Boron Joins the Rare Earths Club

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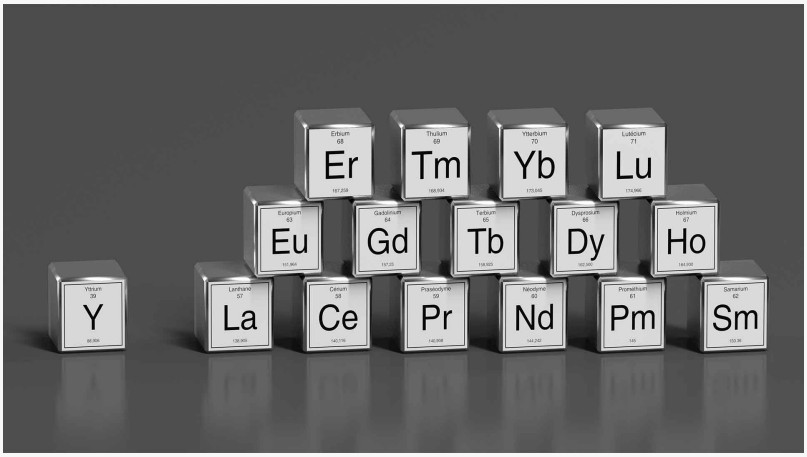

boron critical mineral rare earth

NEW YORK, NEW YORK, USA, April 20, 2022 /EINPresswire.com/ -- The Boron market is set to grow as the energy sector continues to advance. Demand for boron is expected to rise with increased demand from new and emerging sectors such as electric vehicles, high-efficiency wind turbines, and advanced solar panels. Boron is not strictly a rare earth mineral but studies argue it should be included in this valuable set.

Rare Earth elements are valuable because they have magnetic and optical properties which create technologies in components such as audio speakers, hard drives, camera lenses, MRI imaging, and monitors of all sorts. But there is a cost to mining them as post-mining purification processes create hazardous waste. Boron is a potential alternative, providing clean and superconductive, energy-efficient benefits while being cheaper and more environmentally friendly.

Research by Shi-Bo Cheng, Cuneyt Berkdemir, and A. W. Castleman, Jr. from the Department of Chemistry and Physics at Pennsylvania State University shows that boron-doped lanthanide superatom clusters mimic the valence electron configuration of certain rare earth elements, and may serve as rare earth analogs. Their work is published in the Proceedings of the National Academy of Sciences.

Huge demand for (near) rare earths

The rare earth market and near rare earths such as Boron will see rapid growth as the development of new technologies continues. The new report says that the increased demand for rare earth metals in hybrid and electric vehicles combined with the shift towards cleaner energy may drive its market growth. According to Global Market Insights Inc., this growing industry was valued at $13.2 billion in 2019 and is expected to hit nearly $19.8 billion by 2026, registering a CAGR (Compound Annual Growth Rate) of 10.8%.

Current driving factors and geographical presence

As per multiple reports, there are 2 main reasons behind the increasing demand for rare earth materials over the last years. They are:

The global demand for magnets has grown rapidly over the past few years, with Asia-Pacific leading this trend. Driven by various factors such as growing product requirements and increasing adoption of cost-effective products in Asian countries, including China and Japan, the magnet market witnesses significant growth across different end-use industries like electrical & electronics (E&E), automotive industry, and others.

Growing product demand across Asia- Pacific has driven an increase in magnets' popularity globally due to their efficient manufacturing process, which helps reduce costs while delivering high-performance results. The increased focus on clean energy is another trigger factor driving up consumption levels.

Geographical market share breakdown

In the future, North America will hold a higher market share for rare earth metals than it does currently. The U.S.'s investment in production and product R&D will increase its dependence on these resources from other countries less over time and reduce their dependency so they can use this to develop new products more easily.

This region has a high demand for alloys, colorants, optical instruments, and magnets which are expected to grow with an impressive CAGR through the forecast period of ten years or more.

The Asia Pacific region is likely to be the largest regional market by 2026, accounting for more than 55% of global demand. China's presence in this region has allowed it a significant portion of its rare earth metal reserves, thus increasing its need and consumption over time. The growth will be due largely in part to domestic demand and export demands from other Asian countries such as Japan, which are also looking into acquiring these resources by any means necessary.

Recent technological advancements

Automobile industry

The market for rare-earth permanent magnets is expected to grow over the next five to ten years. The major reasons behind this growth are their properties, such as remanence and high coercivity that keep these magnets from losing magnetization even after long periods. These metals find many applications in automotive markets and depend on them.

The growing market for hybrid vehicles is expected to drive a stronger demand shortly as they use more rare-earth magnets per vehicle when compared with conventional cars. On average, each hybrid car contains 650 grams of neodymium or 1,000 grams of neodymium.

However, they're working rapidly on reducing dependence and working on alternatives. For

example, Toyota's new magnet is an improvement on its predecessors because it doesn't require the use of rare earth elements that are scarce. The publication projects for this technology to be implemented in various applications by 2021 and further developed for application in high-performance vehicle drive motors by 2025.

According to a press release from Toyota, their newest development will not need either terbium or dysprosium, both relatively expensive minerals needed when creating magnets previously used within cars. Instead, they have replaced neodymium with lanthanum and cerium, two other earth metals overproduced, currently making them cheap enough without being too hard to find as well. This innovation, including a significant amount of the culled materials, will likely make way into everything we see around us.

Wind energy
A new development in wind turbine technology has made direct-drive turbines a viable option for customers. With rare-earth magnets, weight is reduced, and maintenance issues are eliminated, making this an attractive investment opportunity.

The most popular generator used in wind turbines is a boron-inside permanent magnet. They're used in offshore turbines because they produce high power density and small size with the highest efficiency at all speeds. These generators offer a low lifetime cost for large annual production of energy.

The majority have neodymium magnets that contain smaller quantities of dysprosium to make them even more efficient when spinning faster or slower than their peak speed. In 2018, most offshore wind turbines in Europe used generators containing permanent magnets, as did approximately 76 % of those worldwide. However, replacing these with onshore counterparts may be possible where power and size are not crucial factors.

Nuclear energy
The increasing demand for gadolinium, a neutron absorber in nuclear reactors, is driven by its use as fresh fuel to control and regulate the core's reactivity. Investments are being made in the energy market, which will lead to an increase in consumption. For example, ORNL announced plans to collaborate with six new industry projects advancing commercial technologies related to nuclear power.

The contract and many such, having entailed it from 2018, are projected to increase the market demand of Gadolinium in the coming years. The growing demand for rare earth is also anticipated to be driven by the growth of consumer electronics and nuclear energy industries. According to WORLD NUCLEAR ASSOCIATION, the U.S. has more than 30% of the world's electricity generation and will contribute with two new nuclear reactors soon.

Role of (near) rare-earth metals in safer nuclear energy
The future of nuclear power is thorium. Thorium generates little dangerous, weapons-grade

waste compared to uranium and its radioactive byproducts only last for a few hundred years instead of thousands or millions like those from Uranium. This heavily reduces the threat associated with nuclear proliferation as we know it today.

The byproduct of monazite mining is a mineral containing 15 different rare earth metals and the element thorium. Regulators force companies to keep it safely tucked away, but there's little they can do with this radioactive substance that emits low-level radiation. However, Thorium is not rare, and it exists in ample quantities on most continents. India possesses a particularly abundant supply of thorium which means countries outside of China may want to gear up their own mining industry even though they don't have any control over monazite.

Solar energy industry
Boron is to be utilized as an energy storage medium, showing its potential benefits. In the framework of solar systems development, Boron has been found to reduce power loss during the transfer from areas with high productivity levels, such as Europe, where needs are higher and more demanding. Producing hydrogen or building up transmission lines produces a significant amount of energy loss that can range between 50%-60%.

A cycle is described in which Boron can store and transport solar energy from a production site. This process would solve the long-range transportation problem and address problems with storage for future use of renewable energies like solar power. We discuss how using boron could help resolve both energy efficiency issues related to transporting materials over long distances while also being environmentally safe at the same time.

This is true for many practical energy-transmission purposes even though the same amount of energy can be taken up, dissociating 5.1 kilograms Boria as 6.7 times smaller mass hydrogen: one kilowatt-day. The Boria could be considered a carrier for demand on stored/received power from an external source transmitted to another device or object such as batteries and appliances in our homes, which also use electrical currents to run them.

Boron power systems promise to provide emission-free energy from smaller reservoirs than hydrogen can, using fireproof substances. Boria's high specific binding energy and the undemanding nature as cargoes of both it and elemental boron means they will convey energy lightly and compactly, even in small shipments.

If successfully demonstrated, boron-powered vehicles would show the ability to run on public roads without depending on special fueling stations since their ash could be sent away by any ordinary freight carrier. Operators could blast boron pellets with propane torch flames and show that they don't burn, demonstrating that fuel-fed fires during accidents were not possible.

The demonstration vehicles could have fuel/ash reservoirs two or more times larger than would be safe on a hydrocarbon-burning vehicle since equal energy would require no more than 1.7 times the size of those in current designs should allow for greater speed and range beyond what

is currently available. Despite the initially high cost of fuels like Borax, there seems to be no reason why a small demonstration fleet wouldn't form the nucleus of a quickly growing group of voluntary early adopters.

Demand by the energy industry

The usage of elements in clean energy technologies is not equal. Wind turbines and electric vehicles account for 7% or 9% (respectively) while permanent magnet generators used in wind turbine only accounts for 37%. One should note that terbium isn't found in traction motors; but instead, it's a necessary element to make them work properly.

Projections regarding future supply of (near) rare earth metals

Following the 2010–2011 rare earth crisis and concerns over China's dominant role in the supply chain, several countries have supported geological exploration and mining projects to diversify supply. Some of these include reopening the Mountain Pass mine in America, which is now open following a two-year shutdown after closing down temporarily from 2002-2012, and opening Mount Weld located on Australia's western border with South Africa.

There are six mines under construction or preproduction, twelve more that are currently at the feasibility stage, while forty-nine total (preferably less) are still being developed. These projects will begin production in the next few years and contribute to a diversification of supply. Although it is impossible to determine which mines will be financially viable, we can make estimates based on technical information from each project.

Chinese companies are increasingly buying up minority shares in foreign rare earth mines, allowing them to obtain information on major developments happening worldwide. Shenghe Resources owns both the Kvanefjeld project and Mountain Pass mine, for example. In the United States, particularly when this has created additional tensions, questions have been asked about whether or not the government should fund technical projects in which information is fed directly to Chinese competitors.

Conclusion

Wind turbines and electric vehicles are just two of many sectors that will need (near) rare earth elements. In the long term, it's unlikely there'll be much change in how frequently they're used compared with other technologies like ICT, healthcare, or defense—but in the short-term, things may be different.

The demand for clean energy technologies should be primarily regulated by market dynamics expected between 3% and 10%, depending on the scenario. However, there's a strong political commitment to these products that may significantly impact the next decade.

While many factors contribute to increasing or decreasing demands of specific sectors, one important consideration is how public policy affects those variables. For example, while it's assumed that markets will naturally regulate demand levels from 2018-2030 by varying rates

ranging between 3%-10%, this number can easily change if certain policies pass through government systems. Additionally, some businesses such as Tesla continue producing good quality products even when their stocks crash because they believe strongly enough in what they're doing.

While the world shifts towards green energy for one reason or the other, it is clear that the future of green energy is heavily reliant on rare earth minerals and their untapped potential in hardware as a means to increase the efficiency of current equipment and as a means to be developed into a clean energy source of its own. The global trade tensions and market fluctuations won't affect scientific progress and will be a safe bet in either case.

The most effective way to balance the market in the short term is by curbing demand. We could do this by promoting innovation and green technologies while working towards climate ambitions at a product level, reducing consumption of rare earth elements and/or substituting more friendly alternatives such as Boron.

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