RESILIENT POWER

A project of CleanEnergyGroup

Resilient Power Retrofit: How a Minnesota Nature Center Became a Solar+Storage Community Shelter

October 19, 2016

CleanEnergyGroup

Innovation in Finance, Technology & Policy

Housekeeping

All participants are in "Listen-Only" mode. Select "Use Mic & Speakers" to avoid toll charges and use your computer's VOIP capabilities. Or select "Use Telephone" and enter your PIN onto your phone key pad.

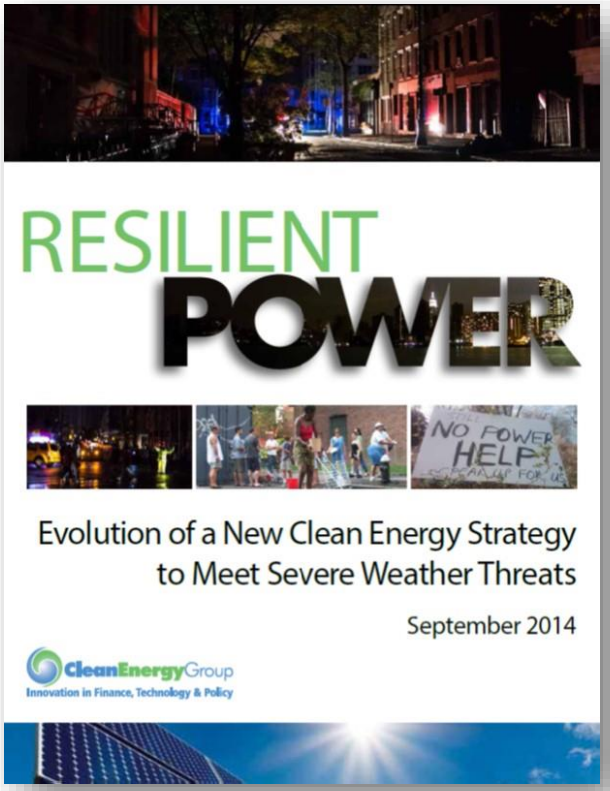
Submit your questions at any time by typing in the Question Box and hitting Send.

This webinar is being recorded.

You will find a recording of this webinar, as well as previous Resilient Power Project webinars, online at:

www.resilient-power.org

Who We Are



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Meridian Institute
Connecting People to Solve Problems

CleanEnergy States Alliance

THE JPB FOUNDATION

Barr Foundation

THE NATHAN CUMMINGS FOUNDATION

THE KRESGE FOUNDATION

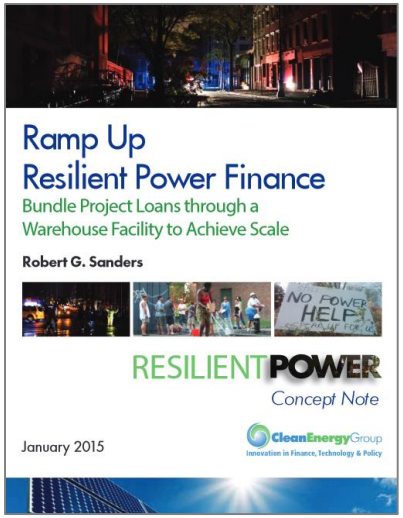
www.cleanegroup.org

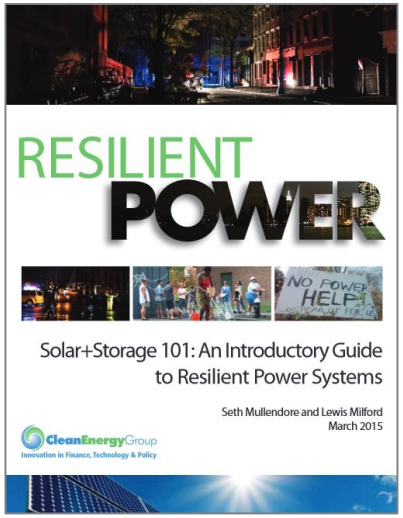
www.resilient-power.org

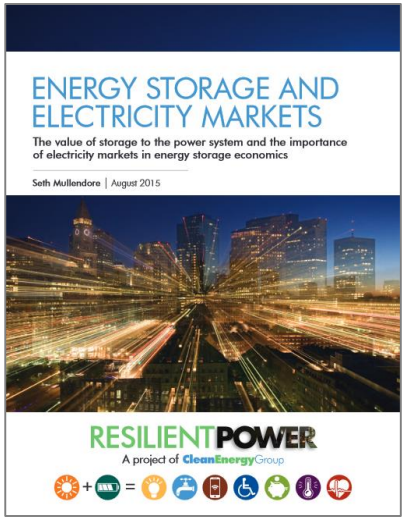
SURDNA FOUNDATION
Fostering sustainable communities in the United States

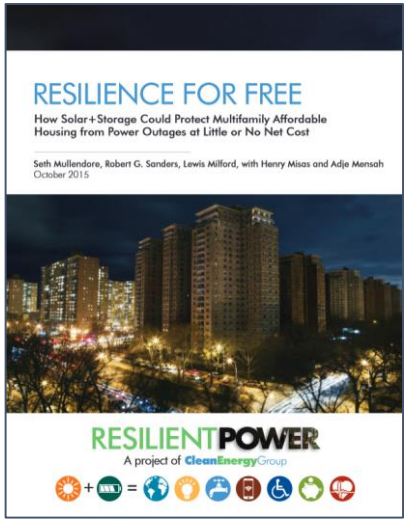
Resilient Power Project

- Increase public/private investment in clean, resilient power systems
- Engage city officials to develop resilient power policies/programs
- Protect low-income and vulnerable communities
- Focus on affordable housing and critical public facilities
- Advocate for state and federal supportive policies and programs
- Technical assistance for pre-development costs to help agencies/project developers get deals done
- See www.resilient-power.org for reports, newsletters, webinar recordings









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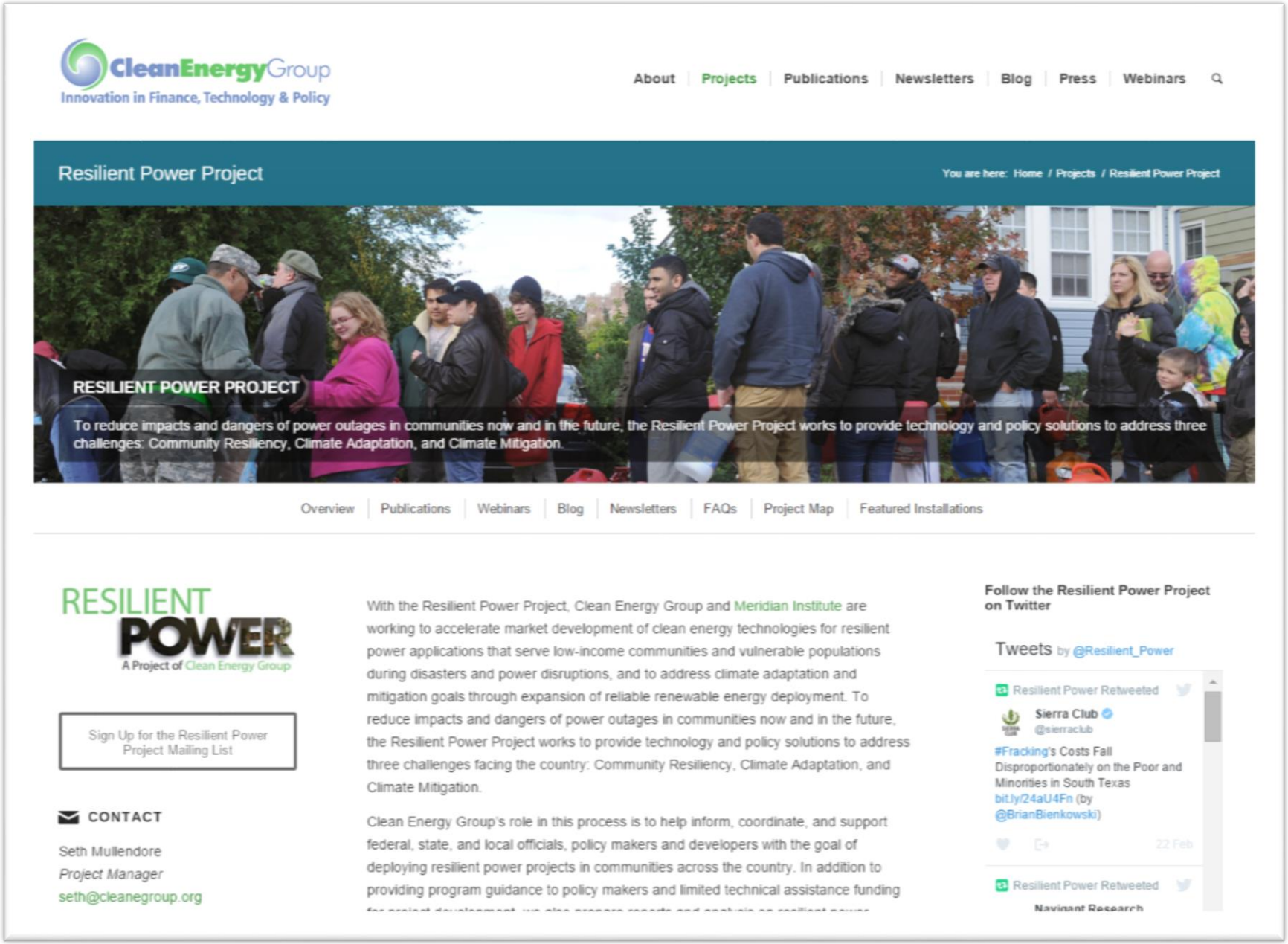

Today's Speakers

- **Bret Pence**, Program Specialist, Ecolibrium3
- **Alison Hoxie**, Assistant Professor – Department of Mechanical and Industrial Engineering, University of Minnesota Duluth

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LOCAL ENERGY MATTERS

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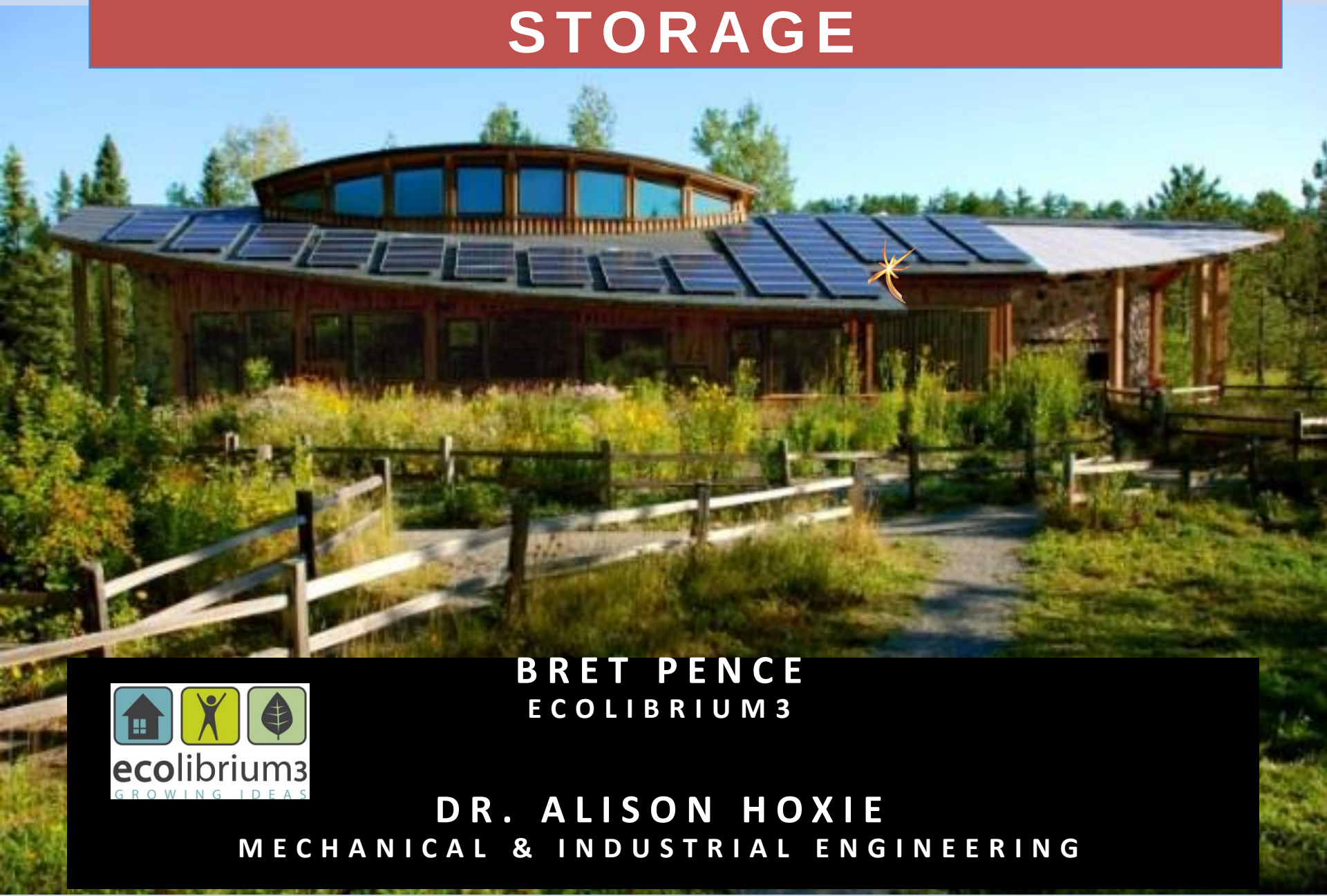
HARTLEY SOLAR PLUS STORAGE



BRET PENCE
ECOLIBRIUM3

DR. ALISON HOXIE
MECHANICAL & INDUSTRIAL ENGINEERING

DULUTH, MN – 86,000 (POP.)

ECOLIBRIUM3

Non-Profit Mission: Our mission is to inspire and lead change in our community toward an equitable and sustainable future.

DEEP, Giving Comfort @ Home, Georgetown University Energy Prize

Solar Market Pathways:

Find out what is happening with solar in our community

- Define barriers to solar adaptation
- Develop pathways to reduce costs and increase adaptation of this technology in our community
- End goal of 1MW of solar on the ground in Duluth

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GROWING IDEAS

- 11,000 students
- Over 500 full-time faculty
- Land-grant university

SWENSON COLLEGE
OF SCIENCE & ENGINEERING
UNIVERSITY OF MINNESOTA DULUTH

PROJECT OVERVIEW

- Hartley Nature Center is a City-owned, nonprofit operated green building.
- The Center serves as a park, environmental center and outdoor-based preschool with annual visitors ~ 30,000

PROJECT OVERVIEW

- HNC had one of the first PV systems in northern MN, installed in 2002–2003. There is 11 kW on the roof and 2 kW on a ground-mounted dual-axis tracker, with 6 inverters.

- By 2016, 4 out of 5 roof inverters were no longer operable, and replacing them all with 2 inverters and rewiring would cost ~$10,000.

- The installation is part of a larger energy retrofit of Hartley Nature center, which includes replacement of the HVAC controls and GSHP, separation of hot water from the GSHP, and lighting upgrades.

PROJECT OUTLINE

- Bringing the Team Together
- Grant Applications
  - RSDP – Seed Money
  - MN Power Foundation
  - City of Duluth
  - Clean Energy Group
- Battery Selection/Purchase
- Technical Design
- Class Development
- Installation
- Optimization and monitoring

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LOCAL ENERGY MATTERS

PROJECT TEAM

- Bret Pence, Ecolibrium3
- Alison Hoxie, UMD
- Alex Jackson, City of Duluth
- Tom O’Rourke, Director Hartley Nature Center
- Brett Amundson, Operations Hartley Nature Center
- Chris LaForge, Great Northern Solar
- Paul Helstrom, Minnesota Power

FUNDING


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Minnesota Power
FOUNDATION


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THE CITY OF
DULUTH
MINNESOTA


Regional Sustainable
Development Partnerships
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PROJECT GOALS

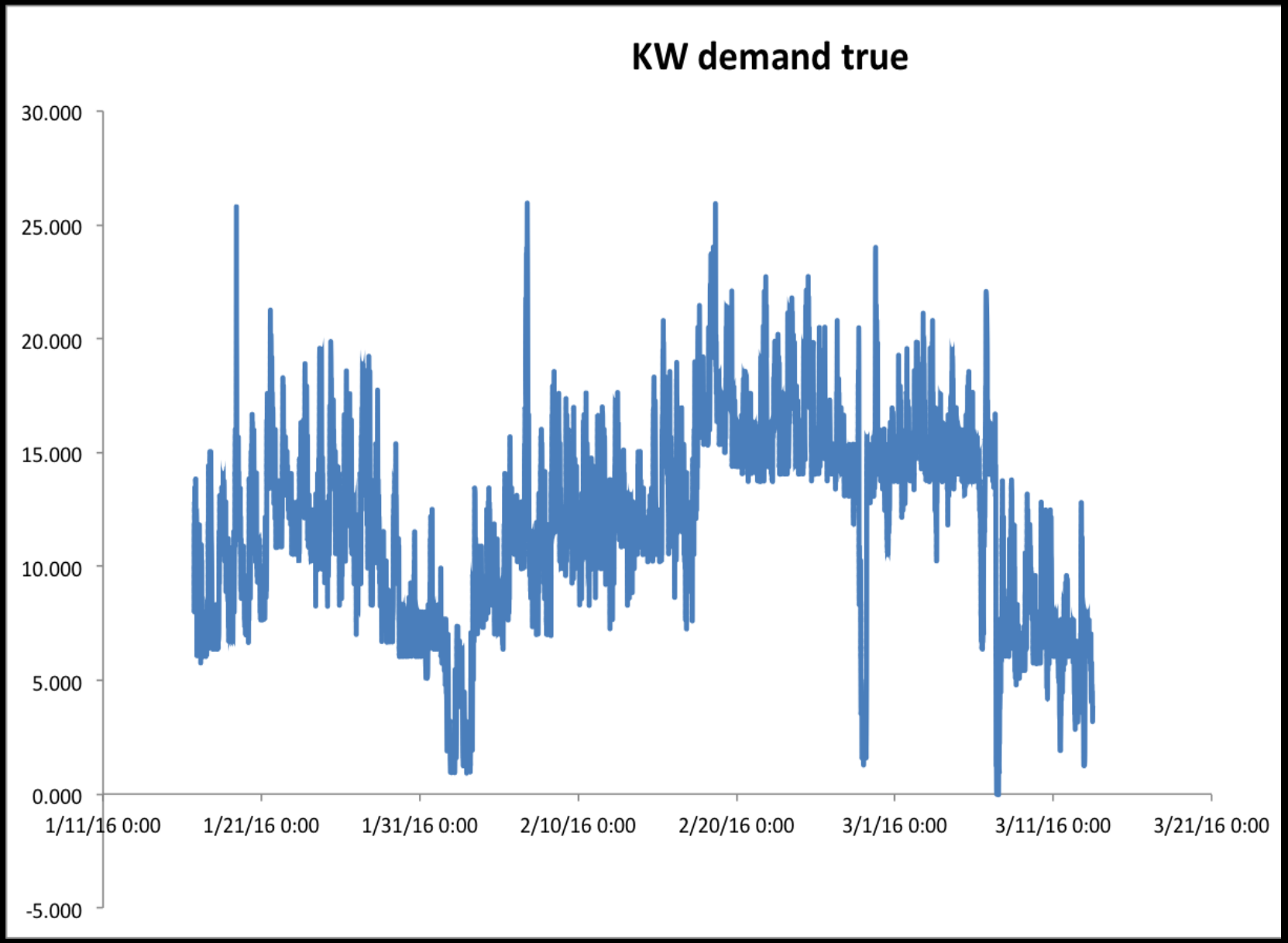
- Replace Inverters
- Create a public emergency shelter
- Move building to net-zero
- Explore added values with storage such as critical load backup and behind the meter savings, including peak demand shaving
- Create an education platform for energy storage

BATTERY SELECTION

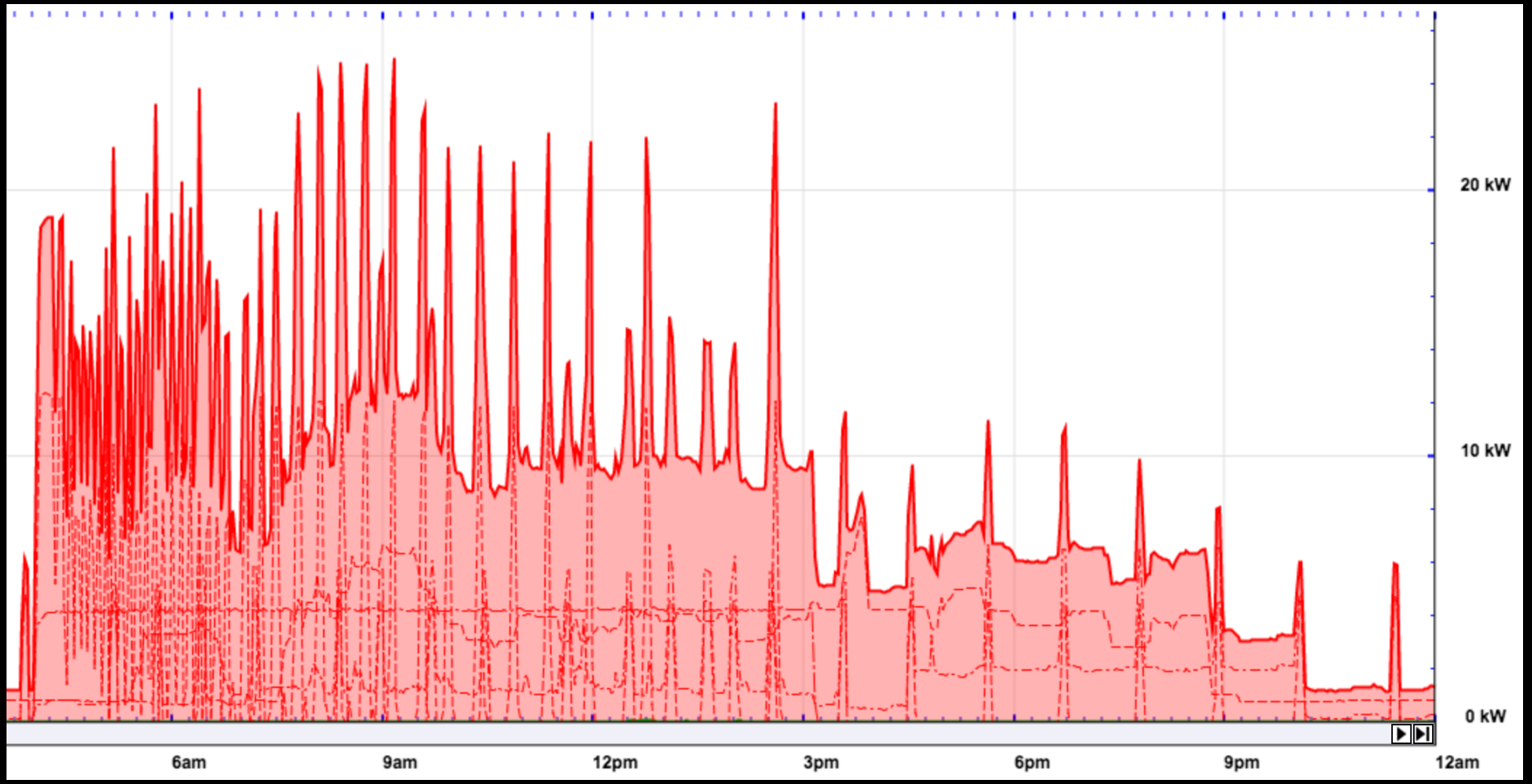
Name	Cost $	kWh	Type	Cycles	Warranty (yr)	Depth of Discharge %	Inverter
Juicebox	13,500	8.6	Li (NMC)	4000	10	70-88	5
Tesla	3,000	6.4	Li?	10 yrs?	10	100	3.3
Sonnen	18,750	12	Li?	10000	10	100	8
Sunverge	17,600	14.2	Li (NMC)	7000	10	80	6

The Challenge – Commercial grade features for a load that may be considered large residential.

15-MIN DATA JAN ‘16-MARCH ‘16



BUILDING ENERGY USE- TYPICAL WINTER DAY



CRITICAL LOADS

Critical Load Backup	Description	Surge Load	Operating Load
Server, Wi-Fi, Phones	Plug load: mech. Room	135 W	15 W
Refrigerator	115 Volts, 7.7 Amps	250 W	250 W
Lighting	Bathroom	610 W	232 W
	Mechanical Room	128 W	128 W
	Classroom 1	46 W	46 W
	Classroom 2	46 W	46 W
Plug Loads	**Exhibit Hall:**	8 W/phone	8 W/phone
	Hartley: (1: 4 plug outlet)	32 W	32 W
	Civil: (3: 4 plug outlet)	96 W	96 W
	Office: 2 desktops	1200 W	10 W standby
	Office Library: 2 Laptops & 6 phones	248 W	248 W
	Classroom 2:		
	Hartley:(1: 2 plug outlet)- 100 W laptop	200 W	200 W
	Civil:(5: 2 plug outlet)- (2) 100 W laptops, (8) 8 W/ phones	248 W	248 W
Maximum Total Loads		**H:2895 W / C:3007 W**	**H:1208 W / C:1319**

BATTERY SELECTION

- Sunverge, only company to meet project needs
- Small Commercial Unit (<15 kWh) & DC coupled (high voltage)
- Software ~ Energy Arbitrage, coming soon more sophisticated Peak Demand Shaving
- Other resiliency option – SPS outlet SunnyBoy grid-tied inverter connected to 5 kW of roof array

OPEN INSTALLATION PROCESS

- 
  - City of Duluth
  - Lake Superior College
  - Chris LaForge, Great Northern Solar
- Community Celebration
  - Solar Storage Awareness Day

LESSONS LEARNED

- Code updates can upset the apple cart (increase cost)
  - Rapid shutdown and arc-fault protection
- Flex plans to accommodate the reality of the built environment – wiring, loads, etc.
- Initial project estimated cost ~20,000, actual ~45,000

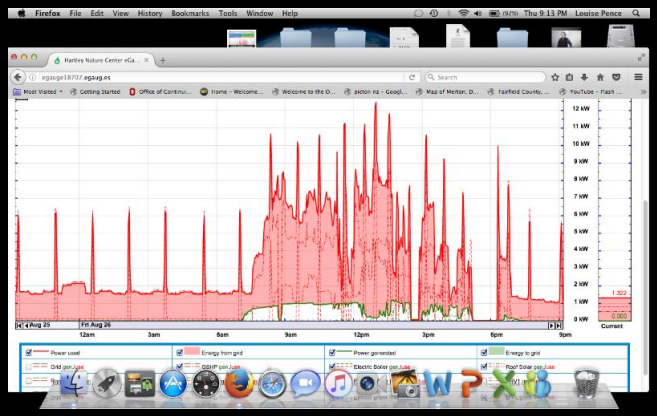
VALUE PROPOSITION

- Project Costs – $45,000
- Financial benefit- $1500/year, 30 year payback
  - Demand charges - $350/year, with a 5kW peak demand reduction per month, $5.84/kW
  - Increased use of solar and stored solar for normal operation - $1150/year
    - Use of solar energy on site is slightly more favorable than net metering
  - Value of backup – Wind storm and the value of storage

- Stretch goal of changing to a non-demand tariff – $5000/year?, under 10 year payback?
  - Below 10kW peak demand, not over 2500kWh/month energy limit for 3 months in a row
  - Believe this is possible with energy efficiency upgrades, increased solar production, and strategic use of energy storage – Ask us in 6 months

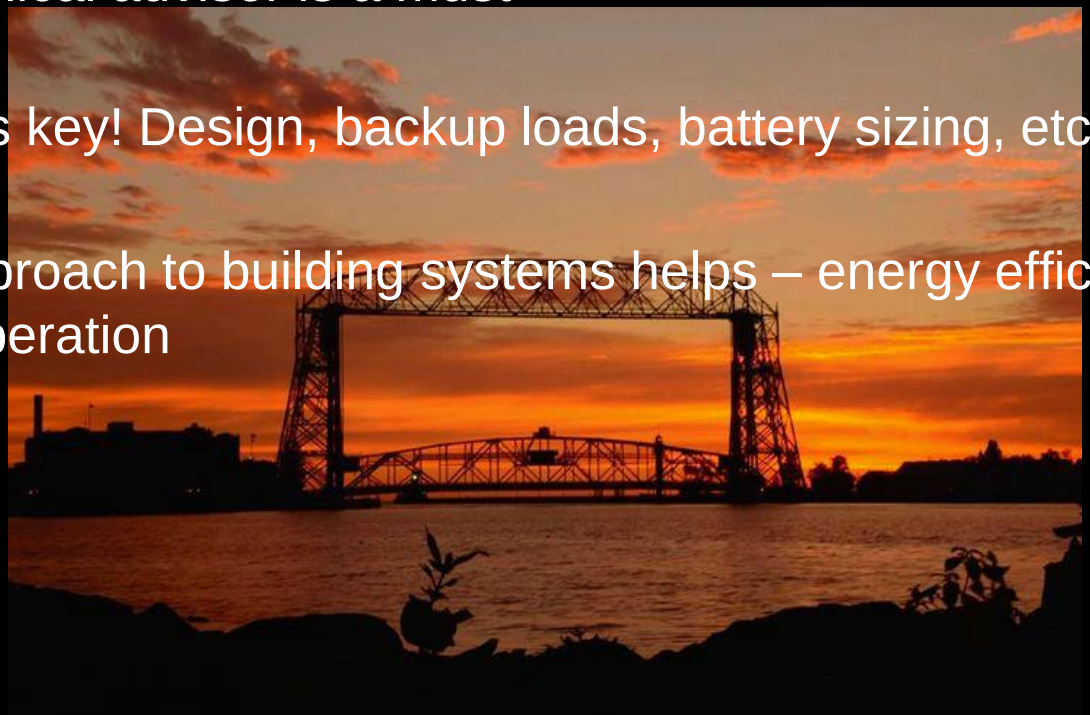
NEXT STEPS

- Replace 200 amp CT to 600 amp CT on main panel for monitoring building usage and minimizing peak demand charges and Rapdid shutdown
- Peak Demand Shaving software to be available by end of year
- Optimize battery deployment, continue to minimize building energy usage through equipment scheduling and energy efficiency improvements
- Monitoring and educational outreach



TIPS FOR SUCCESS

- Determine values of your client(s) prior to examining economic project value
- An advocate at the local utility helps - external disconnect switch
- Great technical advisor is a must
- Flexibility is key! Design, backup loads, battery sizing, etc.
- Holistic approach to building systems helps – energy efficiency, systems operation



THANK YOU.

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Thank you for attending our webinar

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