

The Future of Energy Storage: Liquid-Metal Batteries and the Role of Antimony

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One of the standout attributes of the liquid-metal battery is its competitive edge over lithium-ion batteries. Not only is it more affordable, but its design simplicity, superior chemistry, and impressive durability make it particularly appealing. As Sadoway notes, the battery's non-flammable nature, resistance to capacity fade, and data suggesting an operational life of two decades retaining 95% of its capacity make it a formidable contender in the energy storage sector.

Critical Minerals Expert Lara Smith on the Increasing Demand for Antimony

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In a recent InvestorIntel interview, Tracy Weslosky spoke with Lara Smith, a global critical minerals expert and the Executive Director and CEO of Molten Metals Corp. (CSE: MOLT), an antimony exploration and development company.

Molten Metals Aims to Meet the Rising Demand for Antimony in Energy Storage

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Supply chain disruptions and geopolitical concerns caused Western governments to re-examine the source of critical metals that will drive the economic engine for decades to come.

Media attention seems focused on the battery metals required for electric vehicles (“EVs”), including lithium, cobalt, graphite, and rare earths, but antimony was one of the few metals that is on all of the critical metals lists across Australia, Canada, China, the EU, Japan, and the USA.

The importance of antimony

Currently, Antimony is primarily used as a flame retardant in items such as paints, plastics, and textiles. It is also used in brake pads, ceramics, glass for televisions and monitors, and rubber. When alloyed with lead, it is found in metal products used in ammunition and lead-acid batteries.

As we strive towards transitioning to a carbon-free society, it is essential not only to harness renewable energy but also to store it efficiently. The future increase in demand for antimony lies in its potential to become a crucial component in battery technology.

Antimony’s unique property as a heat retardant is essential in

preventing thermal runaway in batteries, making it a crucial element in the development of effective energy storage systems. Its heat retardant properties enable the mass scalability of batteries, making it the only metal capable of achieving this goal.

Antimony molten salt batteries

[Ambri Incorporated](#), a US-based energy storage company, has developed a long-duration liquid metal battery technology for the power grid with backing from prominent investors, including Bill Gates, [Khosla Ventures](#), and [SoftBank Group](#), and funding from the [US Department of Energy](#).

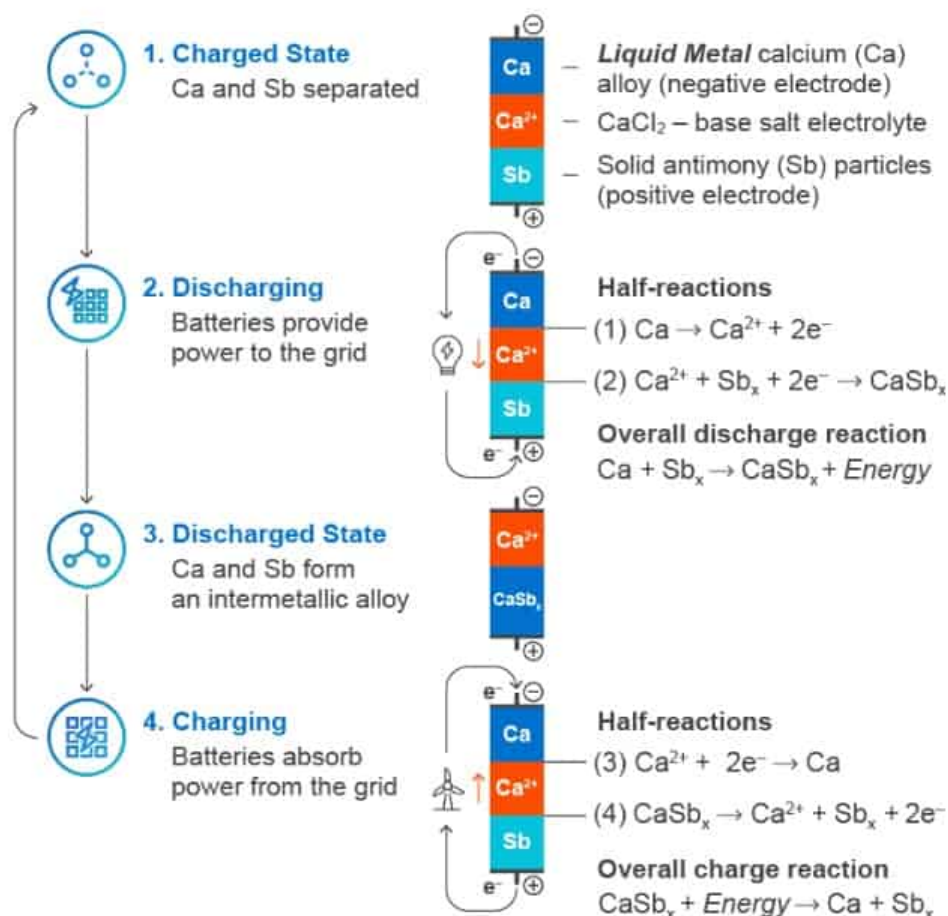
Ambri's battery technology uses solid antimony as the positive electrode, liquid metal calcium as the negative electrode, and a salt electrolyte consisting of calcium and chloride. The use of these metals allows for a reliable, low-cost, long-lasting, and safe energy storage solution that can enable the integration of renewable energy sources into the electric grid.

As Ambri continues with its commercialization efforts, it is estimated that its forward contract sales will require over 25% of the global production of antimony outside of China by 2026.

However, the current supply lacks the necessary capacity to fulfill this demand, leading to an imbalance in the supply-demand equation. This highlights the urgent need for investment in new antimony mines and refining ("roaster") facilities.

FIGURE 1: Ambri's Molten Salt Battery Chemistry

Our Chemistry



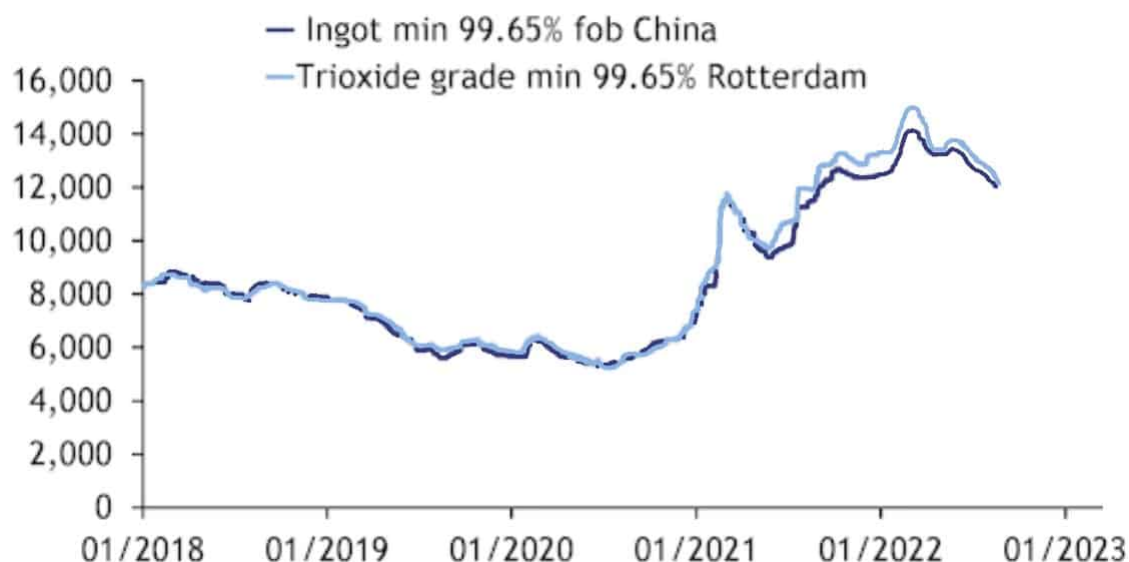
Source: [Ambri's website](#)

Lack of supply and increasing demand drives the price higher

Currently, the global supply of antimony is heavily reliant on China, Russia, and Tajikistan, which produced over 88% of the world's supply in 2022, according to the [US Geological Survey](#) ("USGS").

Antimony prices have surged this year to a record high, currently trading at US\$13,000 per tonne, more than double the US\$5,500 per tonne rate in 2019.

FIGURE 2: Antimony Market Prices (US\$/tonne)



Source: Argus Media

Newly Listed Molten Metals Corp.

Listed in August 2022, [Molten Metals Corp.](#) (CSE: MOLT| FSE: Y44) is a Canadian mineral exploration company and one of the few companies actively developing antimony assets in North America and Europe, reducing the foreign dependence on this resource.

The Company has four properties, which include a former antimony mine in Nova Scotia, Canada and it has two antimony-gold projects and one tin project in Slovakia. All of the Slovakian projects are brownfield sites, either past-producing mines or previously explored.

In Nova Scotia, Molten Metals' [West Gore project](#) is home to one of Canada's foremost historic antimony mines, which has been abandoned since the 1960s. The Company is currently testing the remaining stockpiles and tailings at the site, in an effort to extract valuable antimony and revive the mine.

According to the Company's website, these stockpiles could

contain up to 570 tonnes of antimony and 2,500 ounces of gold, worth approximately US\$7.4 million and US\$5.0 million at today's price, respectively. These estimates were taken from a report released by George Packard in 1949 using a survey undertaken by Nova Scotia's Department of Mines.

The Company is also focusing on the past-producing [Trojarova project](#) in Slovakia with a well-preserved mining infrastructure and a historic resource calculation, which, if correct, would make it one of the world's largest unmined antimony projects globally.

Upcoming exploration plans include confirmation sampling and drill hole twinning to complete a NI 43-101 initial resource to validate the historical resource. Molten Metals could have one of the largest antimony resources globally if it can confirm the historical resources that were calculated in the 1980s and 1990s when Slovakia was part of the Soviet Union.

Offtake agreements and future capital

Molten Metals recently [announced](#) that it executed a non-binding Memorandum of Understanding ("MOU") for a long-term antimony supply agreement with Swedish company [Scandinavian Steel AB](#).

The agreement will be subject to a specific financial investment into the development of one or more of Molten Metals' projects and a provision to upgrade the MOU to a binding offtake agreement within a reasonable time frame.

Final thoughts

Molten Metals (CSE: MOLT| FSE: Y44) has a strong focus on antimony, which is increasingly in demand due to its use in batteries. In the short term, the Company plans to process the remaining stockpiles of tailings at its Nova Scotia project and

advanced its mines in Europe. The company has two antimony-gold projects and one tin project in Slovakia that could provide a near-term, large resource and additional upside.

With a market cap of only C\$1.9 million and a tight share structure of only 16.9 million shares outstanding, if you have confidence in the antimony theme, it should be a stock to watch.

The Department of Defense starts the Invest in Critical Minerals Strategy with the Letter “A”

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What’s old is new again. How many times have we seen an old, either abandoned or suspended mining operation, all of a sudden come back into relevance? This seems to be happening more often as supply chains and global political maneuvering have sparked a race to “onshore” as many things as possible. However, today was a new one for me – antimony. It’s not necessarily at the top of the list of critical materials, as everyone seems to be focusing on the big five (lithium, manganese, nickel, cobalt, graphite) for EV batteries along with copper.

But here are some little known facts that may change your mind about antimony, which is on the U.S. Department of the Interior’s critical minerals list. Antimony trisulfide is essential to national defense as a key component for munitions

and primers used in every branch of the armed services. Additionally, every military uniform is coated with antimony to provide fire protection and minimize infrared detection. It is also a useful material for the energy transition as a glass clarifier in solar panels or as a metal strengthener to wind turbine components. More recently, antimony is gaining recognition as a battery metal for its role in liquid metal battery technology. Yet, the U.S. has no domestic antimony production at present. Even more challenging, roughly 90% of global antimony production is controlled by China, Russia, and Tajikistan. Not exactly, the names you want at the top of your list of a “must have” commodity.

This explains why a domestic mining company was just [awarded a Technology Investment Agreement](#) of up to US\$24.8 million under Title III of the Defense Production Act (“DPA”). That’s right, the Department of Defense has stepped up to the plate to work with [Perpetua Resources Corp.](#) (NASDAQ: PPTA | TSX: PPTA) to complete environmental and engineering studies necessary to obtain a Final Environmental Impact Statement, a Final Record of Decision, and other ancillary permits to sustain the domestic production of antimony trisulfide capability for defense energetic materials. All of this would be for the [Stibnite Gold Project](#) where Perpetua Resources is focused on the exploration, site restoration and redevelopment of gold-antimony-silver deposits in the Stibnite-Yellow Pine district of central Idaho.

The Stibnite Project is one of the highest-grade, open pit gold deposits in the United States and is designed to apply a modern, responsible mining approach to restore an abandoned mine site and produce both gold and the only mined source of antimony in the United States. Further advancing Perpetua Resources’ ESG and sustainable mining goals, the Project will be powered by the lowest carbon emissions grid in the nation and a portion of the antimony produced from the Project will be supplied to Ambri, a

US-based company commercializing a low-cost liquid metal battery essential for the low-carbon energy transition.

There's a lot of interesting things at play here but before you get too excited about this project, it should be noted that there is a lot of work to be done because of all the work that wasn't done back in the 1930's and 1940's. In the absence of modern environmental knowledge and regulation, and later to meet wartime demands, the first generation of miners at Stibnite placed mill tailings wherever they could in the Meadow Creek Valley. By the time mining operations ceased in the 1950's, more than four million cubic yards of tailings had been placed in the upper valley. In 1959, government officials ordered the mine to breach the tailings containment and Meadow Creek flowed through, rather than around, the tailings. Over the next 20 years, an estimated 10,000 cubic yards of tailings were eroded by wind and water and washed downstream into the East Fork of the South Fork of the Salmon River system.

Not surprisingly, the proposed Stibnite Gold Project is in the sixth year of review under the National Environmental Policy Act. However, Perpetua expects that current cash resources, combined with the full DPA agreement, would provide the Company with sufficient liquidity to complete permitting and early restoration activities on the current timeline as well as additional liquidity to begin advancing construction readiness. Once back in production, Stibnite is expected to average ~35% of U.S. antimony demand. Plus, the gold component of the mine has pretty appealing economics as well with a 2020 feasibility study suggesting an NPV (5%) of US\$1.3 billion using US\$1,600/oz gold price, average annual gold production of ~465,000 ounces at a very impressive AISC of <US\$450/oz leading to average annual EBITDA >US\$550 million.

I harken back to a saying used by Tom Hanks' character in "A

League of Their Own” (although that isn’t the original source, it’s just one of the more notable ones) “If it were easy, everyone would do it”. Reclaiming and resuscitating the Stibnite Gold project is not an easy task. But Perpetua definitely has momentum on its side and a very influential supporter in the form of the Department of Defense. It would appear they have as good a chance as any to restore commercial operations at what is arguably a very important (and potentially lucrative) asset.

Antimony – Critical or Strategic or Both?

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China has a very strong position in Antimony and long has had. Indeed this is the metal it has been dominant in for the longest. However, like so many other resources this was squandered through overproduction, predatory pricing and high-grading. China now finds its domestic share of global production plunging and to prop up its dominance it has become a leading importer of artisanal and “conflict” ore from all around the world. It then processes this imported ore/concentrate and manages to hold a still dominant position in processed end-product Antimony Trioxide and other products.

Is the metal strategic? Thus far it does not have the type of sexy applications that other high-tech metals possess, but it is still a key component in the things it is used for such as fire retardants and its historical application as an alloy used to harden Lead in ordnance/ammunition and Lead-acid storage batteries.

And now the latest new technology to utilize the metal is Antimony molten salt batteries for mass storage. The potential here is for a quantum surge in demand. This new application may be its own undoing if the price of the metal goes too high and unravels the economics.

Lighting a Fire Under the Price

After a price slump that lasted several years, and sank the prospects of several Antimony wannabes, the price of Antimony started to uptick in 2016. It got to around \$8,500 per tonne and then plunged again to around \$5,500. That price was the result of a regulator-induced swoon over the use of the metal in fire retardants in children's pajamas (the culprits being the EU and State of Massachusetts), however the main application in fire retardants has not gone away and in the wake of Grenfell Tower fire in London the regulators act against fire retardants at their own peril. This was further complicated by the ever-looming liquidation of the [FANYA](#) stockpile, which amounted to around 19,000 tonnes, which was finally sanctioned by Chinese courts in 2019. The talk in the trade was that the FANYA stocks were bought by one of China's largest Sb producers.



Source: Argus Metals

In the wake of the pandemic and with the marketplace dry of product, the price has had a fire lit under it by Molten Salt batteries capturing the *Zeitgeist*. This move was compounded by global shortages caused by the Pandemic, the coup in Burma, long term underinvestment, declining Chinese production and the arrival of Molten Salt batteries in the commercial marketplace.

The worries about regulators evaporated like Gorillas in the Mist in the last quarter of 2020 and a stampede to rebuild

stocks occurred sending buyers (notably in the US) into a feeding frenzy with Antimony becoming the hottest metal in the last six months (though tussling with Tin for that title) doubling in price from around \$5,500 in late 2020 to nearly \$11,000, from where it has eased back slightly.

On the supply-side protracted low prices have stymied anything beyond small-scale production by artisans outside China.

Molten Salt Batteries as Icing on the Cake

We have written before on how [Molten Salt batteries](#), based on Antimony are starting to make waves. If Liquid Metal Batteries become the “killer application” in grid-linked storage (or non-grid linked) then it potentially lights a fire under Antimony demand and pricing. The announcement that United States Antimony Corporation (NYSE: UAMY) had secured an offtake deal with Ambri for its output lit a fire under the price of that stock in late 2020.

To mix some metaphors, molten salt batteries have flown under the radar thus far but definitely have a place in the evolving battery universe and hopefully will take the Antimony market along for the ride.

In this Third Wave of battery metals, Antimony (the prime component in Molten Salt batteries) has joined the ranks of battery metals and the hunt is on for that scarce commodity, the non-Chinese Antimony miner.

Each GWh of Ambri batteries requires around 1% of current annual production of these (calcium and Antimony) anode and cathode materials. This is the closest we have to divining how much Antimony that the Ambri product line might consume if it gains traction. Current Sb production is around 170,000 tonnes per annum, implying that a Gigawatt of Ambri cell utilizes 1.7

tonnes of Antimony.

Thin Pickings amongst Actual & Wannabe Producers

Despite the metal price excitement, the equities markets are starved for options in this metal. The small field consists of the gold/silver miner, Mandalay Resources Corporation (TSX: MND) that has Antimony as a by-product from its Costerfield mine in the Australian state of Victoria, and United States Antimony with its curious focus upon the Los Juarez Silver-Antimony mine in Mexico. Red River Resources Limited (ASX: RVR), another developer basically focused on gold is trying to revive the Hillsgrove mine in New South Wales (which has Sb as a by-product) and Perpetua Resources Corp. (NASDAQ: PPTA) which was formerly called Midas Gold, has a mega project in Idaho (again with a gold focus) that also has the potential to supply half the current US demand for Antimony displacing China as the main supplier to the US. It will be interesting to see if the price surge broadens the offering in equities markets.