General Overview
Presenter Background

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WERNER ELECTRIC - Solution • Supply • Support

• Previous Work
  • Building electrical systems
  • Automotive energy storage
  • Behind the meter energy storage

• Werner Electric is an electrical distributor specializing in Solution, Supply, and Support
  • Moto
    Transforming what a distributor can do
Energy Storage

• Energy Storage Media
  • Battery, Thermal, Rotational, etc.

• Energy Storage Use Cases
  • Arbitrage
  • Power Quality
  • Demand Management

• Q&A
What is Energy Storage

- Energy Storage Definition
  - Storing energy for latter use to reduce the cost of energy, or for energy resiliency
Energy Storage Media

- **Chemical Batteries**
  - Lithium
  - Lead Acid
  - Flow Batteries

- **Rotational**
  - Motor Mass
  - Flywheel

- **Thermal**
  - High Temperature Brick
  - Phase Change Liquid (Salt Water / Ice)

- **Gravitational**
  - Pumped Hydro
  - Train/Crane

- **Compressed Air**
  - Air Tank
  - Underground / Cave
  - Liquid Air
Energy Storage Media

• Chemical / Batteries
  • Lithium
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Energy Storage Media

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Energy Storage Media

• **Thermal**
  - High Temperature Brick
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Energy Storage Use Cases

- NREL has identified up to 13 use cases for energy storage, but they can all be grouped into 3 categories.
  - Arbitrage
  - Power Quality
  - Demand Management
Energy Arbitrage
Energy Arbitrage - Definition

• The simultaneous buying and selling of energy in order to take advantage of differing prices.

• **Buy Low – Sell High**

• Requires a differential in KWh price of at least 13¢ to be cost effective.

• Can be combined with other use cases

• Types of Arbitrage
  • Pure Arbitrage
  • Time of use
  • Solar + Storage

• Caveats
  • Inverter & Battery Inefficiencies
  • Limited Number of Battery Cycles
  • Tax Incentives
Energy Arbitrage - Pure Arbitrage

Definition

• A utility provides energy at varying costs depending on time of day or week

• Energy is bought and sold directly to the utility (or other entity) to make a profit

Examples

• Spot market pricing
• Wholesale pricing
• On-peak/Off-peak

Caveats

• Non renewable
• No Net metering
• No PURPA rate pricing
Energy Arbitrage - Time of Use (TOU)

Definition

• Utility provides energy at varying costs depending on time of day or week
• Energy storage is used to avoid buying more expensive energy

Examples

• On-Peak / Off-Peak
  • Time of Day
  • Car Charging
• Residential TOU
  • Xcel Pilot Program
    • Off Peak 7 ¢/KWh
    • Mid Peak 12 ¢/KWh
    • On Peak 23 ¢/KWh
• Optional TOU programs in MN
Electric Vehicle Charging Stations

- Werner offers electric vehicle charging solutions for residential, commercial, multi-family, fleet, and fast charge applications.
- Residential
  - Hubbell
  - Leviton
  - Siemens
- Commercial, Multi-Family, Fleet, and Fast Charge
  - ChargePoint
Energy Arbitrage – Solar Self-Consumption

- Storing over produced solar energy for use at a later time.
- Is a form of Arbitrage
  - Cost of energy is 0¢/KWh
- Qualifies for special tax incentives
  - ITC
  - MACRS
- Can help facilities to reach energy independence goals
Solar Equipment

- Werner offers a full line of solar equipment from multiple manufacturers
  - Modules
  - Racking
  - Inverters
Power Quality
Power Quality – Frequency Regulation

• Injecting power into a grid with a time difference to adjust the grid frequency.

• Is valuable to utilities and RTOs/ISOs
• Requires large systems
  • Can be a single large ESS
  • Or an aggregated system of many distributed ESSs
• This market is nearly saturated
• Helpful on microgrids
Power Quality – Voltage Regulation

- Injecting power into a grid at a higher or lower voltage to adjust the grid voltage.
- Is valuable to utilities and customers.
- Can be used:
  - In front the meter
  - Behind the meter
  - Grid wide voltage sags
  - Localized voltage sags
  - At the end of a long power line
Energy storage can power some or all building loads.

Unlike a UPS, energy storage can be charged from renewable sources during an extended power outage.
Power Quality – Deferral

Storage can be used to control flow on congested elements.

Energy Storage

Storage can supply voltage support at the end of long distribution lines.

Energy Storage

Short duration overloads can be economically mitigated with storage.

Energy Storage
Power Quality – Deferral

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  • Demand Management
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Demand Management

**Demand Charge**
- A charge for the highest use of energy during a month
- Not in residential bills (C&I only)
- Measured in KW
- Charged as $/KW

**Typical Cost**
- $5/KW to $25/KW
- Xcel rate $12/KW to $16.63/KW

**How to reduce demand**
- Reduce the highest peak in any month
- Run high demand loads during off peak times
- Avoid running multiple large loads concurrently
- Add solar to reduce daytime peaks
- Use energy storage to cut peaks automatically
  - Requires no changes to existing processes
  - This is the most cost effective use of energy storage in the Midwest

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Demand Management

Building KW Before ESS

Before ESS
Demand Management

![Graph showing Building KW After ESS before and after ESS implementation. The graph compares the power demand over time, highlighting the reduction in peak demand after ESS installation. The x-axis represents the time of day, and the y-axis represents the power demand in kW. The graph includes two lines: one for 'Before ESS' and another for 'After ESS', with the latter showing a decrease in peak demand.]
Project Savings

• Example Project With 30KW/60KWh

Building KW After ESS

Before ESS  |  After ESS

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<th>11:36</th>
<th>16:24</th>
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• Parameters

  • Xcel rate $12/KW winter, $16.63/KW summer
  • Peak reduced by 30KW
  • Typical installed cost < $50,000
  • ROI = 5 years (with ITC & MACRS)

Energy Output and Demand Savings From Energy Storage

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<tr>
<th>Date Range</th>
<th>ESS Energy Discharge</th>
<th>Total Demand Savings</th>
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<td>$362</td>
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Demand Management – What’s a good project?

- Demand Charge Map

- Rule of Thumb
  - $15/KW of demand

- Where?
  - Throughout the Midwest
  - High concentration near the metro

- When?
  - $15/KW are cost effective now
  - Battery prices are coming down
Werner Carries Energy Storage for:

- Residential
- Commercial & Industrial
- Small Utility / Solar Farm
Werner Energy Storage

• Commercial & Industrial
Demand Management – Example
Demand Management – Example
Energy Storage

- Energy Storage Media
- Energy Storage Use Cases
  - Arbitrage
  - Power Quality
  - Demand Management
- Q&A
Questions???

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