

Energy Storage for Businesses

Eric Martinez – Emerging Technologies in Demand Response

October 16, 2012 – ET Summit



Agenda

- Energy Storage Benefits for Customers
- Current Energy Storage Project – Zinc-Flow Battery
- Current Energy Storage Project – Low-Cost Flywheel Energy Storage
- Other Energy Storage Types
- Fit into Current Demand Response Programs
- Research Projects

Energy Storage Benefits



- Representative Benefit Present Values of Selected Energy Storage Benefits
- Today's Benefits:
 - Retail Time Of Use Energy Charges
 - Retail Demand Charges

Value Chain	Benefit	PV \$/kW-h		PV \$/kW	
		Target	High	Target	High
End User	1 Power Quality	19	96	571	2,854
	2 Power Reliability	47	234	537	2,686
	3 Retail TOU Energy Charges	377	1,887	543	2,714
	4 Retail Demand Charges	142	708	459	2,297
Distribution	5 Voltage Support	9	45	24	119
	6 Defer Distribution Investment	157	783	298	1,491
	7 Distribution Losses	3	15	5	23
Transmission	8 VAR Support	4	22	17	83
	9 Transmission Congestion	38	191	368	1,838
	10 Transmission Access Charges	134	670	229	1,145
	11 Defer Transmission Investment	414	2,068	1,074	5,372
System	12 Local Capacity	350	1,750	670	3,350
	13 System Capacity	44	220	121	605
	14 Renewable Energy Integration	104	520	311	1,555
ISO Markets	15 Fast Regulation (1 hr)	1,152	1,705	1,152	1,705
	16 Regulation (1 hr)	514	761	514	761
	17 Regulation (15 min)	4,084	6,845	1,021	1,711
	18 Spinning Reserves	80	400	110	550
	19 Non-Spinning Reserves	6	30	16	80
	20 Black Start	28	140	54	270
	21 Price Arbitrage	67	335	100	500

Energy Storage Benefits

- Today's Energy Storage Value for Commercial Customers
- Assumptions
 - \$27/kW Monthly Peak Demand Charge
 - 4 Hour Length of Peak Demand
 - \$0.113 / kWh Difference Between Peak and Off-Peak Costs
 - 100% AC-to-AC Efficiency

Energy Storage Benefits

- Today's Energy Storage Value for Commercial Customers
- Assumptions
 - \$27/kW Monthly Peak Demand Charge
 - 4 Hour Length of Peak Demand
 - \$0.113 / kWh Difference Between Peak and Off-Peak Costs
 - 100% AC-to-AC Efficiency

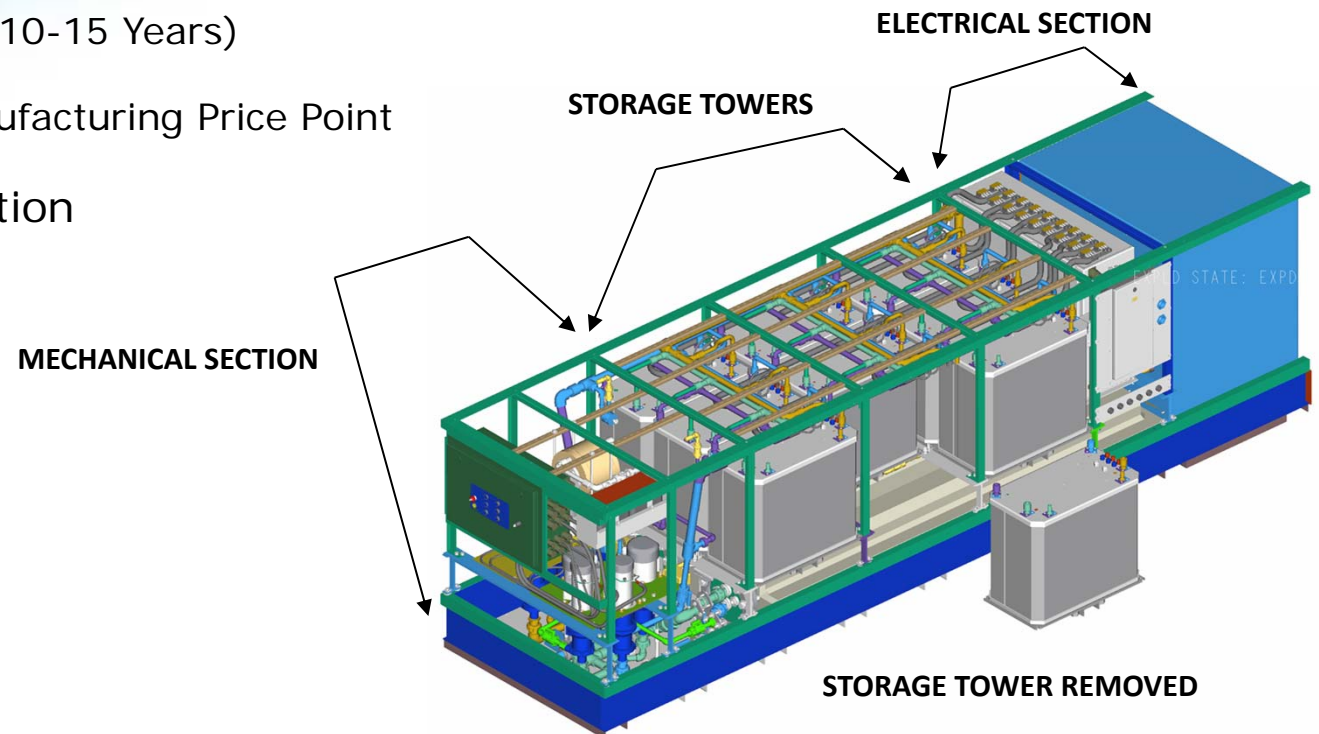
Savings Potential per Year	Savings
Reduced Peak Demand Charge	\$81
Energy Shift to Off-Peak	\$25
Total Energy Savings Per kWh per Year	\$106/kWh

- Battery Backup Value not Included in Calculations

Current Energy Storage Projects

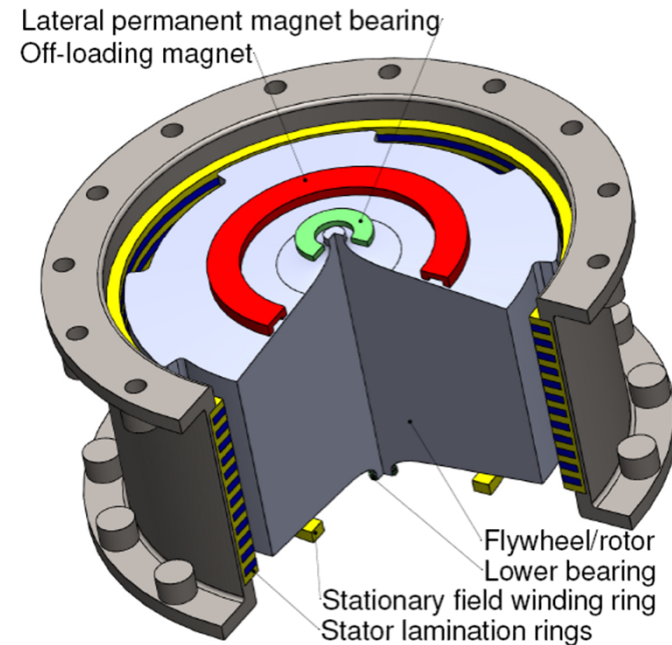
Current Project – Zinc-Flow Battery

- 150 kWh / 100 kW Zinc-Flow Energy Storage System
- Installed at Big Box Retailer
- Collaboration with CEC PIER - \$400K Grant
- Benefits:
 - Long Lifespan (10-15 Years)
 - \$300/kWh Manufacturing Price Point
- Next Step: Installation



Current Project – Steel Flywheel

- 40 kWh / 10 kW Low-Cost Steel Flywheel Energy Storage System
- Installed at Warehouse
- Collaboration with CEC PIER - \$1.8M Grant
- Benefits
 - Long Lifespan
 - Over 90% AC-to-AC Efficiency
- Leads to Second Generation Flywheel
 - 500 kWh / 125 kW
 - About 2 m³ large
 - \$225/kWh Manufacturing Price Point
- Next Step: Build Flywheel
 - 18 Months to Build



Other types of Energy Storage

Thermal Energy Storage

Supplement cooling load (such as HVAC) during Peak Times

- Create ice or cool water during Off-Peak Times
- Ice/cold water is used to meet thermal cooling load in on-peak hours
- Integrates with existing cooling systems (e.g. process, HVAC)
- To be covered under statewide permanent load shift (PLS) technology incentive program

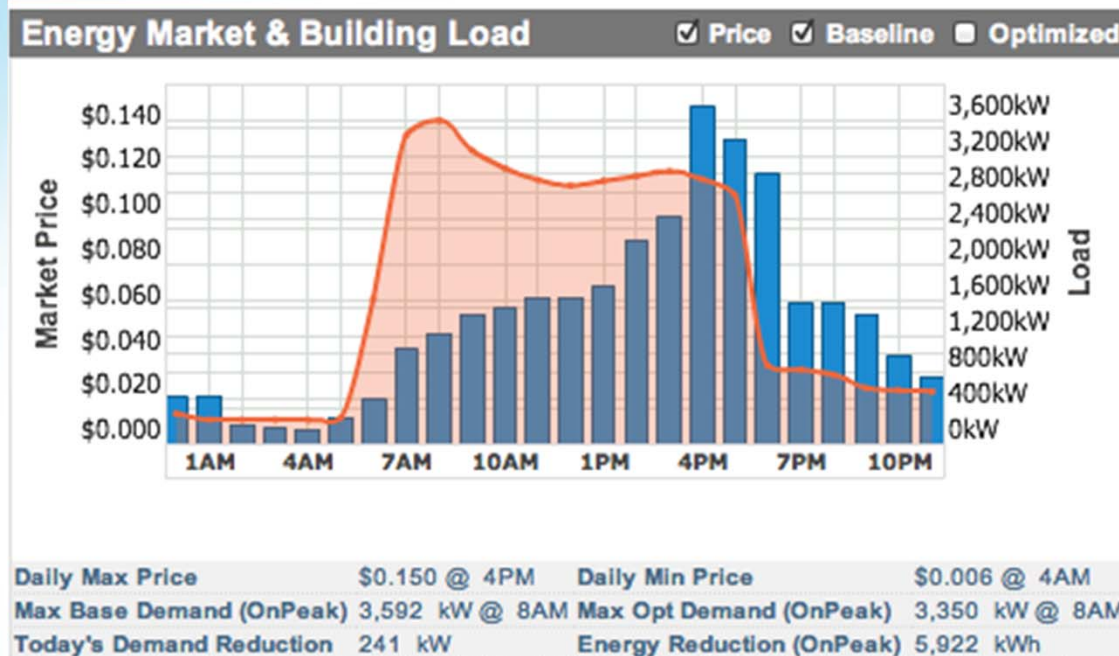
Commercial Ice Machines

- Creates Ice at Off-Peak Times for Commercial Kitchens
- May be possible with simple retrofit of ice maker



Thermal Mass Energy Storage

- Utilize Building Thermal Mass for Energy Storage
- Pre-Cool Large Buildings when prices are low
- Cools to lowest AC Set Point to allow Pre-Cooling without Sacrificing Comfort
- Minimize Peak Demand
- 10-15% AC Energy Cost Savings Potential

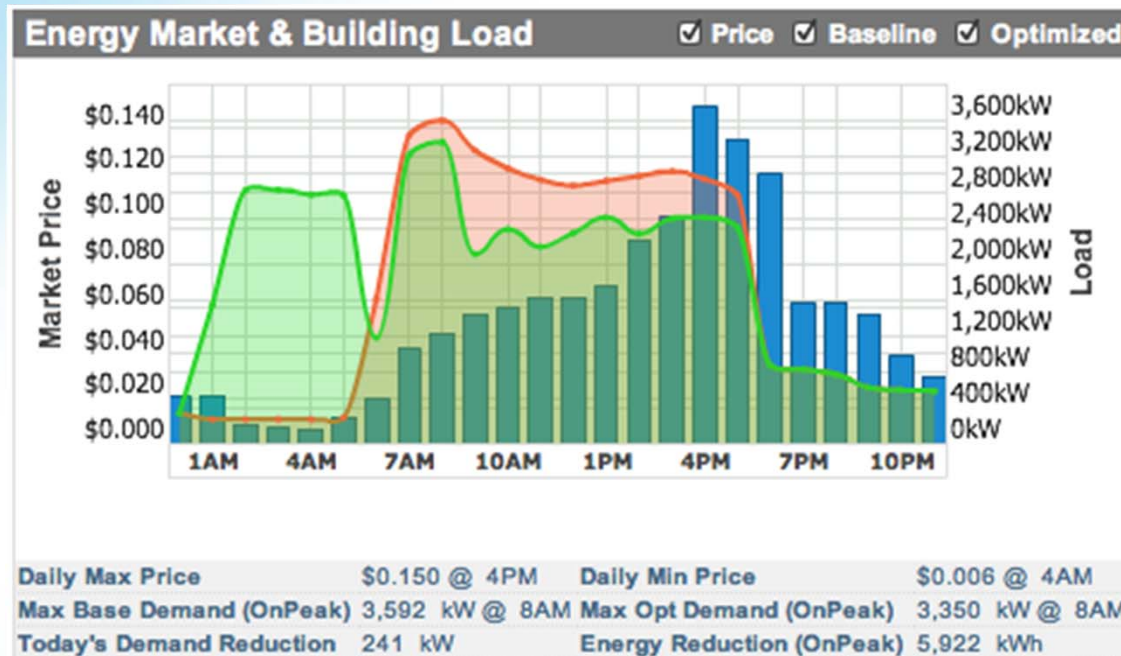


■ Price

■ Baseline Load

Thermal Mass Energy Storage

- Utilize Building Thermal Mass for Energy Storage
- Pre-Cool Large Buildings when prices are low
- Cools to lowest AC Set Point to allow Pre-Cooling without Sacrificing Comfort
- Minimize Peak Demand
- 10-15% AC Energy Cost Savings Potential



- Price
- Baseline Load
- Optimized Load

Current Utility Energy Storage Programs

- Permanent Load Shift
 - Utilities are developing a statewide PLS technology incentive program
 - Eligible technologies limited to thermal energy storage
 - Incentive levels have not been determined yet
 - Shift cooling load from Peak to Off-Peak
- Self Generation Incentive Program
 - Incentives to customers who produce electricity with wind turbines, fuel cells, various forms of combined heat and power (CHP) and advanced energy storage (AES).
 - \$2/Watt Incentive for AES*

* Standalone AES and AES coupled with a renewable or emerging generating technology are funded from the renewable and emerging budget category. AES coupled with conventional CHP technologies operating on non-renewable fuel is funded from the non-renewable budget category.

2012 SGIP Funding Levels

Utility	Renewable and Emerging Technology	Non-Renewable
PG&E	\$25.1M	\$8.4M
SC-Edison	\$19.5M	\$6.5M
So Cal Gas	\$5.6M	\$1.9M
SDG&E	\$7.7M	\$2.6M

Increasing Energy Storage Value – Research Topic

Present Energy Storage Benefits



Value Chain	Benefit	PV \$/kW-h		PV \$/kW	
		Target	High	Target	High
End User	1 Power Quality	19	96	571	2,854
	2 Power Reliability	47	234	537	2,686
	3 Retail TOU Energy Charges	377	1,887	543	2,714
	4 Retail Demand Charges	142	708	459	2,297
Distribution	5 Voltage Support	9	45	24	119
	6 Defer Distribution Investment	157	783	298	1,491
	7 Distribution Losses	3	15	5	23
Transmission	8 VAR Support	4	22	17	83
	9 Transmission Congestion	38	191	368	1,838
	10 Transmission Access Charges	134	670	229	1,145
	11 Defer Transmission Investment	414	2,068	1,074	5,372
System	12 Local Capacity	350	1,750	670	3,350
	13 System Capacity	44	220	121	605
	14 Renewable Energy Integration	104	520	311	1,555
ISO Markets	15 Fast Regulation (1 hr)	1,152	1,705	1,152	1,705
	16 Regulation (1 hr)	514	761	514	761
	17 Regulation (15 min)	4,084	6,845	1,021	1,711
	18 Spinning Reserves	80	400	110	550
	19 Non-Spinning Reserves	6	30	16	80
	20 Black Start	28	140	54	270
	21 Price Arbitrage	67	335	100	500

Source: EPRI Electricity Energy Storage Technology Options A White Paper Primer on Applications, Costs, and Benefits 1020676

Future Energy Storage Benefits



Value Chain	Benefit		PV \$/kW-h		PV \$/kW	
			Target	High	Target	High
End User	1	Power Quality	19	96	571	2,854
	2	Power Reliability	47	234	537	2,686
	3	Retail TOU Energy Charges	377	1,887	543	2,714
	4	Retail Demand Charges	142	708	459	2,297
Distribution	5	Voltage Support	9	45	24	119
	6	Defer Distribution Investment	157	783	298	1,491
	7	Distribution Losses	3	15	5	23
Transmission	8	VAR Support	4	22	17	83
	9	Transmission Congestion	38	191	368	1,838
	10	Transmission Access Charges	134	670	229	1,145
	11	Defer Transmission Investment	414	2,068	1,074	5,372
System	12	Local Capacity	350	1,750	670	3,350
	13	System Capacity	44	220	121	605
	14	Renewable Energy Integration	104	520	311	1,555
ISO Markets	15	Fast Regulation (1 hr)	1,152	1,705	1,152	1,705
	16	Regulation (1 hr)	514	761	514	761
	17	Regulation (15 min)	4,084	6,845	1,021	1,711
	18	Spinning Reserves	80	400	110	550
	19	Non-Spinning Reserves	6	30	16	80
	20	Black Start	28	140	54	270
	21	Price Arbitrage	67	335	100	500

Source: EPRI Electricity Energy Storage Technology Options A White Paper Primer on Applications, Costs, and Benefits 1020676

Future Energy Storage Benefits



- Increase Network and Communications
- OpenADR 2.0
 - Demand Response
 - Ancillary Services
- Develop Codes and Standards
 - Research Project with EPRI

Value Chain	Benefit	PV \$/kW-h		PV \$/kW	
		Target	High	Target	High
End User	1 Power Quality	19	96	571	2,854
	2 Power Reliability	47	234	537	2,686
	3 Retail TOU Energy Charges	377	1,887	543	2,714
	4 Retail Demand Charges	142	708	459	2,297
Distribution	5 Voltage Support	9	45	24	119
	6 Defer Distribution Investment	157	783	298	1,491
	7 Distribution Losses	3	15	5	23
Transmission	8 VAR Support	4	22	17	83
	9 Transmission Congestion	38	191	368	1,838
	10 Transmission Access Charges	134	670	229	1,145
	11 Defer Transmission Investment	414	2,068	1,074	5,372
System	12 Local Capacity	350	1,750	670	3,350
	13 System Capacity	44	220	121	605
	14 Renewable Energy Integration	104	520	311	1,555
ISO Markets	15 Fast Regulation (1 hr)	1,152	1,705	1,152	1,705
	16 Regulation (1 hr)	514	761	514	761
	17 Regulation (15 min)	4,084	6,845	1,021	1,711
	18 Spinning Reserves	80	400	110	550
	19 Non-Spinning Reserves	6	30	16	80
	20 Black Start	28	140	54	270
	21 Price Arbitrage	67	335	100	500

Questions?