Breakout #2
Moving the pack out of the box:

Vehicle/energy storage integration to optimize protection of the battery, vehicle, or driver

Breakout #2: Moving the pack out of the box

- **How much weight and volume are consumed by battery packs in small vehicles versus large vehicles today?**
  - Most small Electric Vehicles are being designed for 100 miles of driving range
  - Large vehicle battery packs are commonly made up of units based on the same modules used in small vehicles.
  - State-Of-the-Art EVs' energy density is nominally <100 Wh/kg (80-100 Wh/kg), SOA Pack weight is ~250-300 kg, and SOA volume is ~180-200 L for small EVs.
- **Can we do better than surrounding batteries with protective metal plates? (lighter plates, different materials, structural designs)**
  - The state-of-the-art material of choice is steel and/or Al. Die-cast Al has been used to reduce weight.
  - There is not enough room to accommodate energy absorbing materials, such as rubber, due to the lack of room in battery packs.
  - Multiple smaller batteries may be an alternative to a single heavily armored battery pack.

Breakout #2: Moving the pack out of the box (cont.)

- **Is a distributed battery pack a potentially viable solution? How about disintegratable battery packs or separating the battery pack from the vehicle during impact to enhance safety?**
  - Potential benefits of distributing the battery pack:
    - Reduced probability for propagation (Easier thermal management through increased surface area per quanta of capacity) .
    - Inherent safety in maintaining smaller packs particularly if the individual pack voltage is ≤60 Vdc.
    - There is the possibility for lowering the weight of the structure, if the overall mass that is being protected is smaller (smaller support structure results in thinner protective shell).
  - Potential challenges of distributing the battery pack:
    - Costly power electronics
    - Cost for distributing the thermal management system
    - Wiring cost
    - Balancing the State of Charge (passive or active). Impedance across the distributed system can be an issue, but balancing within the distributed unit cell could still be accomplished.

  Other potential ideas that may have significant system-level benefits.
  - Disengaging the battery pack from the vehicle at time of impact and/or extending the crumple zone.
  - Cell deformation triggered disconnection or isolation of cells and/or packs.

Breakout #2: Moving the pack out of the box (cont.)

- **Can a battery, either being conformal or integral to the structural body, be a safer and viable solution?** (Conformal is not replacing structural members, just has to match the structures contours and is not necessarily flexible.)
    - Potential advantages of conformal batteries:
        - Possibility for filling the hollow spaces/portions of chassis or framing, leading to more effective packaging
        - Possibility for using the body as the battery’s heat sink
    - Disadvantages
        - Implied risk by mounting the energy storage media to the body, smaller crash events (e.g. fender benders) may increase the cost of replacements parts.
        - Introduces more design complexity, each element must be engineered to its own individual constraints (e.g. mechanical, thermal, intrusion into cabin space….)
- **How do we best quantify the system benefits and/or success criteria?**
    - SAE J2929 was cited as the current testing protocol.
    - There was no clear consensus on developing metrics.