

Lithium Market Dynamics

David Klanecky

CORFO Roadshow

Macro Trends Driving Long-Term Lithium Growth Opportunity



Mobility

- Battery performance, cost and safety
- Demand for mobile devices and tools
- Electrification of transportation

**Salts
Electrolyte Additives
Metal**



Energy Efficiency

- Power grid efficiency and renewable use
- Weight reduction in aerospace and large format transport (metals and plastics)
- Friction reduction (grease and eco-tires)

**Salts
Metal
Organometallics**



Health

- Aging population
- Pharmaceutical synthesis
- Increased respiratory distress and illness

**Salts
Specialties**

Lithium is a Key Enabler to Solving Global Issues

Battery Markets Continue to Accelerate

Battery Market Expectations



Consumer Products

CAGR (2016-21): ~8%
LCE Content: < 0.1 kgs



Transportation

CAGR (2016-21): 30 – 35 %
LCE Content: 40 – 100 kgs



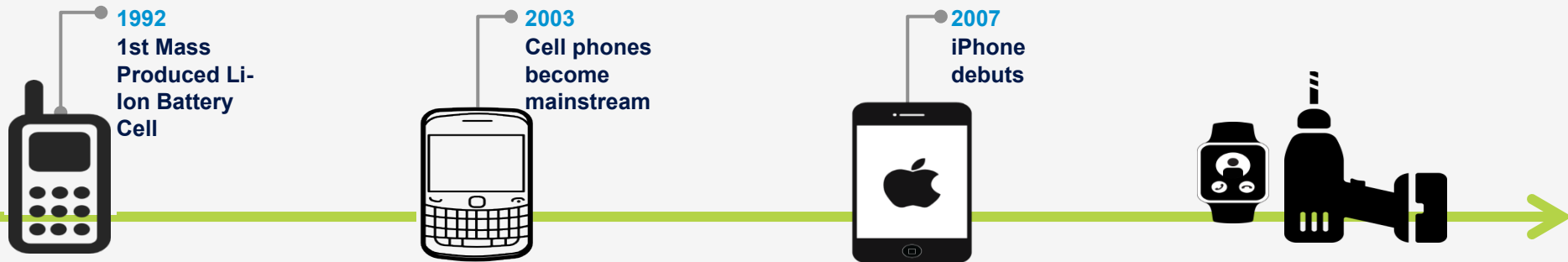
Grid Storage

CAGR (2016-21): > 40%
LCE Content: > 1,000 kgs

Source: Based on Internal Albemarle Demand Model and third-party data

Li-Ion Batteries Enabled Consumer Product Innovation

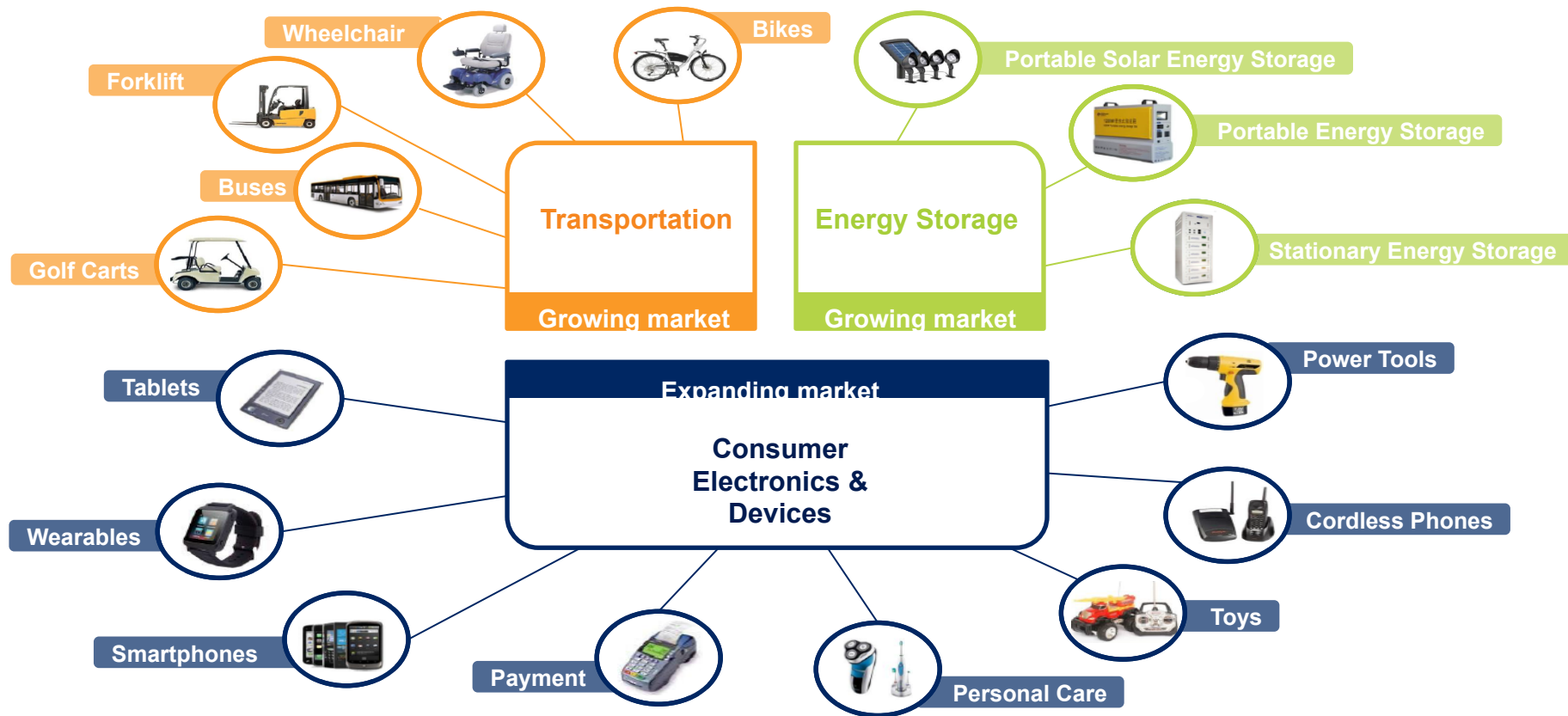
Smartphones | Tablets | Laptops | Wearables | Power tools



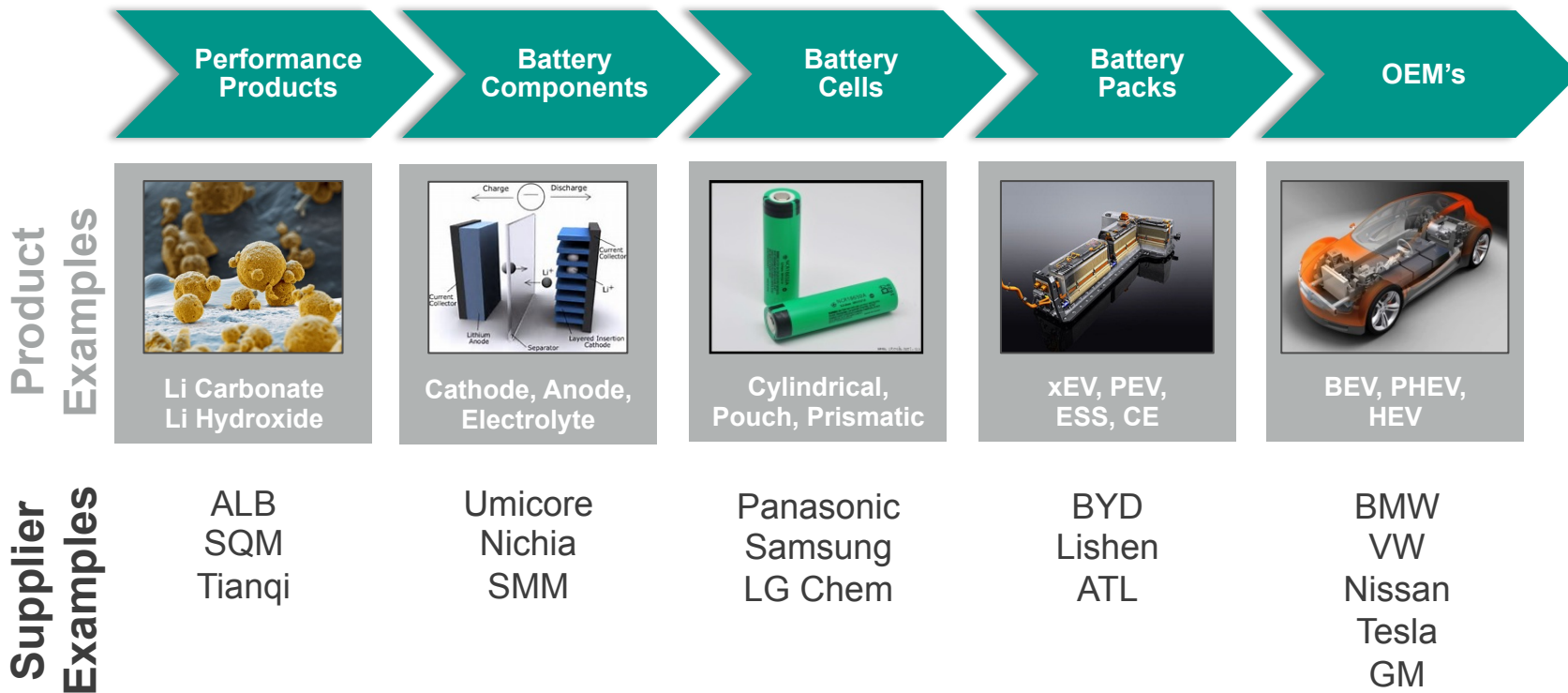
➔ In **5 years**, Li-Ion batteries went from a niche end-use to the #1 consuming market for Lithium with explosive growth from **consumer electronics** and expansion into **additional consumer devices: power tools, lawn and garden equipment, forklifts, golf carts, etc...**

Future Growth Driven by Expanded Use of Batteries in Numerous Consumer Devices

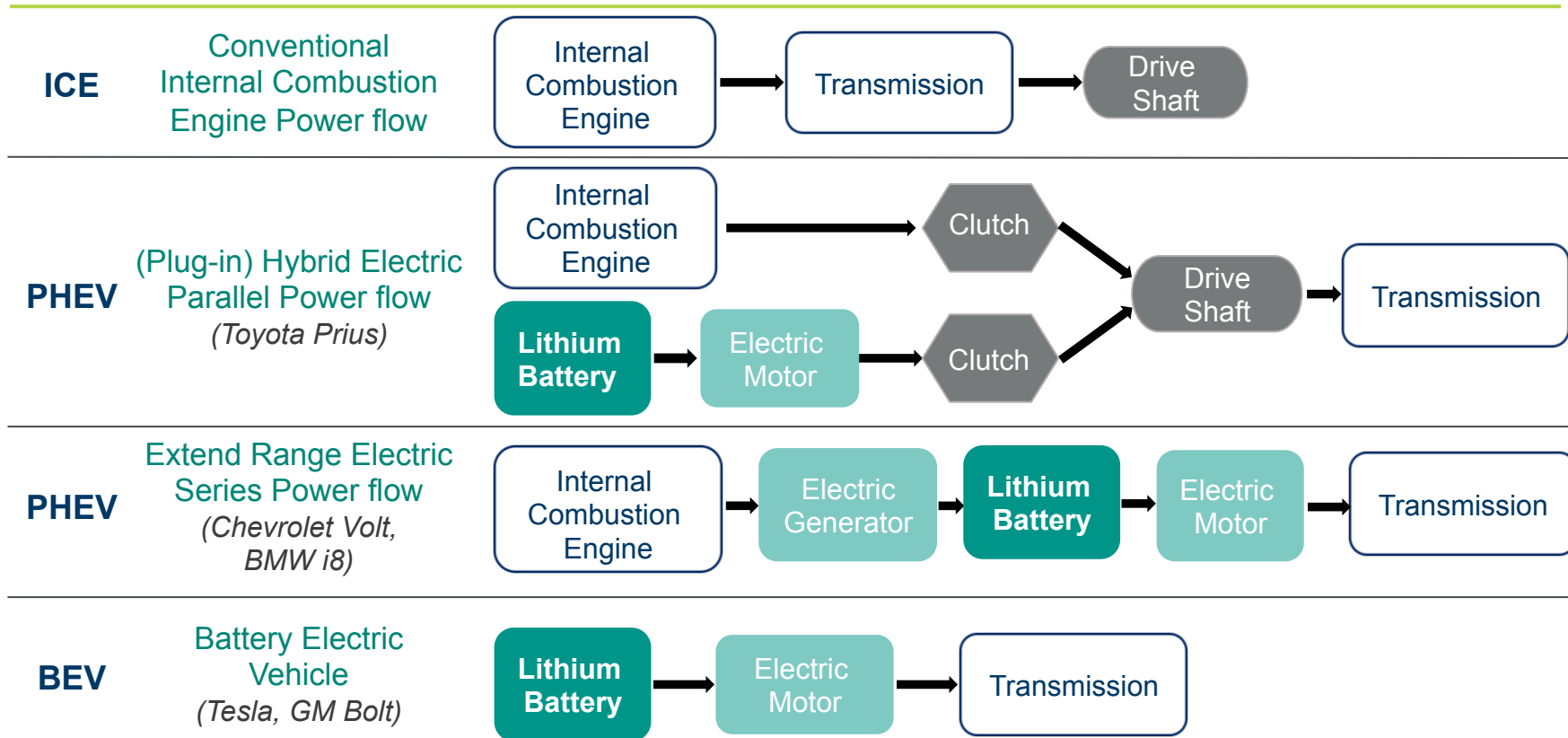
Li-Ion Battery Applications Continue to Find New Applications



Battery Electric Vehicles Value Chain Enabled by Lithium



Lithium Use Grows with Automotive Technology Evolution



New EV Model Launches Gain Momentum



- Over 100,000 EV/PHEVs sold in 2016, 6 new models on the market



- Converting all models to electric drive trains over the next decade



- Launched Chevy Bolt – range of 238 miles at \$30k price point



- Full electric vehicle in 2019, and 1 million electrified cars by 2025



- Tesla SX3 - 500,000 vehicles produced annually by 2018



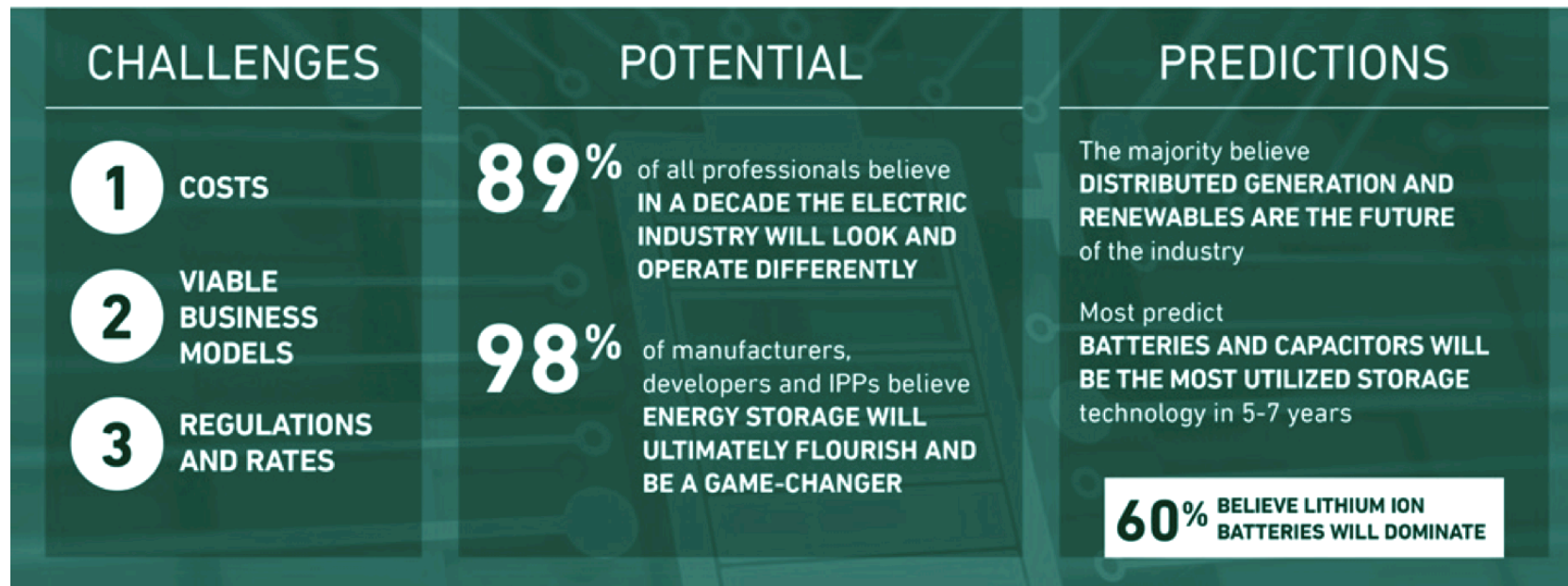
- Ford to invest \$4.5B in EVs to introduce 13 new models by 2025



- 40% of VW's fleet to be electrified by 2025, plus \$2B on infrastructure



The Future of Grid Storage



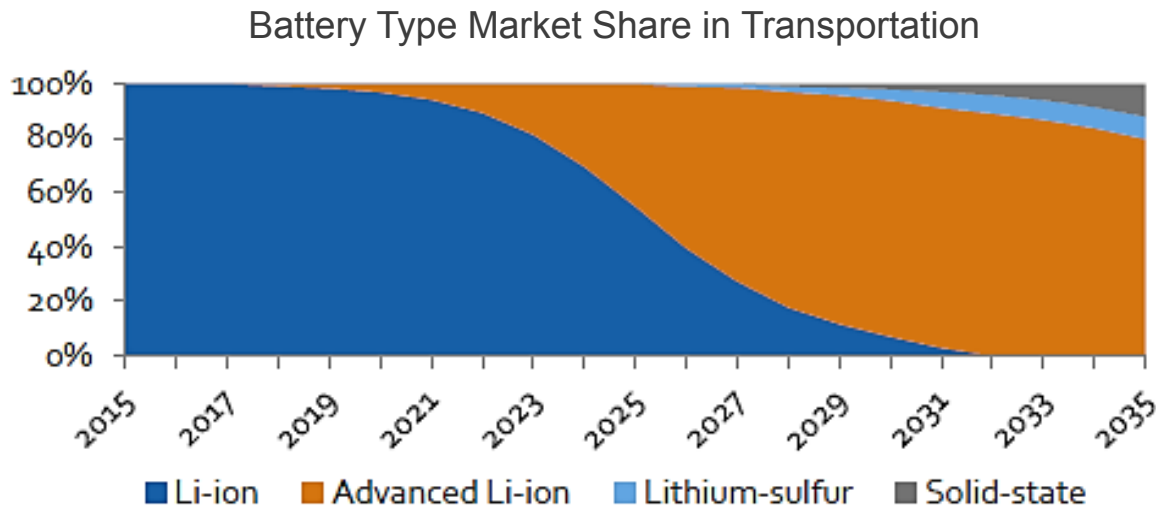
Mortenson (2016), Energy Storage Association Annual Conference and Expo

Grid Storage Likely to Drive Second Wave of Growth Beyond 2021

New Battery Materials Will Involve Lithium

Considerations Driving Continued Innovation in Battery Design:

- Safety
- Cost
- Power
- Durability
- Energy Density



Source: Lux Research 2016 Report

No Disruptive Non-Lithium Energy Storage Technologies on the Horizon

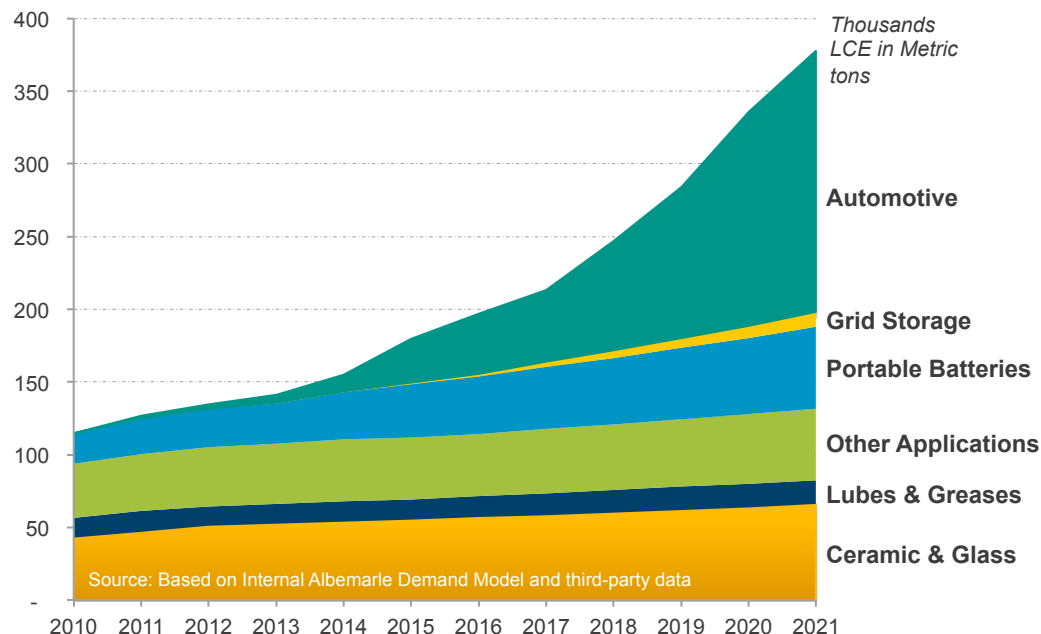
Demand Forecast Raised due to Faster BEV/PHEV Penetration

Forecast Drivers

- BEV / PHEV penetration rate forecast
- New EV model launches
- Battery size / energy density requirements increasing

Penetration Rate Assumptions and Corresponding LCE Demand (thousands MT)

Year	BEV Pen. Rate	BEV MT LCE	PHEV Pen. Rate	PHEV MT LCE
2016	0.6%	21	0.4%	4
2021	2.3%	111	2.7%	30



Demand Growth is increasing due to faster penetration rates in the transportation area.

Key Takeaways – Lithium Market

- Up to this point, energy storage growth has been driven by portable electronic devices
- Transportation & Grid Storage drive Li-Ion Battery Growth in the future
 - Even low EV adoption rate in the automotive world will represent a huge market for batteries
- New Li-Ion applications: Power Tools, Telecom, Forklift, Medical, command a CAGR >15% in the next 15 years
- Application value chains are complex and understanding the inherit partnerships is critical
- Innovation pipeline for “next generation” lithium materials is essential



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Lithium as an Enabler to achieve Energy benefits

- Has the highest **specific heat capacity** among solids
- Has a high **electrochemical potential**
- Has low **atomic mass**
- Has low **density**

Widely used in energy related applications: glass, aluminum alloying, lubricating greases, and energy storage / batteries



Lithium Market Demand in 2016

2016 Global LCE Demand: 190,000 MT

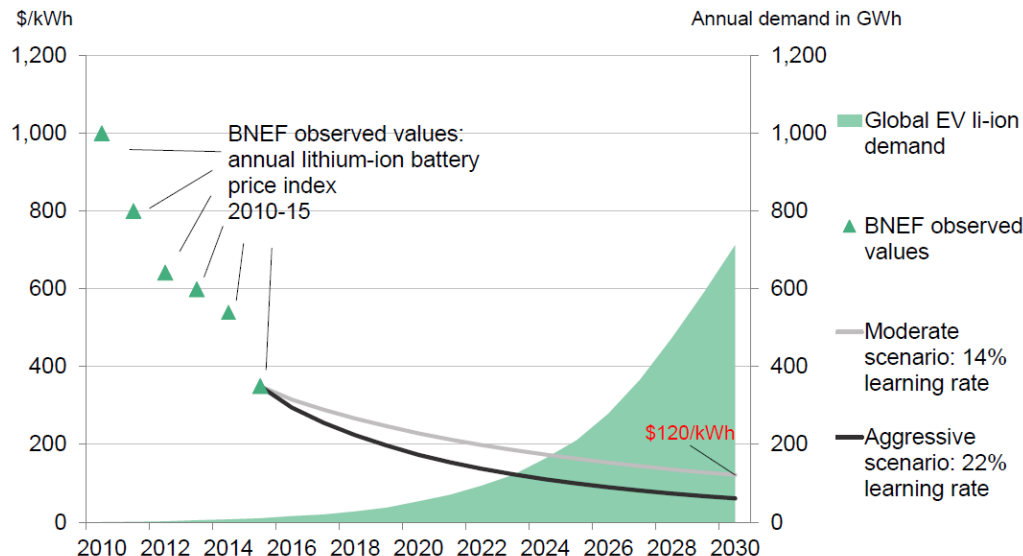


Source: Based on Internal Albemarle Demand Model and third-party data

Growth of 15-20,000 MT LCE in 2016

Continued Declines in Lithium Ion Battery Costs Expected, Enabling Innovation

- According to automaker Tesla, lithium ion battery costs declining to that of an internal combustion engine (\$100/KWh) is "...achievable by 2025"
- Today, lithium represents less than 3% of the cost of a lithium ion battery



Source: Bloomberg New Energy Finance Summit (April 2016)