Breakout #1
Future of abuse tolerant electrochemistries:
Intrinsically safe chemistries, cells and designs

Breakout #1: Future of abuse tolerant electro chemistries

Comments in regard to Li-ion electrochemistry:

- **Can cell components be improved for intrinsic safety and still realize cost/weight/volume reductions?** YES
- **Can a safe cell enable simpler and lower cost balance of plant?** YES
- **Is a non-combustible cell intrinsically safe?** NO
  - A noncombustible electrolyte would be huge win, but it only solves one safety mode – others include electrocution, toxicity, reactivity, ...
- **Are there any unique aspects of a vehicle environment, e.g. size and shape, that could enable new battery architectures for increased safety with reduced system cost?**
  - It is possible if cell could serve dual function as crash protection or the vehicle could be designed smartly to completely protect/isolate battery.

Comments in regard to non Li-ion electrochemistry:

- **Are there options for super safe, but high performing chemistries?** Most likely Yes
  - E.g. Aqueous, Solid state chemistries/designs…
- **Should we consider searching for new battery reactions?** Yes

Breakout #1: Future of abuse tolerant electro chemistries (cont.)

- **How much lower energy is acceptable in an intrinsically safe battery? Alternatively, how much savings would we get today if Li-ion was intrinsically safe?**
  - **How much cell→pack weight/volume/cost is only there for safety reasons?**
    - Take the extreme limit of the entire pack being one super safe cell. In that case, we could take about 50-70% out of the pack. However, most of the added weight/volume/cost for safety plays a dual role and also is necessary for controlling operation and maintaining lifetime.
    - To bound the cost and benefit of having intrinsic safety it was decided, that if an intrinsically safe battery was available for double the price at the same performance or for the same price at half the performance it would not be adopted by industry.
- **How do we best quantify the system benefits and/or success criteria?**

  There is a need to:
  - Establish a minimum system level energy density target.
  - Identify weight, volume and cost metrics normalized to range and/or lifetime (e.g. 10 yrs).
  - Require the battery can sustain ALL failure mechanisms and safety modes.

Breakout #1: Future of abuse tolerant electro-chemistries (cont.)

Characteristics of an ideal system:

- Absolutely no need for control
- Located w/in the crash zone
- Lower energy density is ok if at lower cost and a system level benefit exists (but the group recognized this scenario as a really hard task for new technology)

Potential technical areas of interest …

- Cell design optimization
- Inactive materials/designs that absorb abuse
- Preventing propagation
- Eliminating combustion
- Electrochemically benign systems
- Gas management
- Complete containment
- Spatially isolate reactive components
- Intracell thermal management