The Australian Government Steps into the Critical Minerals Supply Chain Ring

written by Jack Lifton | March 14, 2024

A recent monumental development within the mining and rare earths sectors is the Australian government's financial endorsement of Arafura Rare Earths Limited's (ASX: ARU) rare earth mine and refinery project. This marks a significant step forward in the global pursuit of sustainable and secure Non-Chinese owned or operated sources for critical minerals. This move, underscored by an impressive A$840 million in loans and grants, signals a strong Australian governmental belief in the necessity and potential profitability of domestically sourced rare earth elements, vital for electric vehicle (EV) motors and renewable energy technologies.

Gina Rinehart's Hancock Prospecting, alongside other private equity interests, has seen a notable appreciation in value following this announcement, illustrating the private sector's growing confidence in rare earth ventures as a viable and lucrative investment avenue. This confidence is buoyed by government backing, which often acts as a catalyst for further private investment by demonstrating a commitment to the sector's success and stability.

Australia's strategic decision to support Arafura's project, situated near Alice Springs, showcases its ambition to become a frontrunner in the production of rare earth elements, crucial for EVs and wind turbines. This initiative not only addresses the immediate financial hurdles faced by the mining industry but also aligns with broader goals of establishing Australia as a key player in the global supply chain for renewable energy

technologies.

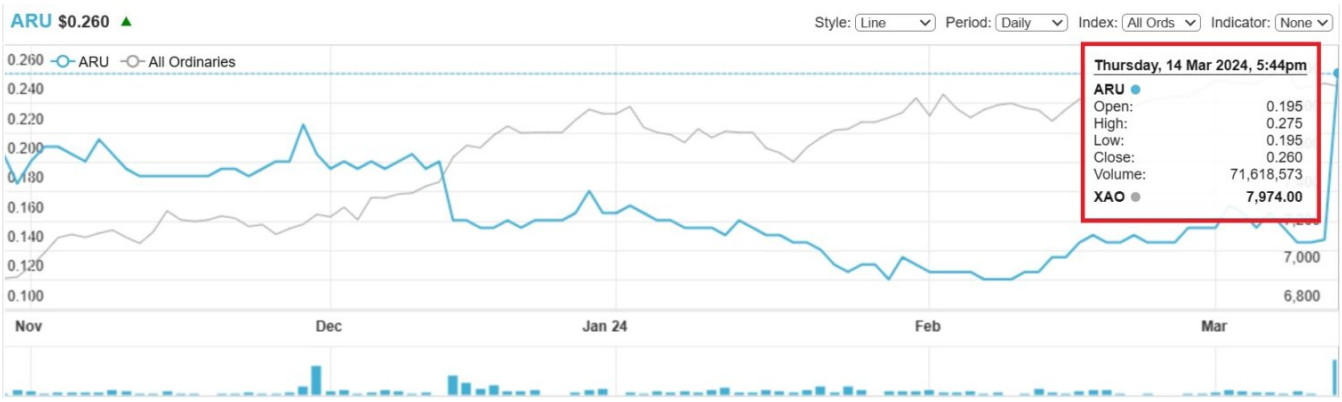
The involvement of figures like Gina Rinehart and Andrew Forrest, both of whom have substantial stakes in mining ventures, underscores a deeper shift towards mining as an investment that offers both substantial returns and strategic value in the context of the global green transition. Their investments in rare earths and the potential for vertical integration, as seen in the partnership between Forrest's Hastings Technology Metals Limited (ASX: HAS) and Neo Performance Materials Inc. (TSX: NEO), highlight a keen understanding of the sector's critical role in future technologies and energy solutions.

Australia's proactive stance, contrasted with the more cautious approaches of other Western nations, illustrates a deep understanding of the strategic importance of rare earths and the necessity for domestic processing capabilities. This is not just about securing supply chains but also about capturing more value within the country, creating jobs, and fostering technological advancements in green energy and EV production.

Moreover, the broad financial and strategic implications of this government support extend beyond the immediate economic benefits. They underscore a pivotal moment for the global rare earths market, emphasizing the critical need for diversified, reliable sources of these essential materials. As tensions and competitions intensify on the international stage, Australia's move represents a significant step towards greater independence and resilience in the face of geopolitical and market pressures.

In conclusion, this development is a clarion call to nations and investors alike to recognize the indispensable role of rare earths in the modern world. It is a testament to the vision and audacity of those like Rinehart and Forrest, who see beyond the

immediate to the immense potential that rare earths hold for the future of technology, energy, and national security. As Australia forges ahead, it sets a compelling example for others to follow, highlighting the comprehensive strategy needed to fulfill the burgeoning demand for domestic sourcing of rare earth magnets, especially among European and American EV automotive OEMs.



Codemge's CEO on Leveraging Minas Gerais' Position as Brazil's Niobium Mining Powerhouse

written by InvestorNews | March 14, 2024

In this interview with Critical Minerals Institute (CMI) Director Melissa (Mel) Sanderson at PDAC 2024, Thiago Coelho Toscano, CEO of Companhia de Desenvolvimento de Minas Gerais (Codemge), discussed the strategic endeavors and visionary pursuits of Codemge in Brazil's mining sector. As the economic development agency for the state of Minas Gerais, Toscano shared

insights into the state-owned company's role in leveraging Minas Gerais' position as Brazil's mining powerhouse.

Toscano highlighted Codemge's collaboration with CBMM to exploit niobium deposits in Minas Gerais, a venture that not only boosts regional development through significant profit-sharing but also invests in diverse sectors including real estate and other minerals. Toscano shed light on the innovative use of niobium in enhancing steel and revolutionizing battery technology for electric vehicles (EVs). Niobium, when used in conjunction with lithium in batteries, significantly reduces charging times due to its ability to maintain lower temperatures, thus preventing overheating. For instance, an electric bus utilizing this technology could be charged in just 10 minutes. This breakthrough has implications beyond EVs, potentially benefiting energy storage solutions in wind turbines as well.

The discussion also touched upon Codemge's efforts to attract global investors to the rich mineral sector of Minas Gerais. By simplifying the mining license acquisition process and creating a more transparent marketplace, Codemge aims to create a conducive environment for investors, thereby accelerating economic development within the state.

To access the complete interview, click here

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What are the Implications if Tesla's Next Generation Motors are Rare Earths-Free?

written by Jack Lifton | March 14, 2024

At Tesla's Investor Day on March 1, 2023, Franz Von Holzhausen, Lead Design Executive at Tesla Motors (Nasdaq:TSLA), announced that its next generation of electric motors would not use rare earth materials. With Tesla's current dominance in the electric vehicle ("EV") market, this shift could have a significant impact on the rare earth market and some rare earth stocks were down on the news. Here is what he said:

> *"But at Tesla efficiency means more than just reducing how much energy the cars use it's about how we develop how we manufacture how we refine and how we scale the powertrain. Now the model 3 and Y powertrain is a great example of this broader meaning of efficiency. So since we launched it back in 2017, we've continuously improved that powertrain and the factory that builds it so the Drive Unit the engine of the car is lighter for the same power.* ***We use 25 percent less heavy Rare Earth*** *than when we started and the powertrain Factory which is behind me today is 75 percent smaller and 65 percent cheaper than the one that we originally built. And what I really want to emphasize is that we did all of this without compromising our cars are just as powerful. They go just as far, and they cost the same or less and the factories have the same output."*

> *"There's one more thing that I want to highlight. So, I talked about how we had reduced the amount of rare earth in our powertrains and, as the world transitions to clean energy, the demand for Rare Earth is really increasing dramatically and not*

> *only is it going to be a little hard to meet that demand but mining that rare earth it has environmental and health risks, so we want to do even better than this.* ***We have designed our next Drive Unit which uses a permanent magnet motor to not use any Rare Earth materials at all.*** *So how does all this fit into the master plan we can make lower-cost products that are still efficient and compelling, and we can make them at scale. We're going to use less constrained Commodities."*

Perspective lost! Tesla is not the driver of the global demand for rare earths

Tesla is not the driver of the global demand for rare earths; the global OEM Internal Combustion Engine ("ICE") automotive industry is the principal driver of demand for rare earth permanent magnets followed by or paralleled by the direct drive wind turbine electricity generation industry (at the moment), the Global OEM EV industry, and the global military industry.

Tesla is an example, even perhaps a symbol of something. It is not the thing itself. The thing is the expanded use, albeit in very small quantities, of scarcely produced, due to costs, technology metals that enable miniaturization and thus widespread consumer use of information and entertainment technologies.

Rare earth permanent magnets, which have allowed the miniaturization of electric motors, are used today primarily for convenience and style accessories in cars, power windows, power seats, windshield wiper motors (ok, this is a safety necessity), audio loudspeakers, and power steering. Their use in drive motors for vehicle power trains is not necessary and never has been.

Using rare earth permanent magnet motors in drive trains increases the efficiency of the power train (over the use of AC motors) and lowers the weight of the vehicle. Both factors increase range, the real target of using rare earth permanent magnet drive motors.

Wind turbines drive rare earths demand

Direct drive wind turbine generators, today about a third of the production of these gargantuan devices, are the largest demand drivers for rare earth permanent magnet motors (in this case, generators) after the OEM ICE automotive industry.

The, as yet, small OEM EV industry is catching up due to scale. An average EV using rare earth permanent magnet drive motors such as today's Teslas requires between 5 and 10 times as much rare earth permanent magnet material as an ICE-powered vehicle. So, if and when the EV market segment reaches 10% of the ICE segment and if all EVs use rare earth permanent magnet drive motors then EVs would double the current demand for rare earth permanent magnets by the global OEM automotive industry.

China set to double rare earths capacity in 2 years

I think we can all see why the Chinese rare earth permanent magnet manufacturing industry is on a course to double its capacity by 2025!

Teslas or any car or truck made outside of China will be hard-pressed to get non-Chinese (or perhaps even Chinese) sources of rare earth permanent magnets after 2025. So will wind turbine generator manufacturers and even small accessory motor and loudspeaker makers.

China today controls the production of rare earths, rare earth

permanent magnets, and rare earth permanent magnet motors. Deglobalization of trade without a focused and funded non-Chinese rare earth permanent magnet production industrial policy just cements China's dominance of this industry.

Elon Musk is just reading the tea leaves better than his cohorts in Detroit and Stuttgart.

Zentek's revolutionary graphene based icephobic coating targets billion dollar ice-resistant market

written by Tracy Weslosky | March 14, 2024

Ice build-up on wind turbines, airplanes, and cars in cold regions is a real problem. For example, Texas residents may remember the February 2021 ice storms and extreme cold weather that hit south-central USA. The storm resulted in over 4.5 million homes and businesses being without power for several days. Frozen gas lines and ice buildup on wind turbines were key factors in the power failure as wind generation dropped by almost 50% over the entire state of Texas.

The airline industry spends significant time and money 'deicing' (removing ice and snow build-up) on their planes before take-off. Consumers in cold countries often have to do the same with their car windscreen. The drone market is another industry where deicing is important.

Now there is a better solution to de-icing. Today's company has developed an 'icephobic coating' technology that is effective at preventing ice build-up. 'Icephobic' effectively translates to 'repelling ice'. It is also sometimes referred to as 'ice-resistant coating'.

The global market for ice-resistant (icephobic) coatings

It has been reported that the global market for ice-resistant coatings is forecast to reach **more than $1 billion in 2023**, growing at a CAGR of 23.3%.

An excerpt from a 2021 report on the ice-resistant coatings and surfaces market

Source: ResearchAndMarkets

Zentek Ltd. (NASDAQ: ZTEK | TSXV: ZEN) announced in September strong test results supporting their patent-pending, graphene-based, icephobic coating technology. The testing concluded that Zentek's icephobic technology is durable in adverse conditions for both wind turbine and drone industries, which are the initial focus markets for Zentek's icephobic coating.

Zentek state that their icephobic "coatings have demonstrated an adhesion strength repeatedly around 20 kPa (results under 100 kPa are considered to demonstrate low adhesion), a significant improvement over the current commercial products. Testing at the National Research Council (NRC) and Anti-icing Materials International Laboratory (AMIL) in Quebec is ongoing."

Some of the September announcement highlights included:

- "Flight tests in real-world icing conditions demonstrated good performance of Zentek's coating, with results

indicating retardation of ice accretion (icephobicity) and low adhesion to accreted ice….

- Sand erosion testing demonstrated medium to good performance at a high speed of 540 km/h.
- Rain erosion testing at AMIL demonstrated good performance at 160 km/h and 320 km/h based on our interpretation, speeds at which the leading edge of wind turbines blade tips are exposed.
- NRC drone testing demonstrated consistent results of maintaining control of rotor thrust in icing conditions…..
- Zentek has filed a full patent application with the Patent Cooperation Treaty, the international patent office, on August 2nd, 2022, for Nanomaterial-Enhanced Elastomer for Passive Ice Accretion Prevention."

Source

Icephobic coatings have many applications and significant demand

An exciting part of the above news is the potential for Zentek's technology to be used in a huge variety of uses globally, particularly the energy and aviation/aerospace industries.

Zentek states:

"*Commercial applications of our patent-pending coating could be used in drone technologies allowing for efficient all-weather operation. Other additional applications include powerlines, large wind turbines, ship structures (railings, etc.), and oil rigs, especially in Arctic operations, along with tall buildings where ice buildup could pose a public hazard.*"

Icephobic coatings could revolutionize aviation and wind power generation industries

Source: Zentek website/icephobics

In addition to their icephobic coatings Zentek is also advancing multiple other initiatives including the commercialization of their "Canada patent allowed" ZenGUARD™ (a 'graphene-silver coating' shown to have 99% antimicrobial activity used on masks or PPE, also used in HVAC systems to improve air quality), aptamer enabled Pathogen Detection Technology, anti-inflammatory therapies, fuel additives (to reduce carbon emissions), conductive filaments for 3D printing, fire retardant coatings, and graphene wrapped silicon anodes for batteries.

Zentek Ltd. trades on a market cap of C$235 million on the TSXV or US$175 million on the Nasdaq.

Molybdenum – securing a domestic supply of the vital but underappreciated mineral

written by | March 14, 2024

Element 42 on the periodic table is Molybdenum (Mo), commonly referred to in the industry as the easier to pronounce moly. Most of the world's moly production comes as a byproduct from copper or tungsten mining. Most people know it as a lubricant. The main use of moly is in steel production as it gives weather and acid resistance in certain steel alloys, particularly stainless steel. This is an element largely overlooked as current production is in the range of 290,000-300,000 metric tonnes per year, which makes it a $10 billion annual business at

its current pricing of $16/lb. Pricing earlier this year reached $20 per pound. Those are prices that have not been seen since 2008. Two years ago, the price was under $8 per pound.

According to the CPM Group, there are 76 mines globally that produce moly and 36 are inside China, with China producing over 40% of the world's output. Between 70-80% of that output is from copper mines. In 2021 the world's top 10 moly producing countries were:

Outside China, there are only two pure moly plays, and both of these are in Colorado and operated by Freeport-McMoRan (NYSE: FCX) subsidiary Climax Molybdenum. 90% of western-sourced moly comes from copper production. This means that the main driver for moly production is copper production, so output and pricing can be counterintuitive. An example of this was in 2020 when prices dropped 30% but production went up, while in 2021 prices climbed 96% but production went down.

According to a World Bank report on the impact of low carbon technologies (LCT) in 2018, 21 million tonnes of copper were produced compared to 0.3 million tonnes of moly, or about 1 tonne of moly per 7,000 tonnes of copper. Moly is used in wind turbines, with one megawatt of output requiring 130 kilograms of moly. A typical offshore turbine is 12MW, which requires 1.56 tonnes of molybdenum.

One of the issues facing the industry is Chile's production. According to CPM, moly production in 2021 dropped 7.5% from 2020. The main drop was from Codelco, a state owned Chilean company, whose production declined 24%. A presentation by Codelco in 2019 indicated they needed new investment, otherwise production would fall by 74% by 2029. The Chilean government has asked Codelco to find $1 billion in annual savings and make a $8

billion cut in planned investments. This may delay investments. The Chilean government is talking about privatizing the mining industry and taking a royalty of up to 12%. These steps will likely give companies pause for thought on new investments. Based on this, the CPM Group is looking at a deficit position for moly over the next five years.

There is one potential new moly mine opportunity that is intriguing – Stuhini Exploration Ltd. (TSXV: STU) based in British Columbia. The CEO, David O'Brien, pulls a monthly salary of $2,000 which is different than a lot of junior mining companies. The share structure is very tight with 26.1 million shares issued and fully diluted at 28.3 million shares. Insiders hold 43% and Eric Sprott is a strategic investor.

Stuhini's project is in Northwestern British Columbia and is called Ruby Creek. It has an option to earn 100% interest with a 1% NSR. There is a $22 million road built by a previous operator so there is access to the site. The mine was under construction by Adanac Molybdenum Corp. when it went bankrupt because of the 2008 financial crisis. This is a pure moly play, like the two mines in Colorado. A resource was released earlier this year with a measured and indicated resource of 433 million pounds. This gives an in situ value of $6 billion at current prices. Additionally, there are gold and silver indications on the property. Interestingly the market cap is $14 million while the previous operator had a market cap of $300 million.

It bears keeping an eye on this moly as low carbon technologies expand and what decisions Chile makes over the next few years. At present pricing, it can support new mines but there are few stand-alone opportunities. It is well worth keeping an eye on this market.

Get Ready, Get Set, Go – EV Demand Raises the Boron Bull Flag.

written by InvestorNews | March 14, 2024

NASDAQ listed 5E Advanced Materials is building a vertically integrated boron products operation in California to supply growing EV and decarbonization demands

Today we take a look at the chemical element boron and at a NASDAQ-listed boron company with a globally significant boron resource in California. 'Boron' is element number 5 in the periodic table and its demand is growing as we move towards a green energy and electric vehicle (EV) future. That is because boron is lightweight, very hard (boron carbide), and has strong heat and corrosion resistance. It is also quite rare, making up just 0.001% by weight of the Earth's crust.

About 2.5–3.0% of an EVs weight is boron, or put another way there is about 46–50 kg of boron in the form of alloys in a passenger EV. Examples of boron use in EVs include high-strength boron–infused steel and boron containing magnets used in drivetrains. Boron alloys and compounds are also used in solar panels and wind turbines, in micronutrients and super fertilisers, in nuclear reactors, and in military applications such as boron-infused tank armor plating.

Boron demand is increasing especially in the areas of green energy (decarbonization applications). Boron demand is forecast to grow 10x by 2050, with a supply gap (deficit) forecast to widen from the end of 2022. ~60% of global boron supply comes from Turkey and its state-owned assets and 85% of global supply comes from just two companies (Eti Maden & Rio Tinto).

Note: When you hear about electric motors being made with NdFeB permanent magnets, the 'B' refers to boron.

Boron uses

Source: 5E Advanced Materials company presentation

Boron supply gap forecast from end 2022 as demand increases and the new pipleine of projects supply is small

Source: 5E Advanced Materials website – Boron 101

5E Advanced Materials Inc.

5E Advanced Materials Inc. (NASDAQ: FEAM | ASX: 5EA) (5E) core business is founded on its low cost, light environmental touch, boron resource in Southern California, USA. According to 5E: "The Resource is designated Critical Infrastructure by the U.S. government and is the largest known conventional boron deposit globally."

5E is building a BORON^{+} Advanced Materials business that operates across the value chain from resource extraction, to refinement, to distribution. The business is backward integrated from customer product offering into processing and extraction methods. In other words, 5E finds the customer first and then

works backwards from there.

The 100% owned Fort Cady Project in Southern California has a Total Resource of ~327 million tons at 8.22% boric acid content and 323ppm lithium. The Total JORC Code Compliant Mineral Resource Estimate is 120.44 million tons at 6.51% B2O3, 11.57% H3BO3 and 344ppm lithium. Either way, it is a very large resource with a high boron content and some lithium by-product.

5E has already achieved an eDFS for Fort Cady and has all substantive permits in place. Next steps in 2022 will include a BFS, a small scale boron facility, and advancing off-take and potential partnerships. Beyond that production is targeted to begin by 2024+, subject to the above steps being completed.

5E's management and board have a wealth of relevant experience including CEO Henri Tausch having worked for Honeywell and COO Tyson Hall having worked for lithium giant Albemarle.

There are very few near term new boron projects, especially now that the Serbia government has blocked Jadar

Source: 5E Advanced Materials company presentation

Closing remarks

It is quite interesting that an EV has about the same amount of boron as lithium. As a critical technology material boron's use in rare earth permanent magnets is, indeed, critical. As an essential structural material boron's use in the many alloys and glass in an EV is necessary for light-weighting of the vehicle. While there are 100's of junior lithium miners scrambling to meet future lithium demand, there are very few companies focused on boron. Therein lies the opportunity. Even more important is the fact that 5E has a USA based project. It should not be

overlooked, either, that 5E’s boron deposit is the largest one known in the world.

5E has recently listed on the NASDAQ under the ticker “FEAM” so this should start to raise more awareness about the company and the ‘under the radar’ demand boom for boron potentially ahead as the green revolution takes off.

5E Advanced Materials Inc. trades on a market cap of US$801 million.