Energy Storage: Overview and Case Studies

Renewables Integration and Commercial Real Estate Team meeting

June 7, 2016

Introduction and Agenda

- Meeting Objectives:
  - Provide team updates
  - Discuss energy storage and hear case implementation case studies
- Agenda
  - Introduction – Cindy Zhu, DOE
  - Energy Storage Overview – Jay Paidipati, Navigant Consulting
  - Energy Storage Benefits - Carl Mansfield, Sharp Energy Storage Solutions
  - Case Study - Troy Strand, Baker Electric
  - Q&A Discussion

Renewables Team Update - New Resources

Commercial business owners recognize the economic and environmental benefits of a solar PV system. These resources provide a how-to manual to procure and install an on-site solar energy system.

Visit it on the Solution Center

- **7 Steps to Selecting a Solar Provider: Fact Sheet**
  Step-by-step guide to selecting a solar PV system and submitting an RFP based on best practices
- **Solar Request for Proposal Template** Provides a format for business owners to easily present their solar project objectives, criteria, and timeline to bidders
- **Cost Proposal Template**
  Financial tool that provides business owners a price proposal template and NPV cash flow template with step-by-step instructions

CRE Team Update

- 2016- 2018 CRE Steering Committee for BBA partners
  - Self-nominate by June 15th to bba@ee.doe.gov
- BOMA Convention June 26-28th
  - ILC Campaign awards
  - Green Lease Leaders awards

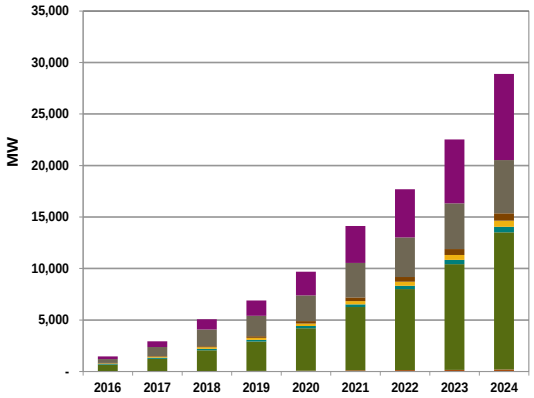
Why Energy Storage Now?

Industry changes are driving demand for energy storage, while policy, technology, and cost advances are making it a more attractive option.

Strong Demand for Energy Storage

- Increasing Intermittent Renewable Generation
- Increased Customer Expectations and Engagement
- Aging Infrastructure
- Utility Transformation from Centralized to Networked Grid

Increased Energy Storage Adoption



Increased Performance at a Decreased Price

- Policy Initiatives
- Technology Performance Advancements
- Technology Demonstration Validations
- Cost Reductions

What Can Energy Storage Do for You?

Energy storage has many applications, but only a few are relevant to commercial and institutional buildings.

Electricity Cost Optimization

- **Peak/Off-Peak Price Management**
- **Demand and Power Factor Charge Management**
- **Renewable Energy Shifting**

Capacity

- Generation Resource Adequacy (e.g., capacity markets, capacity contracts, operating reserves, demand response programs)
- T&D Infrastructure Adequacy

Routine Grid Operations

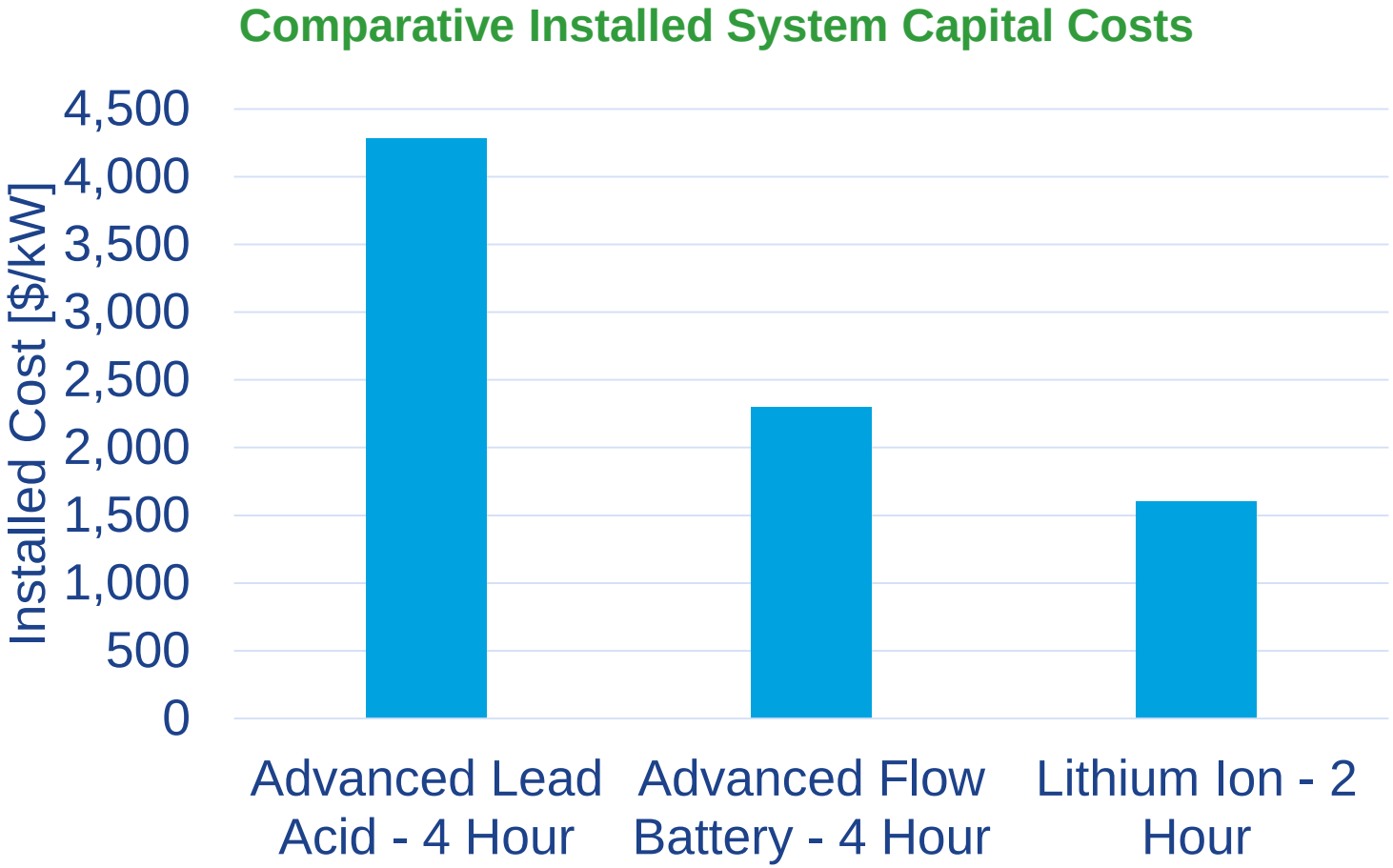
- Frequency Regulation
- Voltage/VAR Support
- Renewable Energy Ramping
- Renewable Energy Smoothing

Contingency Situations

- Black Start
- **Sustained Outages**
- **Momentary Outages**

Costs

There is significant variability in installed cost by technology and by application.



Source: Navigant Research, Q1 2016

Technology Options

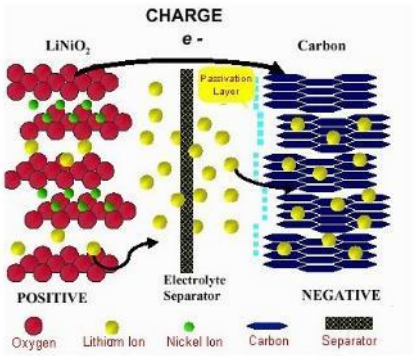
Electrical energy storage comes in many forms and only some of them are practical for commercial and institutional buildings.

Mechanical

Source: Beacon Power

- Pumped Hydro Storage (PHS)
- Compressed Air Energy Storage (CAES)
- Flywheel

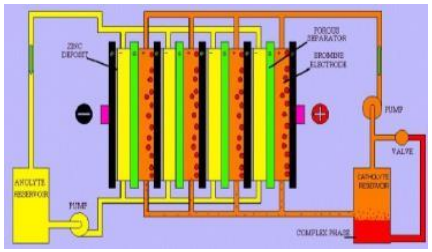
Batteries



Source: SAFT

- **Lead Acid**
- **Advanced Lead Acid**
- **Zinc Air**
- **Sodium Sulfur**
- **Sodium Metal Halide**
- **Sodium Ion**
- **Lithium - Ion**

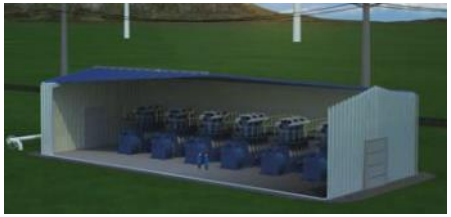
Flow Batteries



Source: www.ZBEnergy.com

- **Zinc Bromine**
- **Vanadium Redox**
- **Iron Chromium**
- **Other**

Other



Source: www.smartgrid.gov

Thermal
- **Ice Based**
- Thermal Molten Salt

Power To Gas
- Hydrogen
- Synthetic Natural Gas

Capacitors
- **electric double-layer capacitors, or "supercapacitors" or "ultracapacitors"**

Business Model Options

Business models are still evolving, with the most typical options shown below.

Storage Developer - Offers	System Ownership
Shared Savings Model	Third-Party Owner (TPO)
Sale/Lease + Host Control	Host Owned
Utility Procurements	Third-Party Owner (TPO) Utility-controlled
Sale/Lease + Utility Tariff Rate	Host Owned Utility-controlled

- Due to differences in tax treatment for owned assets vs. leased assets, some businesses may prefer an operational lease instead of a capital lease.
- Many customers prefer TPO owned systems for other reasons, including ease of financing, and operation and maintenance services.
- Utilities are willing to offer special tariffs and pay for systems if they are allowed to control them and able to use them for investment deferrals and during emergencies.

Carl Mansfield, Sharp Energy Storage Solutions

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smartstorage®
by SHARP®

Facility Demand Management System

Carl Mansfield
General Manager
Energy Systems & Services Group
Sharp Electronics Corp

About Sharp Electronics Corporation

A wholly-owned subsidiary of Japan's Sharp Corporation

1. Sharp is a global leader with a 100 year track record
2. With 130 MW of energy projects in service, Sharp already has a nationwide infrastructure ready to support you.
3. Sharp is recognized for building innovative products that work.

SHARP®
100 YEARS OF EXCELLENCE

THOMSON REUTERS
TOP100
GLOBAL INNOVATORS

ENERGY STAR AWARD 2012
EXCELLENCE IN ENERGY EFFICIENT PRODUCT DESIGN

★★★★★
MOST SATISFIED CUSTOMERS
ELECTRONICS RETAILERS - 2012

What is Sharp's SmartStorage® Energy Management System?

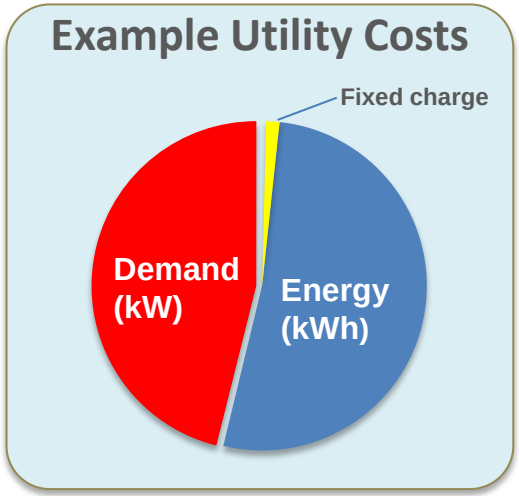
- Energy Management System (EMS) for commercial building owners
- High capacity battery system under automated, intelligent control
- Sharp's predictive software manages building peak utility demand
- Substantial savings realized from reduced utility demand charges

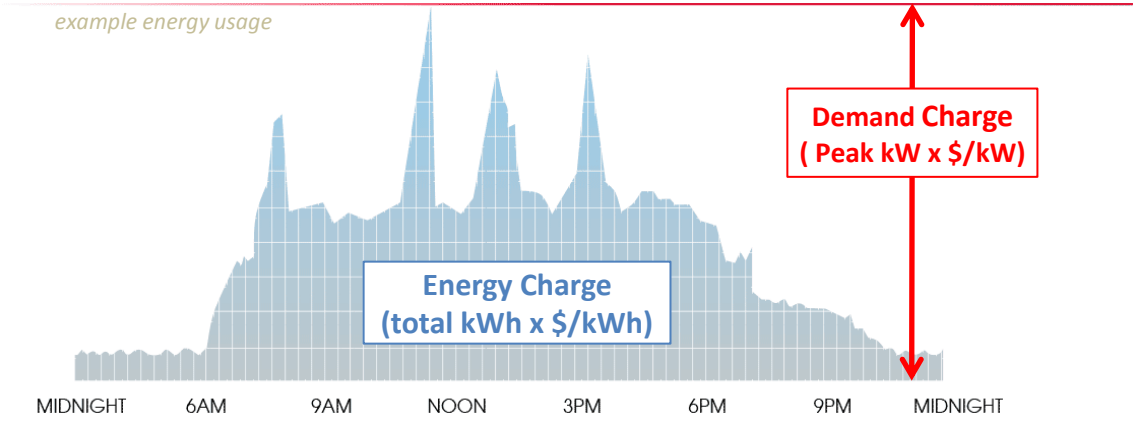
Feature Highlights

- *Indoor and outdoor deployment options*
- *Highly scalable to meet site specific needs*
- *Fully automated operation*
- *Web-based real-time monitoring*
- *Deployable with and without onsite solar*
- *10 year asset management with performance guarantee*

The SmartStorage® System Cuts Demand Charges

Your electricity bill has two major parts:



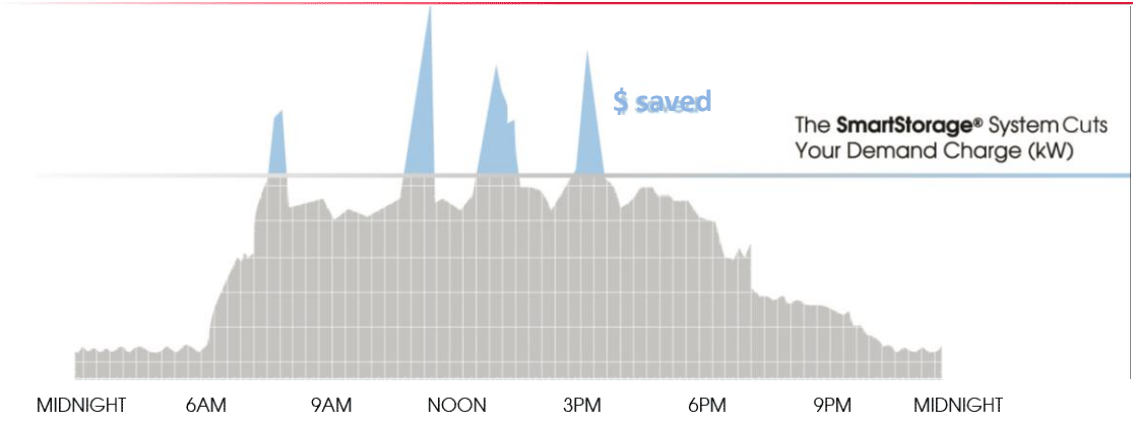


The SmartStorage® System Knows When to Discharge

As your building's demand begins to spike

Your SmartStorage® intelligent controllers trigger a battery discharge

Your demand is cut and savings are realized

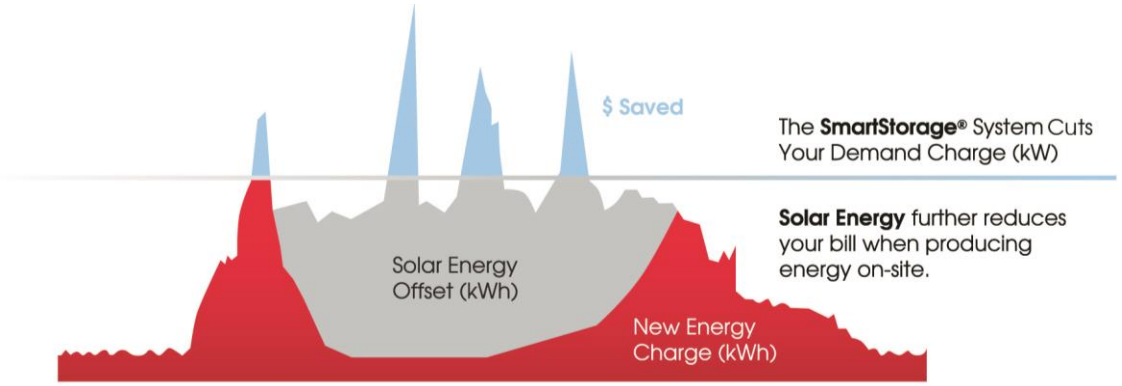


SmartStorage® System + Solar = Triple the benefit

Solar PV offsets your Energy Charges

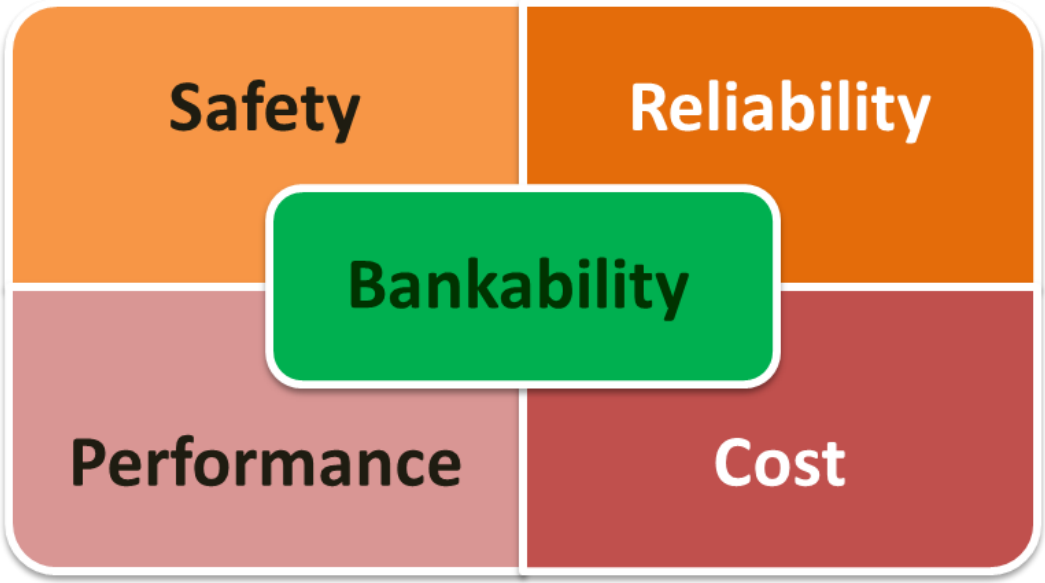
A Hybrid SmartStorage® system with PV offsets both Energy & Demand Charges

You may be eligible for Federal Tax Credits for your entire hybrid system



Energy Storage for the Utility Customer

Factors to consider when selecting an energy storage solution…



Five Steps to Safety

I. Component level safety: Standards & Certifications
   - UL 1973 (rack)
   - UL 1642 (cell)
   - UL 1741 (inverter)
   - UL 508 (controls)

II. Safety-focused integrated system design

III. Rigorous lab and field testing

IV. Safety-focused monitoring of operational systems

V. End of life system management

All are provided by Sharp, backed by our 10-yr Asset Management Service

Ensuring Reliability

New market with limited long-term proven reliability

Short system outages can significantly impact economic benefits

Select products from a proven company that stands behind its long-duration guarantee

10 YEAR **Asset Management Service Agreement** plus **Demand Reduction Performance Guarantee**

Available with every SmartStorage® energy management system

- ✓ 10 Year Warranty Service
- ✓ 10 Year Performance Guarantee
- ✓ 100% Free Maintenance

Backed by SHARP®

Performance

- ✓ Predict
- ✓ Guarantee
- ✓ Deliver

Performance Achieved

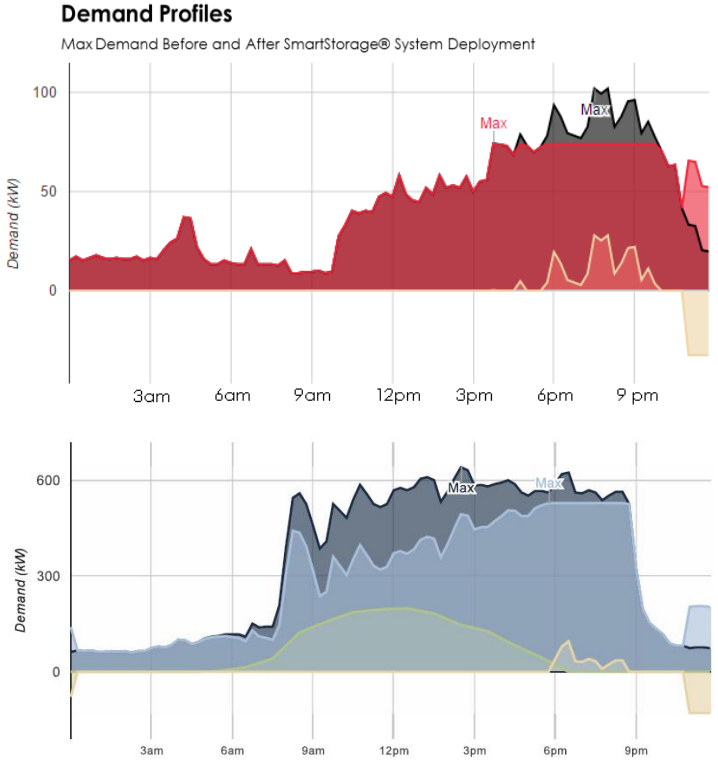
Month	kW before	kW after	Peak Clip kW
April 2015	80.76	41.19	39.57
May 2015	73.60	42.47	31.13
June 2015	87.84	54.09	33.75
July 2015	90.24	57.60	32.64
August 2015	103.02	69.44	33.58
Total demand Savings (April 2015 – March 2016)			365.47
		Annual Performance Guarantee	300.00

10-yr kW demand reduction Performance Guarantee

Backed by SHARP

Cost

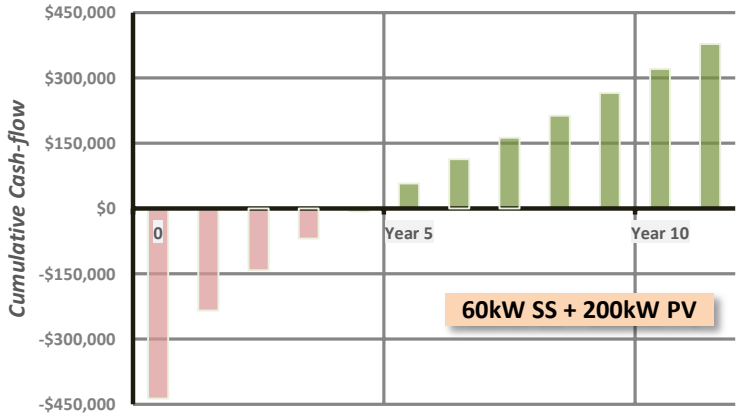
- **Critical for determining ROI, but only once performance is clearly understood**
- **System must be properly dimensioned for needs of the site to assure highest possible ROI**
- **Sharp's design tools rapidly provide ROI assessment for any given property**



Deployment Alternatives

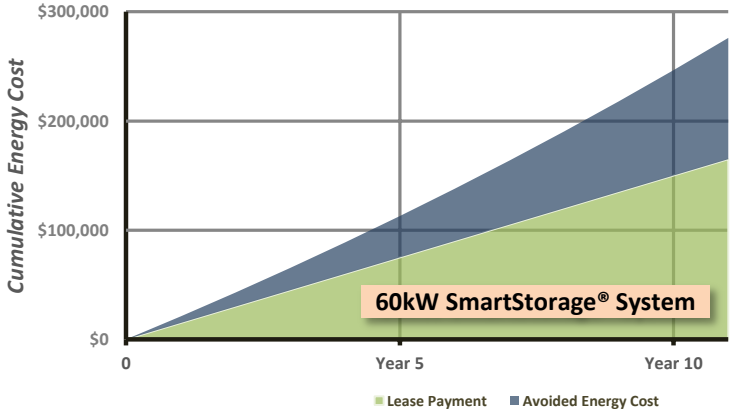
Purchase

- 3-5 years return typical
- Benefit from Federal Tax credits (ITC) and applicable state or local incentives



Finance

- $0 down, immediate savings and cash-flow positive operation
- Offers available for both hybrid Solar+Storage and Storage-only installations



In Conclusion

- Demand charges are a significant portion of today's utility costs
- The SmartStorage® system can substantially reduce demand costs
- The SmartStorage® system has been designed with safety, reliability and performance in mind
- System costs typical recovered in 3-5 years
- Financing alternatives are available which provide immediate cash flow positive benefits

SHARP®

100 YEARS OF EXCELLENCE

For more information, send inquiry to

info@sharpsmartstorage.com

smartstorage by SHARP

Troy Strand, Baker Electric

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SHARP SMARTSTORAGE® SYSTEM INSTALLED AT BAKER ELECTRIC

Presented by Troy Strand
Renewable Energy Solutions Director
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tstrand@baker-electric.com

COMPANY SNAPSHOT 2016

- Revenue in excess of **$140 million**
- **$75 Million** Single projects bonding capacity
- Over **130** office employees and **800** field staff
- Excel at **Design-Build**
- Single largest contract for electrical **$37 million**
- 2015 EMR of **.73**

Serving All Construction Market Sectors In Southern California:

- **Utility**
  - Solar (1 Gigawatt Installed)
  - Sub Station
  - Battery Energy Storage
- **Co-Generation**
- **OSHPD**
- **MOB**
- **Commercial**
  - Solar
  - Battery Energy Storage
- **K-12 / Higher Education**
- **Controls & Services**
- **Military**
- **Commercial & Industrial**

Baker Electric
Established 1938

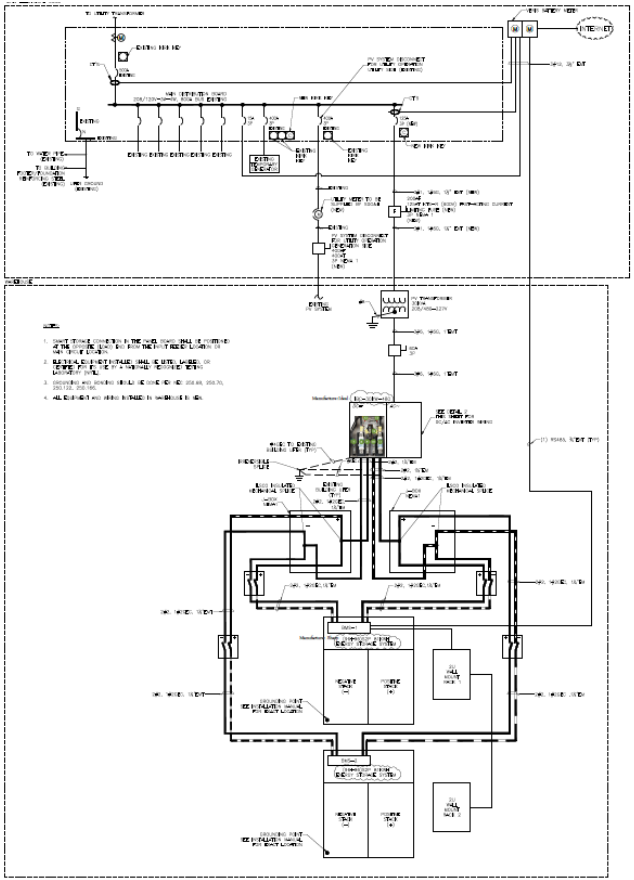
WHY BAKER SELECTED SHARP

- 10-Year Asset Management Service Agreement
- Performance Guarantee
  - 25kW/Month Minimum
  - 300kW/Year
- Backed by Sharp

Baker Electric
Established 1938

SYSTEM DETAILS

- 86 kWDC Photovoltaic (PV) System
- 30 kWAC/80kWh Battery Energy Storage System (BESS)



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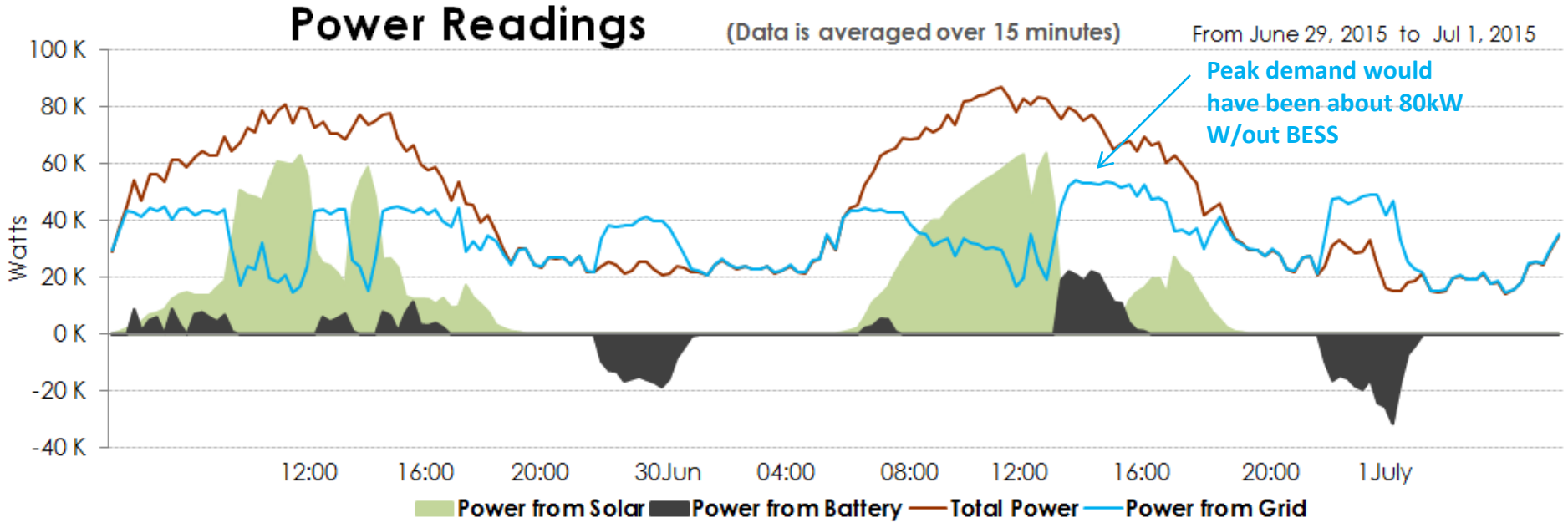
ACTUAL SYSTEM PERFORMANCE



YEAR 1 ACTUAL SYSTEM PERFORMANCE BY KW

Billing Period	Peak Building Load Before (kW)	Peak Building Load "After" (kW)	kW Saved	Savings (%)
2015-04-03 - 2015-05-02	80.76	41.19	39.57	49.00%
2015-05-03 - 2015-06-03	73.6	42.47	31.13	42.30%
2015-06-04 - 2015-07-02	87.84	54.09	33.75	38.42%
2015-07-03 - 2015-08-01	90.24	57.6	32.64	36.17%
2015-08-02 - 2015-08-30	103.02	69.44	33.58	32.60%
2015-08-31 - 2015-10-01	108.43	77.87	30.56	28.18%
2015-10-02 - 2015-10-30	100.94	61.71	39.23	38.86%
2015-10-31 - 2015-12-02	74.66	56.96	17.7	23.71%
2015-12-03 - 2016-01-02	73.5	47.11	26.39	35.90%
2016-01-03 - 2016-02-01	70.09	54.24	15.85	22.61%
2016-02-02 - 2016-03-02	76.95	44.28	32.67	42.46%
2016-03-03 - 2016-04-02	70.08	37.68	32.4	46.23%
Averages	**84.18**	**53.72**	**30.46**	**36.37%**
Total			**365.47**	

YEAR 1 ACTUAL ECONOMIC RESULT

Payback: $77,653/$20,300k savings = 3 ½ years payback

Billing Period	Peak Building Load Before (kW)	Peak Building Load "After" (kW)	$ Saved (ALTOU)
2015-04-03 - 2015-05-02	80.76	41.19	$ 795
2015-05-03 - 2015-06-03	73.6	42.47	$ 1,056
2015-06-04 - 2015-07-02	87.84	54.09	$ 1,063
2015-07-03 - 2015-08-01	90.24	57.6	$ 1,546
2015-08-02 - 2015-08-30	103.2	69.44	$ 2,042
2015-08-31 - 2015-10-01	108.43	77.87	$ 2,191
2015-10-02 - 2015-10-30	100.94	67.71	$ 2,376
2015-10-31 - 2015-12-02	74.66	56.96	$ 2,697
2015-12-03 - 2016-01-02	73.5	47.11	$ 2,547
2016-01-03 - 2016-02-01	70.09	54.24	$ 2,319
2016-02-02 - 2016-03-02	76.95	44.28	$ 752
2016-03-03 - 2016-04-02	70.08	37.68	$ 924
Averages			$ 1,692
Total			**$ 20,308**

*BESS Installed Cost (2016 Prices) - $77,653 pre-tax, $54,357 post-ITC (*Storage is eligible for 30% ITC when installed in tandem with PV)*

IN CONCLUSION

- Eligible for 30% ITC when Installed in Tandem W/PV
- 3 ½ Years Simple Payback
- System is Delivering
  - Guaranteed = 300kW/Year (25kW/Mnth)
  - Actual for 1st Year = 365kW

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Discussion

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Thank you!

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