



Hallgarten & Company

Sector Review

Christopher Ecclestone
cecclestone@hallgartenco.com

Manganese & the Battery Revolution

A Base Metal No More....

The EMD Universe

	Strategy	Ticker	Price	12mth range	Market Cap	Target
Manganese X	Long	MN.v	0.84	\$0.055-\$1.11	CAD\$79.6mn	\$1.10
Euro Manganese	Neutral	EMN.v	0.10	\$0.05-\$0.20	CAD\$25.8mn	\$0.12
Giyani Metals	Long	EMM.v	0.235	\$0.04-\$0.31	CAD\$23.7mn	\$0.42

Manganese & the Revolution

A Base Metal No More....

- + The fears about Cobalt's viability in Lithium Ion Batteries were long only price-oriented but now the most crucial fear is on strategic access grounds
- + Increased Manganese weighting in new LiB formulations is driving a refocusing on the potential of this metal
- + Manganese is not problematical due to its image of being "cheap" and "not difficult" on the supply-side. These are in fact its two main virtues
- + The wild gyrations in Vanadium's price has made Manganese look like a tempting option to replace, in part, Vanadium in Redox Flow Batteries for mass storage
- + Lack of Manganese production or resources in North America, makes the few deposits that exist, interesting as crucial assets in the hunt for non-Chinese supply chains for LiBs
- ✗ Cobalt is down, but not out for the count, as a Lithium Ion Battery component
- ✗ There is a perception that Manganese (somewhat like Nickel) is prolific and thus "nothing to worry about"

Manganese – The Road Less Travelled in Battery Metals

The pace of change in the battery space has shifted up a few gears since a small group of developers moved into the Manganese space in 2016/7. Lithium plays first proliferated (and then came tumbling back to earth) and then Cobalt became the word on everyone's lips as the Cobalt crisis moved into centre stage and focusing minds on supply issues in the battery space. Manganese was regarded as the worry-free component of the Lithium Ion Battery formulations, however this ignored the fact that there is almost no production of the metal in North America.

Now, however, the metal is receiving increasing attention for its potential to reduce the Cobalt component in various battery types using that metal via the rebalancing of the relative weightings of elements in the battery cathode formulations, particularly Nickel/Cobalt/Manganese in NMC batteries.

A Blizzard of Technologies

Battery technologies have been proliferating in recent years like mushrooms after the rain. Most of the buzz in the mainstream media is about battery options that extend the life of cellphones or laptops and other PDAs or with regard to hybrid- or all-electric vehicles. However the really great economic leap forward has to do with mass storage devices which mesh with energy grids to provide off-peak storage of electricity. Industrial or natural gas has been stored since its inception in the industrial revolution in massive tanks, caverns or gasometers, while a solution to massive electricity storage has been much more

elusive. With conventional dry-cell battery using two electrodes separated by an electrolyte, it would require thousands of individual cells, the size of soft drink cans, to be strung together in a massive installation to create a mass storage battery of any usefulness to be attached the grid.

The relevance of this has been heightened with the burgeoning of alternative energy sources (wind and solar) that are irregular in their generating periods and do not always coincide with peak demand. While Elon Musk muses on giving his auto-batteries a life-after-death as Powerwalls, the real mass storage device catching attention is Redox Flow Batteries (RFBs), with Vanadium (hitherto) being the main beneficiary of investor enthusiasm. However, this has overlooked the different ways in which Manganese can be mobilized for battery and mass storage technologies.

A Case Study: Manganese X Energy

Like many other companies, Manganese X (TSX-V:MN, OTC: MNXXF) was launched upon the tide of the second Battery Wave in the middle years of the last decade. Many of the other names, particularly in Cobalt and Lithium ended up grounded, on the rocks or sunk.

Though financing was almost non-existent across the swathe of battery metal juniors, the management at Manganese X battered down the hatches and stayed the course. Now that a certain confidence has returned to the broader mining markets it has had a firming effect on even the battery metals. However the emphasis has shifted. Lithium still remains central to the LiB story but cobalt has fallen into deep disdain.



The market cap is up, and financing more available, enhanced potential to finally kick up the resource

calculation, potential mine development and moreover implementation of a demonstration plant prompt us to maintain a **LONG** stance on Manganese X Energy with a 12-month target price of \$1.10.

Conclusion

The issue at the root of all this though is the availability of metal supplies. Lithium seemingly has a supply situation with little in the way of constraints for a long way out. Cobalt though is relatively scarce, moreover with the Chinese having cornered the supply, as least as it pertains to the largest producer, the DRC. With no current supplies of Manganese in the US or Canada, and Electrolytic Manganese production under Chinese control, the US ambitions in the EV space are essentially at the mercy of China.

The US is reduced to the status of a Manganese scavenger unless it has access to not only non-Chinese sources of ore, but also, and more importantly non-Chinese Electrolytic Manganese. With the strategic stockpile starting to have EMM added again, for the first time since 2004, there is clearly rising concern in Washington. It needs a complete North American supply chain

Combined the rise of EVs and the possibility of Manganese muscling in on Vanadium's turf in the VRB space and the developers in the EMM (mining) space are few and far between. Increasingly the hunt for enhanced economics in EV production will mean that cheaper, more secure and more efficient battery formulations will be required and Manganese might well be the secret sauce to make EV economics more palatable to the mass market.

See complete research report at:

http://hallgartenco.com/pdf/Battery/Manganese_Batteries_Sept2020.pdf

© 2020 Hallgarten & Company, Ltd. All rights reserved.

Reprints of Hallgarten reports are prohibited without permission.