

NOHMs Technologies, Inc.

Improving Battery Safety &
Performance with
Advanced Electrolyte

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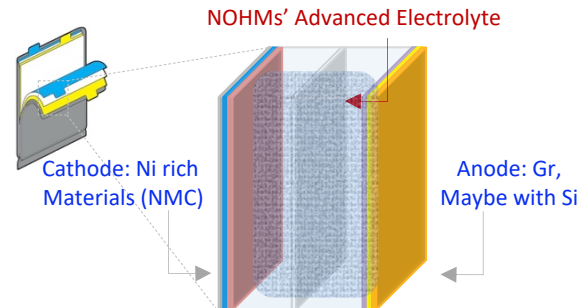


NOHMs Technologies

NOHMS Develops Advanced Electrolyte Additives and Formulations, Significantly Enhancing Lithium Ion Battery Safety

Battery Electrolyte is a High-Growth Specialty Chemical Market

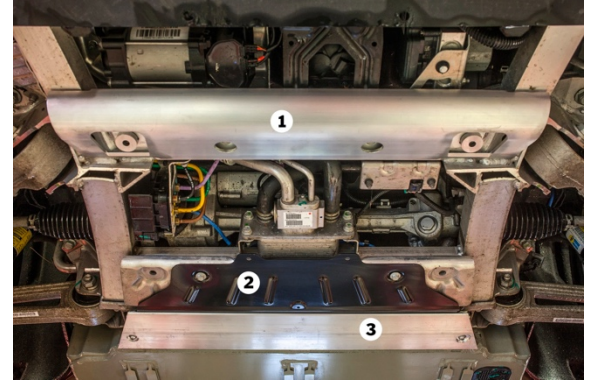
NOHMs' Technology Facilitates and Enhances EV Market Growth



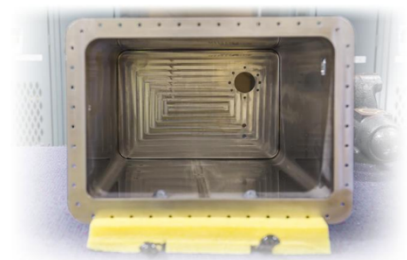
- \$3B Market Today
- 20-30% CAGR Through 2030
- NOHMs Proposes a Capital-Efficient Specialty Chemical Business Model
- Addresses Safety Concerns
- Enabler of Safe Advanced Battery Cell Chemistries: Higher Energy Density Materials
- Reduces System Complexity and Safety-Related Costs

What Is “Safety”?

- Completely Non-Flammable Battery
 - Unrealistic; Everything burns, at some temperature
 - Chemistry/Physics gets involved
- China:
 - 5 minutes to egress car after thermal-runaway warning from BMS (time expected to be raised in 2020)
- Tesla:
 - Structural Protection Added:
 - Hollow aluminum deflector bar (1)
 - Expensive titanium plate, est. \$35 / car (2)
 - Solid aluminum extrusion (3)
 - Estimated Weight: 4.5 lbs (2 kg)
 - Estimated Full Cost for Retrofit: \$200-250 / car
- Boeing 787 Dreamliner (LCO):
 - Structural Protection, Insulation and External Venting Added
 - Additional 185 lbs (84 kg) / Plane (3x the original weight)
 - FAA Estimate: \$465K / Plane
 - Design Point: Starve a fire of oxygen
 - Fuel Penalty: 17% of Weight / 1000 km
 - Potentially \$58K / Year
 - 2017: UAL 915, IAD->CDG Incident



Source: NY Times, April 11, 2014



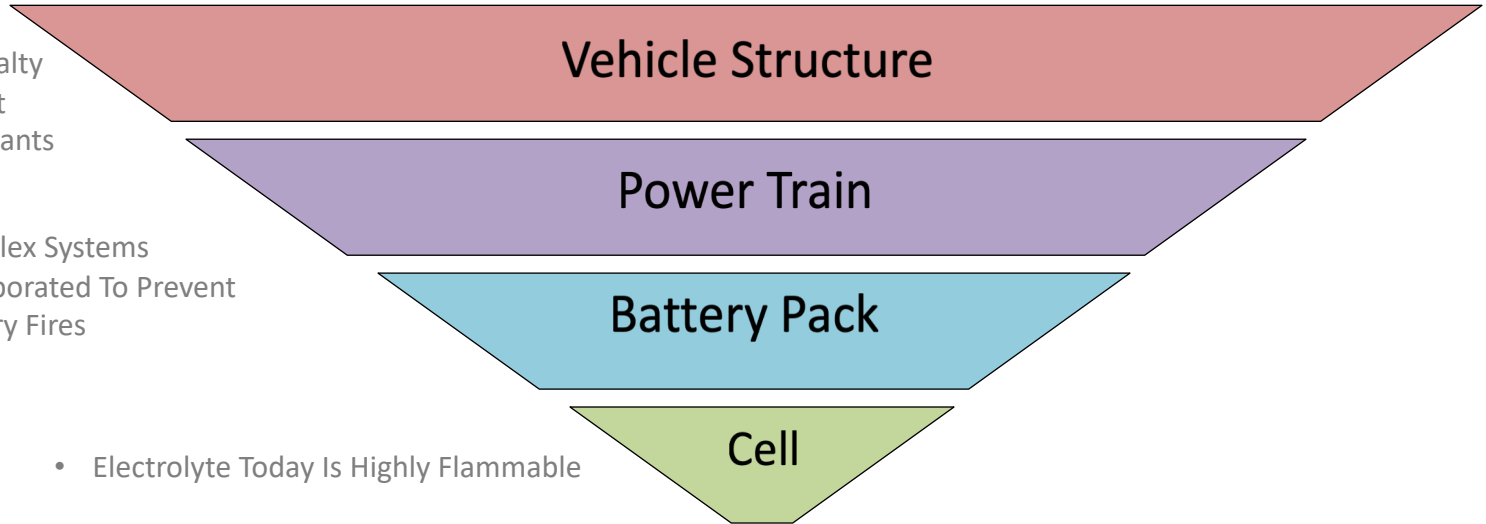
Source: Boeing

Battery Safety Starts With Safe Electrolyte Material

- Heavy Weight Penalty Incurred to Protect Battery and Occupants

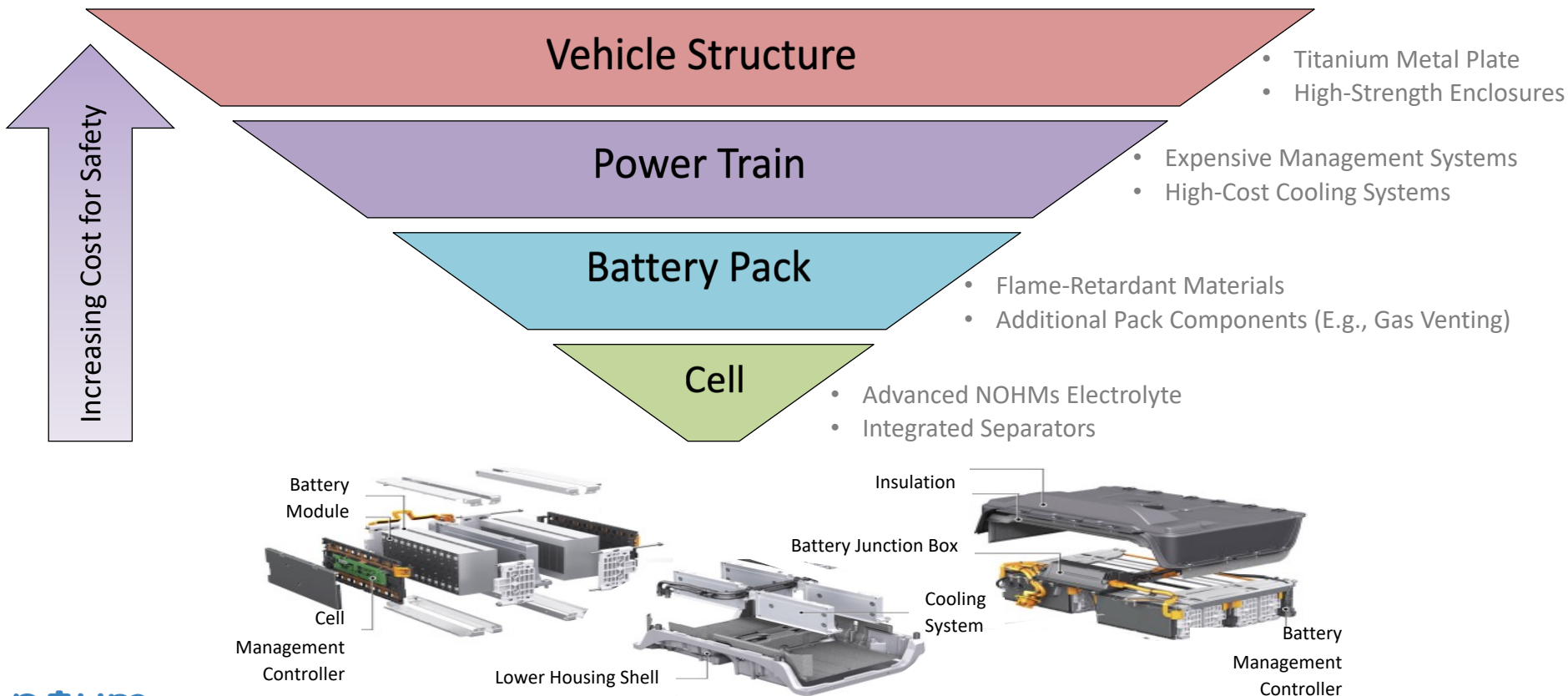
- Complex Systems Incorporated To Prevent Battery Fires

- Electrolyte Today Is Highly Flammable



NOHMs' Electrolyte Platform Is Key To Safety

Battery Pack Safety Costs Increase with System Level



Electrolyte Innovation Stagnated... for Three Decades

1991

Sony Commercialized the Lithium Ion Battery

- The electrolyte contained carbonate solvents and LiPF₆ salt.

Since 1991

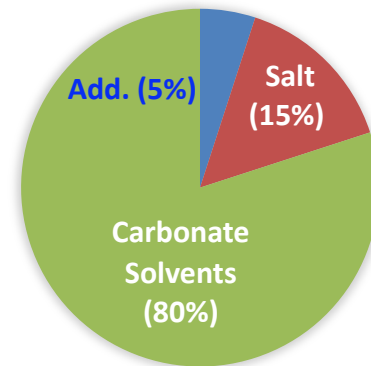
95% of Electrolyte Composition Is The Same

- In today's batteries, performance additives do not improve safety.

2020

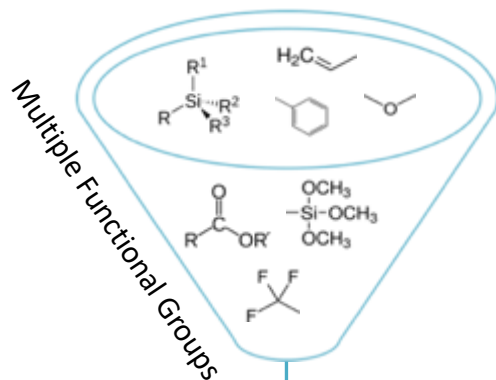
For future batteries, new electrolyte is needed to improve performance and safety.

Today's Electrolyte is 95% similar to Sony's 1991 battery formulation.

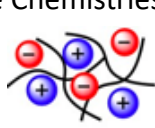
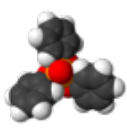
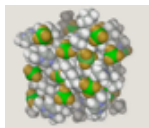


NOHMs' Solution: Simpler, Multi-Functional Molecules

NOHMs' unique approach introduces multiple functions via core molecules.

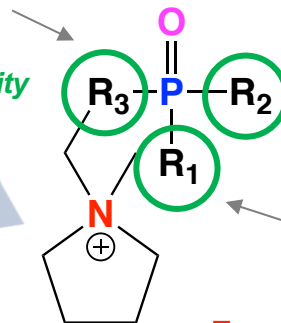


NOHMs Core Chemistries



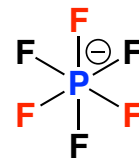
NOHMs' products address multiple functions with one additive.

- Reduce Internal Resistance
- High Voltage Stability
- Reduce Viscosity



- Fire Safety
- Prevent Thermal Runaway

- SEI Protection
- Temperature Stability

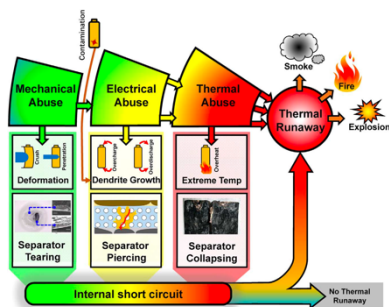


P (Phosphorous) = Flame Retardant

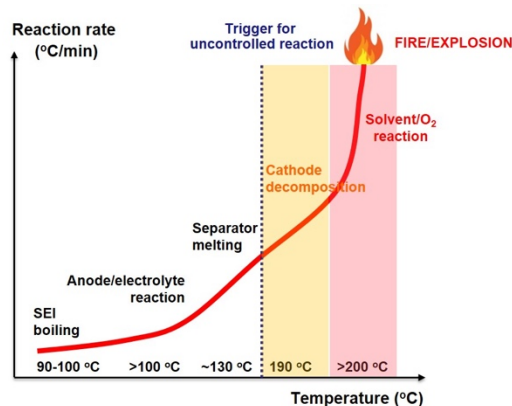
Key Benefit

**NOHMs Has One Key Benefit:
Improved Lithium Ion Battery Safety**

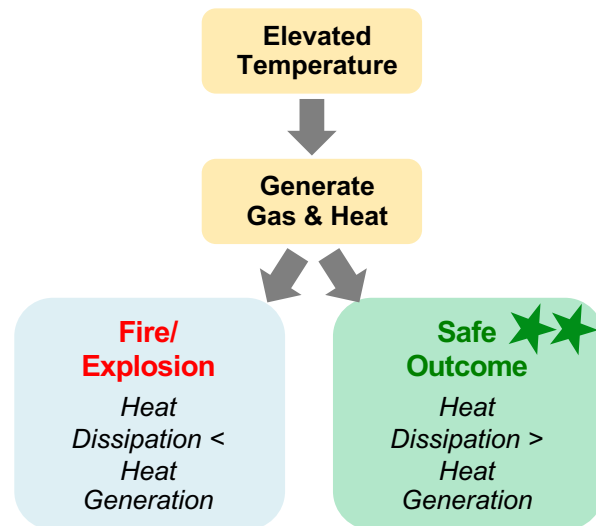
NOHMs' Safety Co-Solvents Prevent or Delay the Onset of Thermal Runaway at the Cell Level



Thermal Runaway Reaction



Ethylene carbonate (electrolyte) reacts with oxygen from the cathode decomposition

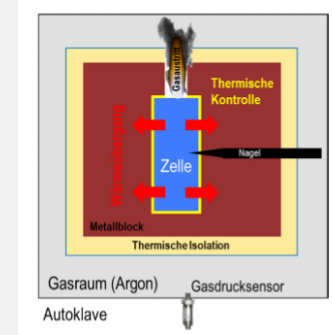


Safety Validation Testing

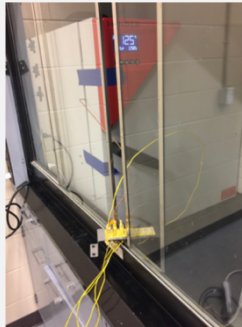
ARC



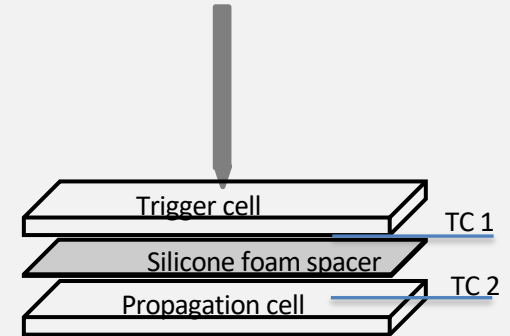
Autoclave



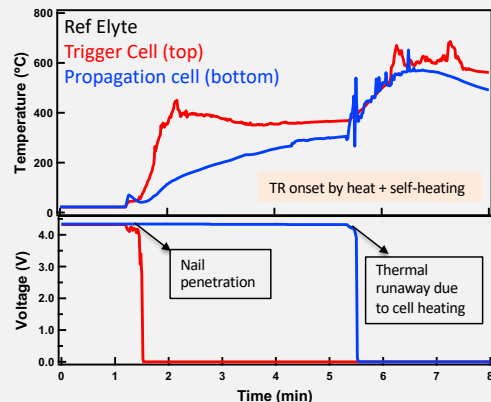
Hot Box



Propagation

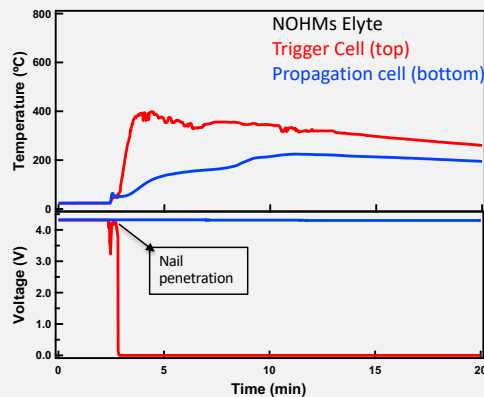


Delivering Safety Without Compromising Performance



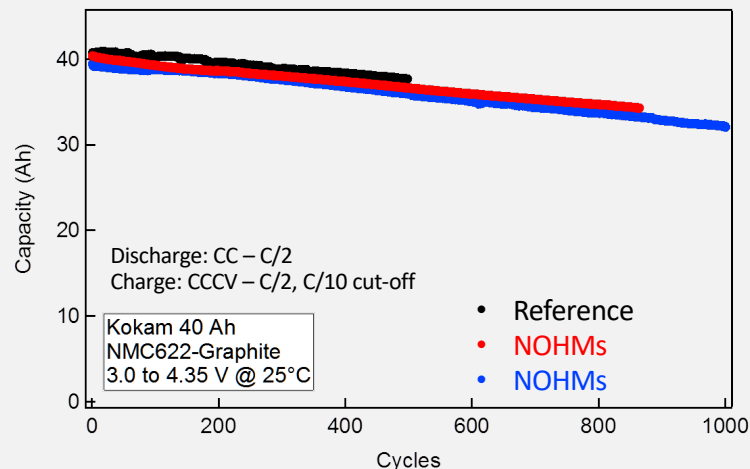
Reference Electrolyte

- Trigger cell enters thermal runaway upon penetration
- Adjacent cell enters thermal runaway in 4 min



NOHMs Electrolyte

No Propagation To Adjacent Cells

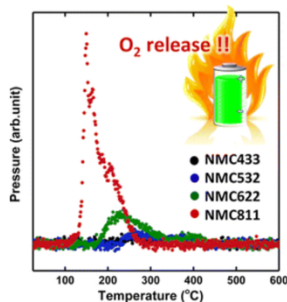
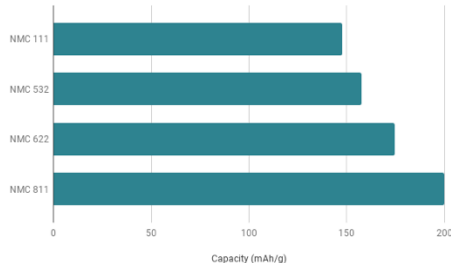


NOHMs Electrolyte

NOHMs electrolyte achieves comparable electrochemical performance.

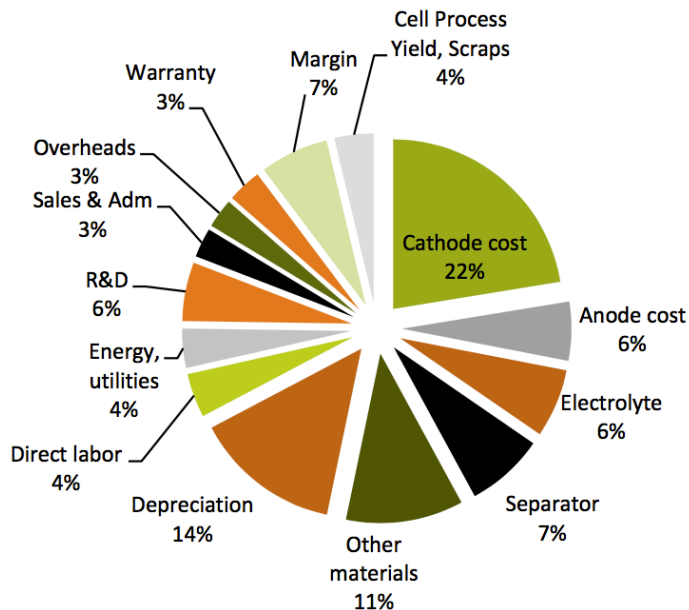
Cost/Performance Benefits

NOHMs Offers System Cost Reductions: Improved Performance With Reduced Costs



- Higher Energy Density
 - Transition from NMC622 to NMC811: ~16% Improvement
 - Silicon Anodes: 25% or More
- Larger-Capacity Cells
 - Greater Energy in Large-Capacity Cells Makes the System Inherently Less-Safe.
 - But It Also Reduces Cost of the Overall Pack: System Safety Components, Wiring, BMS, Etc.

Cost Reduction via Advanced Electrolyte



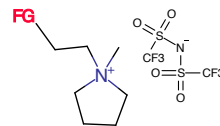
*6% * 24% Cost Increase = 1.44% Increase in Total Battery Cost*



NOHMs' electrolyte components (12% by weight)

- High voltage stability
- Broader temperature range
- Non-flammable

NOHMs Functional ionic liquids

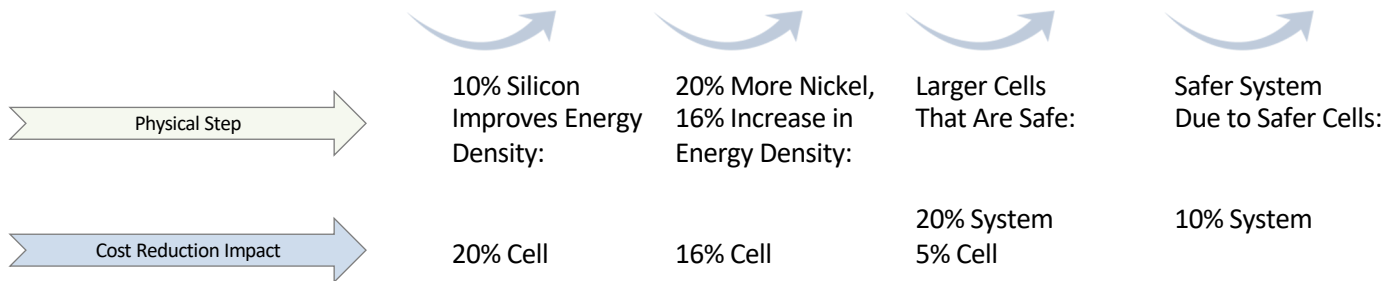


Benefits to Partners/Customers:

- Overall Improvement In Performance
- Reduction in Battery System Cost by 36% (Estimated)

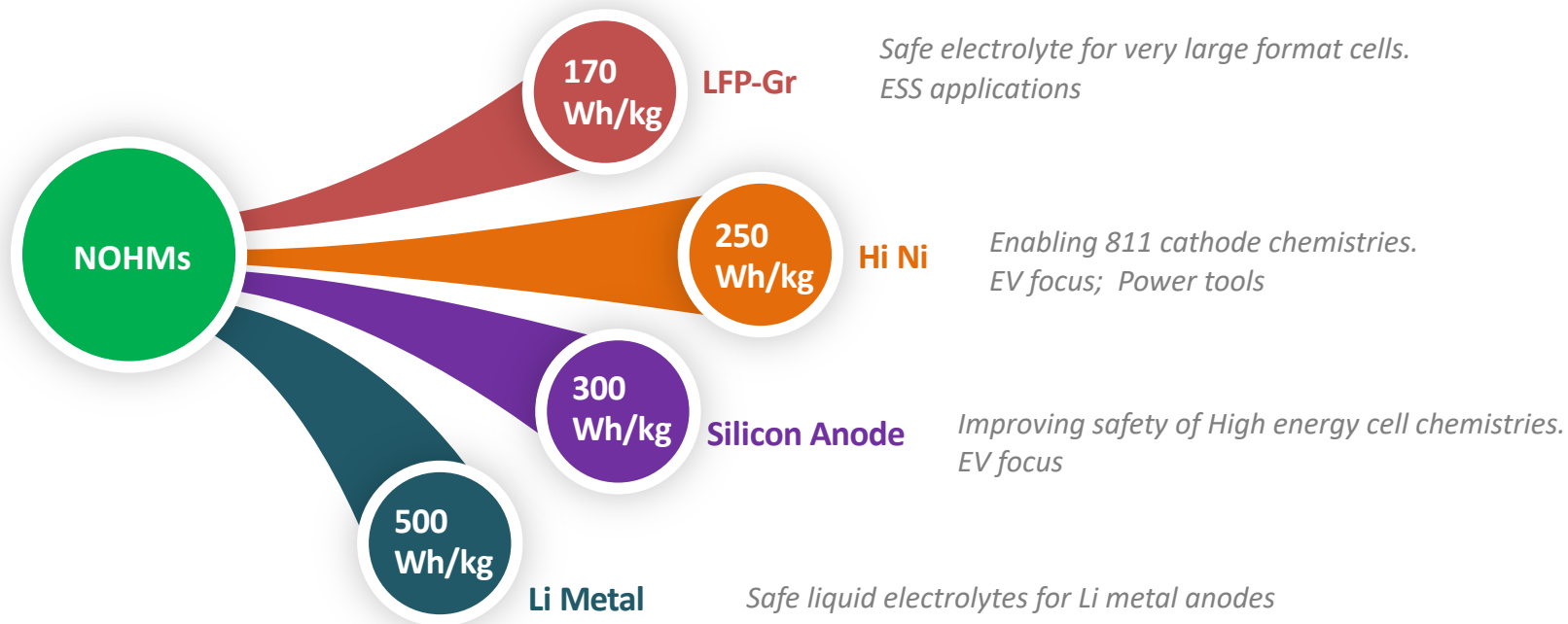
Potential Cost Savings – Advanced Electrolyte

Normalized Cost		Cost Profile Using Advanced Electrolytes			
Today's Commercial Battery Packs		10% Si Anode	811 Cathode	Larger Cell Capacity / Safer	Safety / System Design
System Cost	30%	30%	30%	24%	19%
Cell Cost	70%	56%	47%	45%	45%
Total Cost	100%	86%	77%	69%	64%



Easily Offsets the Approximate 1.44% Increase in Electrolyte Cost

NOHMs Safe Electrolyte Platform



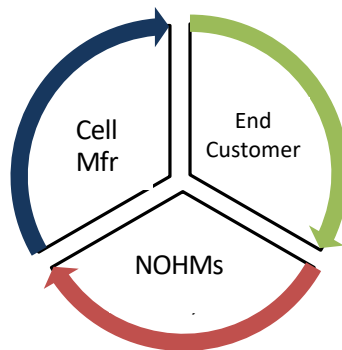
Business Model: Collaboration With NOHMs

Cell Manufacturing Partner

- Provide Superior Product to Customer
 - Safety
 - High Performance SEI
- Partner's Cells In-Line With Customer Requests
 - Customers Understand NOHMs Positioning
- Shortens Partner's Time-to-Market
 - Extensive Testing Already Performed
- Customized and Optimized Electrolyte For Partner's Products
 - Marketing Advantage

End Customer

- Achieve Their Main Goals
 - Safe / Non-Explosive Cells
 - Performance Targets
- Extensive Testing During E/L Development
 - Customer Acceptance of Technology Occurs Prior to "A Samples"



NOHMs

- Close Integration Into Supply Chain
- Expanded Development and Testing
 - Focus On Exact Requirements
 - Performance and Safety Targets Established Early On

Summary

Benefit

NOHMs Proposes Advanced Electrolyte Additives And Formulations Significantly **Enhancing Lithium Ion Battery Safety**

Growth

Battery Electrolyte Is A High-Growth, Specialty Chemical Market

- *\$3 Billion Today*
- *20 – 30% CAGR Through 2030*
- *Addressable by NOHMs Via a Capital-Efficient Chemical Business Model*

Low Risk

Experienced Start-Up Managing and Innovation Team

- *Product De-Risked With \$20M and 100+ Person-Years Since 2010*
- *Customer De-Risked With Funded Joint Development Efforts Since 2015*

Future

Technology Accelerating EV Market Growth

- *Safety Concerns*
- *Cost Reduction of Battery Systems*

Electrification of Vehicles Is Key Component of GreenTech's Positive Impacts