AMPED Annual Review Spring 2015 Meeting

Battery system challenges that attendees would like AMPED teams to address in their presentations.

Attendee CATEGORY	BATTERY CHALLENGES
Vehicle OEMs	Battery system cost Battery system volume (everything else comes back to those two) Sensors for battery health monitoring Feedback control of sensor input to battery management system with advanced algorithm Battery Remaining useful life estimation Prognostic approach for battery failure Innovative BMS architecture for cost reduction and flexibility
System Integrators	Life Safety Cost
	Battery management Modeling Control
	1. SoC / SoH measurements 2. Specific power for hybrid applications (impulsive loads) 2. active cell balancing 1. Cell balancing 2. Cell prognostic information (cycle count/life expectancy) 3. Cell SOC estimation
Sensor Systems Manufacture	Challenges: 1. Lack of standardization around components/assemblies/testing 2. volume volatility in EV/HEV market 3. Need for stronger, longer, and more durable regulatory/incentive framework to guide implementation
Pack Tester	I think my main issue is that of 'perceived' liability and that is because of a screwed up legal system. Not a technical issue.
Pack Integrator	State of Health Safety Cell costs
Pack Engineer	Expense Capacity Safe
Pack Component Supplier	1. Battery thermal management -> ensuring smallest temperature gradient through the cell 2. Predicting battery lifetime as a function of temperature 3. An understanding of cell volume changes as the cell ages and for new cell chemistries to ensure adequate thermal management over the life of the cell
Grid Storage	I don't think the AMPED teams can address this, but perhaps ARPA-E could do more to disseminate information concerning the AMPED technology developments. Safety Cost Energy density

Attendee CATEGORY	BATTERY CHALLENGES
DOD	Safety, battery utilization, cycle life
	Cost, Safety for ship and air transport and cycle life
	Safe battery design Increased energy density while maintaining power rate Cost Affordability Military Application
Cell Manufacturers	Low cost cell sensing interconnect solutions for multiple cell packages and configurations highly accurate low overhead SOC determination methods Low cost flexible cooling techniques State of health measurement/calculations State of charge measurement/calculations Thermal management We see the top 3 system challenges to be (1) modeling / controlling battery packs to extract maximal capacity while also giving long cycle life, (2) and doing so with lightweight, yet accurate battery model to provide optimal power performance, SOC within real world context of aging cells, and (3) designing controls and packs for fast charging. System level integration of innovative technologies Commercialization pathway Techno economic impact BMS accuracy - battery cost - energy density
	Cost and safety
Battery Diagnostics Supplier	1. Testing new BMS designs using real cells is dangerous, and not repeatable, because the characteristics of cells vary based on SOC, etc. 2. Testing new BMS designs using power supplies and loads is cumbersome and inefficient (Specialized battery simulators addresses issues #1 and #2). 3. Is there an informal standard evolving regarding the ratio of temperature measurements to cells for large format Li-Ion batteries? i.e. 1-to-1? 4. What are the pros and cons of monitoring cell temperature with thermistors versus RTDs?
Academics	In situ/in operando characterization of physical properties, SOC, SOH High throughput quality control at every stage of production Improving recharge ability of Zn/MnO2 systems Lifetime Cell Balancing Age Prediction

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Academics (cont.)	1. Can your technology be <5% total system cost but give me more than 5% value add? 2. How flexible is your system really? As in is it easily modified for: pack size, chemistry, thermal management, user types. 3. We want to go to developing countries, with hot climates, poor maintenance and near-zero local expertise. Can your system provide value in such a situation?
ARPA-E Staff	1) cost vs. complexity 2) new methods to determine SOH 3) higher utilization of cell capacity in a long-lived pack
	Knowing what the actual state of the art battery performance is, especially battery life.
	Cell level fault detection and diagnostics
	Variations in charge/discharge rates Ideal vs actual model performance
	Sensors Controls Architectures
AMPED Awardees	Production cost estimation TAM Next stage funding
	1. Examine technology to market strategies that further bridges the different interests to the Government, National Laboratories, and private industries. 2. Examine approaches that facilitate the sustaining to the technical and industrial partnerships that transitions beyond ARPA-e direct funding. 3. Examine opportunities and constraints to expand partnerships.
	Failure modes
	Sensor design. Cost projections. Market projections.
	Adoption, validation, cost
	Better cheaper safer
	I am part of AMPED team - I don't think this applies as we don't do battery systems
	Fast-charging - charge and discharge based on internal states limitation - smaller packs with same energy capacity
	Model based battery management algorithms Li-ion ageing models Li-ion battery model validation
	Cost Cycle life Energy and power density Cost, Quality and Reliability.
	Modularity One system for the full range of environments Rapid response
AMPED Awardees (cont.)	1) Fast charging 2) Electrochemical model parameter identification 3) Electrochemical model state estimation
	1. SOC Estimation 2. SOH Estimation 3. Power capability estimation
	Accurate physics-based cell models
	1) Making a stronger, more quantitative connection between better cell sensing and extracting better pack performance, life, and oversizing trim 2) Sharing best practices on AMPED technology commercialization strategies. 3) Discussing differences in application of AMPED technology to various domains beyond xEVs, such as grid storage and aerospace.
	Data collection and ageing models from vehicle fleets
	Full System Optimization
	1. Life monitoring 2. SOH prediction 3. SOC determination over entire life
	Getting a vehicle platform to test our product/protocol. Access to past failure and crash testing data. Low temperature performance curves
	1. How to reduce the life cycle cost 2. How to get more predictable life/reliability 3. How can the battery management and prognostics technology keep up the pace with the advancement in battery chemistry and packaging
	Battery and BMS failure modes Battery safety systems - current practices Battery off-gassing
	Energy storage management model validation
	Extending battery pack lifetime - decreasing battery pack weight - improving battery cell performance
	Long-term effect of thermal management Cost of sensing batteries other than voltage and current How do you define a true comparison of the effectiveness of system level controls?
	Safety Reliability Modeling
	1)SOC estimation accuracy 2)SOH predication 3)Safety prevention
	Safety Power and Energy density
	Associated power electronics