RESILIENTPOWER

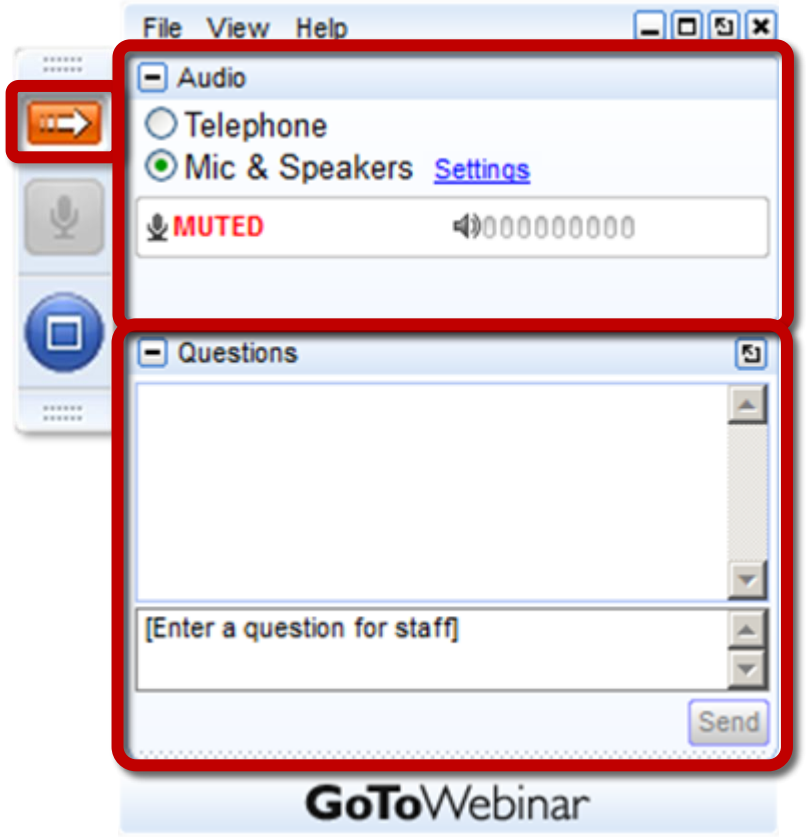
A project of CleanEnergyGroup

Resilient Solar+Storage for Cooling Centers

CleanEnergy Group

November 16, 2022

WEBINAR LOGISTICS



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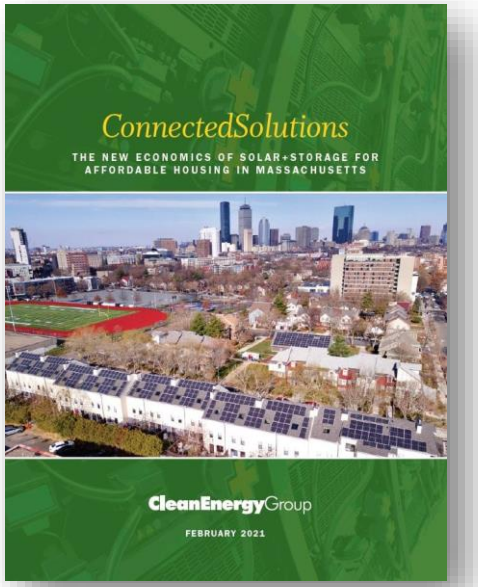
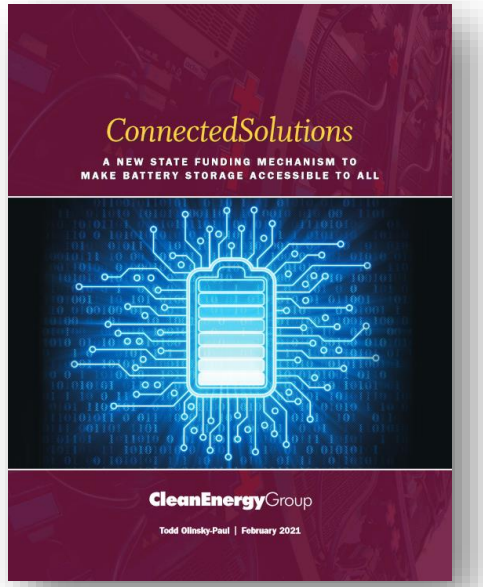
Clean Energy Group (CEG) works at the forefront of clean energy innovation to accelerate an equitable and inclusive transition to a resilient, sustainable, clean energy future.

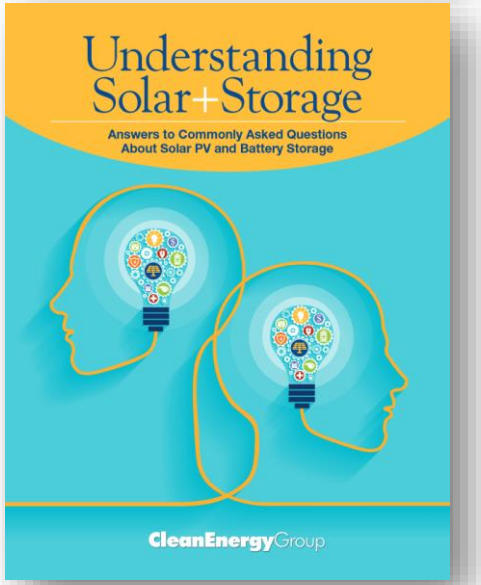
Visit www.cleanegroup.org to learn more about our current initiatives, recent publications, and upcoming events.

THE RESILIENT POWER PROJECT

- Increase public/private investment in clean, resilient power systems (solar+storage)
- Protect low-income and vulnerable communities, with a focus on affordable housing and critical public facilities
- Engage city, state and federal policy makers to develop supportive policies and programs
- Visit www.resilient-power.org for more information and resources







SUPPORTING 250+ PROJECTS ACROSS THE COUNTRY

Boulder: Nonprofit transportation center serving elderly and disabled residents

Boston: Multiple housing properties representing 1,000+ units of senior and affordable housing

DC: First solar+storage resilience center at affordable housing in DC

New Mexico: Added resilience for remote wildfire operations command center

Puerto Rico: Supporting the installation of solar+storage at multiple community medical clinics

RESILIENT POWER TECHNICAL ASSISTANCE FUND

Technical support to build local resilience

DONATE or APPLY: https://tinyurl.com/CEG-TAF

WEBINAR SPEAKERS

Nate Mills
Operations, American Microgrid Solutions

Nikki Lim
Executive Director, California Indian Museum and Cultural Center

Marriele Mango
Project Director, Clean Energy Group

Abbe Ramanan
Project Director, Clean Energy Group (moderator)

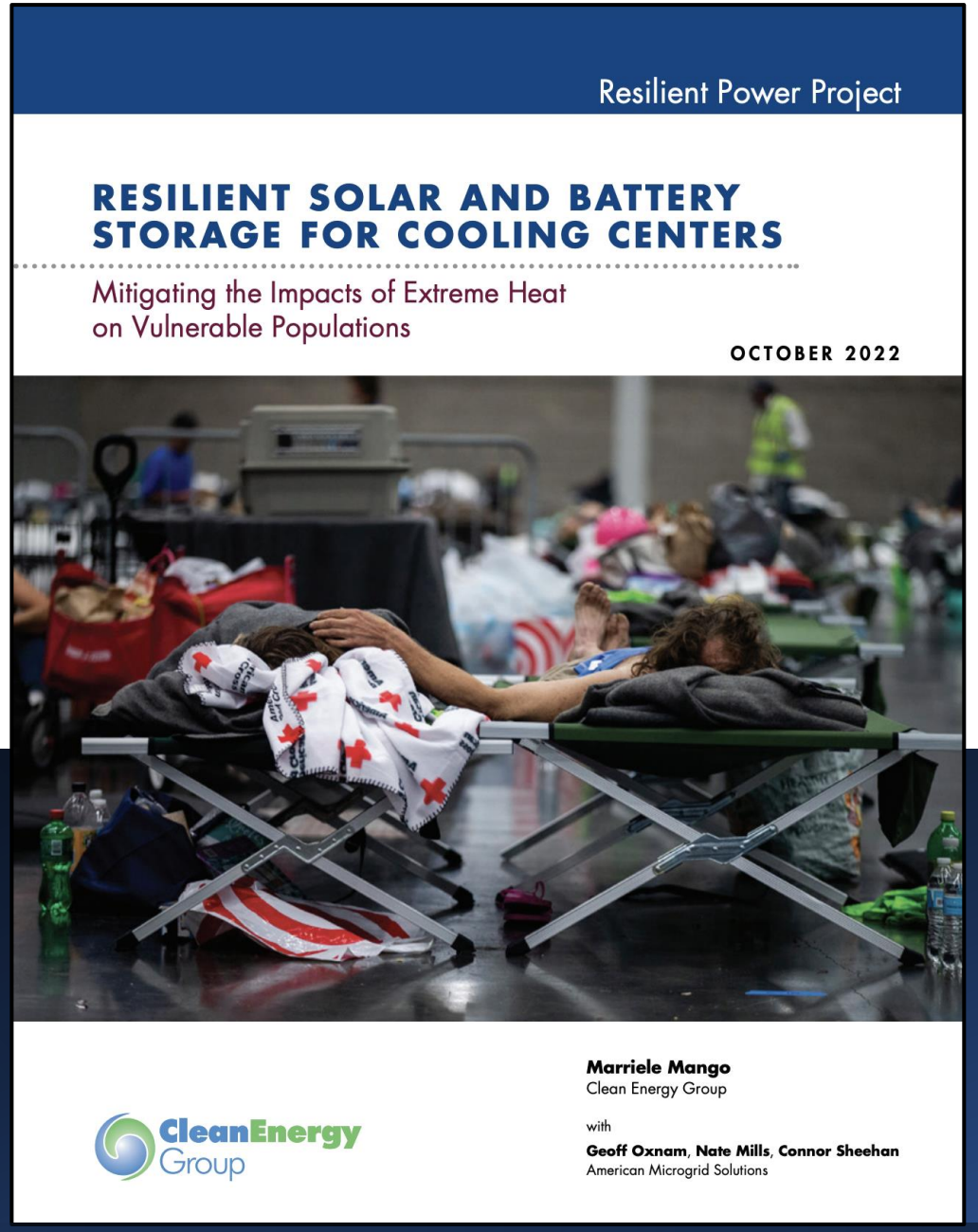
AMERICAN MICROGRID SOLUTIONS

CALIFORNIA INDIAN MUSEUM & CULTURAL CENTER

CleanEnergy Group

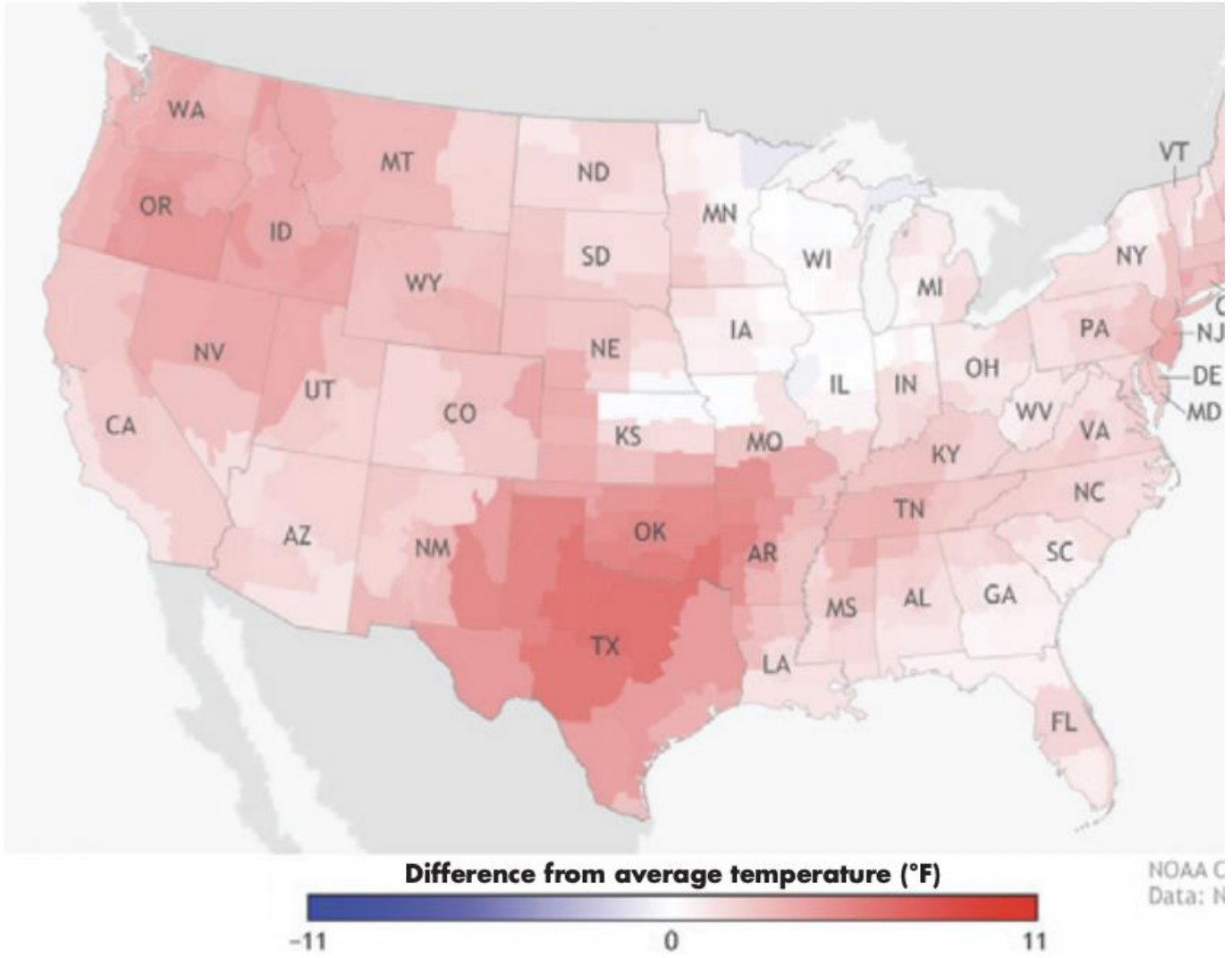
Resilient Solar and Battery Storage for Cooling Centers

Marriele Mango, Clean Energy Group



PUBLIC HEALTH: Extreme Heat and Power Outages

- Extreme heat ranks #1 for weather-related deaths
- Summer 2023: over 1/3 U.S. population under extreme heat warning
- One study predicts 1/4 of the country would be in the “extreme heat belt” by 2053
- 2020: U.S. households averaged a total of 8 hours of power outages
- Seniors, medically vulnerable, low-income and communities of color are most vulnerable



Heat map detailing increase from average temperatures across the continental US in July 2022 as compared to average July temperature from 1981–2010.

Photo: NOAA

COOLING CENTERS

What is a cooling center?

Cooling centers are air-conditioned buildings that are open to the public on extreme heat days.

How are cooling centers part of community preparedness planning?

Key to community preparedness and providing relief during high temperatures.

What happens when there is an outage?

Cooling centers must have access to reliable backup power to maintain operations

Image: People making use of a cooling center in Portland, Oregon during heat wave.

RESILIENT POWER - solar paired with battery storage - can support cooling center operations in the event of an outage

...without the climate, air quality, and reliability issues that come from using traditional diesel generators.

SITE 2

Community Center in the Mid-Atlantic

Facility Description: A large community center with multiple temperature zones that can be independently operated. This facility had personnel dedicated to building operations.

Resilience Goal: A cooling center to be established in a portion of the building. The building is 60,000 square feet, but the entire facility would not be used for a cooling center.

HVAC system: Multiple zoned rooftop units of varying sizes.

Considerations: This facility had an existing fossil-fuel-powered generator that was already set up to provide backup for a portion of the building. The generator would remain separate and support separate loads from the new solar+storage system. A major consideration was the reduction in resilient load because full building backup would have resulted in a prohibitively expensive system.

Constraints: The square footage to be used for the cooling center was identified, along with the HVAC units that serviced it, to minimize the amount of the building that needed support. The resilient load forecast was adjusted to reflect the reduced installation footprint, and an operational plan was put into place where the staff would monitor the indoor temperature, adjusting it to a higher minimum temperature before the battery started to run low to preserve as much power as possible.

Duration of Backup Power: 27 hours minimum, 72 hours typical. The objective, a minimum of 24 hours backup power, was met with a relatively large battery. The solar installation was enough to provide long-duration backup power throughout the year.

Site 2: Community Center	
Region: Mid-Atlantic	
Annual electricity consumption (kWh)	1,070,000
Ratio of backup load consumption to annual consumption (percent)	37%
Solar installation size (kWdc)	237
Annual solar production (kWh)	323,000
Ratio of solar production to backup load consumption (percent)	83%
Battery power (kW)	250
Battery capacity (kWh)	2000
Duration of backup power (Minimum) (hours)	27
Duration of backup power (Typical) (hours)*	72
Total solar+storage system cost	$2,160,000
Year 1 utility savings	$41,000
Annual operations and mainentance cost	$36,000
Net Present Value of installation (20-year at 6% discount rate)	($835,000)

* All typical results greater than 72 hours are capped at 72

CASE STUDIES and KEY TAKE AWAYS

- 7 facilities chosen based on geographic diversity and type of facility
  - Obstacles and opportunities specific to each region of the country and building type.
- All facilities were assessed through CEG's Technical Assistance Fund
- Trends became clear based on a review of all the sites and the standardized results, despite different locations and assessment results

Table 1

Original Study Results

	Site 1 Library	Site 2 Community Center	Site 3 Community Center	Site 4 Municipal Building	Site 5 Museum and Community Center	Site 6 Middle School Gymnasium	Site 7 Community Center
Region	**Southeast**	**Mid-Atlantic**	**Northeast**	**Southwest**	**West Coast**	**Northwest**	**Midwest**
Annual electricity consumption (kWh)	488,000	1,070,000	50,000	146,000	74,000	157,000	265,000
Ratio of backup load consumption to annual consumption (percent)	41%	37%	82%	37%	66%	100%	100%
Solar installation size (kWdc)	115	237	43	40	77	161	69.5
Annual solar production (kWh)	151,000	323,000	51,000	67,000	94,000	211,000	86,000
Ratio of solar production to backup load consumption (percent)	75%	83%	124%	124%	192%	134%	32%
Battery power (kW)	100	250	30	125	125	60	100
Battery capacity (kWh)	198	2000	60	250	220	240	165
Duration of backup power (Minimum) (hours)	3	27	3	28	33	3	2
Duration of backup power (Typical) (hours)*	12	72	51	72	72	52	6
Total solar+storage system cost	$182,000	$2,160,000	$194,000	$268,000	$557,000	$781,000	$513,000
Year 1 utility savings	$6,600	$41,000	$10,700	$9,500	$21,700	$13,400	$10,800
Annual operations and mainentance cost	$2,700	$36,000	$1,700	$3,300	$4,100	$4,900	$7,200
Net Present Value of installation (20-year at 6% discount rate)	($152,000)	($835,000)	($11,000)	($200,000)	($141,000)	($645,000)	($465,000)

* All typical results greater than 72 hours are capped at 72

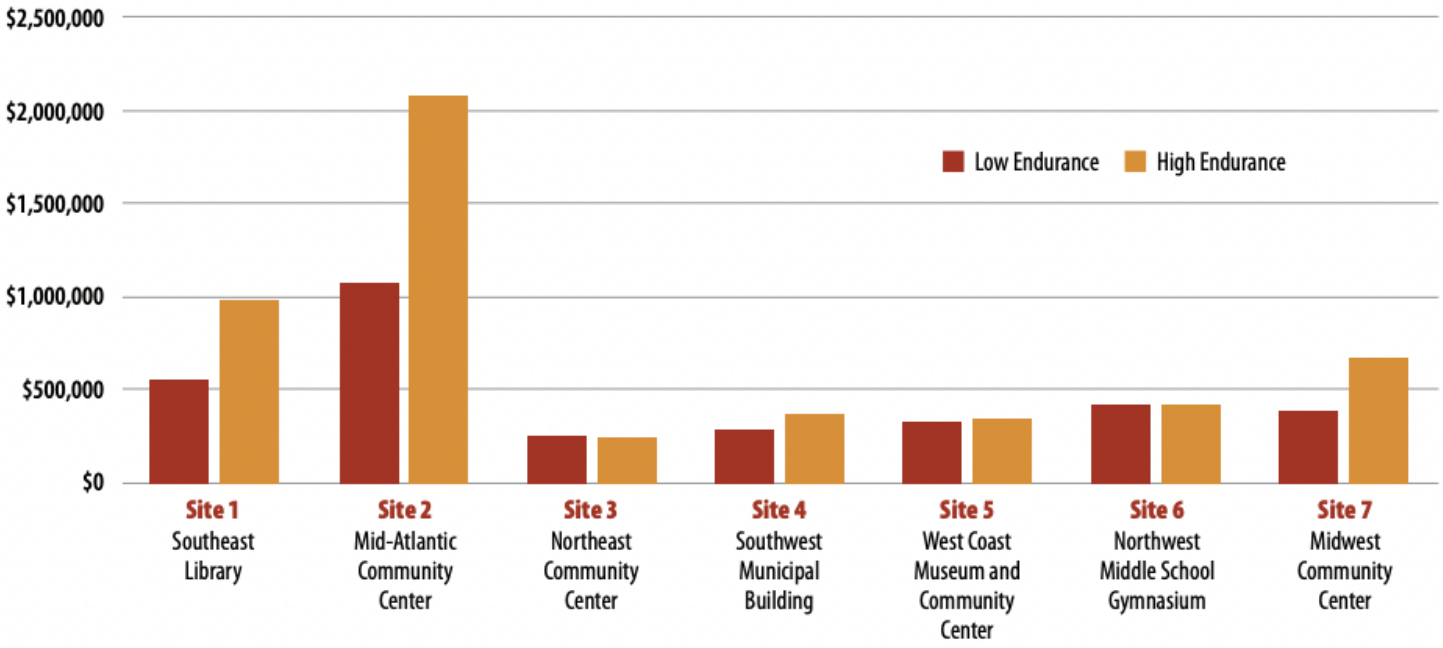
KEY TAKEAWAY:

Small to medium size facilities should consider investing in a larger battery as the total system cost differential is minimal versus the benefit of a significantly higher endurance.

Relationship between system cost and endurance

Figure 1

System Cost per Site: High Endurance vs. Low Endurance



NEED for TECHINICAL ASSISTANCE

- Limited staff capacity and lack of prior knowledge is the number one barrier to developing resilient power projects
- Pre-development feasibility analysis links organization to trusted allies who can provide independent background on solar+storage
- Provides clear picture of costs, ownership structures, and financial incentives to help with decision making and fundraising
- CEG provides ongoing support even after analysis is complete
- Solar+storage provide unique financial and resiliency benefits

Clean Energy Group Technical Assistance Fund

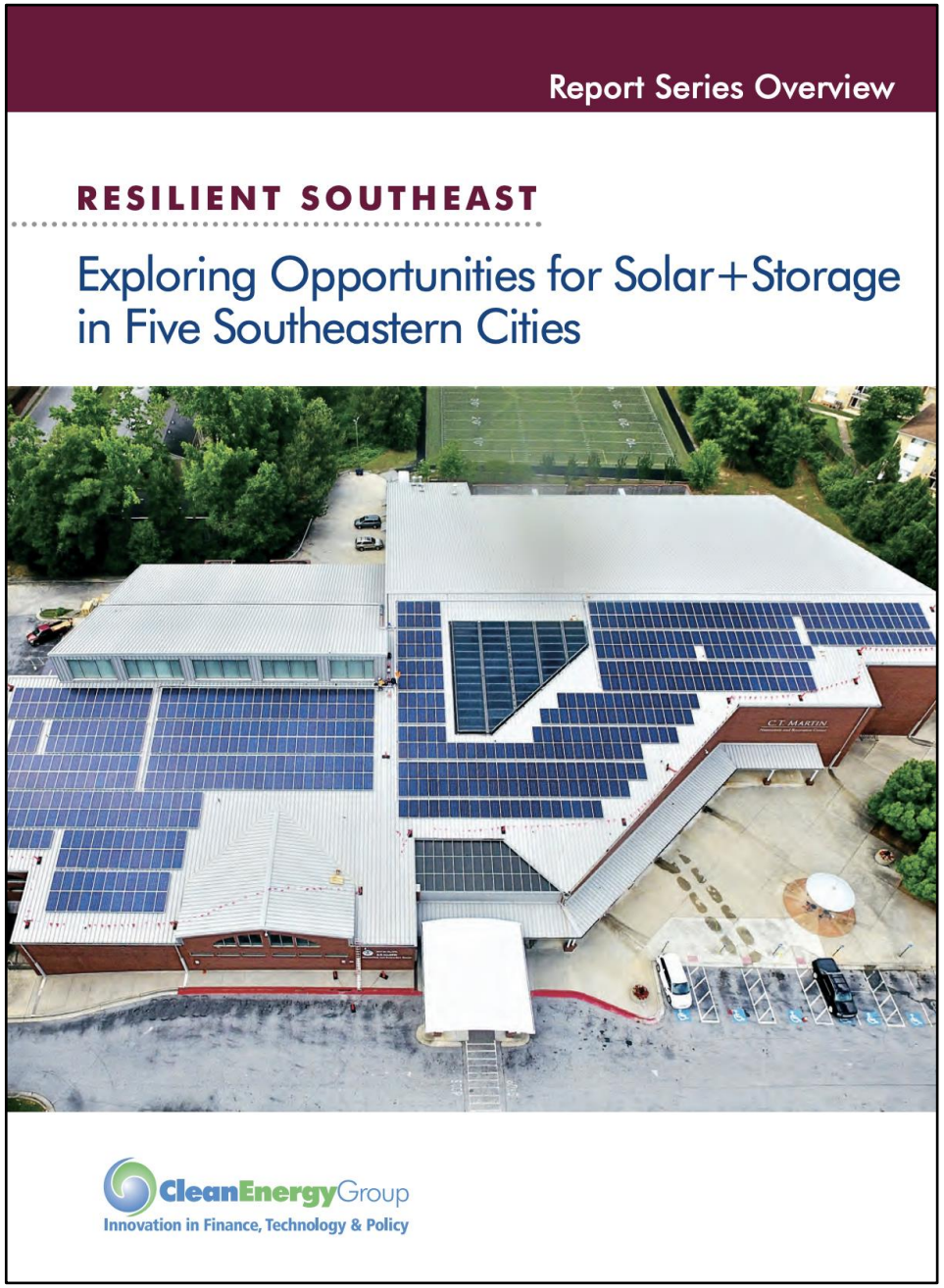
- Supports the development of clean energy projects aimed at decreasing energy burdens and increasing resiliency
- Funds preliminary technical and financial feasibility analyses to help determine size, cost, and benefits of solar, battery storage and other resilient energy technologies
- Grants range from $5,000 -$15,000 depending on scope of project
- Prioritizes projects serving low-income populations or Black, Indigenous, and People of Color (BIPOC) communities
- Low barrier to entry

OVERCOMING OBSTACLES for Solar+Storage Development in Critical Community Facilities

- State Policy
  - ConnectedSolutions program (MA)
  - Energy Storage Solutions program (CT)
  - Self-Generation Incentive Program (CA)

- Federal Investment Tax Credit
  - Updates to the Inflation Reduction Act

- Valuing Resilience



Marriele Mango, Project Director

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Cooling Centers and Resilient Power

November 2022

American Microgrid Solutions

Project Team

Geoff Oxnam, CEO & Project Lead
Geoff Oxnam is a microgrid specialist with more than two decades of experience in the energy sector. Geoff earned a BA in History from Williams College and an MBA from The Johns Hopkins University Carey Business School. Maryland Governor Larry Hogan appointed Geoff to chair the Maryland Clean Energy Center board of directors.

Nate Mills, Operations
Nate is a program management and leadership expert with over two decades of experience leading technically complex engineering efforts from design through construction. A former Navy officer, Nate holds a Naval Engineer's degree and an MS in Mechanical Engineering from MIT, an MS in Earth and Planetary Sciences from the University of New Mexico, and a BS in Geology from Cornell University.

Connor Sheehan, Project Management
Connor is a project manager and former Air Force logistics officer with experience working on projects with teams from around the United States and its allies. He was handpicked to serve in unique leadership positions with oversight on projects involving supply chain management, finance, and contracting. Connor is a decorated former collegiate athlete having won 3 championships playing Division 1 football while earning a BA in History of Science from Harvard University.

Drushti Rane, Project Analyst
Drushti is a Project Analyst with academic experience in utility scale energy modelling projects and expertise in data analysis. Drushti comes from a strong engineering background with a B.S in Aerospace Engineering from Florida Institute of Technology with over 100 hours of flight training experience working towards her Private Pilot License. Drushti also has a passion for sustainability and renewable energy technologies and holds a M.S in Energy Systems Management from the University of San Francisco where she worked on interdisciplinary projects on clean energy solutions.

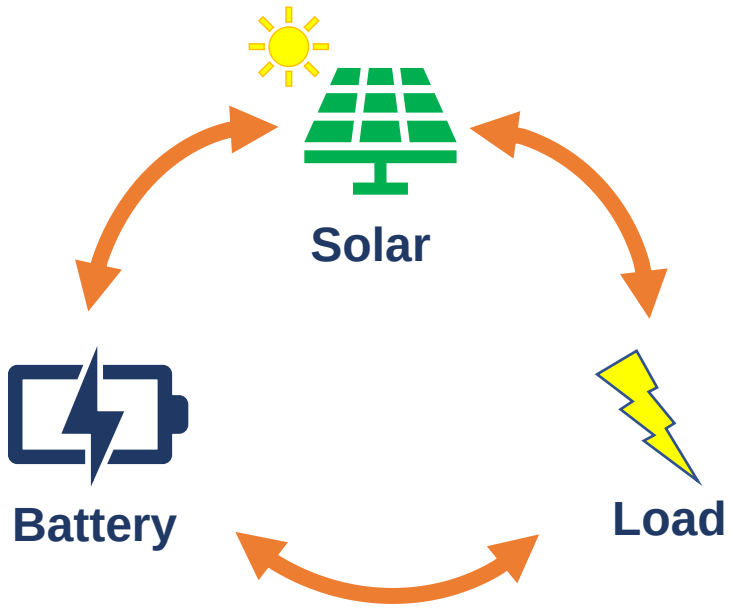
Resilience Determination - General

Solar installation

- Solar typically drives savings
- Maximizing solar is “good”
- Solar is most important for long-duration endurance

Battery Sizing

- Capacity is most important for short-duration endurance
- Expect diminishing economic returns with increasing size

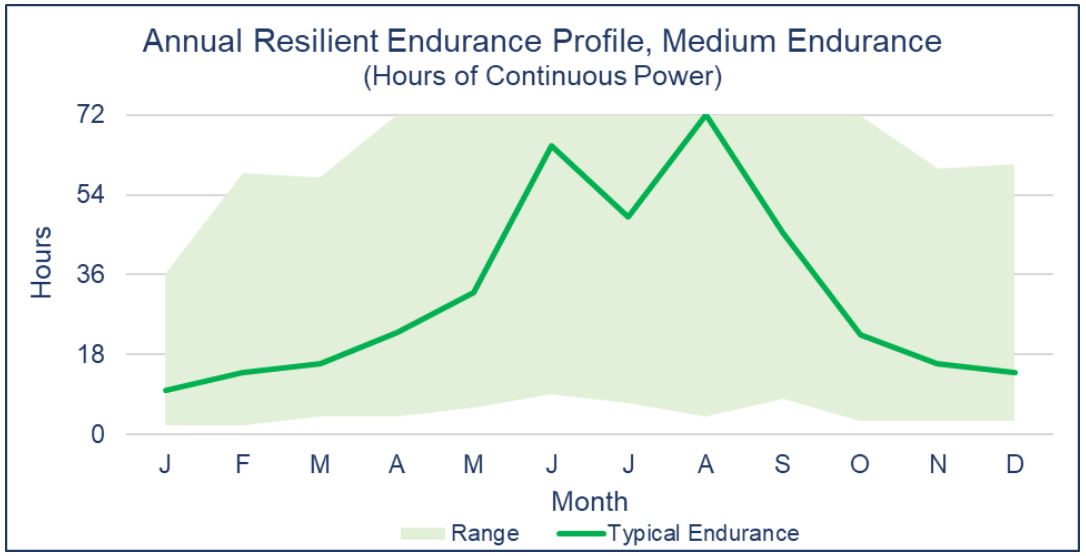


Load Considerations

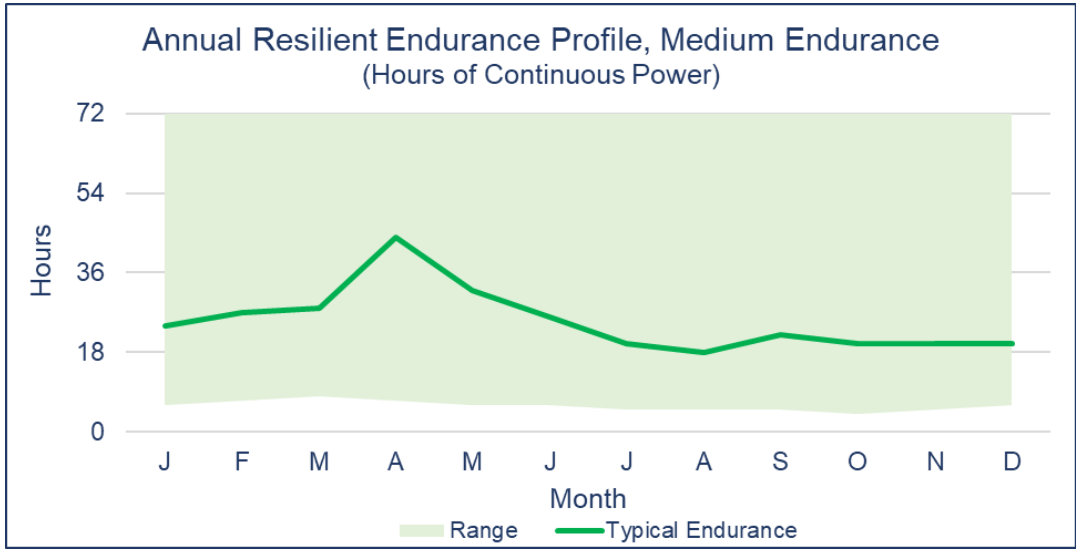
- More load = more capability
- Less load = longer endurance
- Consider manual vs automatic load shedding

Resilience Determination – Case Study Examples

Northwest



Southwest



Similarities:

- Size: 18,000 sqft
- Nominal load: 150,000 kWh / year
- Critical load: 50% of nominal
- Battery sized for 24 hour typical endurance

Differences:

- Solar: NW is 107 kW; SW is 40 kW
- Location: NW at higher latitude
  - Less efficient production per kW
  - Higher seasonal dependence

Cooling Considerations and Takeaways

Cooling Center Specifics

- Make an operational plan
  - What areas of the building will be used as the cooling center
  - Control of access, airflow, and setpoints
- HVAC type matters
  - Efficiency always wins
  - Zoning helps reduce critical load
- Building specifics make more of a difference than location

Takeaways

- Battery capacity drives the worst-case result
- Solar size drives the expected result
- Reducing load makes everything easier
- Seasonal and daily variations can be wide
- Accurate load predictions set expectations well
- Be wary of easy answers

Thank you for the opportunity to work with you on this Resilient Power project!

American Microgrid Solutions
Geoff Oxnam, CEO & Founder

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Resilient Solar + Battery Storage for Cooling Centers

Weaving Native Culture into the Future

CALIFORNIA INDIAN MUSEUM & CULTURAL CENTER

California Indian Museum and Cultural Center

The purpose of the California Indian Museum and Cultural Center (CIMCC) is to educate the public about the history, culture and contemporary life of California Indians and to honor their contributions to civilization.

Community Need

- CIMCC provides direct services annually to more than 200 native youth and families.
- In Sonoma County 19.6% of Native individuals have incomes below poverty level, about 40% of Native families earn less than $40,000.
- The unemployment rate for Native people is almost twice that of the Sonoma County population.
- Almost 22% percent of Sonoma County Native youth drop out of school compared to 10% of all youth. Only 18% of them are prepared to enter college.
- According to Portrait of Sonoma County (2021) Native peoples had substantially higher mortality rates for 2020 (38%) than they did in 2017-2019 on average.

Community Resources

CIMCC direct service programs seek to overcome disparities in income, career readiness, school achievement and health status. Many of these programs are offered under CIMCC's Resilience Hub, our long-term initiative to help Native peoples and communities in Sonoma County increase their resilience to climate change.

Tribal Youth Ambassadors Program: Engages youth ages 10 – 24 in project-based learning to address critical issues in their communities.

Native Arts Gift Store: Provides a centralized marketplace and special retail events for over 40 local Native artists and crafts people.

Advancing Cultural Opportunities to Reclaim Nutrition (ACORN): Native youth (ages 11 to 18) created and lead this social enterprise.

Resilience Hub Disaster Relief: Will provide services to 100+ vulnerable Native families during climate emergencies including wildfires, extreme heat days, and power outages. CIMCC is upgrading its facility with a resilient power system and high efficiency HVAC system affording it the ability to help families obtain power, communications, cooling/heating, cleaner air, and trauma-informed programs during emergencies.

COVID 19 Relief: Offers healthy and traditional food assistance, cash assistance, utility assistance and other aid to Native families in need.

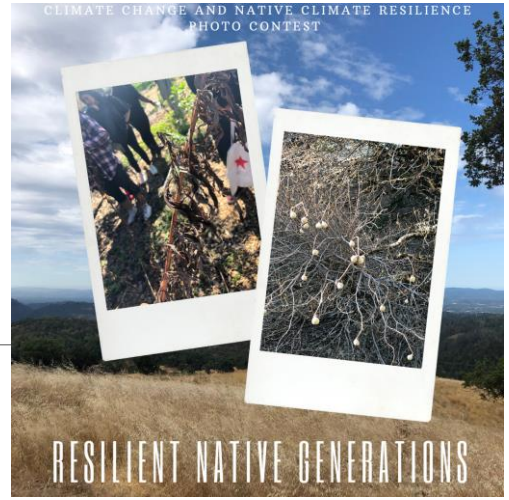
California Indian Traditional Food Incubator and Hub: Provides business development assistance to emerging and established Native Traditional Food Producers (TFP) to help them start-up and/or expand successful micro- and small businesses.

Healing through Cultural Arts Wellness Workshops: These workshops serve Native peoples with monthly cultural arts hands-on activities to help them address the trauma and cultural losses they experienced in wildfires and to keep them culturally connected during the pandemic. Over 400 participants served from 2020 to 2022.

Climate Emergencies

Our goal is to increase the climate resilience of CIMCC and our Native audiences. The objective is to complete CIMCC's resilient power system by adding battery storage to supplement our rooftop solar array, by October 31, 2023. The purpose of the project is to be able to maintain disaster relief operations in our 24,000 square foot facility for up to 3 days during climate emergencies in order to protect the health and welfare of Native families (especially those with young children and elders). Climate emergencies include but are not limited to extreme heat days, wildfires, floods, and pandemics.

Resilient Native Generations



2019 Community Needs Assessment Findings:

- Protection and perpetuation of cultural and natural resources and the related issues of traditional food security and clean water.
- People seek to advance Native environmental knowledge and practices as key to resilient lands and waterways.
- People want to learn about and acquire clean energy resources to reduce their carbon footprints, keep pace with changes occurring locally in building codes and better weather the grid shutdowns being undertaken by the public utility to prevent wildfires.
- People expressed the need for CIMCC to develop a resilient power system so that a culturally relevant and safe refuge for Native people is available in emergencies and to spur equity in emergency preparedness resources.
- Additional research about our vulnerable community members was requested and people suggested that a plan be developed and shared with others to promote resource equity in a region where very little funding goes toward Native resilience needs.

Climate and Community Vulnerabilities

Native peoples and communities are experiencing repeated catastrophic wildfires and extreme heat and drought from climate change in concurrence with a global pandemic.

Rolling blackouts and multi-day public power safety shut-offs. The shut-offs (up to 7 days in 2020) are challenging for all community members and especially hard for certain groups, particularly when coupled with dangerous air quality conditions and COVID 19.

Elders and others with health conditions who need to power medical equipment and/or keep medicines refrigerated are at extreme risk.

With the high rates of asthma, heart conditions and other chronic diseases in our communities, peoples' need for clean air is critical.

To add to this, those who cannot afford air conditioning are exposed to extreme heat and the associated health risks.

Moreover, when the grid goes down peoples' ability to stay connected during emergencies is greatly diminished when they lose Internet service and can't charge their phones. Less than half of 1% of Native people in our region has solar and even fewer have resilient power such as solar+battery storage.

Climate emergencies pose risks to the vitality of Native cultures!

Native peoples are already hindered in their abilities to tend to their places and secure traditional foods and medicines to improve their health status because of structural inequities arising from colonization.

Extreme heat and drought are impacting traditional food systems by causing plants and animals to migrate to other areas and/or not thrive in their current places.

Catastrophic wildfires produce massive amounts of ash laden with toxins such as heavy metals, plastic, and asbestos from burning structures and vehicles. The toxic ash contaminates the soil and is washed into aquatic and drinking water systems with the winter rains, and can permeate traditional food systems.

The ocean is become more acidic from greenhouse gases impacting the ability of fish, shellfish and sea mammals to survive.

CIMCC Resilient Power System

74.25 kW Rooftop Solar Array

125 kW/220 kWH Battery Storage – 72 hours of operation

High Efficiency HVAC System

Traditional Food Incubator

Reduced energy costs of $21,700 annually

Off set 68 metric tons of carbon per year

Provide services/Remain in operation up to 3 days during Public Power Safety Shut Offs, Wildfires and Poor Air Quality to provide direct services

Culturally relevant facilities, equipment, training, technical assistance, policy advocacy for traditional local food systems

Challenges

Resilience Hub Designation

Battery Contracting and Funding

SGIP Application

Permitting and Equipment

Partnerships (education, trust, outreach)

Forecasting Emergency Needs

Contact Information

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Thank you for attending our webinar

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Upcoming Webinars

- Behind-the-Meter Energy Storage: Comparing State Policies (11/17)
- Energy Storage in the Southwest: Battery Case Studies from Albuquerque Public Schools and the Navajo Tribal Utility Authority (12/1)
- California's Solar for Multifamily Affordable Housing Program: Effective Collaboration for Equitable Solar (12/2)
- State Leadership in Solar+Storage, Featuring Maryland and Oregon (12/9)
- Environmental Justice Strategies for Hydrogen Opposition (12/15)
- New Federal Money for Energy Storage: The Inflation Reduction Act (12/16)

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