

**EVALUATING THE SUPPLY OF
BATTERY METALS**

**An alternative view about the current and future
outlook for critical metals**

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SOME OF THE COMPETING TECHNOLOGIES

Li-Ion – the fatal flaw is the Cobalt in the mix

Zinc - Oxidisation

Lead-acid – headed for the scrapheap - literally

Molten Salt:

NaS – Sodium Sulphur – hot yet effective

NaNiCl – Sodium Nickel Chloride – ditto

Vanadium Redox – the future of mass storage?

NiCd - Toxic

LiB – making graphene's potential real?

METALS/MINERALS IN CONTENTION

Lithium – Off the boil – destined to recover

Cobalt – many fakers – few real projects of merit or size

Graphite – no shortages foreseen

Nickel – pipeline of future projects severely restricted by Capex

Cadmium – On the way out – too toxic

Vanadium – The future of mass storage – supply constrained

Manganese – the key to reducing the cobalt component in LiBs

A KEY MISTAKE

Governments around the world have been sounding off about plans to go “all-electric” by certain targeted dates in the medium term.

The politicians that have done this have paid scant regard to the availability of key components in the supply chain of EVs and HEVs, this goes beyond just battery metals and includes those once obscure objects of desire (and panic) Rare Earths.

LITHIUM – CRISIS AVERTED?

It is a fallacy to believe that there is any sort of Lithium oversupply looming.

Indeed, the current price pullback has significantly damaged the timelines of serious companies and doomed a large swathe of junior lithium wannabes.

Wall Street doomsters confound their own prophecy.

Funds for exploration are now virtually non-existent.

Launch of new players has ground to a halt. The “boom” is over.

Even “largish” projects (e.g. Sonora) have been mortally wounded.

Everything is being reassessed with a steely glaze.

COBALT - THE WEAKEST LINK

This key metal in Lithium Ion battery formulations is currently flirting with a supply crisis.

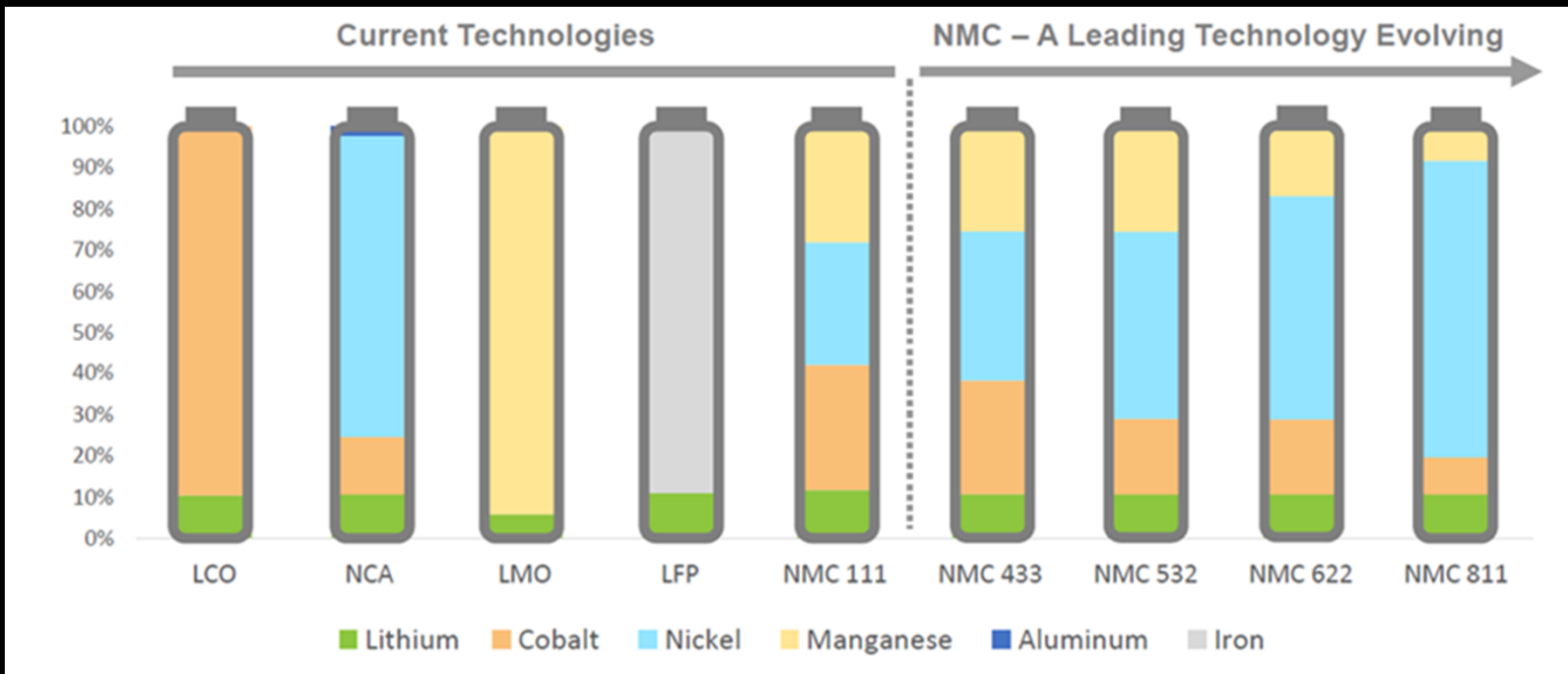
Overconcentration in sources of supply

China securing, by fair means or foul, near exclusive access to the largest sources of the metal

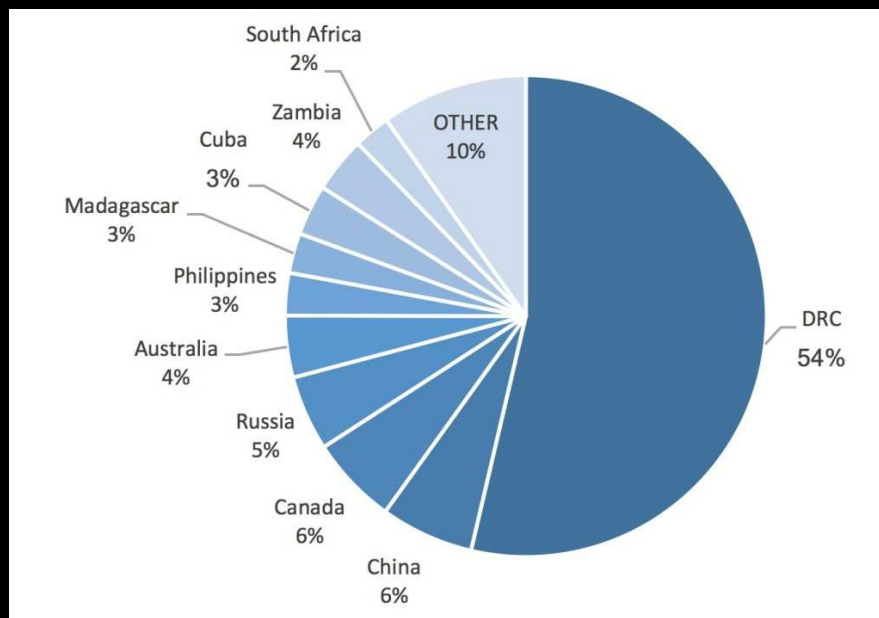
Long-term underinvestment in developing mines in metals (particularly in nickel) for which this metal is a by-product

Potentially, Western OEMs may see their upside in the EV space cramped, if not blocked, by constrained cobalt supply

GRAPPLING WITH COBALT



COBALT – SOME GEOLOGY



- Primary cobalt mines scarcely exist
- Cobalt is a by-product of some copper and nickel mines
- Only some copper mines have cobalt as a by-product
- Nickel mines of size are a dying breed due to the horrific experience of mine developers this century (e.g. Goro, Ambatovy)

COBALT – WHERE NEXT?

- Less cobalt in LIB formations
- Development of new mines (maybe some small mines, almost certainly no big mines)
- Vast reduction in cobalt wannabes
- Rationing?
- Recycling – low-hanging fruit – needs organisation

Challenge – not enough capital and what there is has been atomised across too many claimants and “non-productive” participants

GRAPHITE – COMMON AS DIRT

- Chinese disinformation re “environmental closures” is a danger in this space
- So far all we have is one 800-lb gorilla producer
- This presents political, event and financial risk to the supply equation rather than alleviating supply fears
- In theory supply needs in the short-term are being met though with risk of crowding out
- Ideal situation would be five or seven non-Chinese mid-tier producers

NICKEL – BATTERIES PLAY SECOND FIDDLE

- While nickel is the major metal across the battery space (excepting lead-acid) battery usage only takes up only 4% of production and even bullish projections for 2025 put it at 14-15%
- Main use is stainless steel and that will drive prices and mine development decisions
- A number of debacles in building major mines have detracted from anyone following the mega-mine path
- Future mines will be small- to medium-sized with no mega-mine certainly being built before 2030
- Ergo, nickel is one of the least problematic battery metals

CADMIUM – TOXIC WASTE

- Less critical is the creation and use of this metal in batteries, but its disposal.
- It is a classic “heavy metal” that insidiously inserts itself into the environment and food chain and stays there
- It is largely heading towards extinction of use in battery formats

MANGANESE – COBALT'S CHALLENGER?

- This metal stands the greatest chance (in its EMM format) of partly solving the cobalt crisis by acting as an agent in minimising cobalt in Lithium Ion Batteries
- 8.1.1 uses half as much cobalt as 6.2.2
- Manganese is not in short supply
- Manganese is NOT dominated by the Chinese (but they do dominate EMM)

VANADIUM – THE MASS STORAGE SOLUTION?

- Vanadium is seen in some quarters as the solution to the mass storage conundrum using the Vanadium Redox Flow Battery (VRB) format
- Metal price has taken off in recent times due to changes in Chinese standards for its utilization in rebar
- This focuses attention on supply. There is strong potential supply however only few doing something about it
- VRB surge is small so far. Hopefully this will occur when more supply is available but (price) overheating might occur which would then make the format less viable on economic grounds.

KEY TAKEAWAYS/ISSUES

- Lithium 2.0 is over. Roll on Lithium 2.1 – which will be far less frothy
- The pullback has delayed and possibly killed some projects
- Cobalt 1.0 is over – reality has not set in, but clarity will improve from here on out
- Cobalt minimisation, rather than replacement, is the new mantra
- Nickel, graphite and manganese are not facing shortages
- Mass storage is the KEY to removing the vagaries of solar and wind power and Lithium Ion batteries will NOT be the mode of choice for truly large storage devices