

**EV Everywhere Workshop**  
**July 26, 2012**

# **BATTERIES**

**Next-generation Li-ion batteries**

# Next-generation Li-ion batteries

## Breakout Session #1 – Discussion of Performance Targets and Barriers

### Comments on the Achievability of the Targets

- Overall, everything is achievable, but, clearly, the cost targets are dramatic, particularly for AEV 300. (I have discussed this with Yet-Ming Chiang, who has a good feel for cost reductions, both their importance and interesting approaches.)
- AEV 100 achievable with a good silicon/graphite composite anode and LMRNMC (unsure timeline)
- AEV 300 would require cycleable Li-metal anode and UHVHC cathode (can't get there with Li-ion intercalation on both electrodes) (unsure timeline)

### Barriers Interfering with Reaching the Targets

- Pack - too high a fraction of inactive materials/inefficient engineering designs.
- Materials don't perform the way we need them to (voltage, capacity, power, stability)
- Lack of new high-energy intercalation materials
- Lack of stable high-voltage electrolytes
- Lack of cycleable, high-density anode (e.g. metallic lithium)
- Lack of thick electrodes

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## Breakout Session #2 – Discussion of Breakthroughs and Research Needs to Overcome Barriers and Reach Performance Targets

### Technology Breakthroughs Needed

- Stabilized LMRNMC, with high energy
- Stabilized Si, with high energy
- Stabilized HV electrolyte (or massively improved SEI to enable use of lower-voltage electrolyte systems)
- Stabilized metallic anode
- Thicker electrodes
- (Pack design is engineering)

### “Out-of-the-Box” Ideas

- Lack of new ideas for Li-ion intercalation materials
- Solid-state electrolytes to enable Li-metal
- Inter-digitated electrodes for improved fast-charge capability
- Nano-engineered electrode films to allow for thicker films

### Research Suggestions

- See above regarding materials discovery and design
- Need larger, single-mission projects to work on couples instead of single-PI projects
- Industry-lab interactions early in research

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## Breakout Session #3 – Discussion of Action Plans and Next Steps

### Comments Regarding the Other Technical Areas Being Discussed

- Main point: we should consider next-gen Li-ion and beyond Li-ion together as a single portfolio of work, in which risk and reward is balanced. Meaning, with advanced Li-ion, the risk is significantly lower (success is likely) even though success means double or triple the performance at lower cost; beyond Li-ion systems have greater promise, but are also unproven and represent significantly higher risk. This portfolio of research should be balanced by pursuing both avenues and competing the technologies over time.
- Could combine Li-metal work with Li-ion
- Same thing for multi-valent (particularly for solvent systems)
- Eliminate manufacturing steps (i.e. formation steps, materials fabrication-film creation, reduce energy usage during synthesis or coating)

### Next Steps for Reaching Targets (including roles for DOE and industry, e.g., lead or support)

- See above - expedited materials R&D + industrial involvement