Solar + Storage at Hartley Nature Center in Duluth

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#2018CERTs
HARTLEY SOLAR PLUS STORAGE

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MECHANICAL & INDUSTRIAL ENGINEERING

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
• Installed in 2002–2003 ~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 dead longer operable, and replacing them all with 2
• Other energy upgrades: HVAC controls GSHP Lighting
PROJECT GOALS

• Replace Inverters
• Public emergency shelter
• Move building to net-zero
• Peak demand shaving
• Create an education platform for energy storage
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
BATTERY SELECTION

- Sunverge
- (<15 kWh) & DC coupled (high voltage)
- Peak Demand Shaving
- SPS outlet SunnyBoy grid-tied inverter connected to 5 kW of roof array
## Critical Loads

### Critical Load Backup

<table>
<thead>
<tr>
<th>Description</th>
<th>Surge Load</th>
<th>Operating Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server, Wi-Fi, Phones</td>
<td>135 W</td>
<td>15 W</td>
</tr>
<tr>
<td>Refrigerator</td>
<td>250 W</td>
<td>250 W</td>
</tr>
<tr>
<td>Lighting</td>
<td>610 W</td>
<td>232 W</td>
</tr>
<tr>
<td>Mechanical Room</td>
<td>128 W</td>
<td>128 W</td>
</tr>
<tr>
<td>Classroom 1</td>
<td>46 W</td>
<td>46 W</td>
</tr>
<tr>
<td>Classroom 2</td>
<td>46 W</td>
<td>46 W</td>
</tr>
</tbody>
</table>

#### Plug Loads

<table>
<thead>
<tr>
<th>Description</th>
<th>Surge Load</th>
<th>Operating Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exhibit Hall:</td>
<td>8 W/phone</td>
<td>8 W/phone</td>
</tr>
<tr>
<td>Hartley: (1: 4 plug outlet)</td>
<td>32 W</td>
<td>32 W</td>
</tr>
<tr>
<td>Civil: (3: 4 plug outlet)</td>
<td>96 W</td>
<td>96 W</td>
</tr>
<tr>
<td>Office: 2 desktops</td>
<td>1200 W</td>
<td>10 W standby</td>
</tr>
<tr>
<td>Office Library: 2 Laptops &amp; 6 phones</td>
<td>248 W</td>
<td>248 W</td>
</tr>
<tr>
<td>Classroom 2:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hartley: (1: 2 plug outlet)- 100 W laptop</td>
<td>200 W</td>
<td>200 W</td>
</tr>
<tr>
<td>Civil: (5: 2 plug outlet)- (2) 100 W laptops, (8) 8 W/ phones</td>
<td>248 W</td>
<td>248 W</td>
</tr>
</tbody>
</table>

**Maximum Total Loads**

- H: 2895 W  /  C: 3007 W
- H: 1208 W  /  C: 1319 W
OPEN INSTALLATION PROCESS
SOLAR PLUS STORAGE AWARENESS DAY
DATA COLLECTION & ANALYSIS
SPRING 2016
TIPS FOR SOLAR WITH STORAGE RETROFIT 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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