

Betting the farm on lithium in the short term and the long term.

Politics Before Economics: The Coming Train Wreck of Peak Lithium, Mandated EVs, and Alternate Electricity Generation

This is the best time ever to invest in lithium mining and processing because the legacy global OEM automotive industry as well as dozens of newcomers, including TESLA, have bet their continued and future existence not on the market but on the politically mandated ultimate replacement of internal combustion engine power trains by rechargeable battery fueled electric ones. This powertrain replacement is to be 100% dependent on lithium-ion batteries to store the electricity (i.e., fuel) to supply the electric motors that will replace fossil fuel using internal combustion engines. These EV batteries are, for their operation, 100% dependent on the chemical element, lithium.

At the same time, the politicians have also decreed that the generation of relatively inexpensive electricity, which today is mostly done by the use of the fossil fuels, coal, oil, and natural gas (with the balance, more than 20%, coming from nuclear) shall be completely replaced by alternate forms of electricity generation dependent upon the wind and the sun with their excess outputs stored until needed in lithium ion batteries. Wind and solar are, at best, intermittent, and they are therefore not remotely reliable or dependable. They exist only because of government subsidies and, worse, mandates. Alternate energy generation being intermittent must be smoothed out (continuously maintained) ideally (in the Green

Dream) by backup batteries. This would ultimately require enormous quantities of lithium, more than for EVs, for the gigantic smoothing and backup systems that would be necessary.

From the perspective of the supply of the key critical battery metal, lithium, these two goals, electrification of mobility and stationary storage of electric power for grid smoothing are competitive with each other for lithium, and this competition shows the complete ignorance of politicians and manufacturers of the fact that the overall demand for lithium from the two mandated uses cannot possibly be supplied from currently existing, planned, or known accessible sources.

A recent article in the Wall Street Journal states that “mining is like anything else. Eventually high prices stimulate more production. But the slow real-world expansion capabilities of mining explain the IMF’s forecast that mineral inflation would last “roughly a decade” until supply catches up.”

This is utter nonsense.

Mining any natural resource is entirely dependent on the physical accessibility of the resource, the grade (concentration) of the desired mineral, the ability of deployable technology to extract the desired mineral, the economics of the processing of the mineral concentrate to a usable form, and that the total costs incurred by the entire supply chain can be borne by the selling price for the end user products enabled or manufactured from that resource.

Supply of anything cannot “catch up” to demand if that supply is limited by a maximum price limit for the demanded form and for the accessibility, grade, and applicable process technology for the “deposit.”

The highest grade accessible and processable deposits of lithium from brine and from hard rock minerals are, respectively, in Chile, Argentina, and Australia. These

deposits are already mined at scale and represent the lowest cost of production today. So, since the highest grade, accessible, physically and technologically, deposits are in production why can't they just ramp up and supply any amounts of lithium needed? Those writers who are ignorant of geology, mineral economics, and geopolitics, and who are not aware of the limitations of contemporary known deposits of natural resources, think that lithium production is organic, i.e., that to get more lithium you simply do more mining. But, in fact, all mineral deposits decline in grade and fall below economic grades after a time. The period during which the mine is projected to be profitable is called, for that reason, the life of the mine.

In 2007 the global production of lithium, measured as metal, was 16,000 tons. In 2021 that figure was 86,000 tons, a 5.5X increase. Yet at the beginning of 2022, the price of metallic lithium, \$60,000 a ton in January 2021 had reached \$360,000 a ton! I note that lithium metal is now more expensive than silver.

Why?

The demand for lithium today just for batteries is 60% of global lithium production, and new battery factories are coming online and being planned and under construction daily. The total demand for lithium for all of these factories by 2025 is calculated to be 2.5 times total global lithium production in 2021. By 2030 that figure would be 5 to 10 times the total global 2021 output of lithium.

It is likely that the lithium supply is already in deficit due to existing battery factories buying for inventory and traders buying for speculation.

The legacy OEM car/truck makers have almost all allocated essentially all of their R&D capital and their new manufacturing construction to EVs. The better managed ones

realizing that the total conversion of their outputs solely to EVs cannot be supported anytime soon, if ever, by the lithium supply chain and that the cost of such vehicles is already prohibitive in the mass market are hedging their bets by continuing to plan for a mixed output of EV and fossil fueled powertrains indefinitely.

Mis-allocations of capital in the most capital intensive industry on earth, the OEM automotive industry, cannot be reversed rapidly, and the damage to competitive advantage from losing the lead in internal combustion engine and transmission development could be fatal. This misallocation is not confined to the assembly operations of the global legacy OEMs. It could also be fatal to suppliers of ICE specific components.

There are today some 1.5 billion ICEs in use globally, and the number is growing. Imagine that each of them will use on average 4 kg of lithium, measured as metal, for a 50 kWh lithium-ion battery. A Tesla Model 3 uses 6-8 kg for a 100 kWh battery. So to replace just today's powertrains would require 6 billion kg of lithium, or 6 million tons of lithium, or 36 million tons of LCE (lithium carbonate equivalent). This is more than 70 years total global 2021 lithium production with nothing left over for the stationary storage market for grid smoothing of wind and solar generation. Neither conversion will ever happen, because it is beyond the capability and capacity of our current know-how in mining, refining, and fabricating the end-use raw materials.

The looming and fatal to the green revolution lithium supply deficit has spawned an enormous price increase for the metal and its compounds, which has reversed the steady decline in the costs of lithium-ion batteries.

But is it too late to stop the attempted suicide of the global OEM automotive and electric energy generating industries?

Cars and trucks running on high priced electricity generated

by increasingly expensive wind and solar systems backed up by hugely expensive stationary storage battery parks will not have large enough markets to be self sustainable or reasonably priced.

Lithium mining and processing will boom until no one can afford the vehicles or the electricity. At some point before that occurs the decarbonization of Western society will reverse and steel, aluminum, oil and gas will return to their central place in our world of cheap energy. Until then look for lithium, the rare earths, copper, and uranium to enter a long Super Cycle.

Betting the farm on lithium in the short term and the long term.