

# Bob's Top 10 List

**Bob Galyen**

**SAE Battery Standards Steering Committee Chairman**

**NAATBatt CTO and Chairman Emeritus**

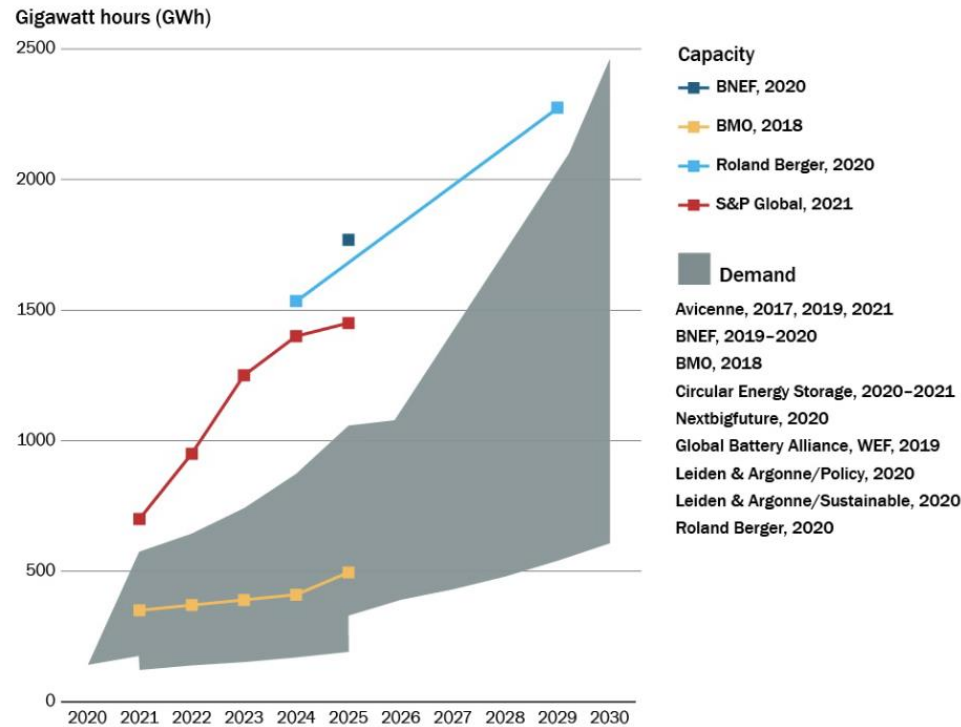
**October 18, 2022**

# Interesting Facts:

- 2012 - 120,000 EV's sold worldwide
- 2021 - 6.6 million sold worldwide (3.3 million in China alone)
- Cumulative end 2021 16.5 million EV's on the road worldwide
- Countries are phasing out ICE
- 450 EV models sold worldwide
- But all falling short of their targets for 2030 to achieve 0 Carbon by 2050
- EV's predicted to be at 20% of global sales by 2030

# Top 10 List: 1 - Remarkable Growth!

- Battery Market: ~34% CAGR globally! Massive demand growth with over \$300bn investment by 2030



**Figure 2.** Global Li-ion EV Battery Demand Projections. Yan Zhou, David Gohlke, Luke Rush, Jarod Kelly, and Qiang Dai (2021) Lithium-Ion Battery Supply Chain for E-Drive Vehicles in the United States: 2010–2020.  
Source: Argonne National Laboratory ANL/ESD-21/3.

# Top 10 List: 2 - Government Engagement

- Governments: Scrambling on what to do! What model to follow? Lack of knowledge in decisions!

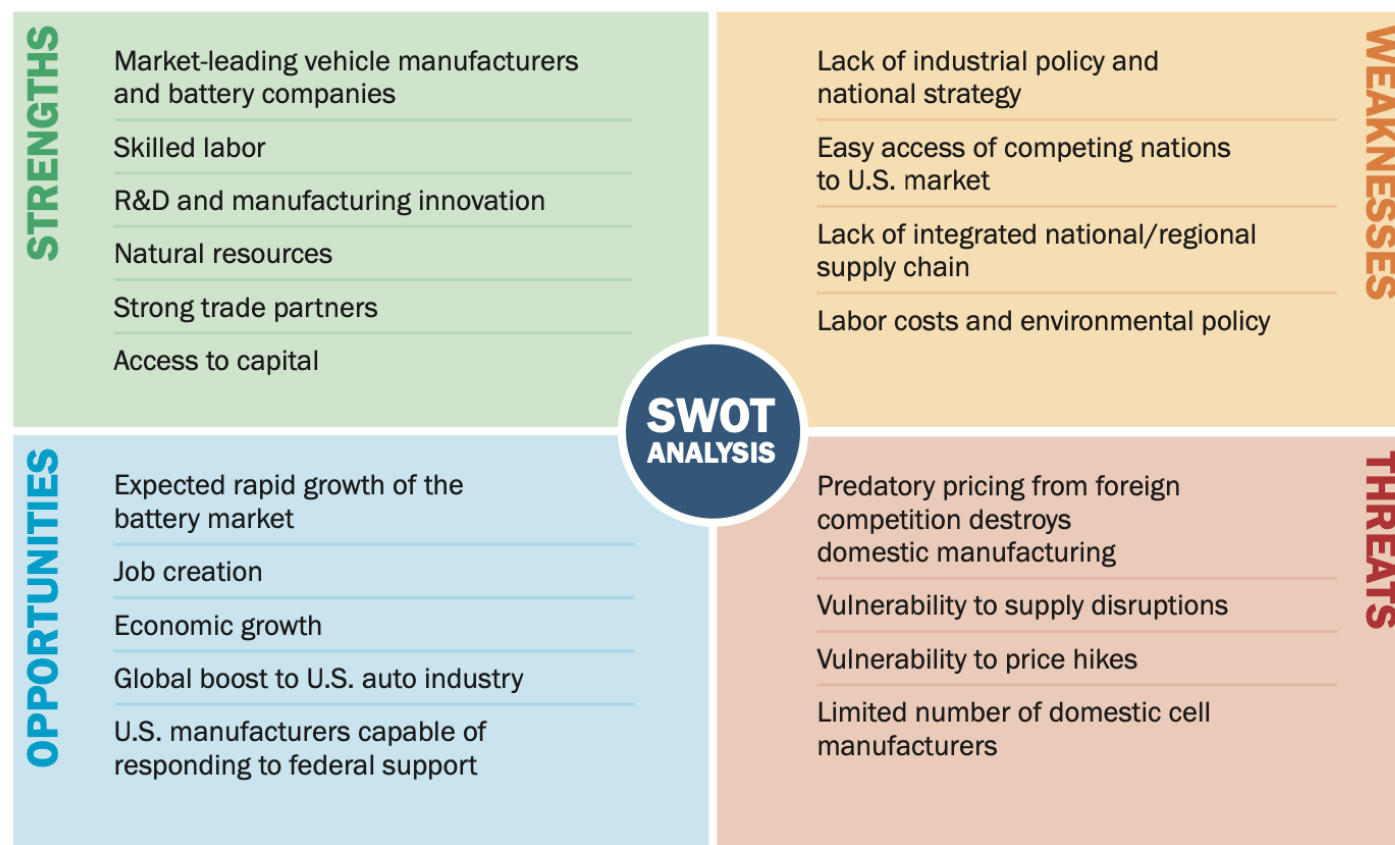
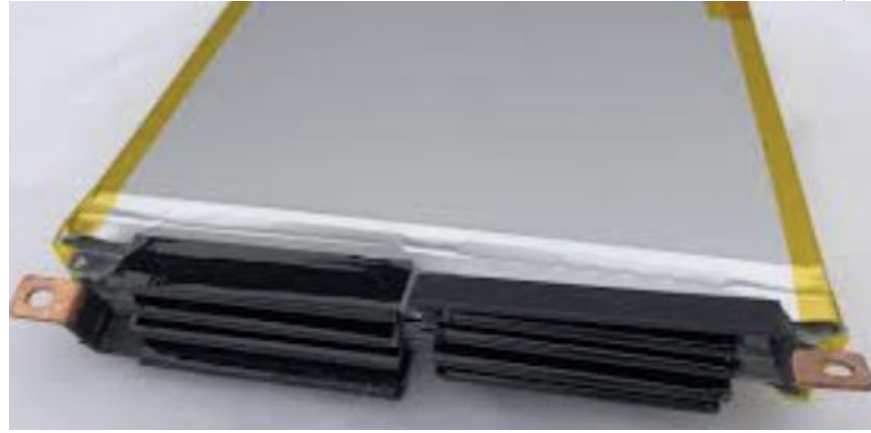


FIGURE 4. Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis of the U.S. position in global battery manufacturing.

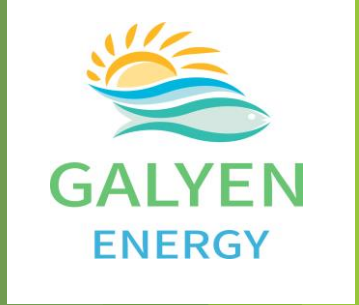
# Top 10 List: 3 - Technology Decisions

- Technology: What to use? NMC/LFP/other.....



# Top 10 List: 4 - Infrastructure Required?

- Infrastructure: Charging capacity deficiencies?





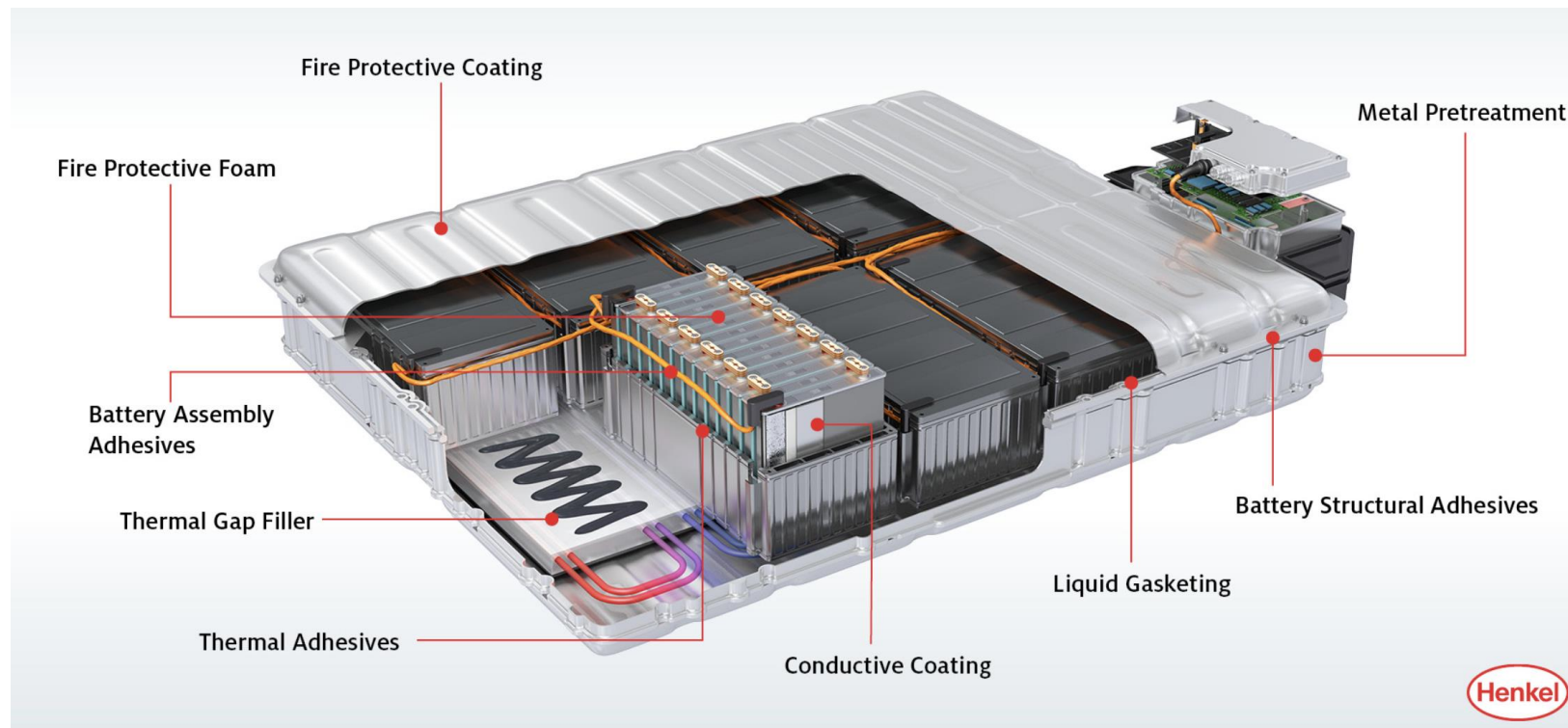
# Top 10 List: 5 - Industrialization

- Industrialization: Building materials availability?



# Top 10 List: 6 - Fire Concerns

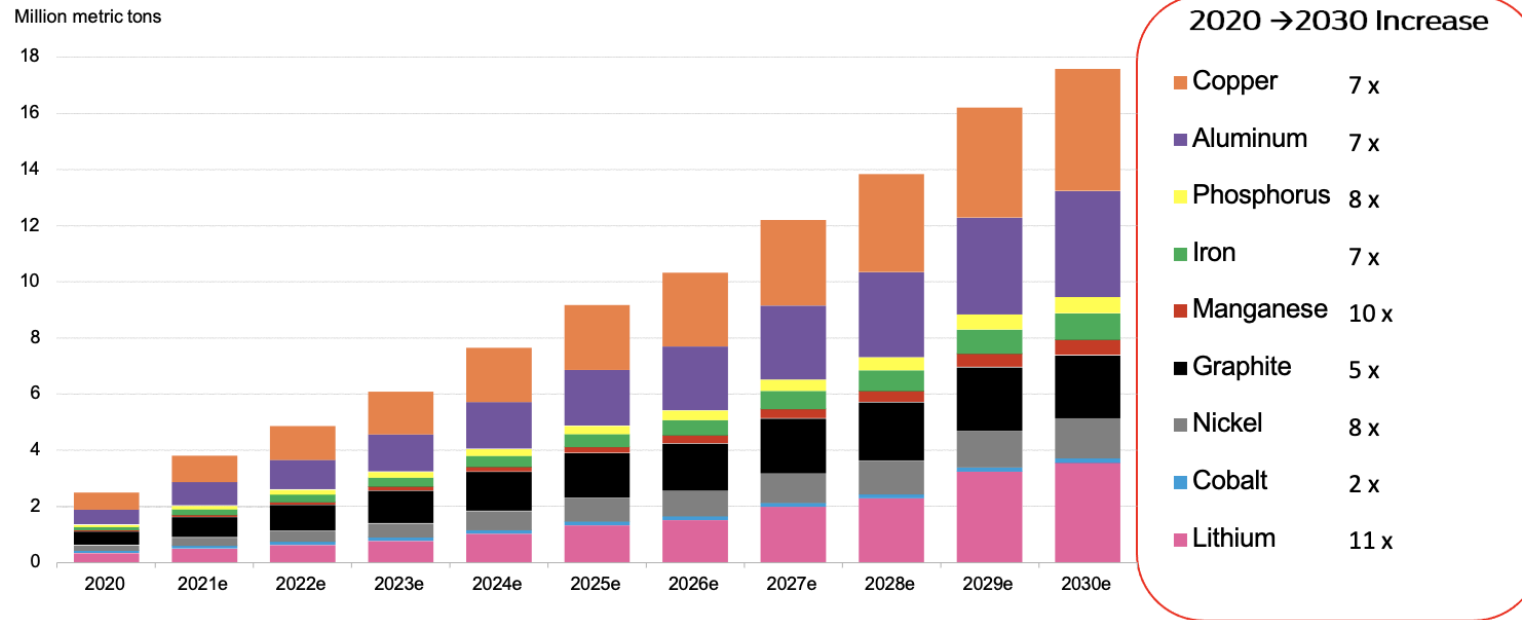
- Fire propagation and prevention: massive efforts





# Top 10 List: 7

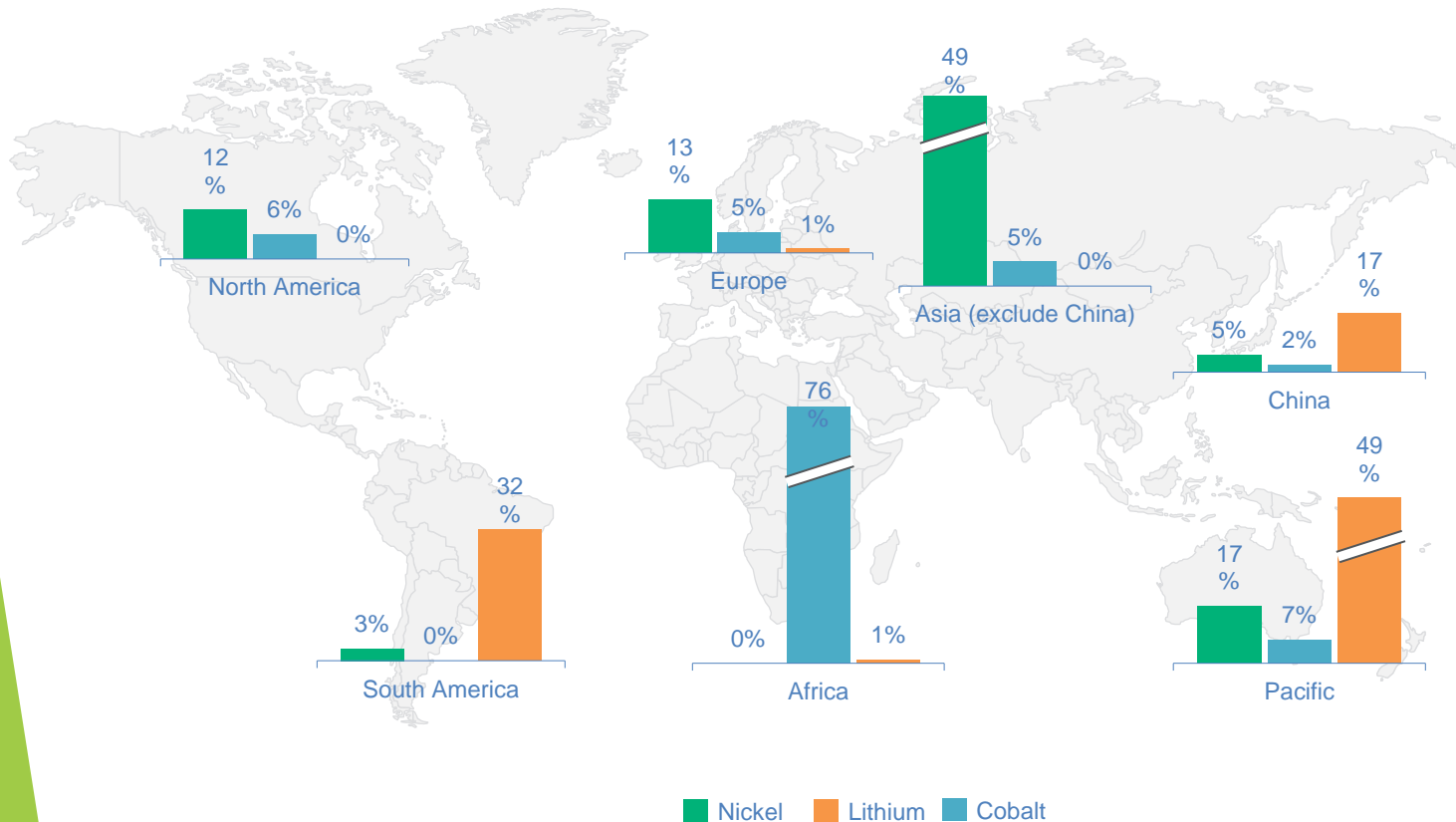
- Supply Chain: Raw material supply-demand
  - Deficits at cell level (Li, Ni, Co, Mn, Graphite)
  - Lack of mining, 10 years est. to open new mines
  - Lack of processing capacity



Source: BNEF July 2022

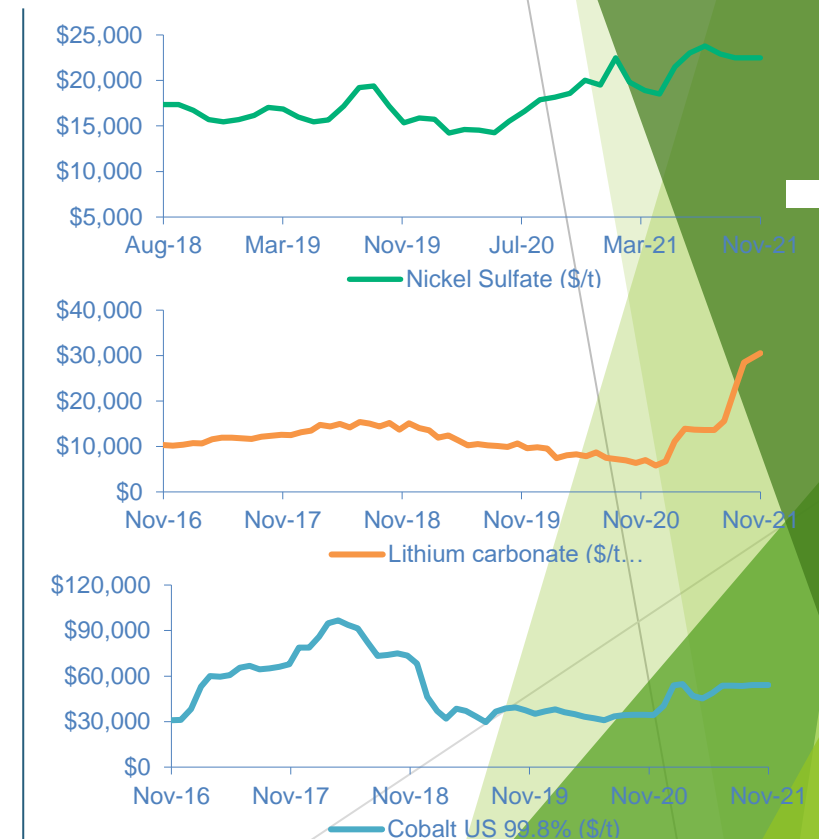
# Battery raw materials situated in politically risky or less sustainable locations, with substantial geo-political risk

Virgin raw materials supply, 2020 (% share of global)<sup>(a)</sup>

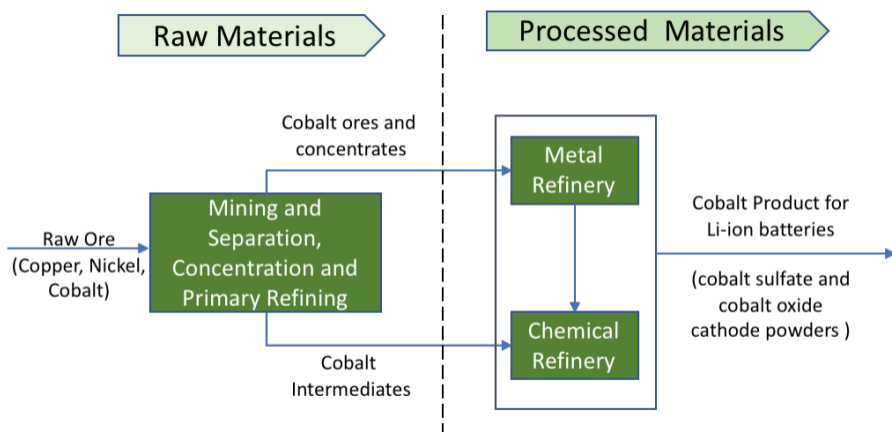


(a) China shown separately. Excludes data of countries either due to small amount or proprietary data  
Source: United States Geological Survey, Roland Berger, CRU, Broker research

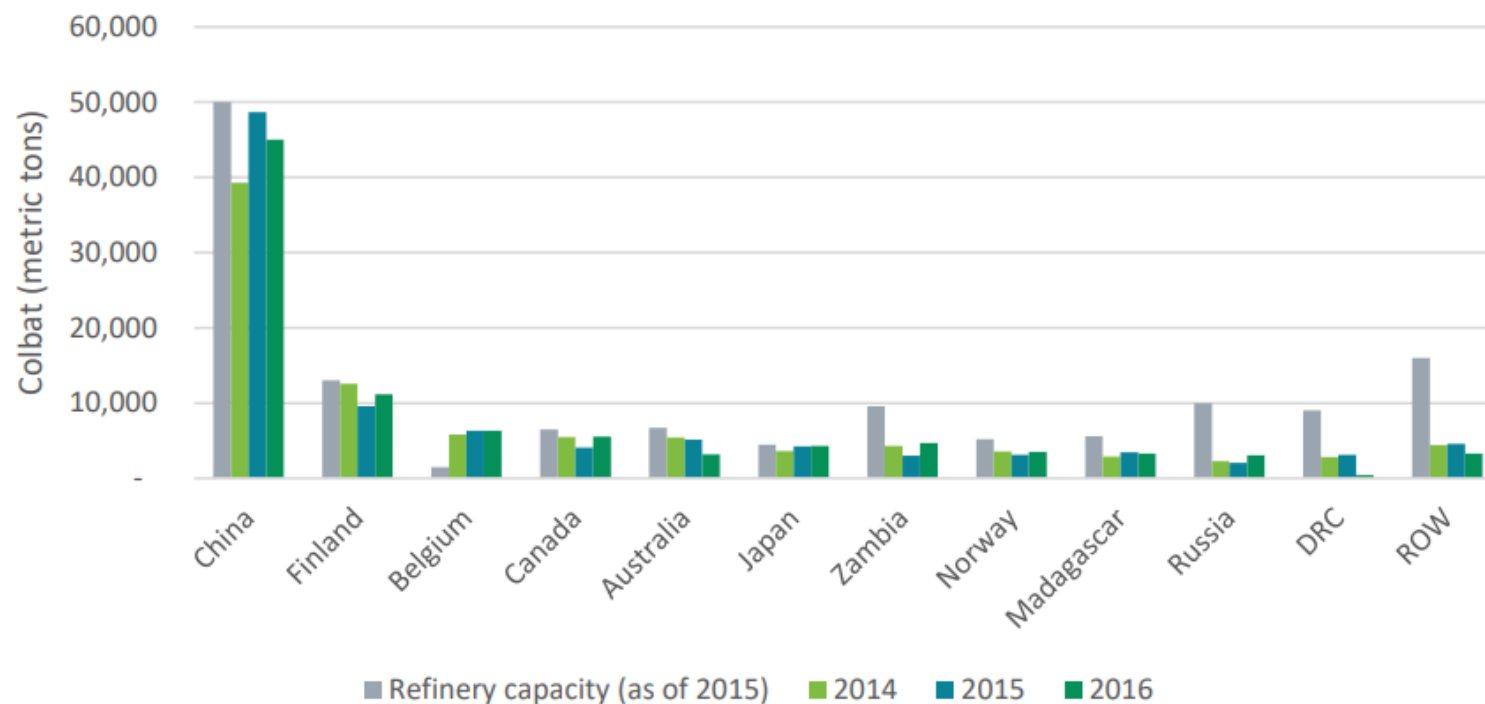
Historical pricing trends



# Battery Processing is More Politically Risky!



- **Material Refining is similar technology to solvent extraction practice on ores**
- **Market dominated by Chinese players**



# Top 10 List: 8 - Recycling

- Recycling: collection, shipping, shredding, etc.
  - A major effort to reconstitute precious materials

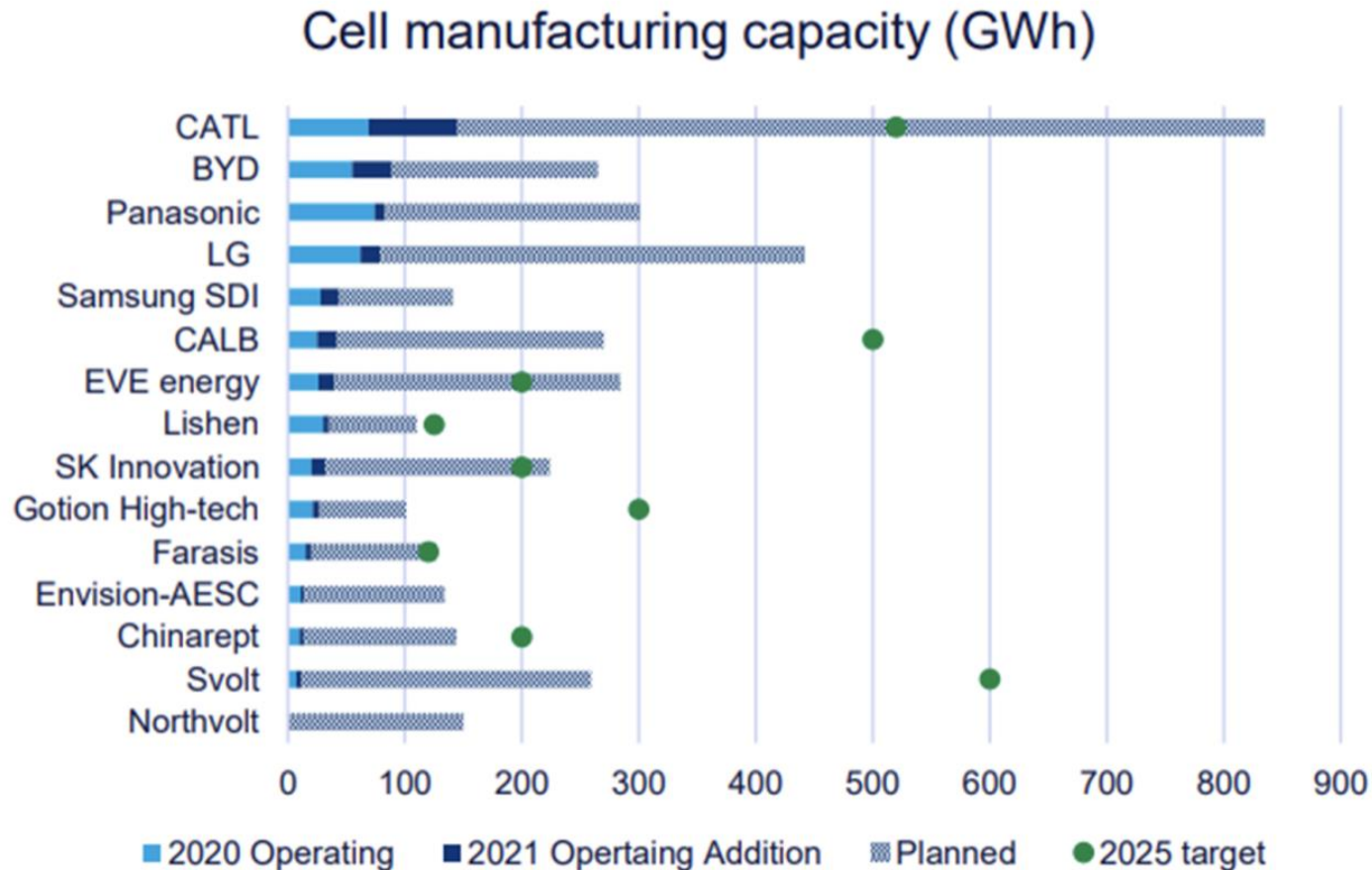


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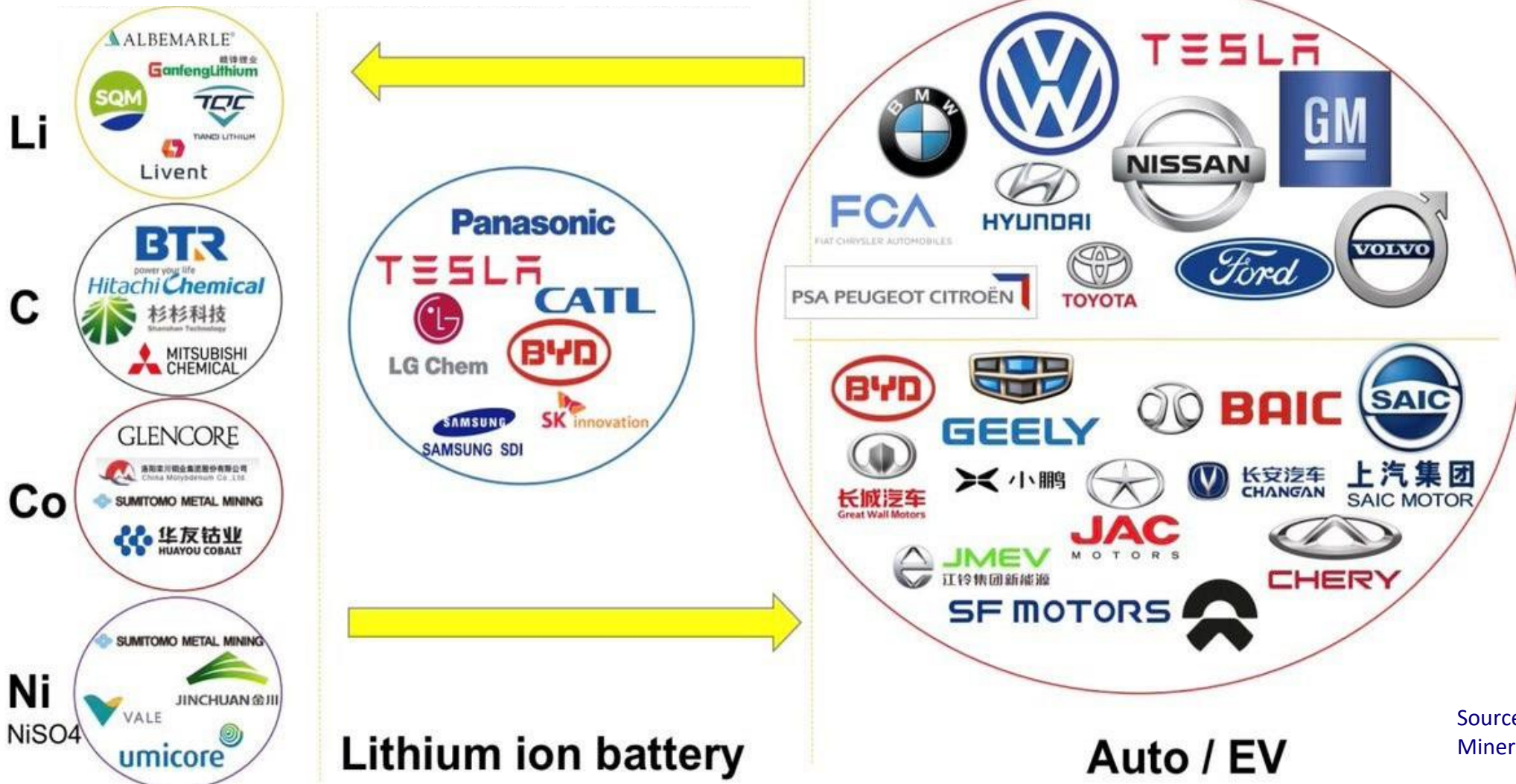
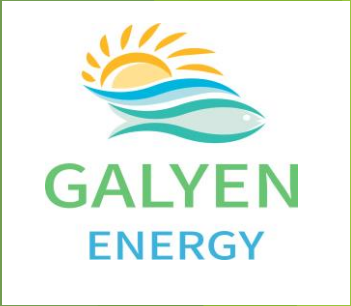


# Top 10 List: 9 - Corporate Structure

- Corporate structuring: JV's, partnerships, etc.



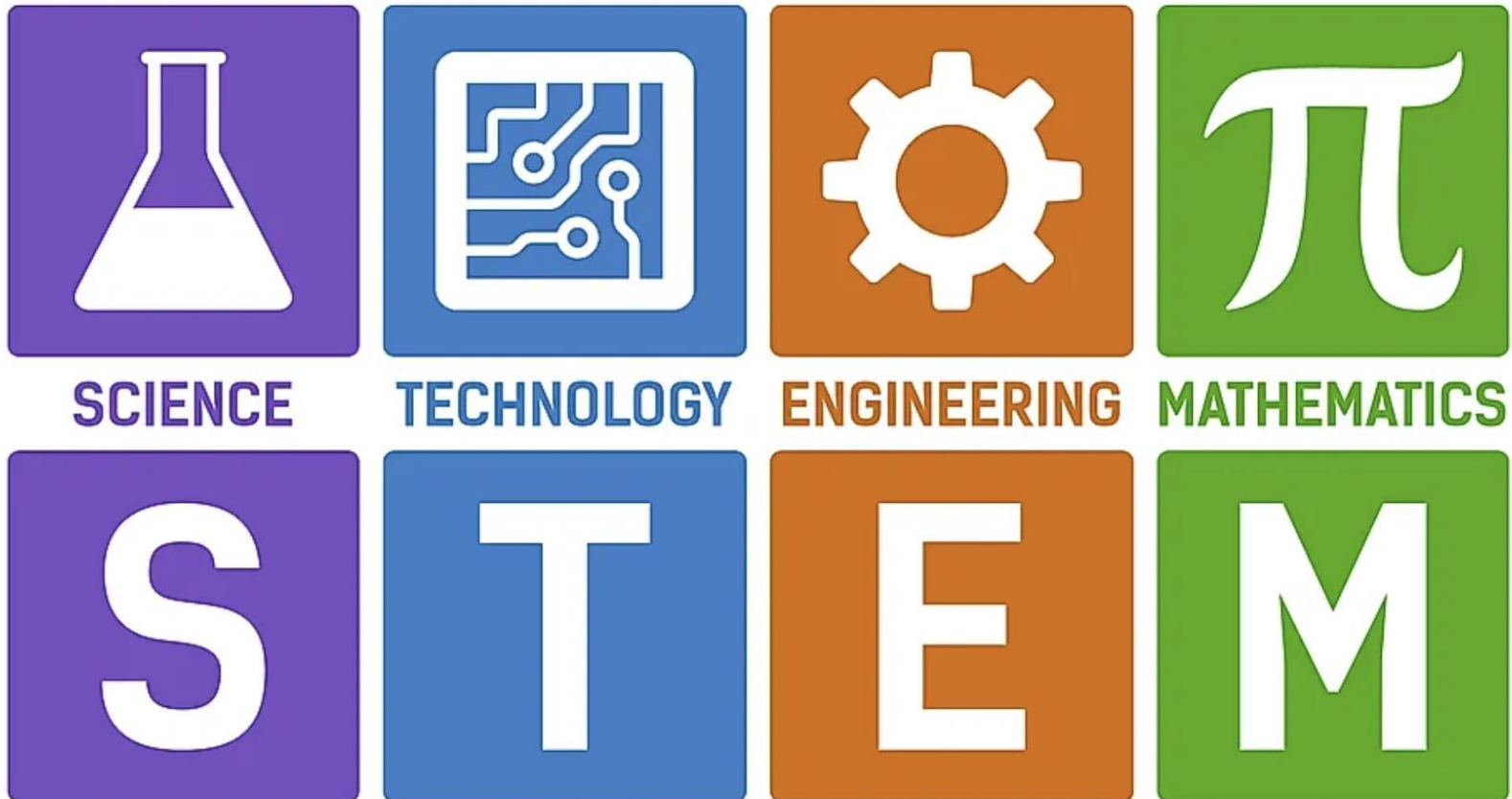
# New Era of Vertical Integration and Strategic Partnerships



Source: Benchmark Minerals Intelligence

## Top 10 List: 10 - Education & Training

- Current workforce, scientist, engineers, lawyers, academicians, college, high school, grade school



The background is a composite of several elements. On the left, a black diagonal band contains a network diagram with three white circular nodes and numerous blue lines connecting them. The rest of the background is composed of overlapping, semi-transparent green geometric shapes in various shades, creating a modern, abstract look.

# Thank You!