



BATTERY TRENDS

Challenges & Possibilities

Lars Barkler

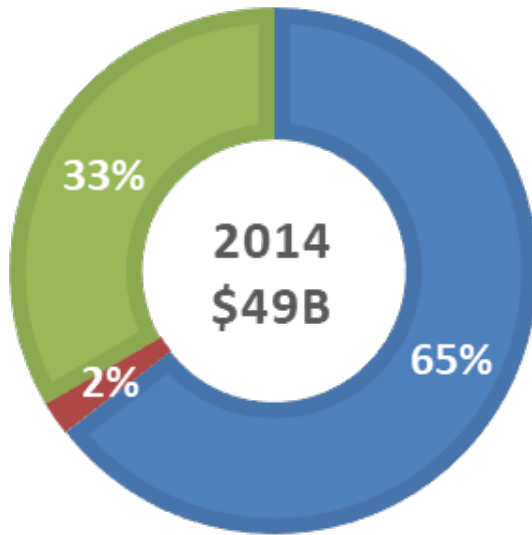
CEO, Lithium Balance

Chairman, Danish Battery Society

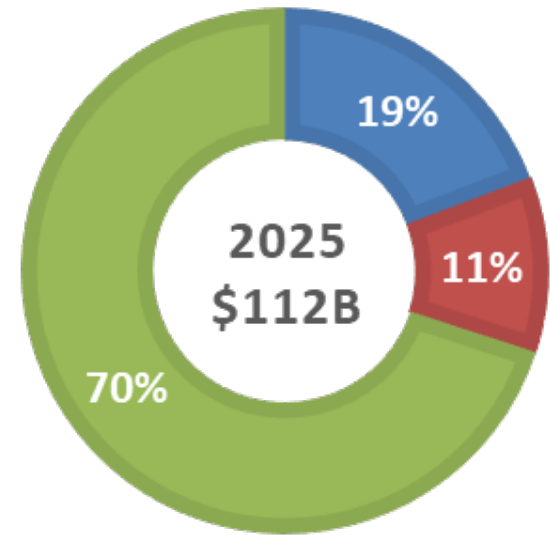


Li-ion dominance

Rechargeable Battery Market



■ Lead-acid ■ Other ■ Li-ion

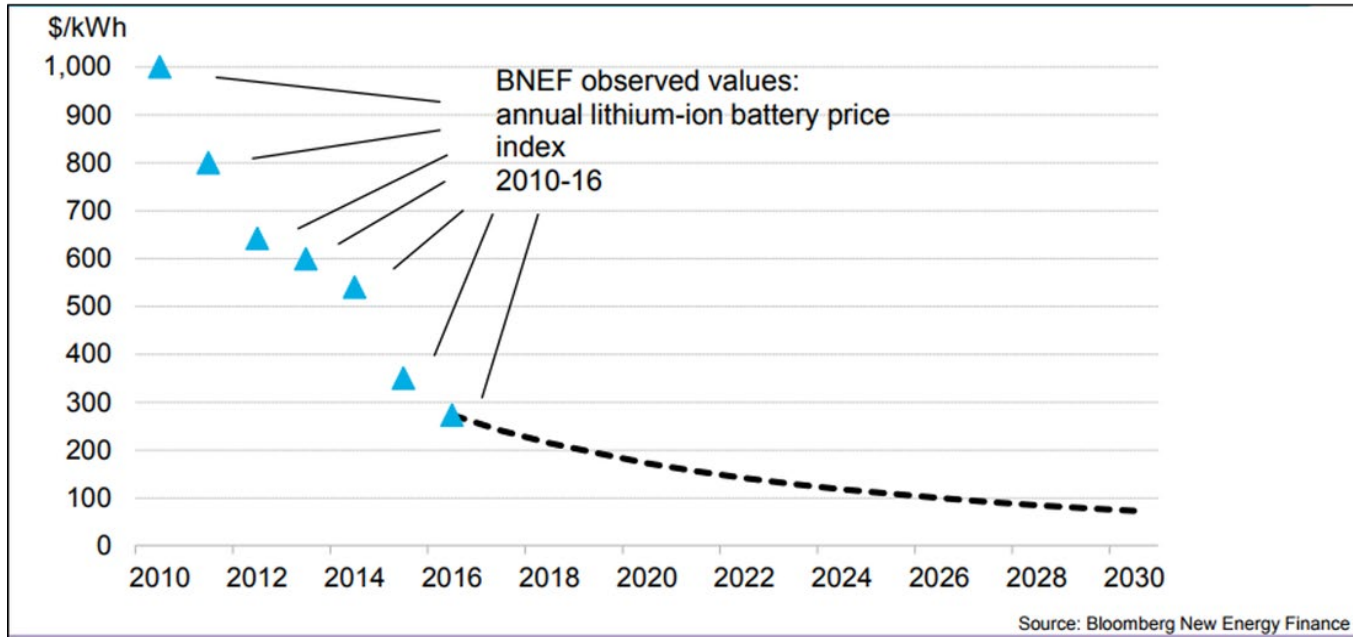


■ Lead-acid ■ Other ■ Li-ion

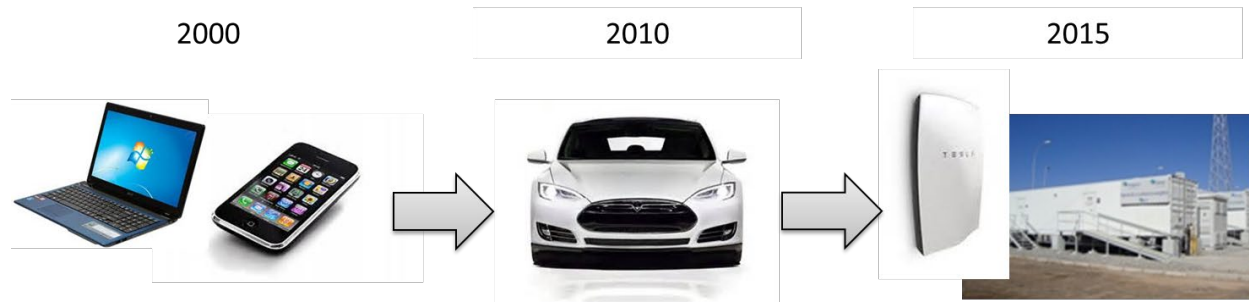
Source: Bernstein/VisualCapitalist



Cost decline opens new markets

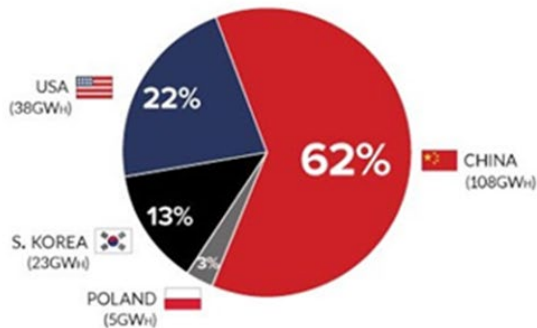
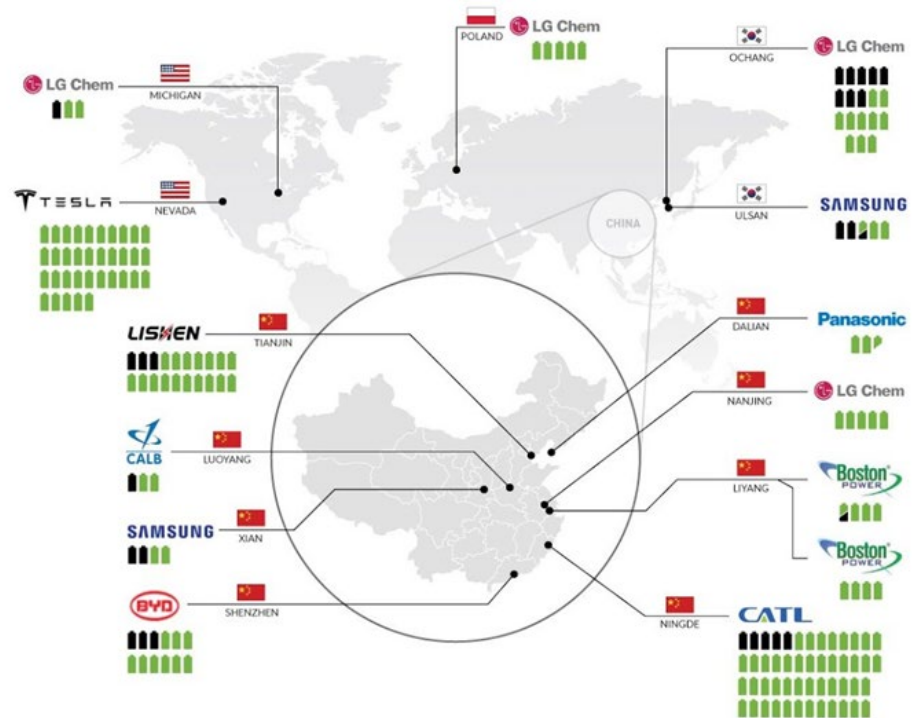


Current industry target 75 \$/kWh



Cost is driven by volume ... and China

Li-ion capacity:
 2016: 28 GWh
 2020: 174 GWh
 521% increase!

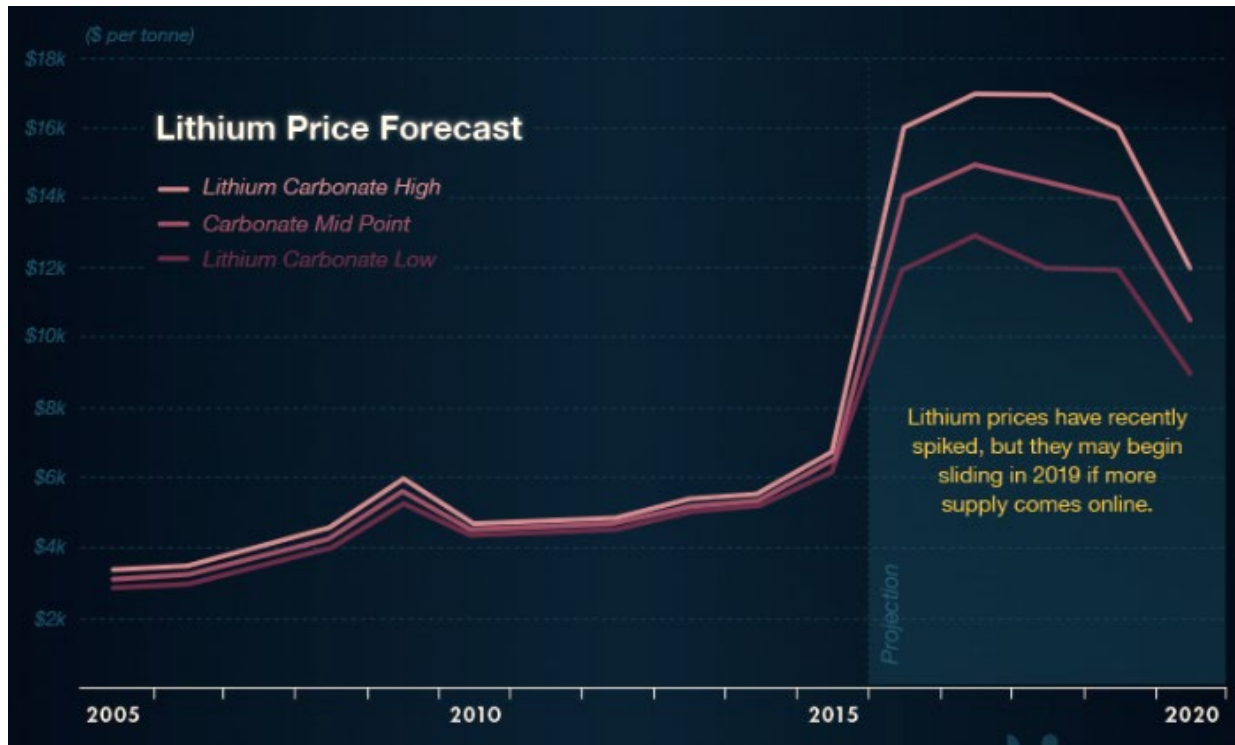


By 2020, mass production of lithium-ion batteries will still be concentrated in just four countries.



Battery material issues

- Graphite: 65% mined in China
- Cobalt: 65% mined in DR Congo, 2015: 40% used for batteries
- Lithium salts: 75% of resources in Argentina, Chile, Bolivia



Higher energy density Driven by industry



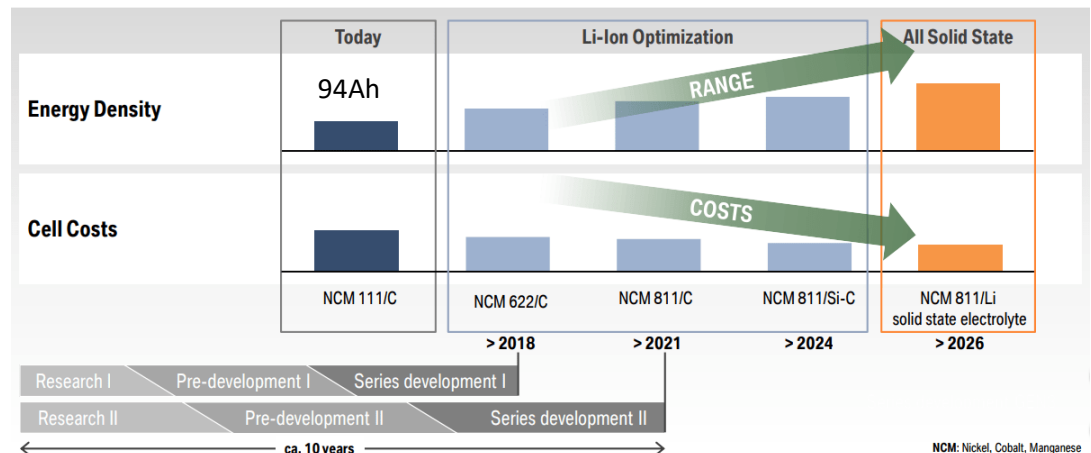
BMW i3 - Same pack size:

2013: 60Ah, 22kWh, 227 Wh/L, 130 km
 2017: 94Ah, 33kWh, 355 Wh/L, 183 km
 2019: 120Ah, 42kWh, 453 Wh/L, 358 km

MATERIAL DEVELOPMENT AND CELL ROADMAP.

Capacity doubled in
only 5 years!

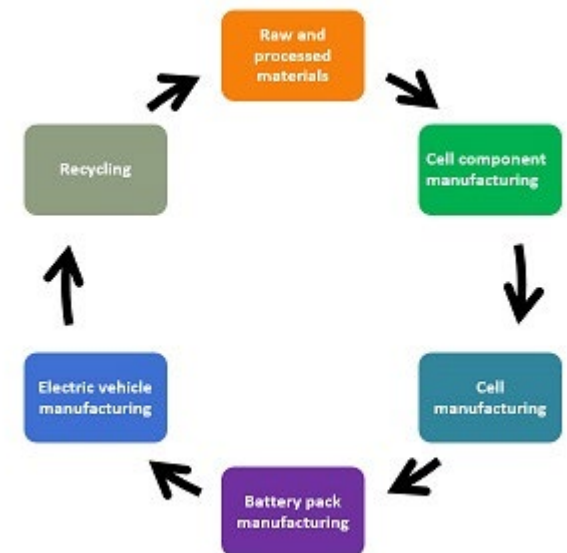
And it doesn't stop.



European Commission Strategic plan for batteries



1. Access to raw materials outside EU
2. European cell manufacturing
3. Accelerate research (disruptive)
4. Develop skilled workforce
5. Lowest environmental footprint
6. Consistency with EU regulation





Dansk perspektiv

Kunderne er der nu: europæisk bilindustri, vedvarende energi

Værdikæden:

- Materialer / miljø
- Celleproduktion
- Effektelektronik
- Batteripakker
- Elbiler, Energilagring

Danske aktører:

Haldor Topsøe, AU, DTU ...

Danfoss, Libal, AAU, SDU ...

Banke, N.C. Nielsen ...

Banke, Libal, Visblue ...

Kan vi komme med på materialer og celler?

Vi er allerede stærke på effektelektronik (Danfoss køber op)

Måske er batteripakker en mulighed (mekanisk, elektrisk, produktion)

Tænk hastighed og skala (som for datacentre)

Hastighed/Skala eksempel



- Zenio (Libal aktionær)
 - Batteripakker til Nio
 - Automatiseret (ABB)
 - 6 min labor/pack
 - Kapacitet 80.000 pakker/år (6 GWh)
 - Bygget på 1 år
 - Investering 1 mia DKK
 - Pay back: år 2
 - Ved 1/3 kap. udnyttelse

