System to rate the scarcity of important metals aims to keep shortage at bay

April 9 2015, by Gawen Jenkin, Dan Smith And Dave Holwell

Rare earth elements, the unusual spices of the industrial world. Peggy Greb/USDA

Store cupboards usually contain the basics – canned tomatoes, soup, dry goods – but rarely the more exotic additions required in small amounts to make a dish sing. In the same way, a growing shortage of some of the rare elements needed for high-tech electronics and environmental technologies is causing manufacturers and governments to panic, with sporadic shortages leading to price spikes in some metals over the last decade.

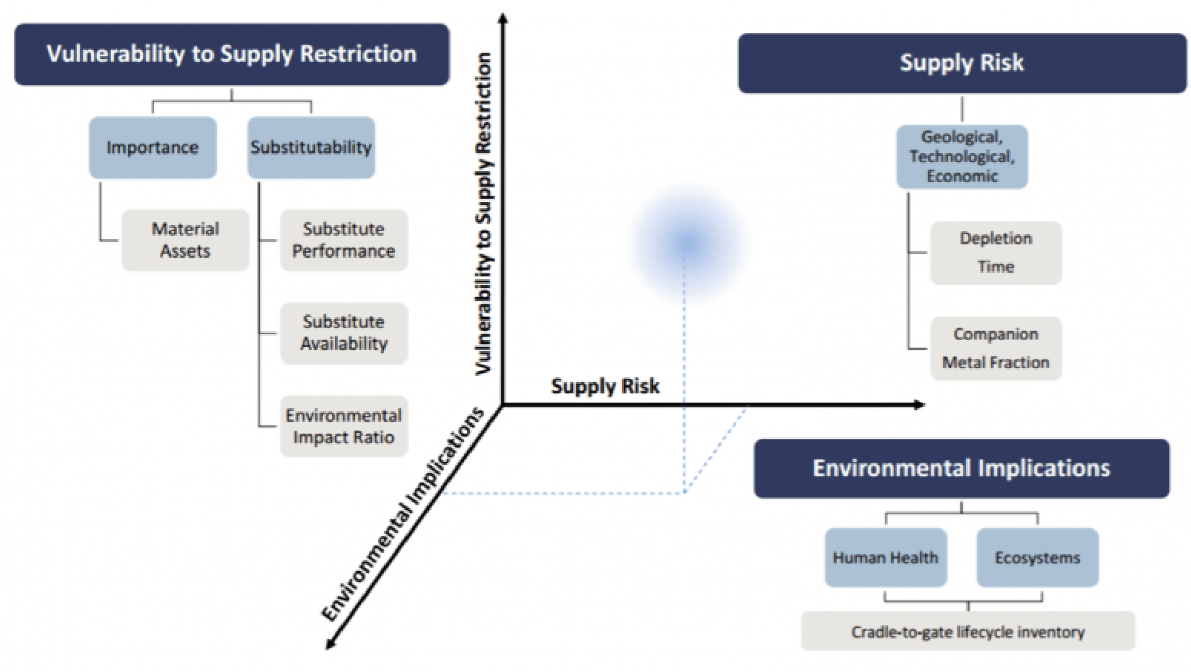
Miners, manufacturers and governments are keen to assess the overall risk, or "criticality", associated with different metals in order to ensure that replenishment efforts are prioritised and business can continue as usual. Of course different firms or governments will have different views, so may come up with widely varying – and hence unhelpful – estimates of criticality for the same element. But a recent study by researchers at Yale University has provided a tool based on three factors that can offer a more reliable approach to estimating metal shortfalls.

You may need only a small amount of exotic spice for your dish, but if it's not stocked at the corner shop, it wouldn't matter if you needed the whole jar. Similarly we can be sure that some metals – iron, aluminium – will be found in deposits suitable for mining across the world, with huge reserves that we know about – so we don't need to worry about these dry goods equivalents. But it's the more exotic elements such as indium and selenium, the truffle oil of our analogy, that due to geology and economics are harder to find. These are high supply risk elements, yet are essential for uses in electronics and solar cells.

Production of some metals is highly concentrated in only a few countries, leading to geopolitical risks to supply – China's moves to restrict rare earth element exports, or strikes in South African platinum mines are recent examples.

Just like that bagged, mixed salad that's so convenient, but wastefully irrigated and flown to Britain from Kenya at great cost, mining is a energy-hungry business. Rarer metals, such as gold and platinum, occur in concentrations as low as 1g per tonne of ore. The additional energy needed to extract and process this ore means mining these metals has a much greater environmental footprint compared to more concentrated metals, such as iron, which is the major constituent of iron ore.

The energy and environmental costs of mining rare metals are no different to the air miles for flying in out-of-season fruit from the other side of the world – and they leave these metals vulnerable to cost spikes due to rising energy costs or environmental legislation.



Credit: Graedel et al/PNAS

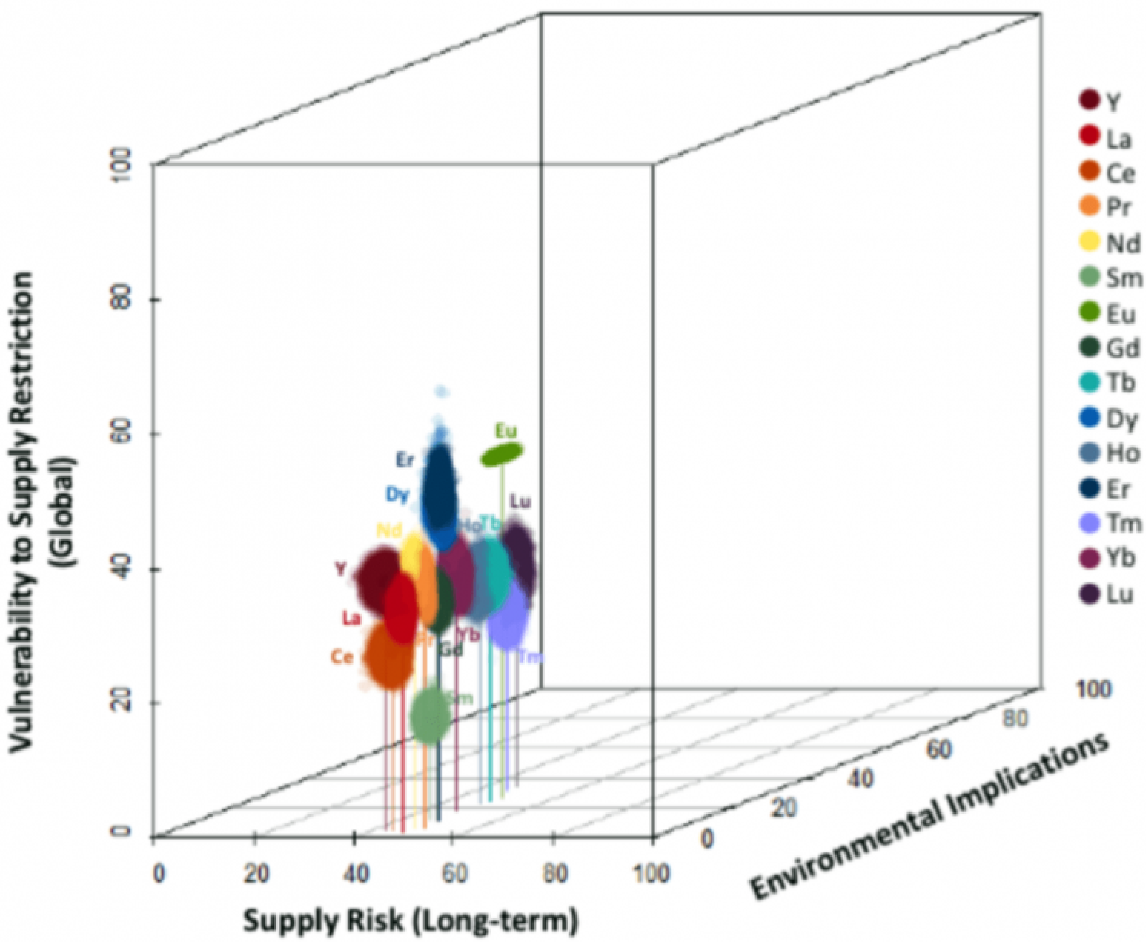
Vulnerability of supply

It's possible to substitute fancier ingredients with something more common – student pasta is generally dressed with industrial cheddar rather than parmesan. Manufacturers will similarly find ways to adapt to what's available in the face of supply restrictions, just as miners will look for fresh deposits in order to take advantage of spiking prices.

For example the rarer metal cobalt can be substituted by the more common nickel for many uses. But other metals, such as thallium and lead, are chemically very difficult to substitute and possible substitutes are equally rare.

Another consideration is how key the ingredient is to the recipe; it might be possible to leave out a bay leaf, but there's no *coq au vin* without the wine. Some metals such as gold and silver are central to world and national economies, whereas others are insignificant.

Where criticality falls down



Risks to global supply and environmental consequences for 15 rare earth elements. Credit: Graedel et al/PNAS

A systematic approach such as this loses sight of details. For example, the Yale researchers' criticality system flags gold as vulnerable to supply restriction because of its wide use and lack of available substitutes. But only 10% of gold has practical uses in electronics or dentistry, so the remaining 90% largely in bank vaults or jewellery boxes could be put to use if necessary.

Also gold is the most highly recycled metal; nearly all the gold ever mined – an estimated 176,000 tonnes – remains in use. Any shortfall from restricting gold supply can easily be made up from domestic gold sales ("Your gold for cash!").

Another issue with criticality figures is that they are a snapshot. Due to the delays in reporting figures, the study is based on 2008 statistics that are already out of date. Nor do they anticipate changes in demand – tellurium is determined to be unremarkable, yet it is essential for solar panels and demand is expected to outstrip supply by 2020, potentially bringing an abrupt halt to the roll out of sustainable solar power.

Despite these issues this study presents the most consistent picture we have of threats to metal supply, one that will be of use to industry and governments alike. More vulnerable metals can be the target of measures to reduce use, increase recycling or locate more environmentally friendly or geopolitically benign sources – such as stocking up from the local farm shop.

Source: The Conversation

Citation: System to rate the scarcity of important metals aims to keep shortage at bay (2015, April 9) retrieved 19 April 2024 from https://phys.org/news/2015-04-scarcity-important-metals-aims-shortage.html