid project.

Source: U.S. Department of Energy Flickr <https://www.flickr.com/photos/37916456@N02/27365396111>

**Community Lifelines**  
Hover over the Primary Lifeline to learn more.



Safety & Security



Food, Water, Sheltering

**PRIMARY LIFELINE**



Energy (Power & Fuel)



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# Microgrids

## Blue Lake Rancheria Tribe Microgrid

### Details

#### Project Owner

The Schatz Energy Research Center and the Blue Lake Rancheria Tribe

#### Type of Project

Microgrid

#### Area of Impact

Over 10 percent of Humboldt County, CA  
(Total Pop: 136,754 in 2017)

### Cost

#### Total Project Cost

\$6.3 million

### Funding Sources

#### Non-Federal Funding

California Energy Commission R&D grant through Electric Program Investment Charge (EPIC) Program: \$5 million

The Blue Lake Rancheria: \$1.3 million

### Benefits

#### Primary

- Less frequent physical damage to system components, less frequent system outages from natural hazards, and better overall system performance and resiliency
- Targets a low-income community facing impacts from future conditions

#### Secondary

- Lower costs for meter reading and usage monitoring, social benefits associated with more reliable electric power, and better business continuity following major disasters that typically would have caused outages for several days or weeks

### Partnerships

- The California Energy Commission (major funder)
- The Blue Lake Rancheria (site host and major funder)
- Humboldt State University's Schatz Energy Research Center
- Pacific Gas & Electric (local utility)
- Siemens (Microgrid Management System [MGMS])
- Tesla (battery energy storage system)
- Idaho National Laboratory (testing and simulation)
- Robert Colburn Electric (electrical contractor)
- REC Solar (turnkey PV system)
- McKeever Energy & Electric (PV installation)

- GHD, Inc. (electrical engineering)
- Kernen Construction (civil construction for the project)

### Project Timeline

#### Start Date

100 percent design completed September 15, 2016; granted full permission to operate July 26, 2017

### ? Challenges Faced

- Challenges with installing new microgrid infrastructure over an existing built environment
- Need for electricians with institutional knowledge of existing systems

### Resources & References

- California Energy Commission. 2019. "California Energy Commission Final Project Report." January 2019. <https://www2.energy.ca.gov/2019publications/CEC-500-2019-011/CEC-500-2019-011.pdf>.
- Maloney, Peter. 2019. "Life Won Thanks to the Blue Lake Rancheria Microgrid," *Microgrid Knowledge*, November 11, 2019, <https://microgridknowledge.com/blue-lake-rancheria-microgrid-outages/>.
- REC Solar. 2017. "Blue Lake Rancheria Native American Reservation Microgrid Goes Live." April 27, 2017. <https://recsolar.com/press/blue-lake-rancheria-live/>.
- Schatz Center. 2020. "Blue Lake Rancheria Microgrid." Accessed March 16, 2020. <https://schatzcenter.org/blrmicrogrid/>.



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# Microgrids

## Bronzeville Microgrid Project



Chicago, IL  
FEMA Region V

The Bronzeville microgrid is a pilot project implemented by Illinois' Commonwealth Edison Company (ComEd) to keep power flowing in the event of an emergency and provide support for solar infrastructure for residents of the historic Bronzeville neighborhood in Chicago's South Side, including its vulnerable populations. The project includes 1,000 residences, businesses and public institutions. The Bronzeville Microgrid project is part of ComEd's broader Community of the Future initiative.

This project:

- Improves energy security, resilience to future conditions, and sustainability
- Provides grid modernization and "smart city" technologies to improve community livability
- Includes extensive stakeholder outreach and engagement within the Bronzeville community

### Technology-Driven Resilience Creates Community-Wide Benefits

A modern energy grid that uses "smart city" technology to mitigate risk across multiple community lifelines, and will reduce vulnerability for an entire neighborhood and the surrounding economy.



Bronzeville, Chicago metro stop station

Source: Shutterstock



Bronzeville, Chicago

Source: Shutterstock

### Addressed Hazards



PRIMARY HAZARD  
All Hazards



Inland Flooding



Winter Storms

### Community Lifelines

Hover over the Primary Lifeline to learn more.



Safety & Security



Food, Water,  
Sheltering



Energy  
(Power & Fuel)



Transportation



Communications



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# Microgrids

## Bronzeville Microgrid Project

### Details

#### Project Owner

Commonwealth Edison Company

#### Type of Project

Microgrid

#### Area of Impact

1,000 residences, businesses and public institutions

### Cost

#### Total Project Cost

\$29.6 million

### Funding Sources

#### Non-Federal Funding

Commonwealth Edison Company

#### Federal Funding

Federal grant funding of more than \$4 million to date from U.S. Department of Energy

### Benefits

#### Primary

- Reduces system outages from natural hazards
- Improves overall system performance, reliability, and resilience for customers within the service area, and potentially neighboring customer areas
- Provides more reliable electric service to the target customers, but also can provide better resiliency to neighboring customer areas that have not had microgrid systems installed

#### Secondary

- Enhances community livability associated with increased reliability in electric power
- Improves business continuity resulting from reduced outages and disruptions in electric power

### Partnerships

Chicago Housing Authority

(manages Dearborn Homes Community in Bronzeville)

Illinois Institute of Technology

Argonne National Laboratory

### Project Timeline

#### Start Date

Plan approved by Illinois Commerce Commission on February 28, 2018

#### Status

In progress

#### Project Completion Date

Targeted December 2020

### ? Challenges Faced

- Securing regulatory and stakeholder approval
- Ongoing community outreach to identify priorities and opportunities to leverage smart grid technology, address challenges and enhance quality of life
- Meeting requirements for a solar installation with a generation capacity of 750 kilowatts at Chicago's first public housing community

### Resources & References

Cohn, Lisa. 2019. "Solar Housing Linked to Bronzeville Microgrid Provides Social Justice, Technology Research." *Microgrid Knowledge*. June 14, 2019. <https://microgridknowledge.com/bronzeville-microgrid-social-justice-solar/>.

Commonwealth Edison Company. 2020. "Bronzeville Community Microgrid." Accessed March 16, 2020. <https://bronzevillecommunityofthefuture.com/project-microgrid/>.

Marotti, Ally. 2016. "ComEd gets \$4 million to build microgrid in Bronzeville," *Chicago Tribune*, January 26, 2016, <http://www.chicagotribune.com/bluesky/ct-comed-smart-grid-bronzeville-bis-20160126-story.html>.



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# Microgrids

*Building Resilient Infrastructure and Communities (BRIC)  
grant program*

*FY2020 BRIC:*

*DHSEM received 3 Microgrid Notice of Intent (NOI)  
C&C of Denver, Pitkin County and Energy Field Services  
Total funding: \$35,600,000.00*

*Difficulties:*

*FEMA approved Benefit-Cost Analysis (BCA) of 1.0 or above*



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# Q&A



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**Matt Arsenault**  
Mitigation Projects  
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Security & Emergency  
Management



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# *Upcoming Webinars*

## **Embedding Climate Equity in Your Community**

June 02, 2021

12 P.M. - 1 P.M.

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*THANK YOU!*



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