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Incentivizing Midstream Expansion to Increase Critical Mineral Supply

The movement to clean energy technologies has and will continue to increase the demand for industrial minerals such as copper, bauxite, and nickel. This increased demand has also made minerals which traditionally were typically by-products of firms production decisions a bigger policy concern. These formerly "minor minerals" are now critical minerals that play an outsized role in new technologies. Metals such as gallium, tellirium, neodymium, and vanadium (to name few) are crucial for products like semiconductors, solar panels, electric vehicles, and grid storage batteries, respectively. The critical (minor) minerals are produced as larger volume minerals are mined and refined, making their cost of supply potentially low. As Organization for Economic Co-Operation and Development (OECD) countries are looking to expand their domestic critical mineral supplies, it would seem straightforward to ensure we are capturing as much of these by-product critical minerals as possible.

However, the story is not that simple. These by-product markets are small relative to most commodity markets. This means that any investment made to capture the by-products, instead of letting them go into the tailings, can have large impacts on the market price. Rio Tinto's recent decision to recover tellurium at its Kennecott copper smelter adds 5% to the world's supply. Its decision to recover scandium from the Sorel-Tracy complex increased world supply by 20%. In large, diverse markets like crude oil changes in supply by these amounts would lead to large swings in price. For example, in July 2023, OPEC announced it would reduce production by 1.3 million barrels per day when the world's supply is around 100 million barrels per day. This has led to oil prices rising from the mid-$70s to the low- $90s. The magnitude of production change when by-product investments are undertaken is many times the case of oil.

Further complicating the story is that markets for these by-product critical minerals tend to have very few customers whose production cannot easily increase. This means that when the market is expanded by such a large amount, stronger bargaining power in negotiating new purchase contracts shifts to the customer's side. The impact of more suppliers chasing the same number of customers can exacerbate the change in prices.

Finally, this change in price from new by-product production reduces the incentive for new mines to develop for these products. Given the expected increase in demand for many of these critical minerals, new mines are likely needed. The reduced investment incentive to open new mines generally occurs through the reduced price of the minerals but can also occur due to changes in supplier composition that lead to market power.

So the main takeaway is that a company that invests in its refining capacity to capture a critical mineral by-product is likely to lower the price received for the mineral through its actions. So how can policy incentives be designed to encourage firms to act against their own incentives?

One concept to help us understand these situations is the idea of an anchor customer. An anchor customer signs a contract to purchase a large percentage of output from a supplier, which "anchors" the investment decision. Often an anchor customer can facilitate other customers coming into the market as they have some certainty that a supplier will be there. In this case, if we had an anchor customer for vanadium it is more likely that vanadium flow battery firms would expand production capacity given that they believe vanadium is available for procurement.

A second concept would be to follow a network model where policies that expand demand for critical minerals are done in concert with policies to expand supply. Often thought of as a “chicken and egg problem”, where supply for the mineral will not occur as they believe there is no demand while demand for the mineral, through new technologies or expanded production capacity, is constrained due to beliefs of no supply available.

Obviously, a final option is to just straight subsidize the firms to make the by-product.