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Energy Storage Technology Panel

Austin Energy Generation Task Force Meeting

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May 14, 2014

Agenda & Topics Covered

- What can Energy Storage Systems Do for You?
- ESS are more than just batteries
- ESS modularity & flexibility can create value
- ESS do much more than just time shift energy

Distribution Level Challenges & Solutions

Distribution Grid Need	Source of Challenge	Current Solutions	Provided by ESS
Voltage Regulation	Peak Load Growth, Distributed PV, Grid Resiliency	Capacitor Banks, Load Tap Changers, Voltage Regulators, Stat Coms	✓
Power Quality	Distributed PV	Harmonic Filters, Surge Arrestors, Oversized Equipment	✓
Demand Management	Peak Load Growth, Grid Resiliency	TOU Tariffs, Demand Response Programs, Equipment Upgrades	✓
Situational Awareness	Grid Resiliency	Smart Meters, Substation Automation, Inefficient Maintenance	✓
Power Surety	Grid Resiliency	Redundant Distribution Lines, Behind the Meter Solutions	✓

Distributed ESS can provide solutions to ALL of these challenges

Transmission Level Challenges & Solutions

Transmission /Generation Need	Source of Challenge	Current Solutions	Provided by ESS
Grid Balancing Services	High renewable penetration, Load fluctuations	Thermal Generation	✓
Peak Power	Peak Load Growth	Peaking Power Plants	✓
Transmission Congestion	Peak Load Growth, Generation Build Out	Transmission Network Upgrade	✓
More Efficient Generation	Aging Plants, Reserve Requirements	Power Plant Upgrades	✓

Grid Scale ESS can provide solutions to ANY of these challenges

Battery Technology Overview

Chemistry	Shorthand	Safety	Energy	Power	Life	Cost	Summary
		Scale 1-5 with 5 Best					
Lithium Manganese Oxide	LMO	3	4	3	3	4	Versatile technology with good overall performance and cost
Lithium Iron Phosphate	LFP	3	3	4	4	3	Similar to LMO, but slightly more power and less energy
Lithium Nickel Cobalt Aluminum	NCA	1	3	4	4	2	Good for power applications; poor safety & high cost
Lithium Titanate	LTO	5	2	5	5	1	Excellent power and cycle life; Highest cost technology
Sodium Nickel Chloride	NaX	3	5	1	4	3	Great for energy applications but low power capabilities
Advanced Lead Acid	PbA	5	1	4	1	5	Very safe and inexpensive, but low cycle life and poor energy

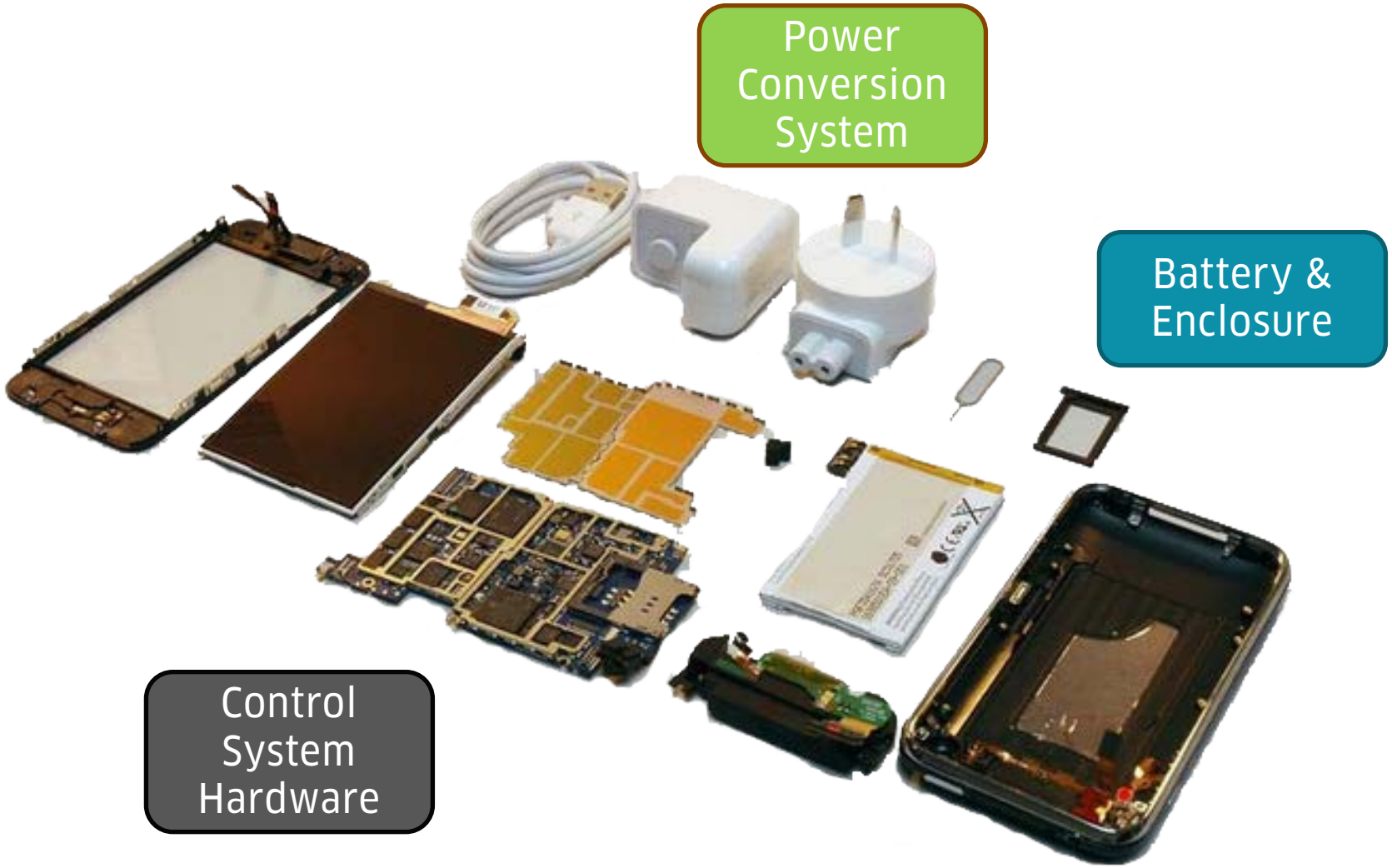
- No perfect chemistry - each has its strengths and weaknesses
- Power ratings (C-rate) determine minimum # batteries required
- High C-rate batteries more expensive than low C-rate batteries

Battery Based Storage Systems

Battery Technology	Power Conversion System	Control System
		
• Power and energy capabilities are chemistry dependent • Usually purchased with Battery Management System (BMS) • Housed in outdoor rated enclosure	• Converts DC power from batteries to AC power onto grid and visa versa • Capable of supplying/absorb real and reactive power	• Takes inputs from BMS and external grid • Commands PCS to charge/discharge according to application • Monitors system health to protect batteries and optimize performance

System Integration
Connects all subsystems to work seamlessly together and with the grid

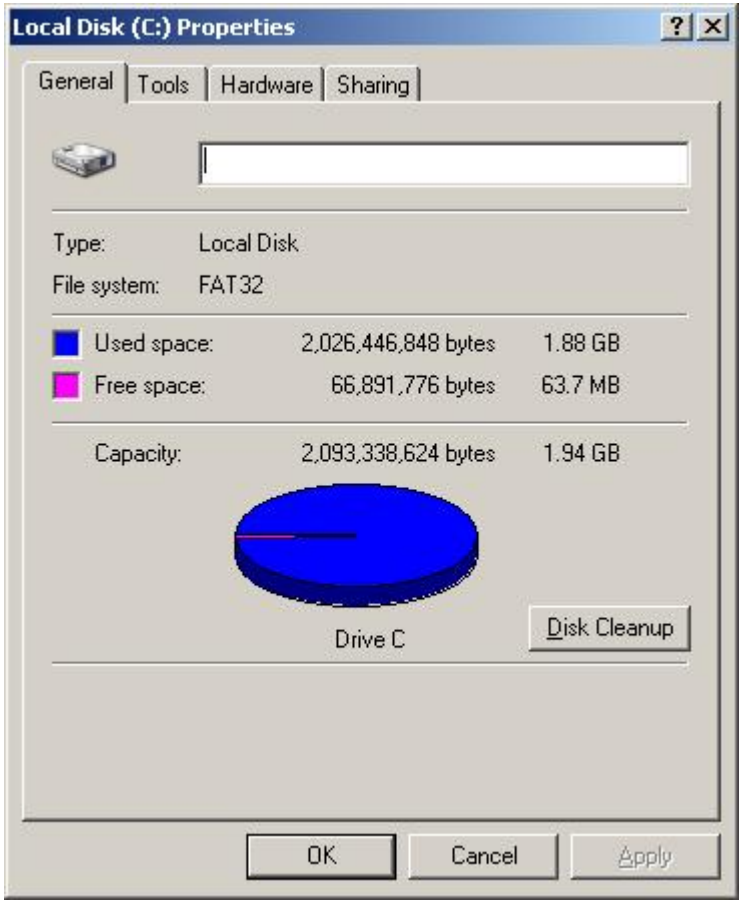
Importance of Controls & Integration



Importance of Controls & Integration

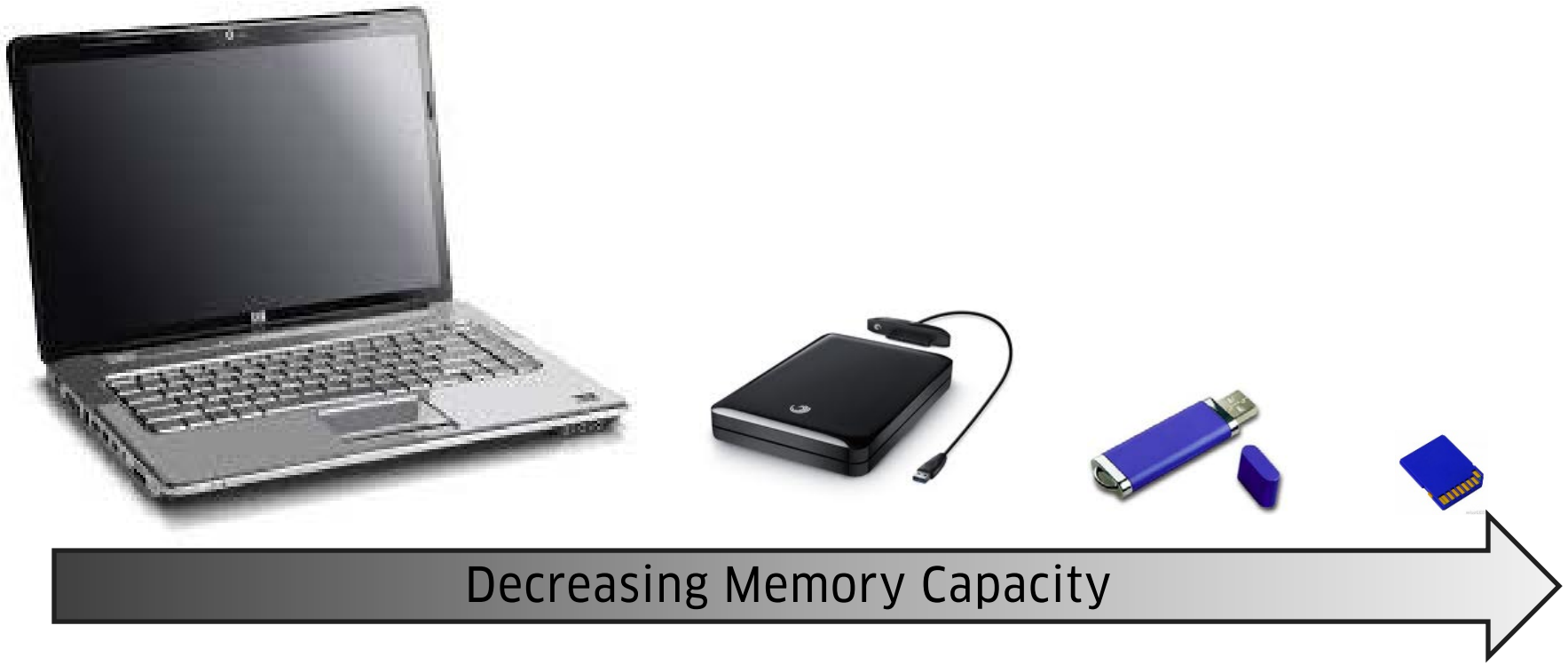
#1 Energy Storage Systems are MORE than just batteries

Ever had this Problem?



You just want to download *one* more data set, photo, program, etc. but memory is full!

Options for more Memory Expansion



- Get a whole new computer ➔ too much?
- Delete content ➔ able to delete enough?
- Incremental storage capacity ➔ just right!

Options for more Memory Expansion

Purchase Precise Amount to Meet Your NEEDS!

Decreasing Memory Capacity

Distribution System Equipment Upgrade

Decreasing ESS Capacity

Options for more Memory Expansion

Purchase Precise Amount to Meet Your NEEDS!

#2 ESS modularity & sizing flexibility can create value

Decreasing Memory Capacity

Distribution System Equipment Upgrade

Decreasing ESS Capacity

Smartphones just used for phone calls…

Category	Landline Phone	Smartphone
Phone Price	$20 - $80	$100 - $300
Annual Fees	$250 - $500	$800 - $1,500

Conclusion➔ Smartphones not economic choice

I don't need a smartphone, I can…

Make Phone Calls

Check Time
Set Alarm

Take Pictures

Listen to Music

Check Email
Surf Internet

Read the News

Schedule Meetings
Manage Contacts

Get Directions

I don't need a smartphone, I can…

Make Phone Calls

Check Time
Set Alarm

Take Pictures

Listen to Music

#3 ESS do much MUCH more than just time shift energy

Check Email
Surf Internet

Read the News

Schedule Meetings
Manage Contacts

Get Directions

Summary & Key Points

#1 Energy Storage Systems are MORE than just batteries

#2 ESS modularity & sizing flexibility can create value

#3 ESS do much MUCH more than just time shift energy

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Thank You

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