Rare Earth Elements and Critical Minerals: The Future is Now

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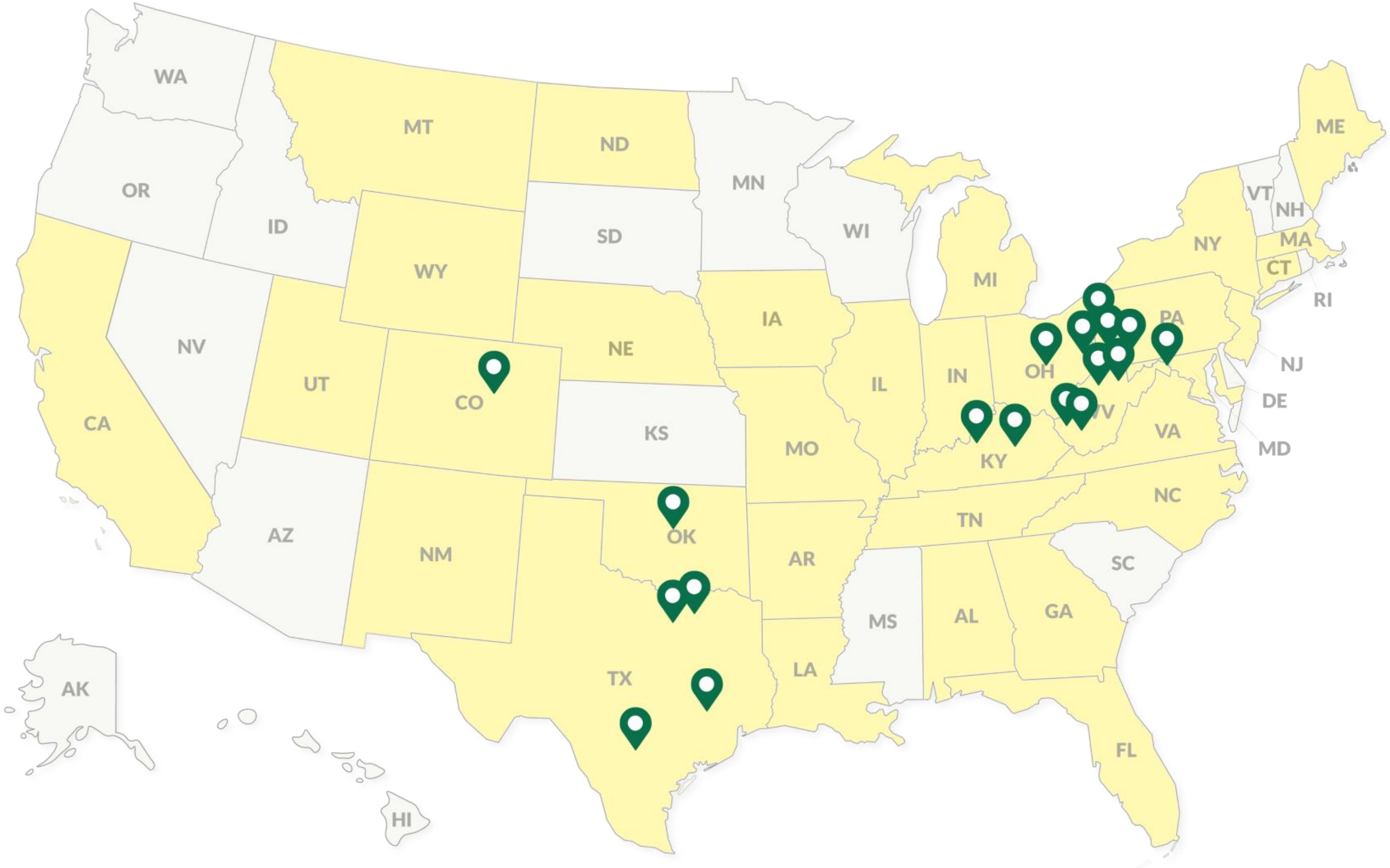

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What are Critical Minerals?

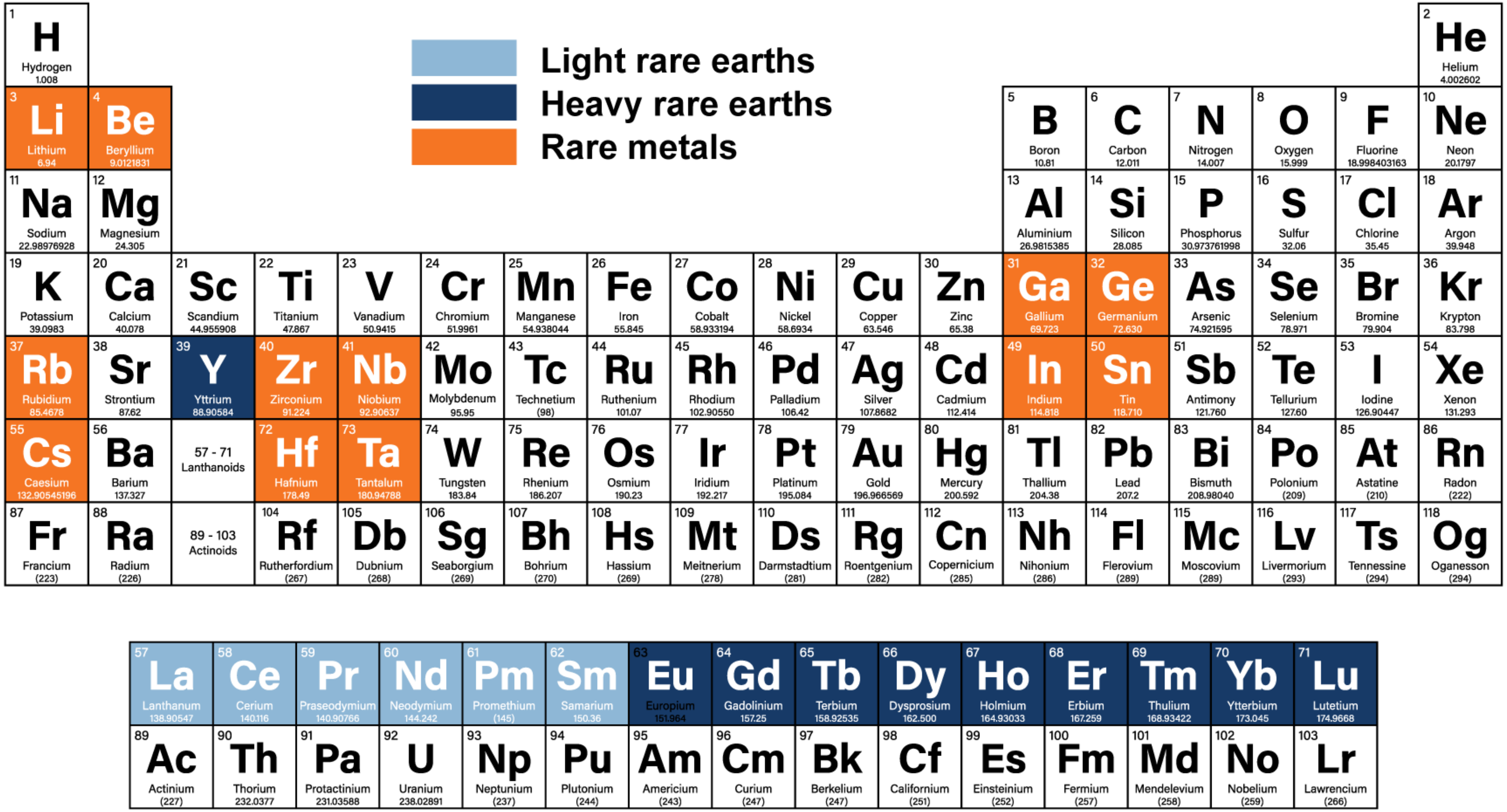
- The Energy Act of 2020, Section 7002, subsection 2, requires the critical minerals list to be revised every three years by the Department of Interior, through the US Geological Survey. The most recent final list is that of 2022.
- These minerals are deemed critical minerals by the US government in light of their role in national security or economic development and face considerable supply chain vulnerabilities. There must be a clear supply chain strategy as they are mostly imported and are, under the US definition, prone to supply chain disruption.
- Additionally, fuel minerals are excluded from the list of critical minerals.

Under the 2022 List, There are 50 Minerals Deemed Critical:

Aluminum	Dysprosium	Indium	Palladium	Terbium
Antimony	Erbium	Iridium	Platinum	Thulium
Arsenic	Europium	Lanthanum	Praseodymium	Tin
Barite	Fluorspar	Lithium	Rhodium	Titanium
Beryllium	Gadolinium	Lutetium	Rubidium	Tungsten
Bismuth	Gallium	Magnesium	Ruthenium	Vanadium
Cerium	Germanium	Manganese	Samarium	Ytterbium
Cesium	Graphite	Neodymium	Scandium	Yttrium
Chromium	Hafnium	Nickel	Tantalum	Zinc
Cobalt	Holmium	Niobium	Tellurium	Zirconium

What are Rare Earth Elements?

- Rare earths are a basket of 17 naturally occurring elements located in the Earth's crust, comprised of 15 elements in the lanthanide series, plus yttrium and scandium. Other than scandium, all rare earths can be divided into "heavy" and "light" categories based on their atomic weight.
- Heavy rare earths are generally more sought after for use in defense and medical applications and used in electric vehicles and windmills.
- Rare earth metals play a significant role in various technologies. They are often used in electronics such as laptops and smartphones. Rare earth elements such as neodymium and praseodymium are used in magnets, aircraft engines, and green technologies, including wind turbines and electric vehicles. Samarium and dysprosium are also used in rare earth magnets. Phosphor rare earths such as europium, terbium, and yttrium are used in lighting, as are cerium, lanthanum, and gadolinium.
- Global rare earth element reserves amount to 130 million MT. In 2022, global rare earth element production was 300,000 MT. That is an increase from 200,000 MT in 2019. China produced 210,000 of the 300,000 MT produced in 2022.


Light rare earths
Heavy rare earths
Rare metals
1 H Hydrogen 1.008
2 He Helium 4.002602
3 Li Lithium 6.94
4 Be Beryllium 9.0121831
5 B Boron 10.81
6 C Carbon 12.011
7 N Nitrogen 14.007
8 O Oxygen 15.999
9 F Fluorine 18.998403163
10 Ne Neon 20.1797
11 Na Sodium 22.98976928
12 Mg Magnesium 24.305
13 Al Aluminium 26.9815385
14 Si Silicon 28.085
15 P Phosphorus 30.973761998
16 S Sulfur 32.06
17 Cl Chlorine 35.45
18 Ar Argon 39.948
19 K Potassium 39.0983
20 Ca Calcium 40.078
21 Sc Scandium 44.955908
22 Ti Titanium 47.867
23 V Vanadium 50.9415
24 Cr Chromium 51.9961
25 Mn Manganese 54.938044
26 Fe Iron 55.845
27 Co Cobalt 58.933194
28 Ni Nickel 58.6934
29 Cu Copper 63.546
30 Zn Zinc 65.38
31 Ga Gallium 69.723
32 Ge Germanium 72.630
33 As Arsenic 74.921595
34 Se Selenium 78.971
35 Br Bromine 79.904
36 Kr Krypton 83.798
37 Rb Rubidium 85.4678
38 Sr Strontium 87.62
39 Y Yttrium 88.90584
40 Zr Zirconium 91.224
41 Nb Niobium 92.90637
42 Mo Molybdenum 95.95
43 Tc Technetium (98)
44 Ru Ruthenium 101.07
45 Rh Rhodium 102.90550
46 Pd Palladium 106.42
47 Ag Silver 107.8682
48 Cd Cadmium 112.414
49 In Indium 114.818
50 Sn Tin 118.710
51 Sb Antimony 121.760
52 Te Tellurium 127.60
53 I Iodine 126.90447
54 Xe Xenon 131.293
55 Cs Caesium 132.90545196
56 Ba Barium 137.327
57 - 71 Lanthanoids
72 Hf Hafnium 178.49
73 Ta Tantalum 180.94788
74 W Tungsten 183.84
75 Re Rhenium 186.207
76 Os Osmium 190.23
77 Ir Iridium 192.217
78 Pt Platinum 195.084
79 Au Gold 196.966569
80 Hg Mercury 200.592
81 Tl Thallium 204.38
82 Pb Lead 207.2
83 Bi Bismuth 208.98040
84 Po Polonium (209)
85 At Astatine (210)
86 Rn Radon (222)
87 Fr Francium (223)
88 Ra Radium (226)
89 - 103 Actinoids
104 Rf Rutherfordium (267)
105 Db Dubnium (268)
106 Sg Seaborgium (269)
107 Bh Bohrium (270)
108 Hs Hassium (269)
109 Mt Meitnerium (278)
110 Ds Darmstadtium (281)
111 Rg Roentgenium (282)
112 Cn Copernicium (285)
113 Nh Nihonium (286)
114 Fl Flerovium (289)
115 Mc Moscovium (289)
116 Lv Livermorium (293)
117 Ts Tennessine (294)
118 Og Oganesson (294)
57 La Lanthanum 138.90547
58 Ce Cerium 140.116
59 Pr Praseodymium 140.90766
60 Nd Neodymium 144.242
61 Pm Promethium (145)
62 Sm Samarium 150.36
63 Eu Europium 151.964
64 Gd Gadolinium 157.25
65 Tb Terbium 158.92535
66 Dy Dysprosium 162.500
67 Ho Holmium 164.93033
68 Er Erbium 167.259
69 Tm Thulium 168.93422
70 Yb Ytterbium 173.045
71 Lu Lutetium 174.9668
89 Ac Actinium (227)
90 Th Thorium 232.0377
91 Pa Protactinium 231.03588
92 U Uranium 238.02891
93 Np Neptunium (237)
94 Pu Plutonium (244)
95 Am Americium (243)
96 Cm Curium (247)
97 Bk Berkelium (247)
98 Cf Californium (251)
99 Es Einsteinium (252)
100 Fm Fermium (257)
101 Md Mendelevium (258)
102 No Nobelium (259)
103 Lr Lawrencium (266)

Rare Earth Element (Periodic Symbol)	Major Applications
Praseodymium (Pr)	NdPr Magnets (Evs), battery alloys, auto catalysts, polishing powders
Neodymium (Nd)	NdPr Magnets(Evs), battery alloys, auto catalysts, polishing powders
Terbium (Tb)	Defense applications; magnets used in high temperature applications
Dysprosium (Dy)	Defense applications; magnets used in high temperature applications
Samarium (Sm)	Samarium Cobalt batteries, ceramics, radiation treatment
Europium (Eu)	Phosphors, defense and commercial optics, flat panel displays
Lanthanum (La)	Battery alloys, auto catalysts, petroleum refining, glass additives, ceramics
Cerium (Ce)	Battery alloys, auto catalysts, petroleum refining, glass additives, ceramics
Gandolinium (Gd)	Ceramics, nuclear energy, fiber optic communications, glass coloring
Holium (Ho)	Nuclear energy, microwave equipment, permanent magnets
Erbium (Er)	Nuclear energy, fiber optic communications, glass coloring
Promethium (Pm)	Nuclear batteries, luminous paint
Thulium (TM)	X-rays and lasers
Ytterbium (Yb)	Cancer treatment, decoy flares, infrared lasers
Lutetium (Lu)	Age determination, medical uses, petroleum refining
Yttrium (Y)	Defense applications, battery alloys, metal alloys, ceramics
Scandium (Sc)	3D printing, high intensity lighting, alloys, solid state energy storage

MAGNETICS

- Computer Hard Drives
- Disk Drive Motors
- Anti-Lock Brakes
- Automotive Parts
- Frictionless Bearings
- Magnetic Refrigeration
- Microwave Power Tubes
- Power Generation
- Microphones & Speakers
- Communication Systems
- MRI

Nd Tb Dy Pr

DEFENSE

- Satellite Communications
- Guidance Systems
- Aircarft Structures
- Fly-by-Wire
- Smart Missiles

Nd Eu Tb Dy Y Lu Sm Pr La

CERAMICS

- Capacitors
- Sensors
- Colorants
- Scintillators
- Refractories

Nd Y Eu Dy Lu Gd La Ce Pr

CATALYSTS

- Petroleum Refining
- Catalytic Converter
- Fuel Additives
- Chemical Processing
- Air Pollution Controls

Nd La Ce Pr

METAL ALLOYS

- NiMH Batteries
- Fuel Cells
- Steel
- Super Alloys
- Aluminum/Magnesium

Nd Y La Ce Pr

PHOSPHORS

- Display phosphors- CRT,LPD,LCD
- Fluorescents
- Medical Imaging
- Lasers
- Fiber Optics

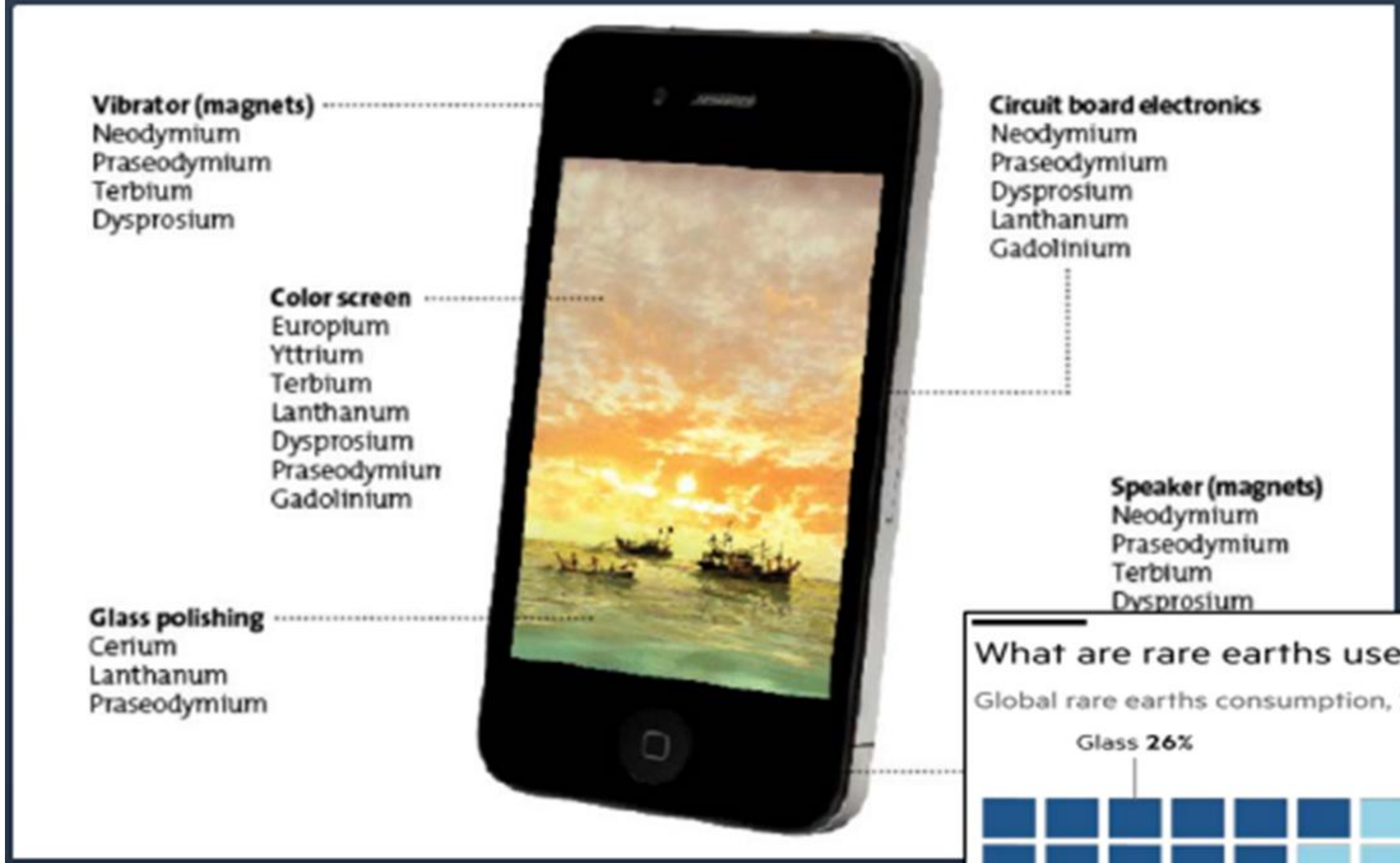
Nd Eu Tb Y Er Gd Ce Pr

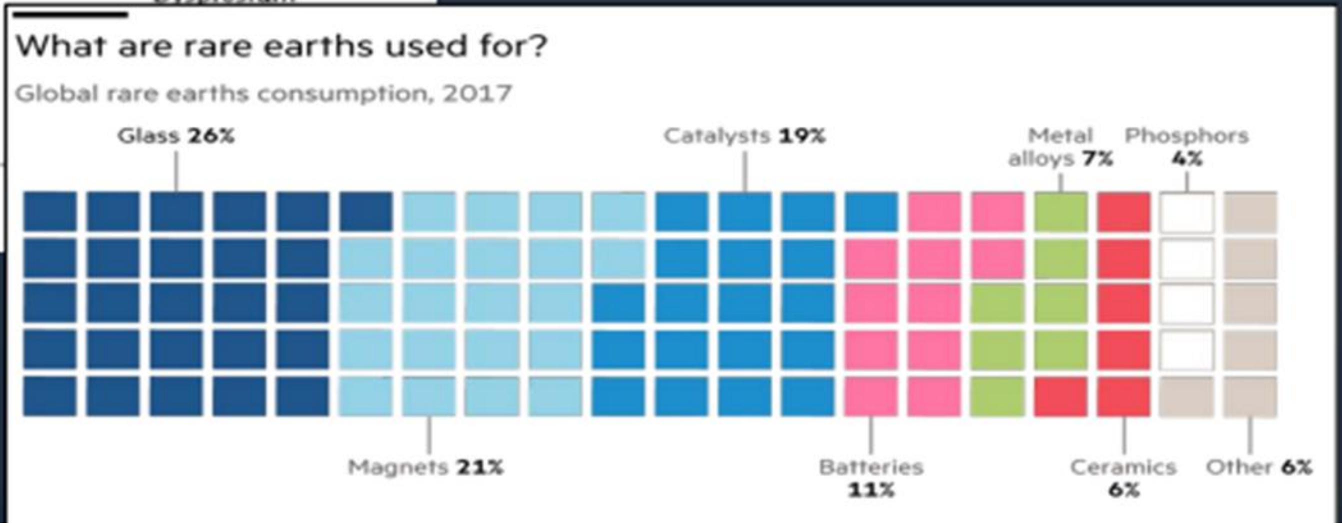
GLASS & POLISHING

- Polishing Compounds
- Pigments & Coatings
- UV Resistant Glass
- Photo-Optical Glass
- X-Ray Imaging

Nd Gd Er Ho La Ce Pr

Cellphones each contain ~$15 of REEs. Electronic equipment imports into US are ~15% of REE total or +$400 B. Cell phones are ~33% of that total.





How Are Rare Earth Elements Mined?

- Rare earth elements are either mined from open pits, like many other metals and minerals, or they are mined through in-situ leaching.
- The metals are found in hard-rock deposits, ionic clay deposits, and mineral sands.
- Some minerals that are mined for rare earths are bastnäsite, monazite, loparite and xenotime.
- The open-pit mining process for rare earths is similar to that of other minerals: hard rock is mined, ore is separated from tailings, and then it is refined.
- In in-situ leaching, which is also a common method of mining uranium, miners pump a chemical solution into an orebody. The solution dissolves the targeted materials into a brine that is then pumped back out of the ore and into collection pools.
- Rare earths mining also has a final step, which is the separation of the different rare earths from each other. However, because the rare earth elements all have similar chemical behavior to each other, they are very difficult to separate, particularly, when separating lights from heavies.

How Dominant is China in the Rare Earths Supply Chain?

- Mining: China accounted for 70% of world mine production of rare earths in 2022, followed by the United States, Australia, Myanmar and Thailand, United States Geological Survey (USGS) data shows.
- Processing: China is home to at least 85% of the world's capacity to process rare earth ores into material manufacturers can use, according to research firm Adamas Intelligence in 2019.
- China is estimated to have 44 million metric tonnes of rare earth oxide (ROE) equivalent in reserves, or 34% of the world total, USGS data showed.
- Vietnam, Russia, and Brazil are estimated to have just over 20 million metric tonnes each, while India has 6.9 million, Australia has 4.2 million and the United States has 2.3 million metric tonnes.
- In July, China imposed export restrictions on gallium and germanium products used in computer chips and other components to protect its national security interests. (Reuters)
  - The decision, widely seen as retaliation for U.S. curbs on sales of technologies to China, raised concerns that China might eventually limit exports of other materials, notably rare earths, whose production China dominates.

From Big Oil to the Big Shovel!

- The shift to the "Big Shovel," is a phrase used by Daniel Yergin, an energy and geopolitics expert, to describe the mining boom that will power the shift from a fuel-intensive energy system to a critical minerals-intensive one.
- Yergin highlights that over the last few years, wind and sun may be seen as free, but the materials that go into renewables are not.
- Offshore wind requires cement and metal. A wind turbine requires lubrication, which is an oil product. An electric car is 20% plastic and has 2.5 times more copper than a car with an internal combustion engine.
- To get to a green energy economy, a lot more mining needs to be done.
- One estimate is that for a 1,000-pound electric vehicle battery, you have to move 500,000 pounds of earth. That's a lot of shoveling to do. Think big shovels.

The Engineering Education Problem

- There are 14 Accredited Mining and Mineral Engineering Degree Programs in the United States, which is down from 25 in 1982.
  - China has 38 mineral processing schools and 44 mining engineering programs.
- Since 2018, there has been a 39% decrease in mining and mineral engineering degrees awarded in the United States.
- In 2021, there were 314 Mining and Mineral Engineering degrees awarded. Beginning in 2024, it is estimated that the industry will need 500 new mining and mineral engineers PER YEAR through 2031 to meet the increasing demand and to replace retiring engineers.

The Supply Chain Problem

- Currently, more than 80% of our nation's supply of critical minerals comes from foreign sources.
- The United States currently imports more than half its consumption of 43 of the 50 most critical minerals and metals, with no domestic production for at least 14 of these critical minerals.
- Over the next years and certainly by 2035, the International Energy Agency estimates that lithium demand will increase 4,300 percent.
- Cobalt and nickel demand will both increase by 2500 percent.
- Copper production will have to double by the middle of 2035 in order to meet the goals set for 2050! Think California's EV mandate that by the mid–2030s all cars sold in the state must be EVs—this means that each vehicle sold in California will require 2.5 times more copper than a combustion car.
- Where are these critical minerals going to come from?
- Unfortunately, China dominates the new mineral supply chains.
- 60% of cobalt comes from the Democratic Republic of Congo—think China's Belt and Road Initiative.
- 80% of lithium-ion batteries and 80% of solar panels come from China or are made from products processed in China.

The Supply Chain Problem (continued)

- So, what is the solution for the future? Opening new mines in the United States.
- By developing a strong domestic supply of critical minerals, we will:
  - Reduce U.S. dependence on other countries
  - Create high-wage American manufacturing jobs
  - Support communities across the country that have long depended on mining and energy production
  - Build responsible critical material supply chains as opposed to depending on countries that do not have the stringent environmental, health, and working condition requirements that the U.S. has.
- Due to long and complicated lead times for permitting and development, it typically takes 15-20 years or more to bring a major new mine into operation. This means that if you started January 1, 2020, you may have a new mine open by 2035, and this is just for mining. Separation, beneficiation, and processing take even longer. This has to change!
- This is a constraint to the energy transition that doesn't seem to be fully recognized or at least *seriously* addressed.

Government Incentives

- Department of Energy and Department of Defense are primary federal agencies in the facilitation of REE development
- Bipartisan Infrastructure Law is the general appropriating legislation with identified priority of the manufacture of permanent magnetics through the "Mine to Magnet Supply Chain Goals"
- <u>Qualifying Advanced Energy Project Credit (48C) Program</u>
    - Established by the American Recovery and Reinvestment Act of 2009 and renewed and expanded under the Inflation Reduction Act of 2022
    - Tax credit for investments in advanced energy projects including Critical Materials Projects
    - Collaborative project between DOD and IRS in partnership with DOE
    - Inflation Reduction Act provided $10 Billion in funding to the Program (IRS allocated approximately $4 Billion for 48C credits on March 29, 2024
    - Critical Mineral Projects: A qualifying advanced energy project in this category re-equips, expands, or establishes an industrial facility for the processing, refining or recycling of critical minerals (as defined in § 7002(a) of the Energy Act of 2020 (30 U.S.C. § 1606(a))
- <u>Rare Earth Security Activities Program</u>
    - Program provided by Department of Energy Office of Fossil Energy and Carbon Management
    - Infrastructure law provides for funding in the amount of $156mm for industry partners and academic institutions.
    - Prime recipients and sub-recipients must be domestic and operating in the US.
    - Eligible Uses of Funding include:
        - Development and assessment of advanced separation technologies for the extraction and recovery of rare earth elements and other critical materials from coal and coal byproducts
        - Determine if there are any potential environmental or public health impacts that could arise from the recovery of rare earth elements from coal-based resources

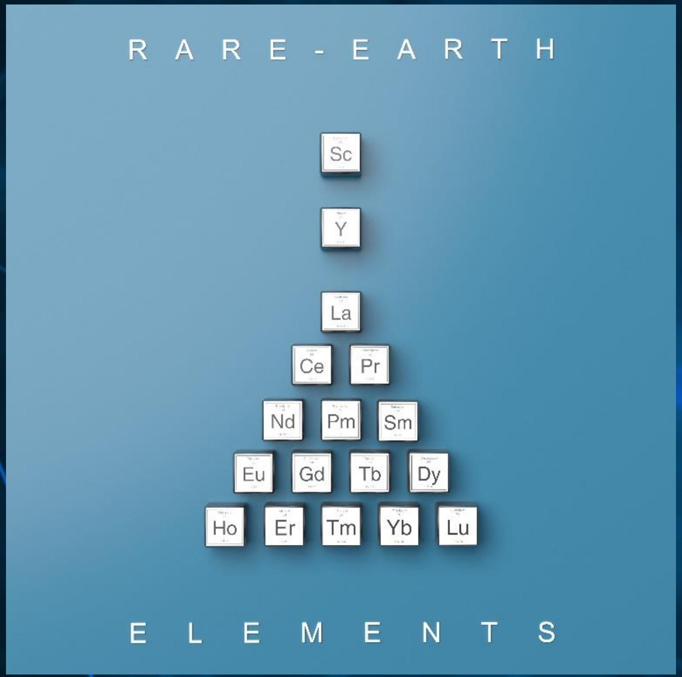
Government Incentives (continued)

- **DOE Funding Efforts**
  - Tetra Tech Inc.; $6.7mm total funding - complete a Front-End Engineering and Design (“FEED”) study for a demonstration-scale rare earth metal and critical minerals production plant for coal-based resources located in Clearfield County, Pennsylvania. The project is a modular rare earth metal, alumina, and lithium carbonate production plant. It will process claystone exposed during surface mining of metallurgical coal for steel production.
  - Winner Water Services, Inc.; $9.9mm total funding – complete a FEED to establish a proof-of-concept commercial-scale plant design for implementing the company’s technology to recover rare earth elements from coal ash at a power plant in Milledgeville, Georgia.
  - University of Illinois at Urbana-Champaign; $5mm total funding - perform a FEED study needed to establish a fully integrated, vertical supply chain for several critical minerals found entirely within Illinois. The objective is to produce lithium, scandium, neodymium and praseodymium, high-purity dysprosium, as well as other rare earth oxides, nickel, zinc, cobalt, manganese, and potentially high-purity aluminum. The project envisions three key facilities: (1) an extraction facility in Marissa, Illinois, at the Prairie State Energy Campus (a combination coal mine and coal-fired power plant complex); (2) a concentration and production plant to be located nearby to produce mixed rare earth oxides, scandium, and other critical minerals; and (3) a purification and refining facility in Urbana, Illinois, to refine individual rare earth oxides and metals (via electrowinning and metallothermic reduction) from the mixed rare earth oxides.

Government Incentives (continued)

- **<u>DOD Funding Efforts</u>**
  - The Manufacturing Capability Expansion and Investment Program (MCEIP), through DOD, has embarked on a five-year rare earth investment strategy to build "mine-to-magnet" domestic capacity at all critical nodes of the rare earth supply chain. Those critical nodes include sourcing, separation, processing, metallization, alloying, and magnet manufacturing. The first of those critical nodes, the sourcing of rare earth elements, means mining rare earth elements out of the ground.
    - DOD has invested over $400mm in enhancing America’s rare earth supply chain resiliency as part of commitment to expanding domestic REE processing capabilities and capacity (public-private partnerships).
    - <u>MP Minerals</u> (Mountain Pass Mine- California); $35mm funding from MCEIP – Establish only integrated REE mine and oxide production facility in U.S., to include a commercial scale processing facility for HREE’s.
      - MP Minerals also awarded $58.5mm to advance U.S. Rare Earth Magnet Manufacturing facility (Texas). Tax credit allocation issued by IRS and Treasury following competitive process.
    - <u>Lynus USA, LLC</u>; $288mm funding from MCEIP – Construct and operate a manufacturing plant in Texas to process heavy REEs to ensure a reliable supply of rare earth minerals and strengthen the downstream supply chains, including for the defense and industrial base of the nation.
    - <u>Noveon Magnetics</u>; $28.2mm funding from MCEIP – Incentive for company to produce qualified magnetics from extracted or recycled material for both defense and commercial applications (Texas).
    - <u>E-VAC Magnetics</u>; $94.1mm funding – Establish a commercial-scale rare earth magnet manufacturing capability by 2025. Will also develop domestic capacity to produce rare earth metals and alloys, a critical node of the supply chain linking early-stage rare earth processing to magnet production.

Rare Earth Elements: Emerging Challenges and Opportunities



The Future of Rare Earth Elements

- Rare Earth Elements (REEs) and unique property characteristics
- REE trends and technological innovations
- REE ownership and property rights
- Emerging legal issues and considerations

Mountain Pass REE Mine, CA, 2018

Key Takeaways

- 2002 closure due to environmental concerns and increasing competition from China suppliers
- Currently, a domestic operating REE mine in the U.S.
  - Owned by MP Materials (*MP*) and has undergone significant modernization since reopening in 2017
  - Key Points:
    - Production & Processing: MP is working on establishing a complete domestic supply chain, a process that began in 2023
    - Environmental Impact: MP aims to create a more environmentally friendly supply chain to significantly reduce pollution and promote clean energy
    - Future Developments: MP is also constructing a magnetics factory in Fort Worth, Texas, to enhance U.S. domestic production of REEs
  - Mine plays a vital role in reducing U.S. dependence on foreign REE suppliers and supporting the growth of domestic renewable energy technologies

Key Takeaways

- Mountain Pass Mine is operational
- The *rare earth oxide* is still sent to China for processing, although developing plans for processing in the U.S. in the future
- MP bought assets in 2017
- Push to reactivate U.S. production as part of the Trump administration's focus on REEs
- MP is owned by SPAC (*comprised of JHL Financial and QVT Group*). Notably, China's Shenghe Resources Holding Co LTD owns 9.9% of MP
- Produced approximately 26,000 tons of REE concentrates in 2019

Round Top Rare Earth and Critical Minerals Project

Round Top Mountain, Texas

- USA Rare Earth Inc. / Texas Mineral Resources Corp joint venture
- TMRC holds leases from the State of Texas covering ~950 acres
  - Secured prospecting permits on adjacent areas (~9,000 acres)
  - USA Rare Earth – 80% stake in the project
- The leased lands are located entirely on State lands, avoiding complications with certain federal agencies
- Believed to contain large REE deposits and lithium and other critical minerals essential for clean energy

Rare Earth Elements Unique Properties

- REEs-collective term for a group of seventeen (17) chemical elements found on the periodic table
- REE group exhibits a diverse range of properties and applications consisting of metal and nonmetal components
  - Sometimes referred to as "*rare earth oxides*" because they are commonly sold and traded as oxide compounds used in the production of magnets, catalysts, and other advanced materials
  - Such compounds are essential for various applications, including electronics, magnets, and other energy-related technologies

REE Characteristics

- Rare earths are **silver, silvery-white, or gray metals**
- They have a high luster
- The metals have high electrical conductivity
- Rare earths have unusual **magnetic, luminescent, and electrical** properties
- Five of the elements (La, Ce, Pr, Nd, Eu) are reactive and, when exposed to air, react with oxygen to form an oxide coating that tarnishes the surface

Geological Formation

- REEs are formed in the Earth's crust and occur naturally as part of the geological process
    - These elements are generally found in minerals and ores
- Despite the name, REEs are not actually *rare* or *scarce*
    - "***Rare***" in the sense that these elements, although widely distributed in the Earth's crust, rarely accumulate in significant quantities or amounts and are often found spread thinly through the Earth's crust
    - Due to such low natural concentrations and often mixed with other elements, mining, extracting, refining and separating processes can be complex and costly

REE Uses and Applications

- REEs diverse features play a pivotal role in shaping a clean energy future and advancing technology
- Uses and applications include:
  - Electric and hybrid vehicles
    - Batteries
    - Magnets
    - Motors
  - Electronics
    - Smartphones
    - Laptops and similar devices
  - Defense systems
    - Radar systems
    - Lasers
    - Guidance systems
    - National security application

REE Projects and Development

- U.S. Department of Energy (*DOE*) announced funding up to $30 million targeted to reduce costs and environmental impacts regarding the production of REEs and other critical minerals from coal, coal wastes, and byproducts
- **Goal**: Meet the growing demand for REEs and reduce reliance on foreign supply chains

Pilot Projects and Research

- Various pilot programs are in progress in Wyoming, West Virginia, North Dakota, Utah, and Kentucky
- Funding and research aimed to develop and assess advanced separation technologies for the extraction, processing, and recovery of REEs and other critical minerals from coal and coal byproducts
    - *42 USC § 13344, Rare Earth Elements*

REEs from Coal

- Significant ongoing REE research relates to recovery of REEs from coal, coal mines, coal refuse, coal ash, and water discharged from coal mines (i.e., AMD)
- National Energy Technology Laboratory (NETL) grants for the development of processes to extract REEs from coal and coal byproducts have been ongoing since at least 2016
- WVU's Water Research Institute is a leading institution in the NETL research, having been awarded $11.8 million
- Demonstration project being constructed now in coordination with the WVDEP on a Special Reclamation site

Deeds, Leases, and Contracts

- General principles of construction and interpretation

REE Ownership

- The landscape surrounding REE ownership, including split surface and mineral estates, is complex, largely unsettled, and evolving
  - Under the current legal framework, REE rights or ownership will often require a case-by-case analysis of the facts and rights granted or reserved in the appropriate vesting instruments at issue
- Historically, many REEs were not originally considered commercially exploitable; *however*, with the increased focus on the future of clean energy, REE development methods, technological advancements, and market demand, they are viewed as valuable resources given their unique qualities and applications
  - REEs, once considered waste products, are now viewed as potentially valuable income streams
- Increased shift to REE prominence has led to potential title and ownership issues:
  - Undefined and unclear ownership structures
  - Complex estates
  - Investment/financing

REE Title Complexities

- REEs and corresponding ownership are relatively new concepts in the context of land titles, and, as a result, REE ownership is largely unsettled due to the lack of case law or other controlling legal authority directly addressing ownership, particularly when dealing with severed estates (e.g., surface and mineral estates are split and owned separately)
- The recent revelation that REEs may be a valuable resource that could be developed raises legal issues not typically present in normal mineral development and production. That is, attempting to apply historic common law real property concepts to relatively new technologies, could potentially lead to unpredictable outcomes.
- As described by the Chief Counsel to the West Virginia Joint Standing Energy Committee in connection with the passage of HB 4003, *"There's an enormous body of mineral law in West Virginia. There's just none of it that directly applies to this particular element."*

House Bill 4003

- In 2022, the WV Legislature passed legislation attempting to establish legal ownership rights regarding certain REEs and other critical minerals extracted or derived from the treatment of acid mine drainage ("*AMD*") – *runoff produced when water comes into contact with exposed rock containing sulfur-bearing minerals that react with water and air to form sulfuric acid-rich in heavy metals*
  - *See West Virginia Code Section 22-2-10(b), (c), and (d)*
- Originally, aimed to urge lawmakers to enact legislation clarifying who owns resources extracted from AMD
- The purpose is to advance legislation stating whoever treats AMD, whoever takes on the environmental liability of treating AMD, ultimately receives the associated benefits

WV-HB 4003 incentivizes REE recovery.

REE – Recent Technology

- Monetary benefits to be derived from REEs recent emergence likely not contemplated when most severance instruments or leases were executed
  - Concerning conveyancing documents executed before the development of such technology or recognition of REEs value, there is likely no language or terms evidencing an intent for the grantor or lessor to retain (or grant, as the case may be), what was, at the time of such instruments were executed, a costly and hazardous waste material
- Other factors driving interpretation and construction
  - Dominance of mineral estate
  - Unique characteristics related to REEs, including the separation and refining processes
  - Specialized policy considerations
  - Importantly, ownership of these rights is even further complicated because they can be owned separately from the land itself

Emerging Legal Issues and Considerations

Looking Ahead

- **Ownership/control issues:** Disputes and lawsuits over ownership rights are likely to increase, including questions regarding ownership when surface and mineral estates are split, as well as issues concerning extraction and processing
- **Environmental regulations:** Extracting and processing REEs can ignite significant environmental impacts, hazards, and concerns
- **Supply chain issues:** Dependence on certain minerals for defense supply chains can lead to potential vulnerabilities
- **REE sustainability:** Complexities regarding the extraction, production, consumption, and recovery of REEs present supply and demand sustainability challenges
- **International trade:** The global fight for REEs and critical minerals is costly and damaging, especially considering trade and security are at risk in the rush to break China's dominance over production

China Dominates Production and Processing

- China continues to dominate global production and consumption of rare earth metals and compounds
- Most of the rare earth mineral concentrates are produced in China
- Smaller quantities are produced in Vietnam, Brazil, India, Malaysia, Russia, Australia, the United States, and several other countries

(USGS 2017 Rare Earth Elements Yearbook)

Critical & Rare Earth Minerals and Geo-Communications

Set the Tone for Responsible Prosperity

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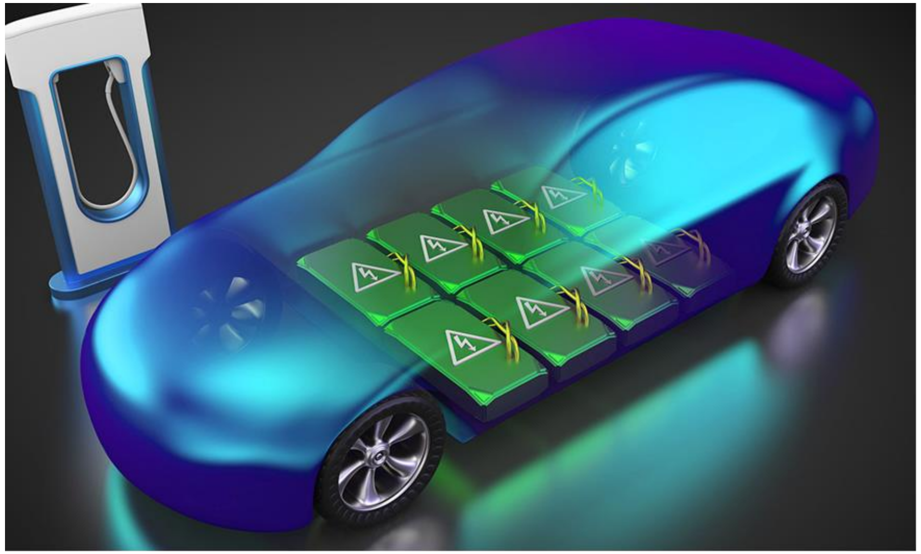
What is the Energy Transition?



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What are Critical and Rare Earth Minerals?

- The Energy Act of 2020 and the USGS 2022 Final List define **Critical Minerals** as those that are essential to the economic or national security of the United States; have a supply chain that is vulnerable to disruption; and serve an essential function in the manufacturing of a product, the absence of which would have significant consequences for the economic or national security of the U.S
- Per the 2022 U.S. Geological Service, **Rare Earth Elements/Minerals** (REE) are relatively plentiful in the Earth's crust but are typically dispersed and found in low concentrations. REEs are integral to modern society and essential to America's growth and national security.

Specific Critical and Rare Earth Minerals (subset)

Aluminum	Dysprosium	Indium	Palladium	Terbium
Antimony	Erbium	Iridium	Platinum	Thulium
Arsenic	Europium	Lanthanum	Praseodymium	Tin
Barite	Fluorspar	Lithium	Rhodium	Titanium
Beryllium	Gadolinium	Lutetium	Rubidium	Tungsten
Bismuth	Gallium	Magnesium	Ruthenium	Vanadium
Cerium	Germanium	Manganese	Samarium	Ytterbium
Cesium	Graphite	Neodymium	Scandium	Yttrium
Chromium	Hafnium	Nickel	Tantalum	Zinc
Cobalt	Holmium	Niobium	Tellurium	Zirconium

Per the 2022 USGS, highlighted are 16 Rare Earth Elements/Minerals plus Promethium = 17 REE

Mining Remains Contentious in the United States

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The Various US Policies (some passed, and some sought) to Promote Mineral Development

- The Inflation Reduction Act – electrical vehicle, reequipping existing manufacturing, and manufacturing production tax credits
- Per Infrastructure Investment and Jobs Act – As it relates to critical minerals, establishes grant program for deployment of publicly available electric vehicle charging, hydrogen fueling, propane fueling, and natural gas fueling infrastructure, and numerous other spending provisions
- Permitting Reform – superficial (i.e., supply chain reliability and forecasting demand of minerals)

What is a Mine?

- Mine Safety & Health Administration (MSHA) has broad discretion to claim jurisdiction over “coal and other mines,” as well as facilities related to mining or where “mineral milling” occurs.
- (A) an area of land from which minerals are **extracted in nonliquid form** or, **if in liquid form, are extracted with workers underground**, (B) private ways and roads appurtenant to such area, and (C) lands …. associated with the work of extracting minerals from their natural deposits in nonliquid form, or if in liquid form, with workers underground, or used in, or to be used in, the milling of such minerals, or the work of preparing coal or other minerals, and includes custom coal preparation facilities.
- Takeaway – Exploration projects are not mines.

Interagency Memorandum of Understanding

- MSHA and OSHA have entered into an agreement to delineate certain areas of inspection responsibility, and to provide for coordination between the two agencies in areas of mutual interest.
- MSHA has jurisdiction over operations whose purpose is to extract or to produce a mineral.
- MSHA does not have jurisdiction where a mineral is extracted incidental to the primary purpose of the activity.
- Congress – "…jurisdictional doubts should be resolved in favor of coverage by the Mine Act.'

What is Milling?

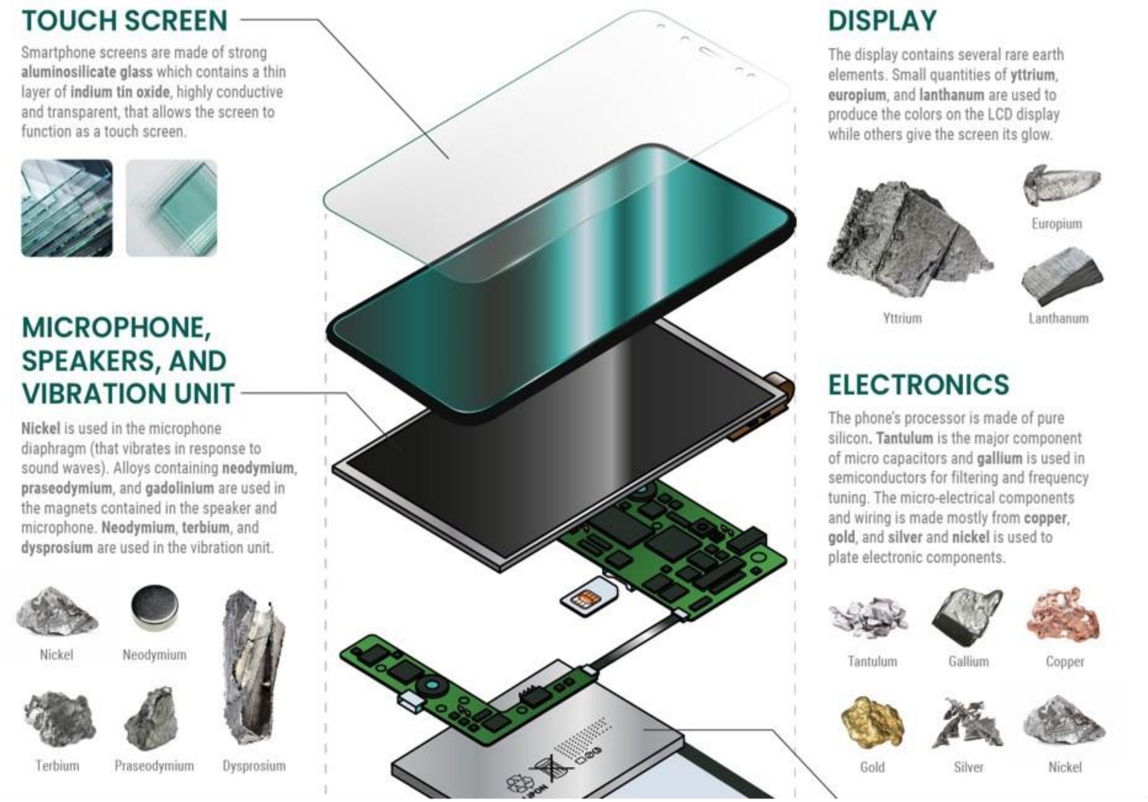
- Per the MSHA/OSHA agreement, milling is defined as "the art of treating the crude crust of the earth to produce therefrom the primary consumer derivatives" and "the essential operation in all such processes is separation of one or more valuable desired constituents of the crude from the undesired contaminants."
- Milling includes "crushing" or "sizing."
- Recycling of existing products like cell phones is not a Mine.

Here Is The Real "Opportunity" for Mine Operators

Typical Electric Large Car Battery

Per Congressional Research Center August 2022 Report, critical minerals in electric vehicle include varying quantities of:

- Lithium
- Nickel
- Manganese
- Cobalt
- Graphite



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How Many Pounds of Minerals Used by a Person in the US in a Year? Lifetime?

Geo-Communications

- It is not a “In your face”; “If it’s not mined, it’s grown”; “You need what I do” approach
- This is an approach or tactic that turns people away and makes it easy for them to despise mining generally and new projects specifically
- It is a “provide useful information to stakeholder’s/affected person’s” strategy
    - Community - Individuals and businesses
    - Landowners – Private is the focus
    - Land agents – Title companies
    - County executive offices
    - State economic development offices
    - State agencies DNR offices
    - State university
    - Partnering type of environmental organization like the Nature Conservancy
    - Affected persons grows over time

What is the General Message?

- **COEXISTENCE** is achievable – We need each other to be a self-sufficient country that meets its energy and communication needs responsibly in all aspects of mineral extraction, refining, use, disposal, and recycling
- Some facts always help:
  - Per International Energy Agency, critical minerals supply (new and existing mines and recycling) will need to grow by 3.5 times by 2030 to meet energy demand
  - Timescale for new mining projects can be nearly 20 years with potential for delay due to range of environmental, social, and permitting issues
  - Without a reliable supply, rising prices and inflation are economic outcomes
  - Without a reliable supply, military readiness will be adversely affected
- **TRANSPERANCY** is critical – The above statement means that sharing information is important for reasonable conversations to occur. The mining/refining company has to be willing to talk about environmental, social, and governance practices which may include social investment, health and safety of workers, gender balance, GHG emissions, water use, and mining waste.

How to Implement this Message?

- Through transparent communications with the stakeholders, the operator must recognize that not all stakeholders have to be vocal supporters, they just cannot adversely affect the messaging
- **Stakeholder analysis**

-2		N		+2
Not in my backyard and will somewhat acknowledge the need for mineral use	→	Not in my backyard and will acknowledge to a point the need for mineral use	→	Understand the need for mining and the positive impact mining has on the economy and still want mining done responsibly

- **Goal** is to move folks toward the plus side

Real Life Example of Geo-Communications

- Interviewed a start-up company COO and co-founder and colleague that mines a critical mineral important to multiple industries including the military complex utilizing proprietary technologies
- The company has two processes involving mining and refining ore and recycling
- Identified the key stakeholders/affected persons and had the conversations
- **Private landowners:**
    - Informed the landowners of how the land would be used
    - Asked the landowner how they wanted the land to look after mining was completed
    - Asked the landowner if there are improvements that could be made along the way
    - Price negotiations were low-key and fair
    - Bring in other stakeholders such as the state university independent knowledge

Real Life Example of Geo-Communications (Cont'd)

- **Community**
  - Attended county commissioner meetings and set up a table with information about the project
  - Visited the local community restaurants wearing company swag and tipped nicely
  - Able to provide donations for local causes such as YMCA
  - Developed a "pick up the phone and call me" relationship with city and county officials and others
- **State economic development / political contacts**
  - Sought out through RFPs the best economic environment to operate including grants, other investment incentives, infrastructure buildout, and the passion behind wanting economic development
  - Contacted the affected state and federal representatives with a positive message of economic impact and responsible mining

Real Life Example of Geo-Communications (Cont'd)

- **Regulating agencies**
  - Before any permitting was started, met with the state agencies responsible for permitting and informed them about the project and asked what they needed for the permitting process
  - Use engineering talent known to the agencies and the community
- **State university**
  - Utilize local university departments such as agricultural to assist in engaging other stakeholders
  - The independent message can build trust in other stakeholders

Real Life Outcomes Example of Geo-Communications

- **Outcomes**
  - Landowners have been cooperative
  - Permitting process was efficient with minimal issues raised by the agency
  - Community: Both individuals and businesses have been receptive
  - Jobs have been created
  - The economic development grant at the state level with county cooperation was significant
  - The new company has a good start on being profitable and providing a needed rare earth mineral to the U.S. consumer and industry

Questions?

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