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REE Mriya Segment - 29 August 2023

1/ The rare earth elements (REE) are a set of seventeen metallic elements that appear on the periodic table that few of us took an interest in at school. These include the fifteen lanthanides on the periodic table plus scandium and yttrium.

Rare earth elements are an essential part of many high-tech devices. Rare earth metals are used in multiple industries, including energy production, medical equipment, military defense systems, smartphones, computers, and electric vehicles. When REE's are used with magnesium alloys, it is a vital element in the making of aircraft engines. You can also use REE's for studio lighting in the film industry and for making permanent magnets.

Rare earth metals have luminescent properties, making them effective in producing fluorescent tubes and LED lights. REEs like yttrium, terbium, and europium can produce different colors in light bulbs, such as red, green, and blue. Due to their luminescent properties, these metals help make LCD screens, from smartphones to large television sets. Lanthanum helps to make approximately half of all digital camera lenses, including those used in smartphones. Its alloys are a key component in the making of batteries for hybrid and electric cars. The rare earth elements in an EV are used in electric car motors rather than batteries. The most used is Neodymium, which is used in powerful magnets for speakers, hard drives, and electric motors. Dysprosium, and other REE's are commonly used as additives in Neodymium magnets.

Other applications of REEs include the making of microphones, headphones, lasers, and a range of commercial and military products including satellites, radar, and sonar. Although using rare earth metals in electronics contributes a small part to the final product, the product can't function without them.

Although the amount of REE used in a product may not be a significant part of that product by weight, value, or volume, the REE can be critical for the device to function. For example, magnets made of REE often represent only a small fraction of the total weight, but without them, the spindle motors and voice coils of desktops and laptops would not be possible.

The U.S. Geological Survey news release "Going Critical" explains: "Rare-earth elements (#REE) are necessary components of more than 200 products - try and google the report for further info on REE's uses and how important they are in your day to day life, without you even knowing about them!

What is the most useful REE? :

The answer is Neodymium. In the light REEs category, neodymium has the highest number of uses. For one, you can use it on mobile phones, medical equipment, and electric cars. It's the best rare metal for making permanent magnets.

Neodymium magnets are strong and highly useful when weight and space are limiting factors. They help make wind turbines and storage devices and hard disk drives. Moreover, you can also use them in automotive systems like audio speakers, power steering, power seats, and electric windows.

2/ Ok, so you know about how important REE's are for hundreds of everyday tech products, and key military equipment from communications devices to planes - who produces them?

The largest rare earth mining companies are from China, Australia, and the United States, owing to these countries generous rare earth mineral reserves and production. In 2023, these three nations collectively contributed over 90% of the global rare earth mineral production and have the highest market capitalization.

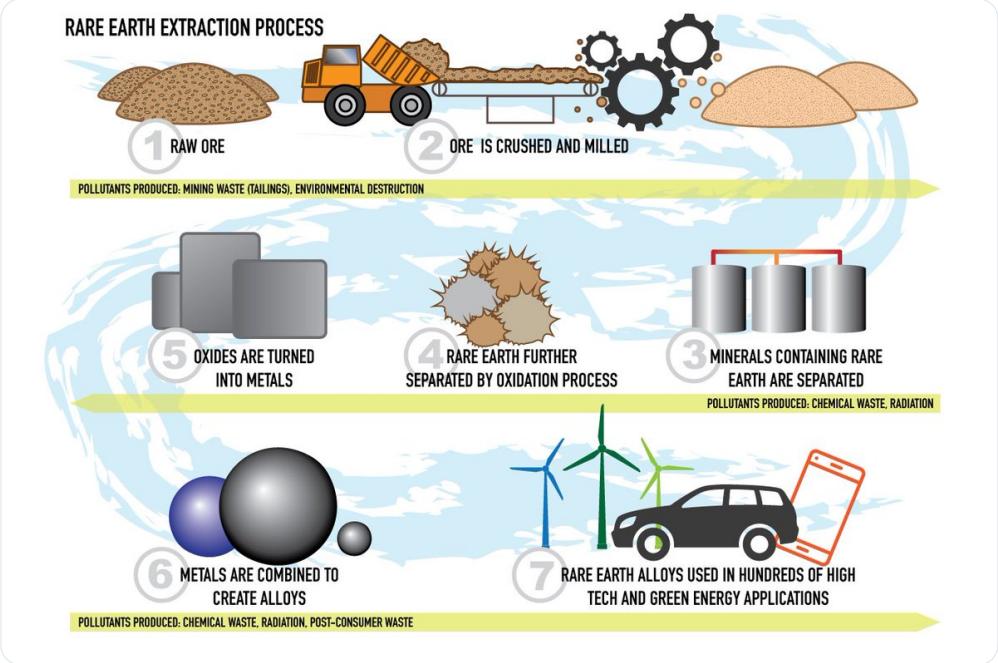
Extracting and producing rare earth elements requires higher capital investment than most traditional mining operations. China's success in this industry thus points to the country's significant advancements to stay independent in the commodity consumption sector. China recognized the strategic value of these elements and invested heavily in building the infrastructure necessary to extract and process them as early as the 1980s. The country's efforts have paid off and put it at the epicenter of REE production as of now.

With a history of aggressive production strategies and mineral wealth, China has maintained a formidable lead in rare earth mining. The country's mining companies capitalize on abundant resources and produce a sizable percentage of the world's mined rare earth metals. China is the largest producer of rare earth minerals and accounts for over 70% of the worldwide output of REEs. The country saw 0.21 million metric tons annual yield of rare earth metals in 2022, and it dominates the market with its expansive mining operations.

Likewise, the advanced mining infrastructure and supportive government policies, have helped Australian mining companies extract and process REEs to meet the world's growing demand.

There are two distinct in the manufacturing of REE's.

Firstly there is the mining and production of REE and secondly there is the processing and refining of REE.



3/ Who exactly are the top producers in this market?

A prominent name in the rare earth metals industry is Australian based Iluka Resources Limited (ASX:), which has a current market cap of $4.976 billion. The company is also building the country's first fully-integrated rare earth refinery at Eneabba.

MP Materials Corp (NYSE:MP) is the largest rare earth mining company in the US that focuses on high-purity neodymium and praseodymium (NdPr) oxide. With a current market cap of $3.854 billion.

Energy Fuels (NYSE:UUUU) is a leading American enterprise that works in uranium mining and has a notable current market cap of $1.01 billion.

NioCorp Developments (NASDAQ:NB) currently boasts a market cap of $202.189 million and is involved in the purification and commercialization of three significant REEs.

Hastings Technology Metals Limited has a market cap of $Au 124 million currently and focuses on extracting neodymium and praseodymium, two critical elements for high-strength permanent magnets and green energy technologies. The Perth-based rare earth company's key asset is the Yangibana Rare Earths Project, which comprises an integrated network of a mining site.

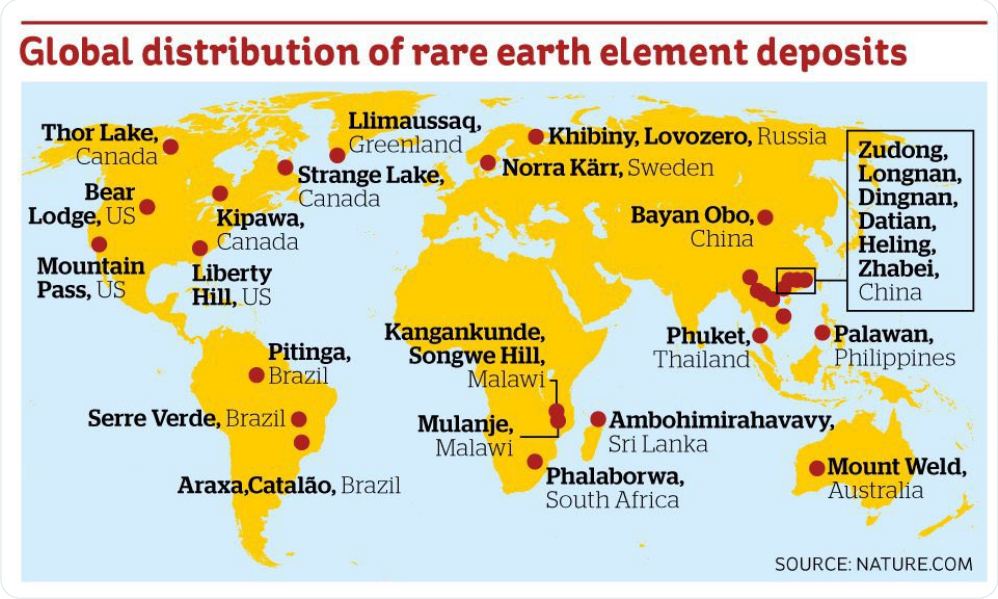
Aclara Resources is amongst the largest rare earth companies in the world, with a current market cap amounting to $66.1 million. This REE mining company is based in Chile.

Rare Elements Resources Ltd one of the largest rare earth companies in the world. It is an American corporation specializing in the mining and provision of rare earth materials. It has experienced significant market valuation growth, with its market capitalization reaching $124 million as of the writing of this article. As a publicly traded entity, the firm's main business scope covers the extraction and refining of rare earth elements.

So far all the quoted capitalisation numbers for western REE companies are in the tens of millions USD. Now I want to talk about the capitalisation of China's largest REE company.

The China Northern Rare Earth Group High-Tech Co. Ltd, is the largest rare earth company in the world that currently boasts a market cap today of 79.6 billion Yuan (or $10.5 Billion), This Chinese company owns the large deposit reserves known located at the Bayan Obo Mining District.

The Bayan Obo Mining District is the world's largest known deposit of REEs, as it's estimated to contain around 100 million metric tons of rare earth reserves.ILU.AX



4/ Global Dynamics of Rare Earth Element Mining

In 1993, 38 percent of world production of REEs was in China, 33 percent was in the United States, 12 percent was in Australia, and five percent each in Malaysia and India. Several other countries, including Brazil, Canada, South Africa, Sri Lanka, and Thailand, made up the remainder.

15 years later in 2008, China accounted for more than 90 percent of world production of REEs, and 18 years later in 2011, China accounted for 97 percent of world production. By the end of 2022, China has a dominant hold on the market—with 60% of global production and 85% of processing capacity.

As China's mine throughput of rare earth minerals accounts for the majority of the world's total production, this heavy reliance on China for REEs raises critical supply chain concerns for the rest of the world. Other nations, mainly the US, are trying to pick up pace in this mining sector. Currently the United States' 78% rare earth imports are from China and there's a rising geopolitical tension between the West and China. In the event of a massive deterioration or even conflict between the US and China, the supply of REE's would end overnight which would have a massive, possible catastrophic impact on the global economy.

Beginning in 1990 and beyond, supplies of REEs became an issue as the Government of China began to change the amount of the REEs that it allows to be produced and exported. The Chinese Government also begun to limit the number of Chinese and Sino-foreign joint-venture companies that could export REEs from China."

In July 2023, China announced that it would impose export restrictions on #gallium and #germanium, these REE's are indispensable in the production of strategically important products such as electric vehicles, microchips and some weapons systems.

It is possibly more of a warning than a full-fledged response to Beijing's restrictions, that the US and its allies have imposed trade restrictions of Chinese imports of advanced microchips?

It was a demonstration of Beijing's control over the supply chain of dozens of materials that Washington has identified as critical to its economic and national security. Control that the dictator and kleptocrat Xi Jinping can use at any time, and this may arguably explain the west's ambivalence to escalate the issue around the Genocide of the #Uyghur and #Tibet populations with over a million held in concentration camps today.

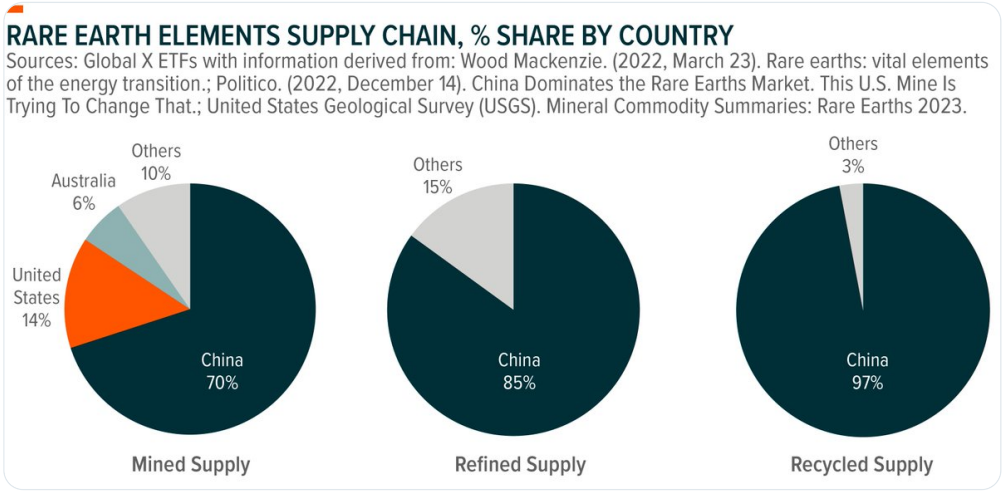
This subject forces the West to face an inconvenient truth:

China is the largest and cheapest supplier of many indispensable materials for "clean technology". The country accounts for about 90% of the production of rare earth elements, at least 80% of all stages of the production of solar panels and 60% of the production of wind turbines and batteries for electric vehicles . And the production of some materials for batteries and more niche products is controlled almost entirely by #China alone.

Lithium is also key ingredient in batteries for electric cars and renewable power storage, making it a critical commodity for the energy transition to reduce emissions of greenhouse gases.

Most of the world's lithium supply is currently produced in Australia and processed in China.

That could change during the next decade though, as new technology such as direct lithium extraction, or DLE, helps ramp up production of this key resource from brine, according to Hugo Nicolaci, an analyst in Goldman Sachs Research.



5/ What are we doing to counter the risk of China's dominance in the REE?

In Europe:
Luleå University of Technology-based LKAB, Sweden's state-owned mining entity, declared the recent identification of an unprecedented volume of rare earths. These rare earth minerals, amounting to 1

million tons, comprise rare earth oxides (REO) concentrated within the remote northern reaches of the Kiruna sector.

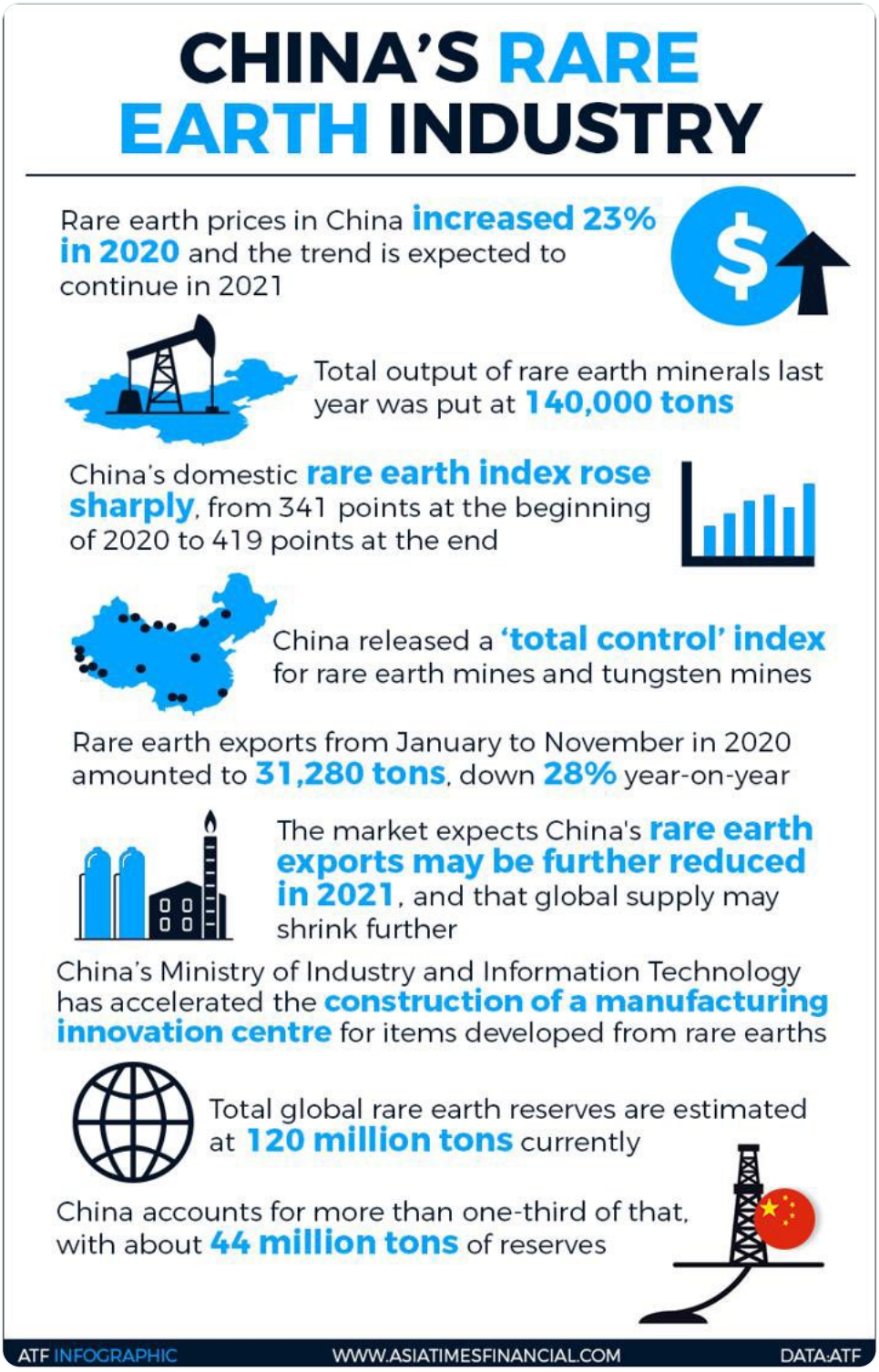
In the US:
Energy fuels in the US is engaged in uranium extraction, a primary ingredient for the production of nuclear energy, and processes it into natural uranium concentrates. Major nuclear utilities use these concentrates as they contribute to the generation of carbon-neutral nuclear energy.

In Canada:
In 2021, on a yearly basis, Canada's exploration budget rose by 62%, followed by 39% in Australia, 37% in the U.S., and 29% in Latin America. The budget for Africa grew only 12%, and the vast majority of exploration continues to be concentrated in gold, rather than rare earths or green metals critical to the clean energy transition.

In South America:
Energy Fuels has recently broadened its international presence with the acquisition of the Bahia Project, a heavy mineral undertaking located in Brazil. The Bahia Project is in relation to a heavy mineral sand deposit which is a rich source of monazite (a phosphate mineral that contains rare earth elements).

The acquisition has the potential to yield between 3,000 and 10,000 metric tons of natural monazite concentrate annually over several decades. As per Energy Fuels, this extracted material will be dispatched to the company's White Mesa Mill located in Utah, where it will undergo further processing to be converted into high-purity rare earth element oxides and other related materials. This strategic move will further Energy Fuels' impact on the supply chain of critical elements for high-tech applications.

Africa:
Africa's full potential in rare earths is largely untapped given low levels of exploration. The mining exploration budget in sub-Saharan Africa is the second lowest in the world—roughly half that of Latin America, Australia, and Canada—despite having triple the surface area of Canada and Australia.



6/ How to maximise the opportunity in Africa:

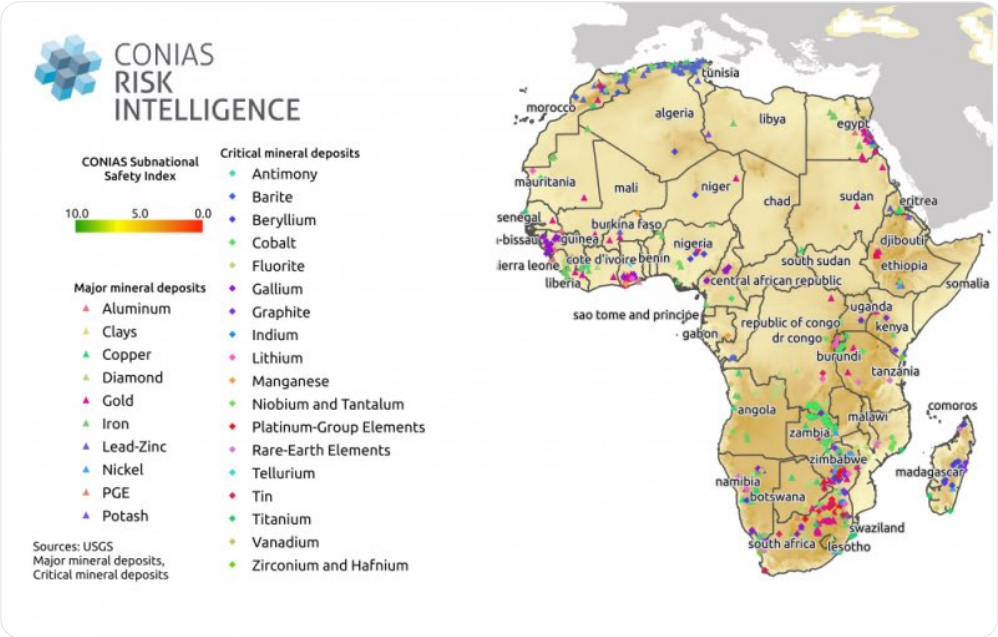
Bookings institute wrote a research paper highlighting the opportunities in Africa. Beyond increasing exploration, there are three ways African countries can maximize the benefits of rare earths for their own economies:

Firstly:
Governments need to strengthen tax policy to maximize revenue collection, while keeping stable fiscal policy to prevent volatilities that can deter investments. For example in 2017, South Africa's mining and quarrying sector accounted for just 1.3% of total revenue collected, compared to its 7.3% of GDP,

partially owing to tax incentives and provision payments. Good governance is required to ensure that these revenues—in the form of production taxes, regulatory taxes, and royalties—are used to reduce reliance on external debt and to finance core socioeconomic objectives. This is particularly important given that Africa may be home to 90% of the world's poor by 2030, as countries have less fiscal space to spend on pro-poor policies.

Secondly:
African countries should leverage the African Continental Free Trade Area to maximize value addition. The process of extraction and value addition is difficult to do within a single country due to the high cost of rare earths separation facilities. The U.S. set aside $156 million for a single facility to extract and separate rare earths—a sum out of reach for most African countries. Yet without continental separation facilities, African countries will export ores and miss out on the benefits of local processing and manufacturing. If implemented effectively, the AfCFTA would enable countries to enhance value addition within the bloc before exporting.

Thirdly:
Africa should use resources strategically to build strong trade partnerships and strengthen its presence in global value chains, particularly with the U.S., EU, and Australia. U.S. Treasury Secretary Janet Yellen has called for "friend-shoring," or building supply chain networks with allies and friendly countries, to reduce exposure to political disruptions. Canada recently invested $162 million to help position Quebec as a center of excellence for critical minerals processing, with the specific intent of building strong global supply chains and strengthening trade relationships with allies. African countries can, as a bloc, forge long-term trade partnerships with these countries who are seeking to build more resilient rare earths value chains.



7/ The relevance of REE to the War in Ukraine - and explain how REE's could be one significant yet unheard of - underlying motivation for the illegal occupation and ongoing war in Ukraine.

For decades, a country's relative energy security was defined almost exclusively by its stock of hydrocarbon reserves, together with its wind, solar, and hydropower generation potential, as well as the physical or commercial ties it maintained with foreign partners to ensure security of supply and to meet domestic energy demand.

As environmental concerns have increased, national governments have begun more methodically steering toward low-emission technologies that could efficiently make use of their countries' natural resource potential. Critical minerals, such as cobalt, titanium, palladium, and various rare earth metals have become seminal for advanced economies pursuing an energy transition away from fossil fuels.

Russia's motivation for invading Ukraine surely encompasses a wide range of strategic, ideological, political, and economic reasons. And while it may not have been a main factor in prompting the full-scale aggression launched on February 24, 2022, one consideration in the Kremlin was likely Ukraine's large reserves of critical metals and their global strategic importance in the decades to come. The cutoff of access to Ukrainian REE resources, combined with the nature of the partnership between Moscow and Beijing — with China being the largest supplier of the necessary critical minerals — may endanger the very notion of the West's energy transition.

Is Russia's aggression in Ukraine also about mineral resources?

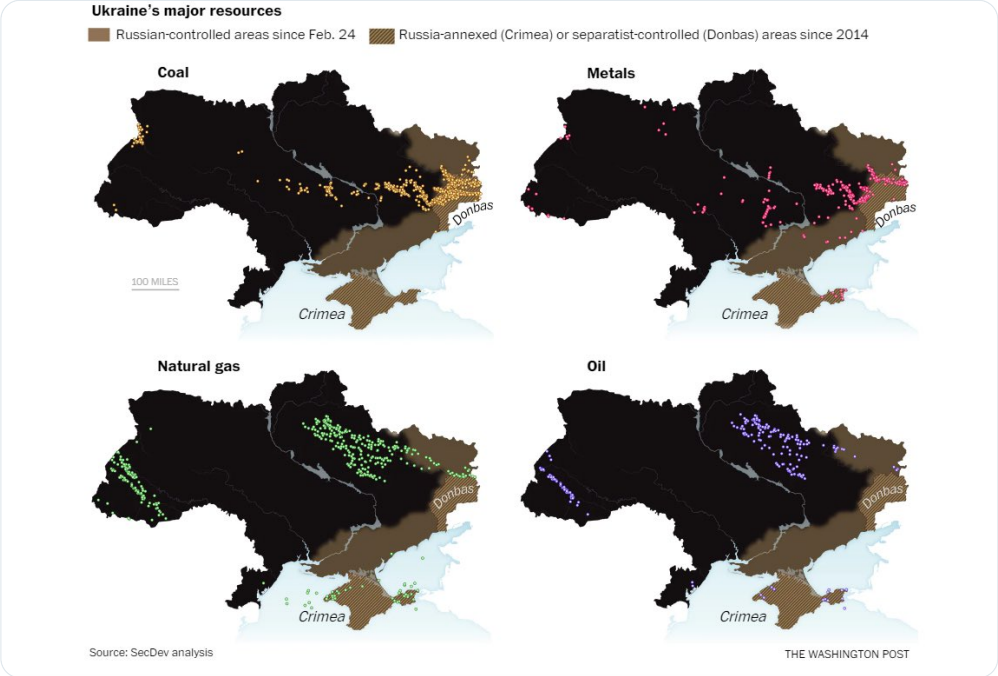
Europe's long-term strategy to phase out fossil fuel use has endangered Russia's main source of state revenue, forcing the Kremlin to focus on acquiring, one way or another, a new, future-proof high-value export — critical minerals.

Despite benefiting from the fourth-largest rare earth metals reserves in the world, Russia has always struggled to scale its output in this sector. Although the country is a major global supplier of palladium, scandium, and titanium, as well as an important seller of nickel and cobalt, it was not perceived as one of the main players in global markets, dominated first and foremost by China. In 2020, the Kremlin pledged the equivalent of $1.5 billion of investments in rare earth metals, in an attempt to become the second-largest producer after China, by 2030. But the fruits of this initiative are yet to materialize.

Ukraine, in turn, is also among the most richly endowed European countries when it comes to rare earth metals and lithium reserves, with estimates of the value of these deposits ranging from $3 trillion-$11.5 trillion. In 2021, the European Union signed a strategic partnership on raw materials with Ukraine, which generated a surge in interest from private companies. Given Ukraine's vast mineral resources, combined with Russia's own ambitions to bolster its market influence over this space, some experts have questioned to what degree Russia's current aggression against its southwestern neighbor may have been driven by a desire to lay claim to those Ukrainian reserves.

In this context, Russia's incursions into the southern and eastern regions of Ukraine may not be motivated solely by military calculations, considering that most of Ukraine's critical materials reserves are located there. Similar reasons were likely at least partly behind the annexation of Crimea in 2014, when Russian military actions also notably targeted Ukrainian natural gas reserves off the coast of the peninsula (totaling up to 13 trillion cubic meters).

The Kremlin's control over these critical mineral reserves would be a game-changer, allowing Russia to increase its influence over multiple facets of Western countries' energy security spectrum. However, controlling these reserves is not synonymous with their immediate commercialization, as the extraction and refining processes are no simple tasks.



8/ Expected evolution of rare earth metals markets

With Europe and the United States transitioning to a low-carbon economy, thus necessitating a speedy adoption of clean energy technologies and reducing their dependence on Russian hydrocarbon exports, the demand for critical and rare earth metals will continue to rise. Consequently, while trying to decrease their reliance on one dominant supplier of energy commodities (Russia), Western societies are inevitably tying, at least to some extent, their longer-term economic development to another one (China), possibly and inadvertently establishing an even more dangerous partnership for critical and rare earth minerals. Moreover, Moscow and Beijing's formal (and especially informal) partnership might additionally exacerbate those trends.

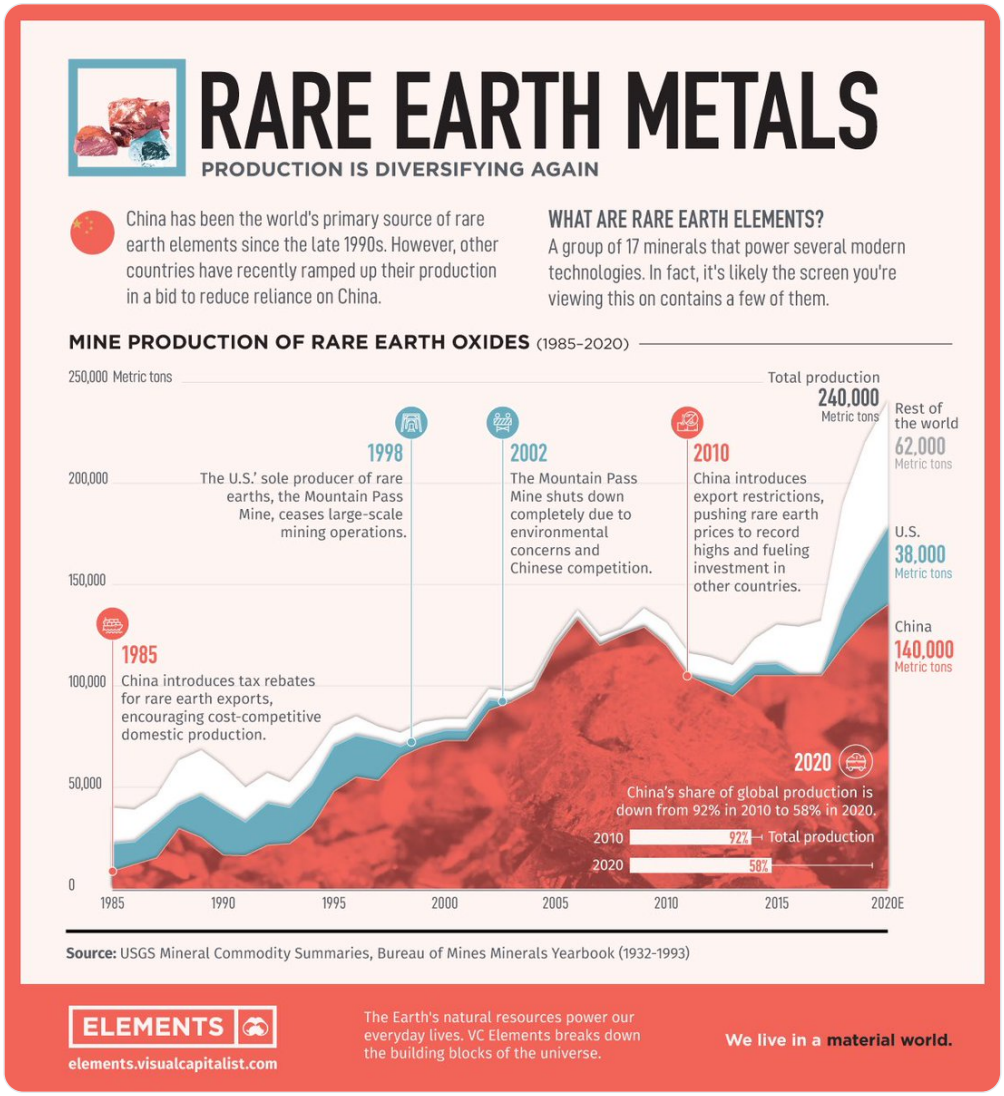
Apart from the drivers that generated higher prices in 2021, the current context could create further bullish factors. In a scenario whereby Russia gains control and, eventually, makes use of Ukraine's critical minerals, Western economic sanctions would consequently apply to these resources too, sustaining and potentially even increasing their prices on the global wholesale markets.

The alternative for the West — developing new mining and processing facilities in Australia, Europe, and the United States — will take time and financial resources, thus slowing down the energy transition process. However, some options are currently being explored.

The European Union recently issued its "2022 Strategic Foresight Report: twinning the green and digital transitions in the new geopolitical context," which also aims, in the medium and long term, to unlock "sustainable access to raw materials." But while some European countries have started exploring these new mineral exploitations options, environmental protests have surged, notably in Spain or Serbia. In contrast, the Norwegian Bjerkreim Exploration Project — which seeks to access one of the largest estimated global deposits of vanadium, titanium, and phosphate — apparently enjoys greater public support.

Additionally, Turkey claims to have discovered the world's second-largest reserves of rare earth metals (up to 694 million tons). According to Fatih Dönmez, Ankara's minister of energy and natural resources, 10 types of rare earth metals (out of 17, in total) will be processed from the central Anatolia region, at

an annual rate of 570,000 tons of ore. He estimated that about 10,000 tons of rare earth oxide will be obtained from the ore processing, together with an additional 72,000 tons of baryte, 70,000 tons of fluorite, and 250 tons of thorium. A pilot plant that will begin by processing 1,200 tons of minerals annually is expected to be completed by the end of this year.



9/ Summary:

REE is a critical factor in the War in Ukraine. It is important to know about the current dominance of China in the market which presents global markets with a single point of failure, in which China could shut the worlds economy down overnight by restricting the supply of REE's.

REE is a critical factor in China and Russia's expansion into Africa, securing mineral extraction rights and concessions - Africa possibly being the largest untapped source of REE's on the planet.

REE is arguably a key underlying factor and motivation for Russia's land grabs across Ukraine, with a substantial identified deposits falling into the areas occupied and claimed by Russia, with Russia desperate to secure their economic future through energy source transition.

REE is a critical component in almost all new technology and you are enjoying the benefits of REE using a smart phone, driving an new EV, using any computer, our military forces technology is

dependent on the REE materials and the risk to the world is greater than it has ever been, with the looming conflicts across all territories that are the worlds reserves of REE.

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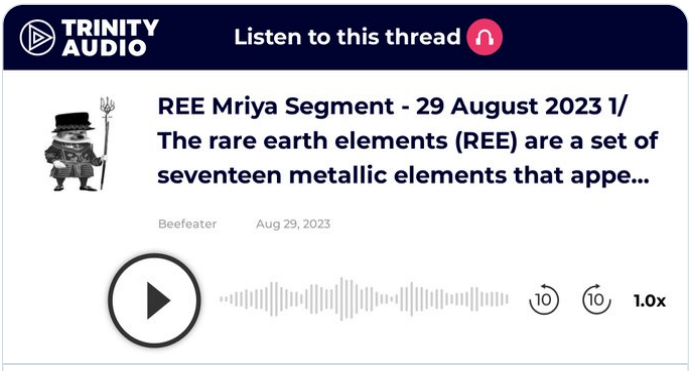

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