# USGS Critical Strategic Mineral List for US Economy and National Security 2022

By Communications and Publishing February 22, 2022

United States Geological Survey, 12201 Sunset Valley Drive, Reston, VA 20192

RESTON – The United States Geological Survey has released a new list of 50 mineral commodities critical to the U.S. economy and national security after an extensive multi-agency assessment.

The 2022 list of critical minerals was determined using the most up-to-date scientific methods to evaluate mineral criticality. The new list contains 15 more commodities compared to the nation's first list of critical minerals created in 2018. Much of the increase in the new list is the result of splitting the rare earth elements and platinum group elements into individual entries rather than including them as "mineral groups." In addition, the 2022 list of critical minerals adds nickel and zinc to the list while removing helium, potash, rhenium and strontium.

"Critical minerals play a significant role in our national security, economy, renewable energy development and infrastructure," said Tanya Trujillo, Assistant Secretary of the Interior for Water and Science. "USGS data collection and analysis scans the horizon for emerging issues in crucial supply chains, and every three years identifies the nation's current vulnerabilities to potential disruptions."

The new list was created based on directives from the Energy Act of 2020, which indicates that at least every three years, the Department of the Interior must review and update the list of critical minerals, update the methodology used to identify potential critical minerals, take interagency feedback and public comment through the Federal Register, and ultimately finalize the list of critical minerals.

The Energy Act of 2020 defines a "critical mineral" as a non-fuel mineral or mineral material essential to the economic or national security of the U.S. and which has a supply chain vulnerable to disruption. Critical minerals are also characterized as serving an essential function in the manufacturing of a product, the absence of which would have significant consequences for the economy or national security.

The 2022 list of critical minerals, while "final," is not intended as a permanent designation of mineral criticality but will be a dynamic list updated periodically to represent current data on supply, demand, concentration of production and current policy priorities.

"Mineral criticality is not static, but changes over time," said Steven M. Fortier, USGS National Minerals Information Center director. "The 2022 list of critical minerals was created using the most recent available data for non-fuel mineral commodities. However, we're always analyzing mineral markets and developing new methods to determine the various and evolving critical mineral supply chain risks."

Prior to publishing the 2022 list of critical minerals, the USGS completed a thorough review of more than 1,000 comments received from the public, stakeholders and local and state officials. These comments were received in response to the draft critical minerals list the USGS released for public comment in November 2021.

"The USGS appreciates the input we received from the public and stakeholders," Fortier said. "In addition to reviewing each comment for the current methodology, we are also identifying opportunities to include some of the suggestions we received in the next update of the critical minerals list methodology."

The list of critical minerals will be the focus of USGS research quantifying critical mineral potential within the U.S. In President Biden's Bipartisan Infrastructure Law, the USGS received funding for its Earth Mapping Resource Initiative, which will update the Nation's mapping of these minerals, including those still in the ground and those present in mine wastes.

The Energy Act of 2020 directed the USGS to update the list of critical minerals, and the list is timely to provide guidance for use of the Bipartisan Infrastructure Law funds, both for the USGS and other agencies.

The 2022 list of critical minerals includes the following — click a mineral's name to find relevant statistics and publications:

Aluminum, used in almost all sectors of the economy

Antimony, used in lead-acid batteries and flame retardants

Arsenic, used in semi-conductors

Barite, used in hydrocarbon production.

Beryllium, used as an alloying agent in aerospace and defense industries

Bismuth, used in medical and atomic research

Cerium, used in catalytic converters, ceramics, glass, metallurgy, and polishing compounds

Cesium, used in research and development

Chromium, used primarily in stainless steel and other alloys

Cobalt, used in rechargeable batteries and superalloys

Dysprosium, used in permanent magnets, data storage devices, and lasers

Erbium, used in fiber optics, optical amplifiers, lasers, and glass colorants

Europium, used in phosphors and nuclear control rods

Fluorspar, used in the manufacture of aluminum, cement, steel, gasoline, and fluorine chemicals

Gadolinium, used in medical imaging, permanent magnets, and steelmaking

Gallium, used for integrated circuits and optical devices like LEDs

Germanium, used for fiber optics and night vision applications

Graphite , used for lubricants, batteries, and fuel cells

Hafnium, used for nuclear control rods, alloys, and high-temperature ceramics

Holmium, used in permanent magnets, nuclear control rods, and lasers

Indium, used in liquid crystal display screens

Iridium, used as coating of anodes for electrochemical processes and as a chemical catalyst

Lanthanum, used to produce catalysts, ceramics, glass, polishing compounds, metallurgy, and batteries

Lithium, used for rechargeable batteries

Lutetium, used in scintillators for medical imaging, electronics, and some cancer therapies

Magnesium, used as an alloy and for reducing metals

Manganese, used in steelmaking and batteries

Neodymium, used in permanent magnets, rubber catalysts, and in medical and industrial lasers

Nickel, used to make stainless steel, superalloys, and rechargeable batteries

Niobium, used mostly in steel and superalloys

Palladium, used in catalytic converters and as a catalyst agent

Platinum, used in catalytic converters

Praseodymium, used in permanent magnets, batteries, aerospace alloys, ceramics, and colorants

Rhodium, used in catalytic converters, electrical components, and as a catalyst

Rubidium, used for research and development in electronics

Ruthenium, used as catalysts, as well as electrical contacts and chip resistors in computers

Samarium, used in permanent magnets, as an absorber in nuclear reactors, and in cancer treatments

Scandium, used for alloys, ceramics, and fuel cells

Tantalum, used in electronic components, mostly capacitors and in superalloys

Tellurium, used in solar cells, thermoelectric devices, and as alloying additive

Terbium, used in permanent magnets, fiber optics, lasers, and solid-state devices

Thulium, used in various metal alloys and in lasers

Tin, used as protective coatings and alloys for steel

Titanium, used as a white pigment or metal alloys

Tungsten, primarily used to make wear-resistant metals

Vanadium, primarily used as alloying agent for iron and steel

Ytterbium, used for catalysts, scintillometers, lasers, and metallurgy

Yttrium, used for ceramic, catalysts, lasers, metallurgy, and phosphors

Zinc, primarily used in metallurgy to produce galvanized steel

Zirconium, used in the high-temperature ceramics and corrosion-resistant alloys.

The USGS delivers unbiased science and information on mineral resource potential, production, consumption, disposal, and how minerals interact with the environment. The USGS National Minerals Information Center provides the Nation with data on domestic and global supply, demand, and trade for minerals and materials. This information is essential to understand mineral dependencies across economic sectors, forecast potential disruptions to mineral commodity supply, and evaluate the impacts of such disruptions.

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# 2022 list of critical minerals FAQs

- What is a critical mineral?
    - The Energy Act of 2020 defined critical minerals as those which 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. The act further specified that critical minerals do not include fuel minerals; water, ice, or snow; or common varieties of sand, gravel, stone, pumice, cinders, and clay.
- Why does the critical minerals list need to be updated?
    - Mineral criticality is not static, but changes over time as supply and demand dynamics evolve, import reliance changes, and new technologies are developed. This analysis represents the most recent available data for mineral commodities other than fuel minerals and the current state of the methodology for evaluation of criticality. The Energy Act of 2020 also required that the list and methodology be reviewed every three years.
- What does inclusion on this list mean in practical terms?
    - This 2022 list of critical minerals represents a whole-of-government determination that the mineral commodities on this list meet the definition to be categorized as critical. However, different parts of the government will prioritize different mineral commodities. Whether and how a specific federal agency will prioritize a particular critical mineral will be dependent on that agency's internal deliberations on how to make supply chains sustainable and any relevant Administration or Congressional direction. Conversely, mineral commodities may be important to an individual government agency's mission or direction even though they are not categorized as critical for the purposes of this list.

- Why did you change the methodology used to create the list?
    - The Energy Act of 2020 required that the list and methodology be reviewed every three years. The 2022 list of critical minerals is based on a methodology developed over several years with leadership by the U.S. Geological Survey and interagency input coordinated by the White House Office of Science and Technology Policy's National Science and Technology Council (NSTC) Critical Minerals Subcommittee. The methodology has evolved significantly over this period to an increasingly quantitative evaluation approach in order to increase transparency and reproducibility wherever possible. Data limitations still prevent a fully quantitative approach across the spectrum of minerals of interest.
- Have these mineral commodities always been considered critical?
    - The mineral commodities that are considered critical have changed throughout history. Different criteria have been applied by different groups for different purposes. Advances in technology and materials science have resulted in new

technologies and applications for many minerals. In addition, U.S. import reliance and the concentration of mining and mineral processing have all continued to increase, supply chains have become much more global, and vulnerabilities resulting from trade tensions, pandemics, and other concerns are increasingly apparent.

- Why are there more minerals on this critical minerals list compared to the last one?
    - Much of the increase in the number of mineral commodities, from 35 commodities and groups on the final 2018 list to 50 commodities on the 2022 list of critical minerals, is the result of splitting the rare earth elements and platinum group elements into individual entries rather than including them as mineral groups. In addition, the 2022 list of critical minerals adds nickel and zinc and removes helium, potash, rhenium, and strontium.
- **Where can I view public input on the list of critical minerals?**
    - Under the Energy Act of 2020, the draft 2021 list of critical minerals was released in the Federal Register for a 30-day public comment period, which was subsequently extended another 30 days. All comments received during the public comment period are public record and will remain viewable at https://www.regulations.gov by searching for docket number DOI-2021-0013.
- When will the list of critical minerals be updated next?
    - Under the Energy Act of 2020, the U.S. Geological Survey, in coordination with other agencies, will review the methodology and the list at least every three years.
- What criteria were used to create the list?
    - The 2022 list of critical minerals is based on a methodology developed over several years with leadership by the USGS and interagency input coordinated by the White House Office of Science and Technology Policy's National Science and Technology Council Critical Minerals Subcommittee. The USGS published the new methodology in 2020 and this methodology was used to create the draft list and update it in 2021-2022. The minerals included in the proposed draft list are based on metrics contained in the new methodology including: a quantitative evaluation wherever sufficient data were available; a semi-quantitative evaluation of whether the supply chain had a single point of failure; and a qualitative evaluation when other evaluations were not possible.
- If a mineral commodity is not listed as critical, does that mean it's not important?
    - No, there are dozens of mineral commodities that are not listed as critical but are still vital to many industries and the economy. The list of critical minerals focuses on those mineral commodities, other than fuel minerals, which are essential to the economy or national security of the United States, whose absence would have significant consequences on both the economy and national security of the United States AND which have a supply chain that is currently vulnerable to disruption. The mineral commodities other than fuel minerals that are essential to the economy and national security of the United States that are not on this list do not have a supply chain that is currently judged to be vulnerable to disruption.

The USGS continues to collect data on all non-fuel minerals and analyze emerging supply chain vulnerabilities in order to update the list of critical minerals in response to changes in supplies and markets. Fuel minerals were not considered for inclusion on the 2022 list of critical minerals.

- Why is this list different from the 2018 list?
    - Mineral criticality evolves over time. The minerals in the 2022 list of critical minerals were included based on metrics contained in the new methodology, including: a quantitative evaluation wherever sufficient data were available; a semi-quantitative evaluation of whether the supply chain had a single point of failure; and a qualitative evaluation when other evaluations were not possible.
- Why was nickel added to the list?
    - Nickel was included based on the single point of failure criterion. This single point of failure is due to the operation of a single refinery in the United States that produced crystalline nickel sulfate.
- Why was zinc added to the list?
    - The increasing concentration of global mine and smelter production and the continued refinement and development of the quantitative evaluation criteria led to zinc being above the threshold.
- What minerals were removed from the list and why?
    - Potash, rhenium and strontium do not meet the quantitative threshold and do not have a single point of failure in the supply chain. These three commodities all had very high trade exposure but low disruption potential, meaning the U.S. is reliant on trade for these mineral resources, but the likelihood of that trade being disrupted is low. Helium does not meet the quantitative threshold nor have a single point of failure. The U.S. is the world's leading producer and a net exporter of helium. Uranium was not evaluated because the Energy Act of 2020 explicitly excluded "fuel minerals" from the definition of a "critical mineral."
- Why is copper not included in the list?
    - Copper is an important host mineral for other critical minerals, including cobalt, however domestic production mitigates its supply chain vulnerability. Supply risk for copper has been increasing in recent years and it merits watching.

- Why were there insufficient data to evaluate some minerals?
    - There were insufficient data to quantitatively evaluate several commodities that were on the 2018 list of critical minerals: cesium, rubidium, scandium and several rare earth elements (REEs), including europium, gadolinium, terbium, holmium, erbium, thulium, ytterbium and lutetium. The U.S. has been net import reliant for all these commodities for many years. No specific global production data were available for these commodities; however, general information suggests that production for each of these commodities is highly concentrated in a few countries. The REEs that were not analyzed because of the lack of data were all heavy REEs that were produced only or predominantly in China. Based on this

qualitative evaluation, none of these commodities is recommended for removal from the list of critical minerals.

- What about coal waste and capturing REE from acid mine drainage?
    - Extracting critical minerals from waste streams is one of a number of solutions that several federal agencies, research institutions and public/private ventures in the U.S. are pursuing. Federal agencies such as the Department of the Interior's USGS and Office of Surface Mining Reclamation and Enforcement, the Department of Energy, and the Environmental Protection Agency are investigating innovative and environmentally sustainable potential sources for critical minerals, such as obtaining rare earth elements from coal, hardrock mining wastes, acid mine drainage and various recycling and reprocessing programs.
- Do we have these critical minerals in the US?
    - Many of the minerals for which the U.S. relies on imports are available in the U.S. in some form but typically aren't mined for economic reasons. However, just because a resource can be economically mined doesn't mean the U.S. could become less import reliant. The U.S. lacks much of the required processing capacity to process and refine many critical minerals. This means that critical minerals that are mined in the U.S. often have to be shipped to another country, like China, for processing and recovery.
- Based on the public comments the USGS received, what opportunities has the USGS identified as things to consider including for the next critical minerals list.
    - Some of the comments we received pointed out that further down some supply chains, there are vulnerabilities for processed mineral products that we didn't evaluate for this cycle of the list. For instance, things like high-purity silicon metal and boron carbide, which are materials the USGS does not have sufficient data to evaluate at this time. These products, among others, are things we plan to investigate for ways we could possibly evaluate and include in our next methodology.
- How has the Covid-19 pandemic affected the critical minerals list?
    - The 2022 list of critical minerals is based on data through the year 2018, so impacts of the pandemic are not reflected.
- How is the critical mineral list different from the critical material determination called for in the Energy Act of 2020?
    - The Energy Act of 2020 authorizes the Department of Energy to make a separate designation of "critical materials" that are at high risk of a supply chain disruption and that serve an essential function in one or more energy technologies. Critical materials determinations are currently under development in a separate process run by the Department of Energy. Both agencies continue to collaborate closely on a range of topics covering both critical minerals and materials.