Electric Vehicles Safety and the GTR

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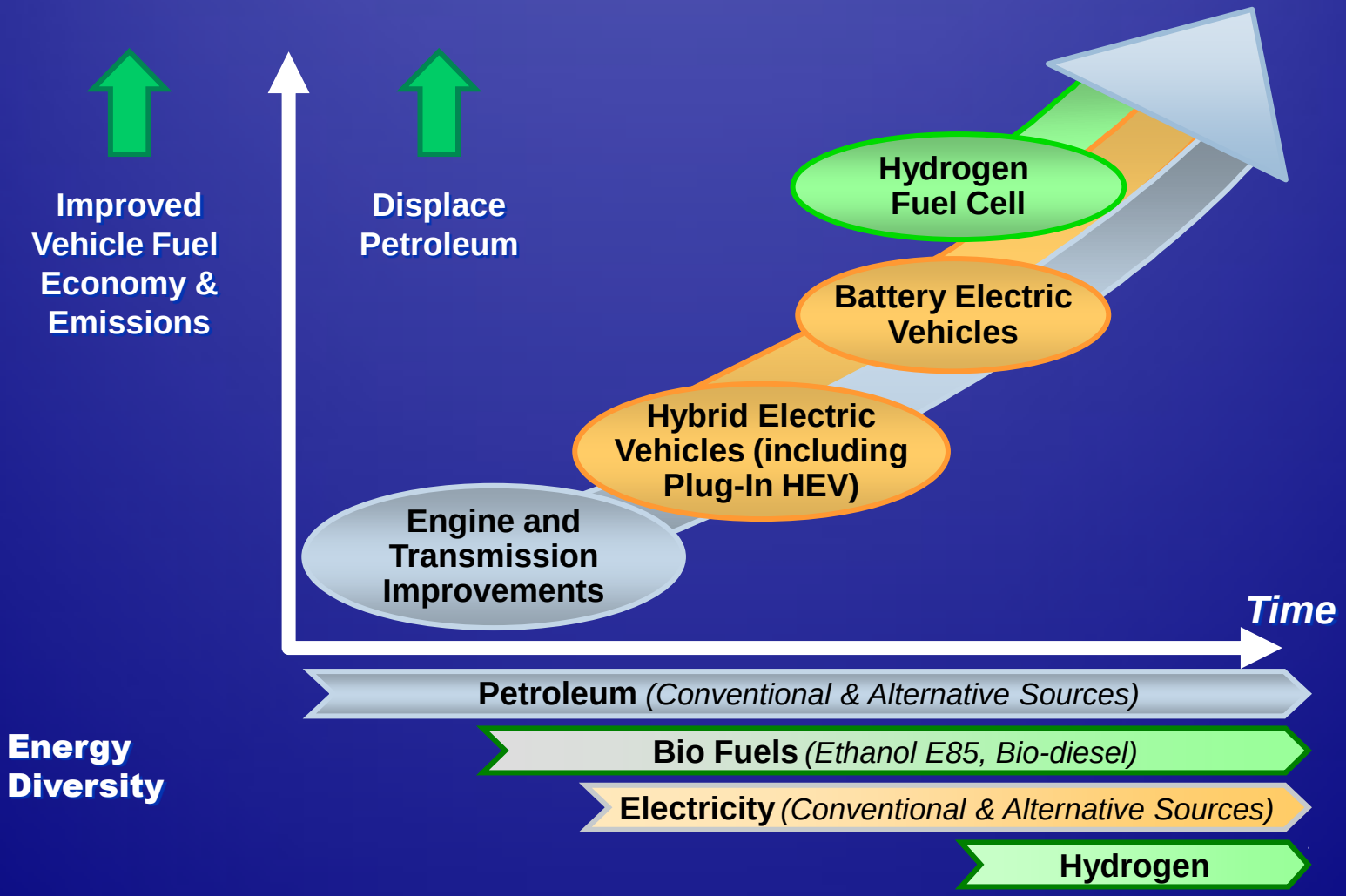
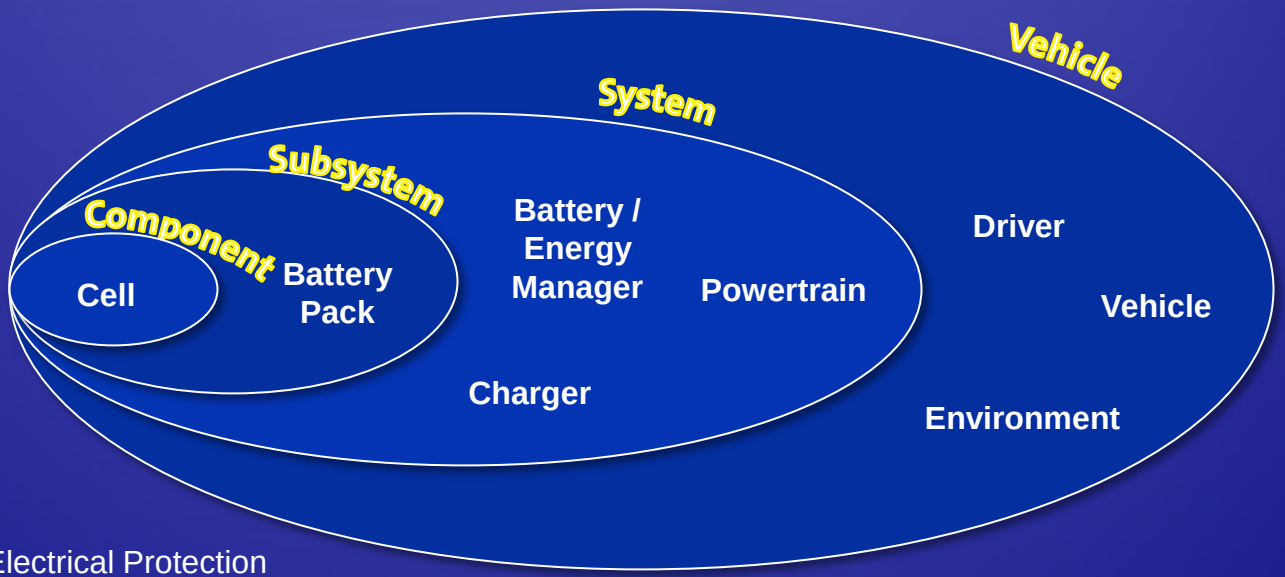
Topics

- GM Alternative Propulsion Strategy
- Battery- and EV Testing
- Standards and Harmonization
- GTR Recommendations

Advanced Propulsion Technology Strategy



Layers of Safety



- Materials,
- Structure
- etc

- Electrical Protection
- Mechanical Protection
- etc

- Charger Control
- Contactor Control
- Diagnostics
- etc

- Driver Message
- Environment
- etc

Safety strategies at each level build from lower level designs

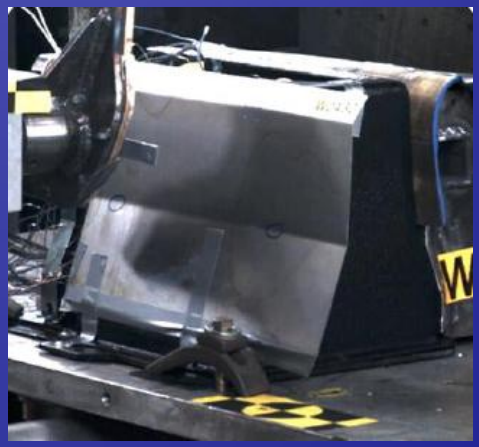
Battery Testing on Bench

- Tests on cell level
  - Power and energy
  - Calendar life at various temperatures
  - Cycle life (USABC DST profile & Volt specific profile)
  - Fault tolerance (overcharge, short circuit, crush, over temperature, etc.)
- Tests on pack level
  - Power
  - Energy
  - Efficiency
  - Thermal system
  - Controls
  - Cycle life

Battery Validation

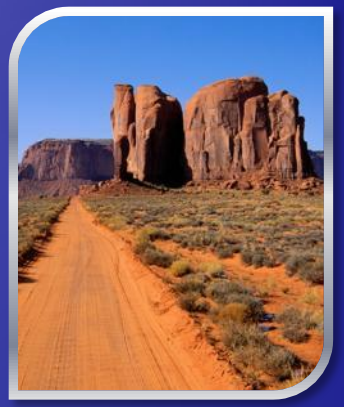
Validation

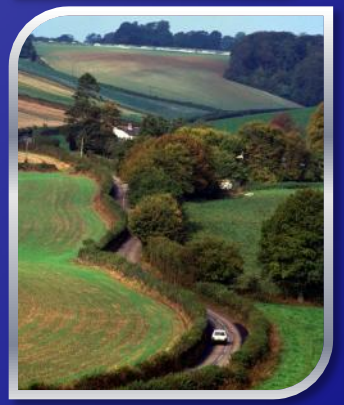
- Crash
- Mechanical: shock, vibration
- Environmental: temperature, salt, water
- Electric: e.g. EMC
- Customer use life cycle



Battery Testing in Vehicle

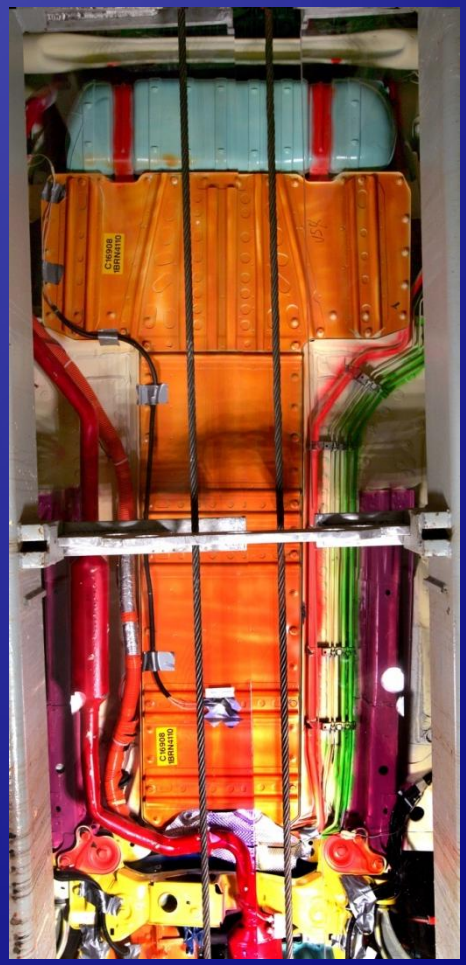
- Hot weather testing
- Winter testing
- Mountain testing
- Several hundred thousand kilometers driven with the development fleet





Vehicle Crashworthiness

- Rigorous vehicle crash testing conducted
- Post crash evaluation includes the following items
  - Short circuits
  - Electrical arcing
  - Bonding of High Voltage enclosures to the EV chassis
  - Battery and component retention
  - High Voltage disconnect and HV bus discharge
  - High Voltage isolation from vehicle chassis
  - Visible electrolyte spillage from RESS
  - Cell venting behavior



EV and battery safety standards and research

- Multiple existing industry and regulatory codes and standards related to EVs provide a rich framework for EVS GTR discussions

- In addition, various countries are conducting research on EV safety, including lithium battery safety

- Learnings from these sources should guide the content of the EVS GTR to assure that it represents state-of-the-art knowledge when published

Global harmonization

- Electrification of motor vehicle transportation is sweeping the world
- Regulatory harmonization is an important enabler for this transition to succeed
- Industry encourages contracting parties to adopt the EVS GTR into their national regulations when it is completed
- Avoid to the extent possible conflicting, altered, or duplicative regulations
- Electrification of auto transportation already faces significant cost challenges, non-harmonized regulations needlessly add burden to this

GTR Recommendations

- The EVS GTR should include in use and post crash electric safety requirements

- Preference for performance-based safety requirements provides the necessary flexibility to accommodate future innovations

- Requirements should reflect the usage of batteries in electric vehicles

- Sufficiently comprehensive requirements without options will avoid the need for country-specific regulations

- The scope of the GTR should be limited to safety requirements for electric vehicles

- Recommendations regarding charging infrastructure, first responders procedures or vehicle/components service, repair, maintenance and transportation issues could be given to the relevant organizations

Thank you !