

Batteries 101, Part 1: An Introduction to Energy Storage and Massachusetts' Battery Storage **Programs and Policies**

May 15, 2024

www.cleanegroup.org | www.cesa.org

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Affordable, reliable, clean energy for all.



Climate Resilience and Community Health



Distributed Energy Access and Equity

www.cleanegroup.org





Energy Storage and Flexible Demand

Fossil Fuel Replacement



Resilient Power Project

Building the foundation for energy resilient communities.



www.resilient-power.org



Rooftop solar installation in Dorchester, MA. Credit: Resonant Energy





The Clean Energy States Alliance (CESA) is a national, nonprofit coalition of public agencies and organizations working together to advance clean energy.

CESA members—mostly state agencies include many of the most innovative, successful, and influential public funders of clean energy initiatives in the country.

Celebrating 20 Years of State Leadership CleanEnergy States Alliance

www.cesa.org

CleanEnergy States Alliance



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Energy Storage Technology Advancement Partnership (ESTAP)

Conducted under contract with Sandia National Laboratories, with funding from US DOE Office of Electricity.

Facilitate public/private partnerships to support joint federal/state energy storage demonstration project deployment

Support state energy storage efforts with technical, policy and program assistance



Disseminate information to stakeholders through webinars, reports, case studies and conference presentations

www.cesa.org/ESTAP



Energy Storage Policy for States

Providing support to CESA members engaged in developing energy storage policy, programs and regulation.

Activities include knowledge sharing, direct policy support, and independent analysis.

The project leverages other CESA and CEG efforts, including ESTAP and CEG's Resilient Power Project.

www.cesa.org/projects/energy-storagepolicy-for-states/

Clean Energy States Alliance

Webinar Speakers Batteries 101, Part 1: An Introduction to Energy Storage and Massachusetts' Battery Storage Programs and Policies



Todd Olinsky-Paul

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Melissa Mittelman

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Tom Ferguson Manager

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Sarah Cullinan

Senior Director, Net Zero Grid Program Massachusetts Clean Energy Center



Energy Storage 101 Webinar Series Outline

Webinar 1: Introduction to Energy Storage

- What is energy storage? What are lithium-ion batteries?
 - Utility scale
 - Residential/commercial scale
- Why is storage important?
 - Role of battery storage in Massachusetts decarbonization plan
 - Resilience
 - Other applications
- Economic landscape for storage State and federal incentives, market opportunities

Webinar 2: Energy Storage Benefits and Applications

- Fossil fuel peaker plant replacement
- Energy and environmental equity
- Grid benefits
- Resilience

Energy Storage 101 Webinar Series Outline (continued)

Webinar 3: Considerations for Battery Siting

- Fire safety
- Environmental considerations
- Security

Webinar 4: Municipal Considerations for Battery Installations

- Siting
- Permitting
- Planning
- Zoning
- Municipal best practices

NOTE: This well purposes only. We will answer prioritizing que residents or ab

NOTE: This webinar series is for informational purposes only.

We will answer as many questions as possible,

prioritizing questions from Massachusetts

residents or about Massachusetts-specific topics.



May 15, 2024

Energy Storage 101: Some Basics



Todd Olinsky-Paul Senior Project Director Clean Energy Group Clean Energy States Alliance todd@cleanegroup.org

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CleanEnergy States Alliance



We are good at storing everything... except electricity!



Why Energy Storage? **Climate and Decarbonization**

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Total U.S. Greenhouse Gas Emissions by Economic Sector in 2021 (US EPA)







US Billion-Dollar Disaster Events 1980-2021 (NOAA **National Centers for Environmental Information**

Our Electric Grids are Changing!

Old Power Grid (world's biggest just-in-time delivery system)



Modern Power Grid (decentralized, flexible, resilient, highly variable)

Dispatchable Generation -AND-Variable (renewable) Generation



- One-way power flow •
- Generation must equal • consumption in real time
- Overbuilt to accommodate • peak demand
- Cannot handle too much ٠ variable (renewable) or distributed generation
- Vulnerable to outages •

Variable Demand -AND-Variable Generation

US electric generation vs energy storage capacity



1 Terawatt = 1 million Megawatts

Global operational energy storage (MW) 2020



Energy Storage Performance Ranges



Battery Technologies and their Energy Densities

Energy Density





Abbreviation	Name
VRFB	Vanadium Redox Battery
Lead Acid	Lead Acid
NiCd	Nickel Cadmium
NiMH	Nickel Metal Hydride
LTO	Lithium Titanate
LFP	Lithium Iron Phosphate
LMO	Lithium Ion Manganese Oxide
NMC	Lithium Nickel Manganese Cobalt Oxide
LCO	Lithium Cobalt Oxide
NCA	Lithium Nickel Cobalt Aluminum Oxide
Zn-MgO2	Zinc Manganese Oxide
NaNiCl2	Sodium Nickel Chloride (Zebra)
NaNiCl2	Sodium Nickel Chloride (Zebra)

Energy storage sizes

Residential Scale

Example: 13.5 kWh



Example: 126 kWh



Utility Scale

Example: 8 mWh

Commercial/Industrial Scale



Tesla Battery Pack: 85 kWh



http://insideevs.com/look-inside-a-tesla-model-s-battery-pac/ http://club.dx.com/forums/forums.dx/threadid.457734



A system like this 20MW/80MWh utility-scale battery in Mira Loma, California requires at least 6.7 million of these 18650 cells

7,104 cells



Currently, global battery production is driven by the electric vehicle industry.

18650 cell format used in 85 kWh Tesla battery



Thank You



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EMPOWERING RURAL COMMUNITIES WITH SOLAR+STORAGE HARNESSING RESILIENT POWER FOR HEALTH, EDUCATION, AND ECONOMIC DEVELOPMENT



www.solarvillageproject.org

AGENDA

Exploring Solar+Storage Solutions for Rural Communities



Introduction Short History of SVP Our Work in Puerto Rico Women in the Solar Workforce Micro-Finance for Homes and Businesses Fundraising and Grant Strategy Micro-Finance Investors Investor Returns Sketch Replicating Our Work What We Need $Q \otimes A$ Session

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SHORT HISTORY OF SVP

- expansion.

• Founded with a vision to combat energy poverty and climate change.

• Distributed over 6,000 solar lanterns, powering 70 rural schools and clinics, thereby enhancing livelihoods in rural villages. Additionally, we have powered 150 homes through microfinance initiatives.

• Impact: Empowering communities with clean energy for health, education, and economic development.

• Expansion efforts: From India to Puerto Rico, with plans for further global

THE IMPACT

Transforming Communities through Sustainable Energy Solutions









Increased access to education: Students benefit from extended study hours and an improved learning environment with access to digital tools

Improved healthcare services: Clinic equipped with solar power for medical equipment.

Community Resilience: Solar + Battery Systems for Uninterrupted Power During Grid Outages and Emergencies.



SOLAR INITIATIVES IN PUERTO RICO

- efforts.

• Post-Hurricanes Maria and Irma, we swiftly responded by shipping solar lights to various organizations across Puerto Rico, aiding in immediate relief

• Collaboration with Local Organizations: Built on initial relief efforts by partnering with local grassroots organizations to install solar arrays on community centers, enhancing long-term resilience and energy independence.



SVP IN PUERTO RICO

- Bringing sustainable energy solutions to Puerto Rico.
 - Providing sustainable and affordable power for homes, schools, and community centers.
 - Improving energy access and fostering education, healthcare, and economic development.
 - Establish disaster relief resilience centers.
- Objectives and Progress.
 - Enhancing energy resilience, reducing dependency on fossil fuels, and empowering communities.
 - Successful completion of 4 solar electrification projects, impacting numerous communities.





DISASTER-RESILIENT PARTNERSHIPS

- Solutions:

• Importance of Disaster-Resilient Power

• Ensuring reliable power supply during emergencies and natural disasters. • Enhancing community resilience and preparedness for future challenges.

• Partnerships and Community Involvement: • Highlighting collaborative efforts with Solar United Neighbors (SUN) and local mutual aid groups. • Demonstrating the power of collective action in advancing sustainable energy solutions in Puerto Rico through these strategic partnerships.

RECENT INITIATIVES AND FUTURE DIRECTIONS IN PUERTO RICO

- Recent Successes:
 - Deployed an 8 kW solar system with battery storage at Buen Pastor Clinic, enhancing healthcare reliability in partnership with SUN.
- Ongoing Assessments:
 - Continuously assessing needs to identify highimpact opportunities for future solar projects in community centers and schools.



EMPOWERING WOMEN IN THE SOLAR WORKFORCE

Promoting Gender Equality and Community Development





TRAINING INITIATIVES

Impact on Gender Equality and Community Development

- development.

• Training programs tailored to women, focusing on technical installation and sales roles within the solar industry.

• Providing women with essential skills and opportunities for career advancement in traditionally male-dominated sectors.

• Promoting gender equality by breaking down barriers and challenging stereotypes within the solar workforce.

• Enhancing family income and economic empowerment through increased female participation, leading to broader community

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SOLAR MICROFINANCE

- Micro-Finance:
 - For Homes and Small Businesses: Small loans facilitate solar installations with flexible repayment terms tailored to the borrower's income.
 - Enhanced Energy Independence: Battery storage allows for surplus solar energy storage, ensuring reliable power during outages and peak times.



MICROFINANCE IN ACTION

Empowering Homeowners with Accessible Solar Financing









Empowering Communities: Microfinance enables access to reliable and sustainable power solutions, transforming lives and livelihoods in rural areas.

Energy Accessibility: Microfinance helps individuals and communities gain access to clean energy technologies, enhancing their quality of life and economic opportunities.

Sustainable Development: Microfinance facilitates the adoption of solar power, promoting environmental sustainability while addressing energy poverty in underserved areas.



MICRO-FINANCE INVESTORS: EMPOWERING SOLAR SOLUTIONS

• Strategic approach: Highlighting social impact and financial returns.

• Outreach efforts: Showcasing scalability, sustainability, and positive outcomes.

• Investors provide crucial funding, while communities benefit from clean energy and economic empowerment.

INVESTOR RETURNS BALANCING PROFIT WITH PURPOSE

- Financial and Social Returns:
 - Investors in the Microfund see both financial returns, provided through an annual ROI, and social returns, contributing to combating energy poverty and climate change.
- Impact Investment Model:
 - The Microfund operates on an impact investment model, balancing profit with purpose. It targets energy poverty and climate change in rural India by financing solar system installations, delivering sustainable energy, and reducing carbon emissions.



COMBATING ENERGY POVERTY IN AMERICA

• Energy Burden in the U.S.:

 1 in 7 families live in energy poverty, struggling with the high cost of electricity and fuel.

• Impact of Energy Poverty:

• In 2020, nearly 34 million households sacrificed essentials like food or medicine to pay energy bills.

Energy Burden among Extremely Low-Income Households

Across the country, extremely low-income households face disproportionately high energy burdens.

Average energy burden





*Rocky Mountain Institute



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ENHANCING ENERGY RESILIENCE IN MARGINALIZED COMMUNITIES



The Impact Of Solar + Storage





• Essential Energy Access:

- Small-scale solar systems (1-2 kW) with battery backup designed to meet critical power needs.
- Enables access to essential services like lighting, refrigeration, and communication in under-resourced communities.

Impact Over Cost:

- Focus on providing reliable power sources to enhance community resilience, especially during emergencies or grid failures.
- Prioritizes impactful benefits over mere cost savings.

EMPOWERING UNDER SERVED COMMUNITIES **IN AMERICA** WITH SOLAR

Lessons Learned and Steps for Replication

Potential for Solar Projects

- development, and resilience.

Steps and Resources

- and assessment.
- and stakeholders.
- implementation.
- up initiatives in rural America.

• Solar projects have significant potential in US rural areas, offering opportunities for clean energy adoption, economic

• Lessons learned from Solar Village Project's (SVP) experience can inform and guide similar initiatives in rural America.

• Identify community needs and priorities through engagement

• Develop partnerships with local organizations, governments,

• Access resources such as funding opportunities, technical assistance, and training programs to support project

• Leverage SVP's expertise and resources to kickstart and scale 16

CURRENT NEEDS

- Financial support to fund ongoing projects and expand our initiatives.
- Equipment donations to enhance our capabilities and reach more communities.
- Expertise in areas such as renewable energy, project management, and community engagement to drive our mission forward.

- Get involved: Volunteer your time and skills to support our projects and initiatives.
- Donate: Make a contribution to help us continue our work in combating energy poverty and climate change.
- Partner: Collaborate with us to leverage resources and expertise, amplifying our impact and reach.
- Soliciting support from donors and investors, including both individuals and corporations, for outreach efforts.

CALL TO ACTION

SVP **RESOURCES: JOIN US IN MAKING A** DIFFERENCE

Website, Videos, Donations, and Contact Information

- Visit our website: www.solarvillageproject.org
- Watch our videos: SVP Youtube Channel
- Support us:

https://solarvillageproject.org/take-action/

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THANK YOU FOR ATTENTION

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