

Vanadium Demand Driven by Large-Scale Energy Storage Market

Vanadium is quickly becoming a critical material for the renewable energy revolution

Tight supply and strict regulations impacting price

Vanadium prices have soared more than [130 percent](#) in the past year—outperforming cobalt, lithium and nickel—thanks to tightening supply and strong orders from the steel industry, which [accounts](#) for 90 percent of demand. Vanadium is a metal most commonly used to strengthen steel; it's also used in alloys of titanium. Only a small [amount](#) of vanadium is needed to significantly increase the strength of steel or titanium, making it useful in jet engines, high-speed aircrafts, gears, axles, crankshafts, superconducting magnets and ceramics.

Roughly 85 percent of the world's vanadium is produced in China, Russia and South Africa. Since the bulk of the metal is either mined or produced as a by-product, any changes in the iron, ore and steel markets are crucial to vanadium production. For instance, last year production was halted in part because of the closure of the Kuranakh mine in Russia, which shut due to low iron ore prices and resulted in zero production in 2017. The Highveld Steel & Vanadium mine in South Africa also shut down in 2015 for two years, affecting the structure of the supply chain.

In China, stricter standards on rebar in earthquake zones and tightening of regulations on the use of all substandard steels were announced in [February](#). The new rules increase the vanadium content in rebar products to make them stronger. An official at the China Iron & Steel Research Institute [estimates](#) the move could increase vanadium consumption by 30 percent, or 10,000 tonnes per year. The enforcement of these regulations is playing a role in vanadium's recent price gains.

But analysts are expecting a [shift](#) in how vanadium is used. With governments investing [billions](#) into renewable energy, vanadium is sought after for use in large-scale battery storage systems which would support the world's biggest renewable energy projects.

Vanadium Redox Flow Batteries in Energy Storage

Large scale energy storage is a favorite topic of futurists, and justifiably so. It's been [touted](#) as the missing link between renewable energy, like solar and wind, and around-the-clock 24/7 reliability. The market for large-scale energy storage systems in the United States is [projected](#) to reach \$2.5 billion by 2020—six times as much as in 2015. In short, energy storage absorbs

power so it can be generated at one time, then releases it so it can be used at another time. It can be beneficial by leveling out the flow of power, which can increase or decrease in unpredictable ways; it can be integrated into electricity systems as a backup to a main source of power; it can increase the power-generation, transmission, and distribution assets (i.e. absorbing power that exceeds current demand); and in some markets where the cost of energy is cheaper at various points in time, storage can help smooth out those costs.

While lithium-ion batteries are popular in electric vehicles, it's vanadium redox flow batteries (VRFBs) that are favored for large-scale energy storage systems. They are longer-lasting than lithium-ion and have potentially [unlimited](#) recharging ability.

Vanadium flow batteries are nonflammable, compact and can be fully contained. They are reusable over semi-infinite cycles, discharge 100 percent of stored energy and do not degrade for more than 20 years. In vanadium flow batteries, energy is stored by providing electrons making V (2+,3+), and energy is released by losing electrons to form V (4+,5+). VRFBs consist of two tanks of liquid. When pumped into a reactor, the two solutions flow adjacent to each other past a membrane and generate a charge by moving electrons back and forth during charging and discharging. This type of battery can offer almost unlimited energy capacity simply by using larger electrolyte storage tanks. It can be left completely discharged for long periods with no ill effects, making maintenance simpler than with other batteries, like lithium-ion. VRFBs reduce the cost of storage to about 5¢/kWh, and they [outcompete](#) lithium-ion and any other solid battery for utility-scale applications. They're safer, more scalable, longer-lasting, and cheaper—less than half the per kWh cost.

Tesla Motors CEO Elon Musk might be the world's most [well-known](#) lithium-ion advocate, but vanadium has the entire country of China behind it.

The China National Development and Reform Commission recently released a policy document calling for multiple 100-MW-scale VRFB pilot projects by the end of 2020. China has also begun construction on a backup power facility in Dalian that's [said](#) to be twice the size of Tesla's plant in Australia, also the [world's largest battery](#), ever, and it will single-handedly triple China's grid-connected battery storage capacity.

Issues with Lithium and Cobalt

While lithium-ion battery consumption grew 73 percent from 2010 to 2014, production only increased 28 percent, according to a 2017 [study](#) published in the energy research journal *Joule*.

Cobalt is one of the main components of lithium-ion batteries—which is increasingly vulnerable to supply chain issues because of volatility in the Democratic Republic of Congo where most of the world's cobalt is produced.

“Current cobalt chemical demand is set to outpace supply should electric vehicle adoption really become a significant portion of the global auto fleet—perhaps 10 to 15 percent by [2025](#),” says Chris Berry, analyst and co-author of the Disruptive Discoveries Journal.

Cobalt is often mined under torturous labor conditions. In 2016, the Washington Post found miners, including children, worked around the clock using hand tools to extract cobalt. Of the 123,000 tonnes of cobalt produced globally in 2017, the DRC [accounted](#) for 66,000 tonnes. It’s [estimated](#) that over the next 15 years, production of lithium-ion batteries could slow down if supply chain issues aren’t fixed.

Vanadium mined as a by-product

Vanadium, although widely distributed and used in a variety of applications, is not found on its own so supply is limited.

“Over the last decade, vanadium surfaced as a subject of interest primarily tied to the fortunes of the then booming steel industry through its use as an alloy,” said Nikolaos Cacos, President and CEO Blue Sky Uranium (TSX-V: BSK, FSE: MAL2; OTC: BKUCF). “Now vanadium is coming back with a vengeance due to the Chinese decision to increase the metal’s percentage in steel alloys and for its potential in mass electricity storage devices, and the underinvestment in new projects. The recently soaring price of this metal has swung the focus onto upcoming projects, of which there is a paucity.”

Blue Sky Uranium owns the Amarillo Grande uranium-vanadium Project located in the Patagonia region of Argentina, the largest generator of electricity from nuclear energy in South America. The country is working to further expand their nuclear energy sector with additional power plants, but lacks a ready internal supply of uranium.

“There are some spots that have a one-to-one ratio with vanadium-uranium, and there are some targets that have been up to 4-to-1 ratio of vanadium to uranium,” [says](#) Cacos. “The soaring vanadium price gives a potential kicker to any mine plan calculation.”

Similar uranium-vanadium deposits exist throughout North America, in Manti-La Sal National Forest, Utah, where uranium miner Energy Fuels was [recently](#) awarded rights to expand, as well

as the Sunday Mine Complex in western San Miguel County, Colorado, operated by Western Uranium Corporation.

Market for Vanadium Redox Flow Batteries impacted by demand

The market projection for VRFB demand in the top 10 countries is growing at an 80 percent CAGR from 2013 to 2020, [according](#) to Chinese firm Azure International, ultimately culminating in more than 7,000 MW of vanadium-flow capacity needed in 2020. This demand could be even more substantial than that if the price of vanadium electrolyte—the key element of the batteries—could be reduced. The cost of vanadium electrolyte makes up about 30 to 50 percent of the cost of each battery alone.

If vanadium flow batteries revolutionize modern electricity grids the way that lithium-ion batteries are powering electric vehicles, the vanadium market will continue to see its prices soar, and investors would be positioned to profit as the world continues its surge towards large-scale energy storage.