

Economy of Scale – A Misused Metric in Mining

written by Jack Lifton | January 27, 2023

I was surprised earlier this week to see an article in the Wall Street Journal in which the rule of “economy of scale” was mistakenly used with regard to the output of a mine to predict that the price of lithium would fall as mine output increased. The author did not seem to understand, and his quoted “experts” didn’t seem to care, that mines are not organic, they don’t continuously renew their ore bodies, nor are concentrations of hard rock minerals uniform, so that such mines have limited useful lifetimes. The concentrations of the minerals first sought out for extraction are always the highest in the deposit, so that as the extraction of the ore continues lower and lower grades are encountered until it becomes uneconomical, at the price then realized for the ore, to continue “mining” it. Economic assessments of the value of the mine describe this metric as the “life of the mine.” The enormous cost of setting up a mining and beneficiating (concentrating) operation assumes that it is unlikely that some new and more economical method of beneficiation will be discovered, and be experimented upon and proven effective, during the life of a mine, so that the life of the mine could be extended economically by enabling the economically effective processing of lower grade ores. Mines are designed with “best practices” at the time of the construction. It is not assumed that new technologies will be discovered during the life of the mine that will extend its life.

Yet, on the 23rd of January, the following sentence appeared in an article about the future supply and price of lithium: “Increasing production, which typically has the effect of reducing unit costs through economies of scale, will likely be

the primary source of growth in the industry this year.”

Mine production decisions will of course be dependent upon the price of the mineral being mined. Gold mines are typically opened and shut down and then reopened, for example, by the price of gold dropping to less than the cost of extracting it and then bouncing back. Note well that gold is often mined in grades of just a few parts per million, because its value is as much as \$2,000.00/oz or more than \$60/gram.

Lithium, today, is produced from two types of “deposits.” One, is hard rock minerals, the best known of which is spodumene and the largest deposits of which are in Australia. The other is from brines typically found in deserts, which may range in “grade” from the 3000+ grams per ton in the vast brine deposits of Chile to, more typically, 300-1000 grams/ton in the more typical desert brines of Chile, Argentina, and Bolivia.

Most of the lithium produced today comes from spodumene mining in Australia. The golden triangle of South American nations contribute less than 40% from their brines due to the enormous costs and time required to dry and process the brine to recover the lithium.

One may ask why are brines, in particular the vast ones in Chile, which have uniform concentration not dominant in the production of lithium. The answer, always, is cost including the cost of time. The brines must be evaporated in order to bring the lithium concentration to 20,000 parts per million (2 percent), at which concentration they can be processed to selectively recover the lithium. The Wall Street Journal writer would probably ask why not just increase production to lower costs? The answer here is cost, and the cost involved is that of time. It takes 18 months for the brine to be evaporated in the sun (the amounts necessary are simply too vast, one million tons

of water must be evaporated to produce 3,000 tons of lithium in Chile's Atacama Desert, for example, to even consider pumping the brines to fossil fuel heated tanks. Note, by contrast, that the production of one million tons of spodumene can recover 60,000 tons of lithium. But again that is an energy and reagent (sulphuric acid at high pressure and temperature) intensive operation, so it is very costly.

I have been told, privately, by the CEO of a large brine operation that his judgement is that lithium production may double by 2025, but that even holding that level of production, economically, depends entirely on the market price of lithium and the price of energy, so that the very high prices of today, a response to the law of supply and demand caused by the lithium industry's inability to keep up with the surging demand for EV and stationary storage batteries, are, as always, the driver of supply. Should the price of lithium drop as precipitously as it has risen, or if the cost of energy rises too much, that part of the lithium supply dependent on high prices will close (at least in the capitalist "free market" economies).

Economy of scale does not apply here. It is an inapplicable metric in mining. Miners always want the prices of minerals to rise, not decline!