

The real “Critical” in the Critical Materials’ Supply Chain is – Vertical Integration.

A great many promotional “announcements” by junior miners contain descriptive business models, of the development of mineral deposits into producing mines, which imply that the product of the mine will be a finished consumer product that is far along down the commercial product supply and value chains from the actual product of the mine. This is at best foolish and at worst purposely misleading.

It is almost always the development of a new advanced use for a natural resource that creates an increased demand for that resource not the development of a supply that pushes a search for new uses.

Thus, for example, a need for the miniaturization of electric motors and generators was followed by the discovery of the magnetic properties of rare earth alloys and this then initiated a rapid growth of rare earth mining for, in particular, the elements, neodymium and praseodymium. In an analogous manner, the invention and deployment of the lithium cobalt-based rechargeable storage battery led ultimately to a need for and thus a search for new sources of both lithium and cobalt, relatively rarely produced metals before the last decade. I note that the original rare earth permanent magnets used in OEM automotive were of the samarium cobalt type and that this use ended when two British brothers cornered the cobalt market in 1980 driving its price too high for OEM automotive use in the non-recyclable miniature electric motors whose widespread use it has enabled. Neodymium iron boron alloy magnets then replaced samarium cobalt mainly from an

economic perspective.

This agenda, demand begets (a search for) supply, is widely misunderstood. It is assumed by the economic press in particular that an efficient market will not only price a resource "correctly" but will also, when shortages occur, mandate its supply expansion. This is nonsensical but nonetheless is gospel today among institutional investor analysts. In every case, increased supply can only occur when accessible deposits, technical feasibility and price acceptance of the new production concur.

In fact, this is today's challenge with technology metals. There are not enough accessible deposits, which are technically and economically mineable, to supply everyone with either alternate sources (to fossil fuels) of energy or consumer products dependent upon miniaturized electronics (phones, computers, television, etc.) The only solution is rationing, by which I mean that rich nations will go "green" while poorer ones will stay black or brown, i.e. will rely on fossil fuels mainly.

Junior miners, who seek investment only from rich nations know that even retail investors will be quickly bored by being told that the actual product of the mine seeking finance has, per se, little use other than as a feedstock for the next step in the total supply chain that eventually produces the product that they believe that they (the investors) understand, such as an electric car drive motor or the motorized actuator on a jet fighter plane, both of which are referred to only as if the total consumer/military mechanism (a motor vehicle or an aircraft) depended critically for its existence upon the chemical element(s) being mined rather than on the complex components containing them in metal, alloy, or fine chemical forms produced by much more complex technologies far downstream of a mine.

There is no point in developing a supply of a chemical

elements unless there is a total supply chain with the capacity and economics to utilize that volume to make the end user products.

Technology is the engineering of science. Mining engineering is itself today as much an art as a science. I have never met a miner who was a skilled high temperature metallurgist specializing in manufacturing specialty alloys, yet one greenfield deposit in the USA advertises itself as a "superalloy mine." Another, actually in production only of ore concentrates, advertises its business model as "mine to magnet." Both descriptions are promotional nonsense.

The tragedy for us is that capitalism does not allow us to create fully staffed and equipped superalloy foundries or magnet making operations without feedstock that is guaranteed of delivery at an agreed price, on time, and to specification. In addition, such manufactories must have customers willing to pay the Cost of Goods Sold plus a profit high enough to allow debt retirement and continuing investment in capital equipment and R&D.

This is where China's "capitalism with Chinese characteristics," aka as Industrial Policy supported by the State Bank, has the rest of the world over a barrel. Chinese heavy industry started with a blank slate just a generation ago. It had no legacy of sunk costs. Chinese consumer demand was designed to follow the construction of a national industrial infrastructure.

In fact, there are Chinese companies with thousands of employees that are totally vertically integrated from the mine to the magnet, in the case of rare earths, and from cobalt production and processing to superalloy production. Mostly though these total supply chains are created from competition among scores of companies with the appropriate skills.

We no longer have such companies in the USA that are or can

assemble a vertically integrated group of operations to produce rare earth permanent magnets or lithium-ion batteries at a scale necessary for electric transportation.

The re-creation of these total supply chains is the real "critical" problem. Not just developing deposits of critical materials. Mines alone are not the answer.