

Critical Minerals and Why They Matter: Supply Chain Shifts, Risks, and USGS Research

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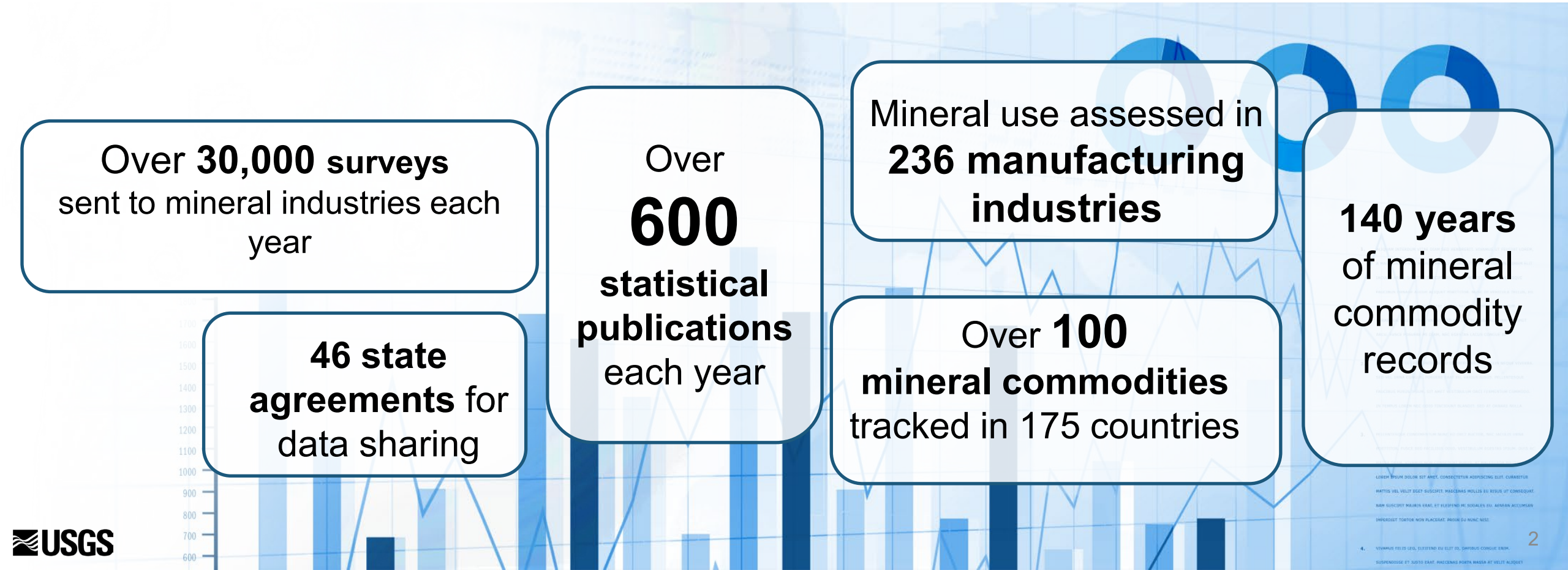
National Minerals Information Center

- Provides the Nation's data on the domestic and global supply of and demand for mineral commodities.
- Analyzes and forecasts supply chain disruptions that impact the Nation's national security and the economy.
- Advises other Federal agencies on investments and trade partnerships for mineral commodities, processing, and related manufacturing.



National Minerals Information Center

Minerals Information Support Systems Section

- Statistical assistants, & other specialists
- Assist in the data collection and provide support functions
- Work is integrated in virtually all non-interpretive work

Mineral Commodities Section

- Commodity specialists
- Cover >100 mineral commodities
- Responsible for Mineral Commodity Summaries, Vol. I of annual Minerals Yearbook, & Mineral Industry Surveys

Global Minerals Analysis Section

- Country specialists with foreign language skills
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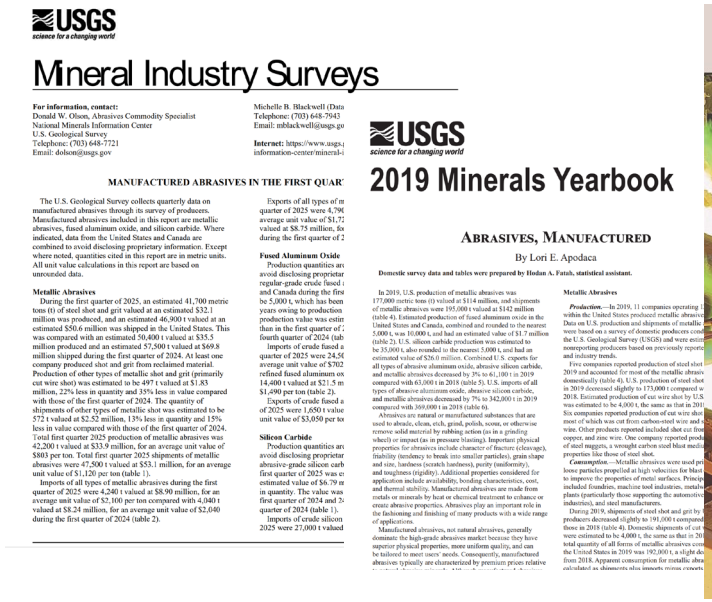
- Sends questionnaires to foreign governments
- Responsible for Vol. III of annual Minerals Yearbook

Minerals Intelligence Research Section

- Materials flow analysts
- Focused on supply chain analysis and interpretive work
- Responsible for the List of Critical Minerals and other supply chain assessments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Mineral Industry Surveys

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information-center/mineral-i

MANUFACTURED ABRASIVES IN THE FIRST QUAR

The U.S. Geological Survey collects quarterly data on manufactured abrasives through its survey of producers. Manufactured abrasives included in this report are metallic abrasives, fused aluminum oxide, and silicon carbide. Where indicated, data from the United States and Canada are combined to avoid disclosing proprietary information. Except where noted, quantities cited in this report are in metric units. All unit value calculations in this report are based on unrounded data.

Metallic Abrasives

During the first quarter of 2025, an estimated 41,700 metric tons (t) of steel shot and grit valued at an estimated $32.1 million was produced, and an estimated 46,900 t valued at an estimated $50.6 million was shipped in the United States. This was compared with an estimated 50,400 t valued at $35.5 million produced and an estimated 57,500 t valued at $69.8 million shipped during the first quarter of 2024. At least one company produced shot and grit from reclaimed material. Production of other types of metallic shot and grit (primarily cut wire shot) was estimated to be 497 t valued at $1.83 million, 22% less in quantity and 35% less in value compared with those of the first quarter of 2024. The quantity of shipments of other types of metallic shot was estimated to be 572 t valued at $2.52 million, 13% less in quantity and 15% less in value compared with those of the first quarter of 2024. Total first quarter 2025 production of metallic abrasives was 42,200 t valued at $33.9 million, for an average unit value of $803 per ton. Total first quarter 2025 shipments of metallic abrasives were 47,500 t valued at $53.1 million, for an average unit value of $1,120 per ton (table 1).

Imports of all types of metallic abrasives during the first quarter of 2025 were 4,240 t valued at $8.90 million, for an average unit value of $2,100 per ton compared with 4,040 t valued at $8.24 million, for an average unit value of $2,040 during the first quarter of 2024 (table 2).

Exports of all types of m
quarter of 2025 were 4,79
average unit value of $1,72
valued at $8.75 million, fo
during the first quarter of 2

Fused Aluminum Oxide

Production quantities ar
avoid disclosing proprietar
regular-grade crude fused
and Canada during the firs
be 5,000 t, which has been
years owing to production
production value was estim
than in the first quarter of
fourth quarter of 2024 (tab

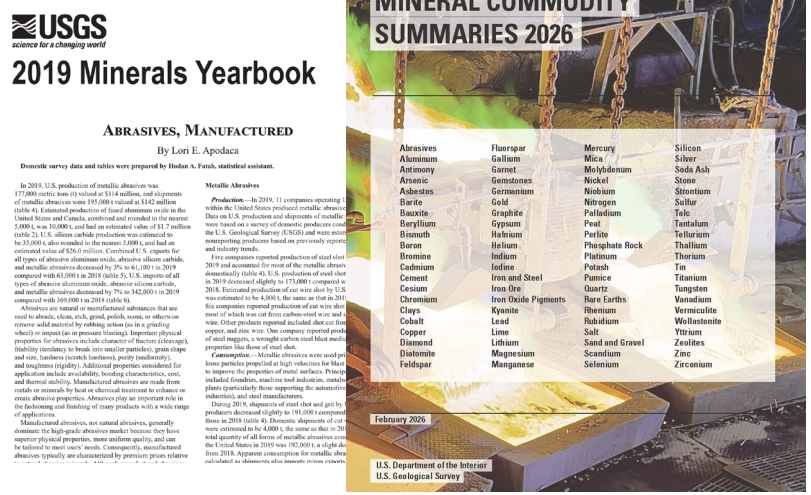
Imports of crude fused a
quarter of 2025 were 24,5
average unit value of $702
refined fused aluminum ox
14,400 t valued at $21.5 m
$1,490 per ton (table 2).

Exports of crude fused a
of 2025 were 1,650 t value
unit value of $3,050 per to

Silicon Carbide

Production quantities ar
avoid disclosing proprietar
abrasive-grade silicon carb
first quarter of 2025 was e
estimated value of $6.79 m
in quantity. The value was
first quarter of 2024 and 2
quarter of 2024 (table 1).

Imports of crude silicon
2025 were 27,000 t valued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2019 Minerals Yearbook

ABRASIVES, MANUFACTURED

By Lori E. Apodaca

Domestic survey data and tables were prepared by Hodan A. Futah, statistical assistant.

In 2019, U.S. production of metallic abrasives was 177,000 metric tons (t) valued at $114 million, and shipments of metallic abrasives were 195,000 t valued at $142 million (table 4). Estimated production of fused aluminum oxide in the United States and Canada, combined and rounded to the nearest 5,000 t, was 10,000 t, and had an estimated value of $1.7 million (table 2). U.S. silicon carbide production was estimated to be 35,000 t, also rounded to the nearest 5,000 t, and had an estimated value of $26.0 million. Combined U.S. exports for all types of abrasive aluminum oxide, abrasive silicon carbide, and metallic abrasives decreased by 3% to 61,100 t in 2019 compared with 63,000 t in 2018 (table 5). U.S. imports of all types of abrasive aluminum oxide, abrasive silicon carbide, and metallic abrasives decreased by 7% to 342,000 t in 2019 compared with 369,000 t in 2018 (table 6).

Abrasives are natural or manufactured substances that are used to abrade, clean, etch, grind, polish, scour, or otherwise remove solid material by rubbing action (as in a grinding wheel) or impact (as in pressure blasting). Important physical properties for abrasives include character of fracture (cleavage), friability (tendency to break into smaller particles), grain shape and size, hardness (scratch hardness), purity (uniformity), and toughness (rigidity). Additional properties considered for application include availability, bonding characteristics, cost, and thermal stability. Manufactured abrasives are made from metals or minerals by heat or chemical treatment to enhance or create abrasive properties. Abrasives play an important role in the fashioning and finishing of many products with a wide range of applications.

Manufactured abrasives, not natural abrasives, generally dominate the high-grade abrasives market because they have superior physical properties, more uniform quality, and can be tailored to meet users' needs. Consequently, manufactured abrasives typically are characterized by premium prices relative

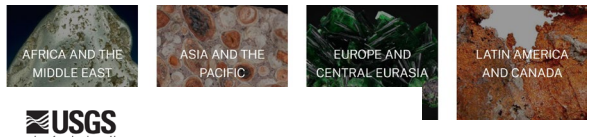
Metallic Abrasives

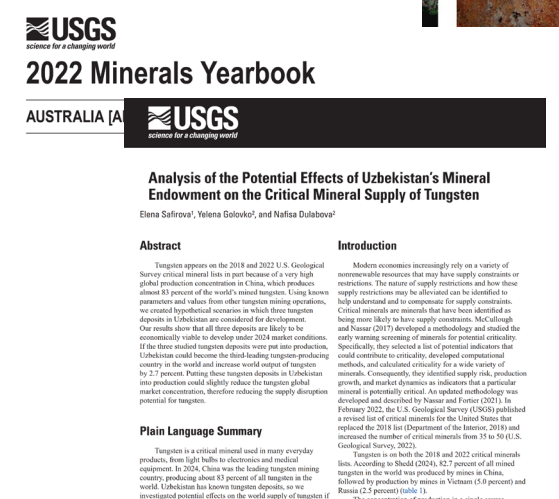
Production.—In 2019, 11 companies operating
within the United States produced metallic abras
Data on U.S. production and shipments of metallic
were based on a survey of domestic producers cond
the U.S. Geological Survey (USGS) and were estim
nonreporting producers based on previously reporte
and industry trends.

Five companies reported production of steel shot
2019 and accounted for most of the metallic abrasi
domestically (table 4). U.S. production of steel shot
in 2019 decreased slightly to 173,000 t compared w
2018. Estimated production of cut wire shot by U.S
was estimated to be 4,000 t, the same as that in 201
Six companies reported production of cut wire dur
most of which was cut from carbon-steel wire and s
wire. Other products reported included shot cut fro
copper, and zinc wire. One company reported produ
of steel nuggets, a wrought carbon steel blast media
properties like those of steel shot.

Consumption.—Metallic abrasives were used pri
loose particles propelled at high velocities for blas
to improve the properties of metal surfaces. Princip
included foundries, machine tool industries, metalw
plants (particularly those supporting the automotive
industries), and steel manufacturers.

During 2019, shipments of steel shot and grit by
producers decreased slightly to 191,000 t compared
those in 2018 (table 4). Domestic shipments of cut
were estimated to be 4,000 t, the same as that in 20
total quantity of all forms of metallic abrasives cons
the United States in 2019 was 192,000 t, a slight de
from 2018. Apparent consumption for metallic abra
calculated as shipments plus imports minus exports

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2022 Minerals Yearbook

AUSTRALIA [A

USGS science for a changing world

Analysis of the Potential Effects of Uzbekistan's Mineral Endowment on the Critical Mineral Supply of Tungsten

Elena Safirova[1], Yelena Golovko[2], and Nafisa Dulabova[2]

Abstract

Tungsten appears on the 2018 and 2022 U.S. Geological Survey critical mineral lists in part because of a very high global production concentration in China, which produces almost 83 percent of the world's mined tungsten. Using known parameters and values from other tungsten mining operations, we created hypothetical scenarios in which three tungsten deposits in Uzbekistan are considered for development. Our results show that all three deposits are likely to be economically viable to develop under 2024 market conditions. If the three studied tungsten deposits were put into production, Uzbekistan could become the third-leading tungsten-producing country in the world and increase world output of tungsten by 2.7 percent. Putting these tungsten deposits in Uzbekistan into production could slightly reduce the tungsten global market concentration, therefore reducing the supply disruption potential for tungsten.

Plain Language Summary

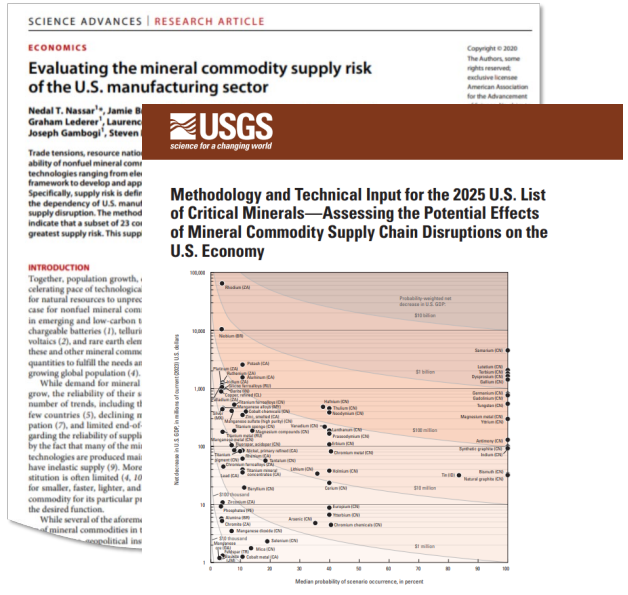
Tungsten is a critical mineral used in many everyday products, from light bulbs to electronics and medical equipment. In 2024, China was the leading tungsten mining country, producing about 83 percent of all tungsten in the world. Uzbekistan has known tungsten deposits, so we investigated potential effects on the world supply of tungsten if three of those tungsten deposits were developed and produced tungsten and other minerals. Using market conditions from 2024 in our models, we determined that these tungsten deposits could be mined profitably. Our results suggest that if

Introduction

Modern economies increasingly rely on a variety of nonrenewable resources that may have supply constraints or restrictions. The nature of supply restrictions and how these supply restrictions may be alleviated can be identified to help understand and to compensate for supply constraints. Critical minerals are minerals that have been identified as being more likely to have supply constraints. McCullough and Nassar (2017) developed a methodology and studied the early warning screening of minerals for potential criticality. Specifically, they selected a list of potential indicators that could contribute to criticality, developed computational methods, and calculated criticality for a wide variety of minerals. Consequently, they identified supply risk, production growth, and market dynamics as indicators that a particular mineral is potentially critical. An updated methodology was developed and described by Nassar and Fortier (2021). In February 2022, the U.S. Geological Survey (USGS) published a revised list of critical minerals for the United States that replaced the 2018 list (Department of the Interior, 2018) and increased the number of critical minerals from 35 to 50 (U.S. Geological Survey, 2022).

Tungsten is on both the 2018 and 2022 critical minerals lists. According to Shedd (2024), 82.7 percent of all mined tungsten in the world was produced by mines in China, followed by production by mines in Vietnam (5.0 percent) and Russia (2.5 percent) (table 1).

The concentration of production in a single source country is the main reason for a high supply risk, so to reduce the level of criticality for tungsten, the concentration of production could be changed either by increasing existing


SCIENCE ADVANCES | RESEARCH ARTICLE

ECONOMICS

Evaluating the mineral commodity supply risk of the U.S. manufacturing sector

Nedal T. Nassar[1]*, Jamie B
Graham Lederer[1], Laurenc
Joseph Gambogi[1], Steven

Trade tensions, resource natio
ability of nonfuel mineral com
technologies ranging from ele
framework to develop and app
Specifically, supply risk is defir
the dependency of U.S. manuf
supply disruption. The method
indicate that a subset of 23 co
greatest supply risk. This supp

INTRODUCTION

Together, population growth,
celerating pace of technologica
for natural resources to unprec
case for nonfuel mineral com
in emerging and low-carbon t
chargeable batteries (1), telluri
voltaics (2), and rare earth elen
these and other mineral comm
quantities to fulfill the needs a
growing global population (4).

While demand for mineral
grow, the reliability of their s
number of trends, including th
few countries (5), declining n
pation (7), and limited end-of
garding the reliability of suppli
by the fact that many of the mi
technologies are produced mai
have inelastic supply (9). More
stitution is often limited (4, 10
for smaller, faster, lighter, and
commodity for its particular pr
the desired function.

While several of the aforem
of mineral commodities in t
geopolitical ins

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for the Advancement

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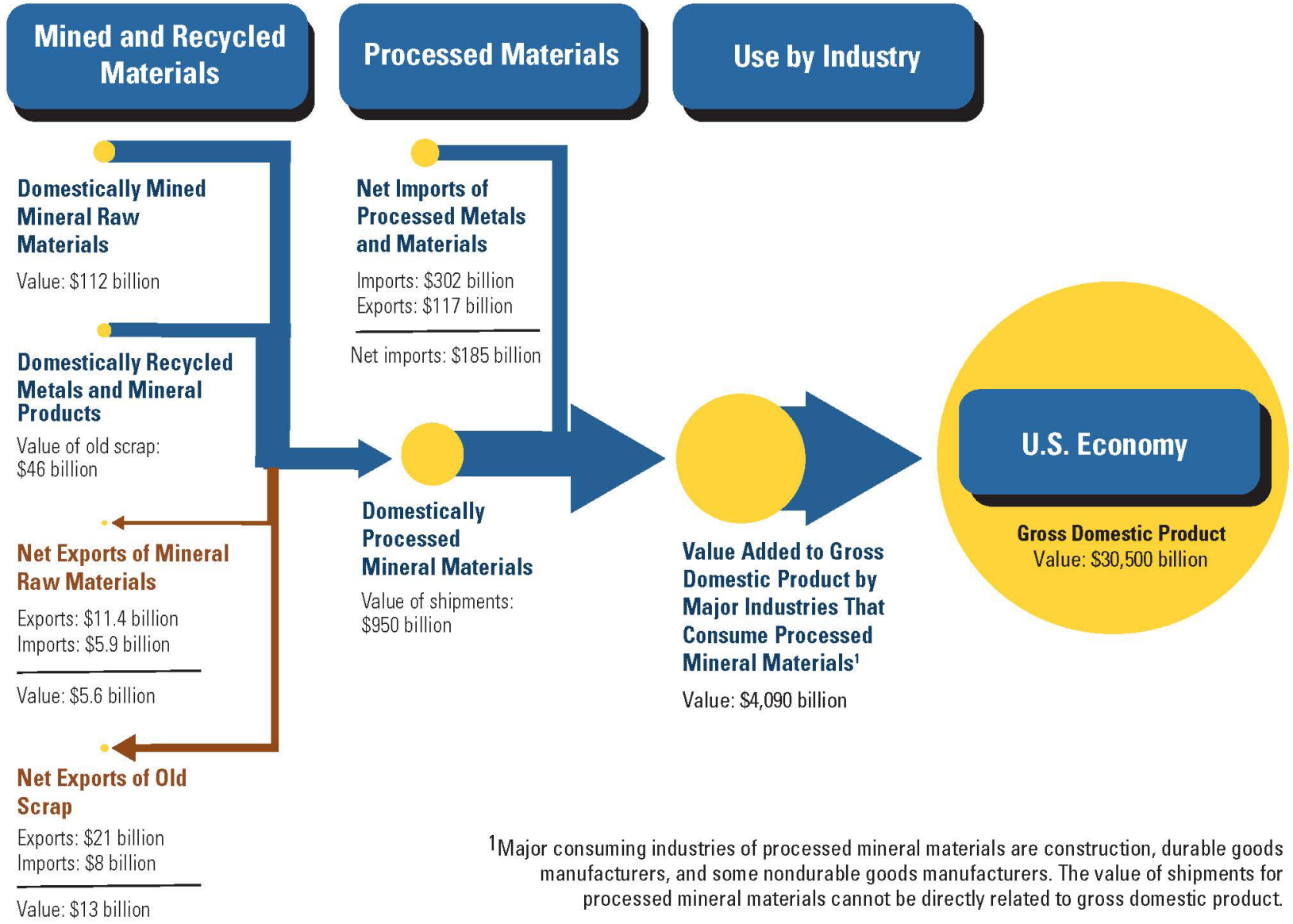
Methodology and Technical Input for the 2025 U.S. List of Critical Minerals—Assessing the Potential Effects of Mineral Commodity Supply Chain Disruptions on the U.S. Economy

Open-File Report 2025–1047

Nonfuel Mineral Commodities in the U.S. Economy

- **U.S. mineral production** contributed **$112 billion** to the U.S. economy in 2025.
- Industries that use minerals—such as steel, aerospace and electronics—contributed **$4.09 trillion** to the U.S. economy in 2025.
- Mineral production employed **150,000 U.S. workers** and industries that use minerals employed **1.7 million U.S. workers**.



[1]Major consuming industries of processed mineral materials are construction, durable goods manufacturers, and some nondurable goods manufacturers. The value of shipments for processed mineral materials cannot be directly related to gross domestic product.

USGS

U.S. Geological Survey, 2026, Mineral commodity summaries 2026: U.S. Geological Survey, 222 p., https://doi.org/10.3133/mcs2026.

Mineral commodities enable faster, smaller, and smarter technology and support essential infrastructure, agriculture, and manufacturing.

Smarter

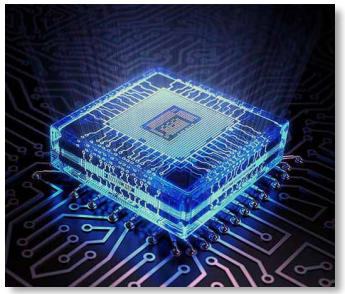


Photo credit: NetBit

Gallium Nitride

With higher power density and the ability to operate at higher frequencies, GaN on SiC is an ideal material for power amplifiers at base stations in mmWave (>28 GHz) 5G wireless technology

Lighter



Photo credit: Airbus

Aluminum-lithium alloys

Al-Li alloys are lighter and stronger than standard aluminum alloys thus providing better fuel efficiency and lower maintenance costs

Higher Yields



Photo credit: Adobe Stock #637608619

Agricultural fertilizers

Potash and phosphates provide potassium and phosphorus, two key nutrients needed by crops to grow and feed the world's populations.

Stronger



Photo credit: HistoricBridges.org

High-strength low-alloy steels

Various combinations of vanadium, niobium, molybdenum, and other elements make steels for bridges, oil & gas pipelines, buildings, and armored vehicles stronger

Hotter



Photo credit: Master Sgt. John R. Nimmo, Sr.

Superalloys

Single-crystal turbine blades utilizing cobalt, rhenium, chromium, tantalum, hafnium, ruthenium, and other elements improve design tolerances that increase thrust and enable higher operating temperatures

Sharper



Photo credit: MedQuest Associates

Superconducting magnets

Medical MRI machines produce higher-resolution images and use less energy by using niobium-based, helium-cooled superconducting magnets

Technology is Growing More Complex



H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn		Fl		Lv		

Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

~30 elements



H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn		Fl		Lv		

Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

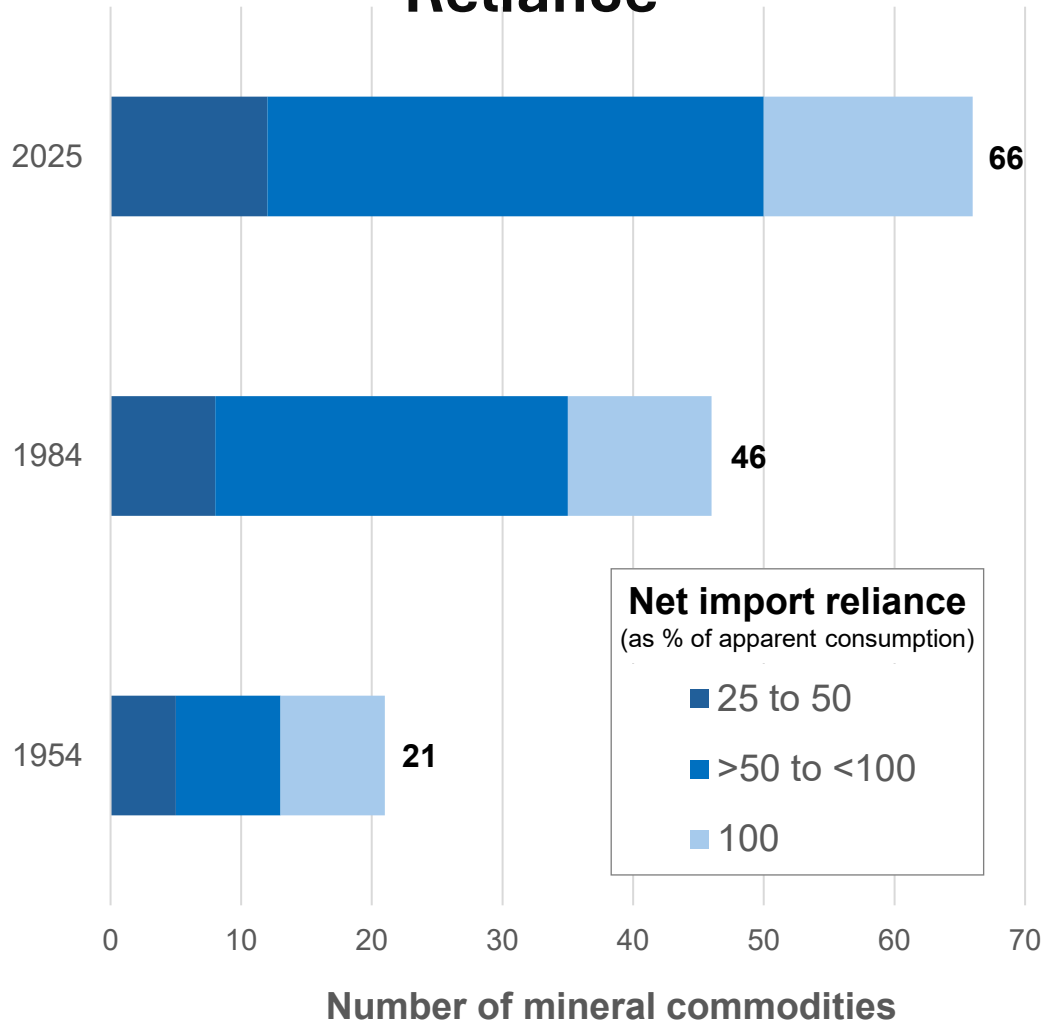
~80 elements

The U.S. has become highly import reliant for a growing number of mineral commodities

2025 U.S. Net Import

Commodity	Net import reliance as a percentage of apparent consumption in 2025	Leading import sources (2021–24)[2]
ARSENIC, all forms	100	China,[3] Malaysia, Morocco
ASBESTOS	100	Brazil
CESIUM	100	China, Germany
FLUORSPAR	100	Mexico, Vietnam, China,[3] South Africa
GALLIUM	100	Canada, Japan, China, Germany
GRAPHITE (NATURAL)	100	China,[3] Canada, Mozambique, Mexico
INDIUM	100	Republic of Korea, Japan, China,[3] Canada
MANGANESE	100	Gabon, South Africa, Malaysia, Australia
MICA (NATURAL), sheet	100	China, Vietnam, Brazil, India
NIOBIUM (COLUMBIUM)	100	Brazil, Canada
RUBIDIUM	100	China, Germany, Russia
SCANDIUM	100	Japan, China
STRONTIUM	100	Mexico, Germany, China
TANTALUM	100	China,[3] Australia, Germany, Indonesia
TITANIUM, sponge metal	100	Japan, Saudi Arabia, Kazakhstan
YTTRIUM	100	China,[3] Germany, Austria
GEMSTONES	99	India, Israel, Belgium, South Africa
XENON	98	NA
ABRASIVES, fused aluminum oxide	>95	China,[3] Canada, Brazil, Austria
NEPHELINE SYENITE	>95	Canada
KRYPTON	93	NA
BISMUTH	92	China,[3] Republic of Korea, Germany
POTASH	92	Canada, Russia, Israel
ANTIMONY, metal and oxide	91	China, Belgium, Thailand, India
PLATINUM	89	South Africa, Belgium, Germany, Italy
TITANIUM MINERAL CONCENTRATES	88	South Africa, Canada, Madagascar, Mozambique
STONE (DIMENSION)	85	Brazil, Italy, China,[3] India
IRON OXIDE PIGMENTS, natural and synthetic	84	China,[3] Germany, Brazil, Canada
DIAMOND (INDUSTRIAL), stones	81	India, South Africa, Russia, Botswana
PEAT	80	Canada
CHROMIUM, all forms	79	South Africa, Kazakhstan, Finland, Canada
COBALT	79	Norway, Finland, Canada, Japan
SILVER	77	Mexico, Canada, Chile, Turkey
TIN, refined	77	Peru, Bolivia, Indonesia, Brazil
RHENIUM	75	Chile, Canada, Germany, Poland
BARITE	>75	India, China,[3] Morocco, Mexico
BAUXITE	>75	Jamaica, Turkey, Guyana, Australia
MAGNESIUM METAL	>75	Israel, Canada, Turkey, Czechia
ABRASIVES, silicon carbide	74	China,[3] Brazil
ZINC, refined	73	Canada, Mexico, Peru, Republic of Korea
ALUMINA	71	Brazil, Jamaica, Australia, Canada
GARNET (INDUSTRIAL)	71	South Africa, Australia, China,[3] India
RARE EARTHS,[4] compounds and metals	67	China,[3] Malaysia, Estonia, Japan

Growing U.S. Net Import Reliance



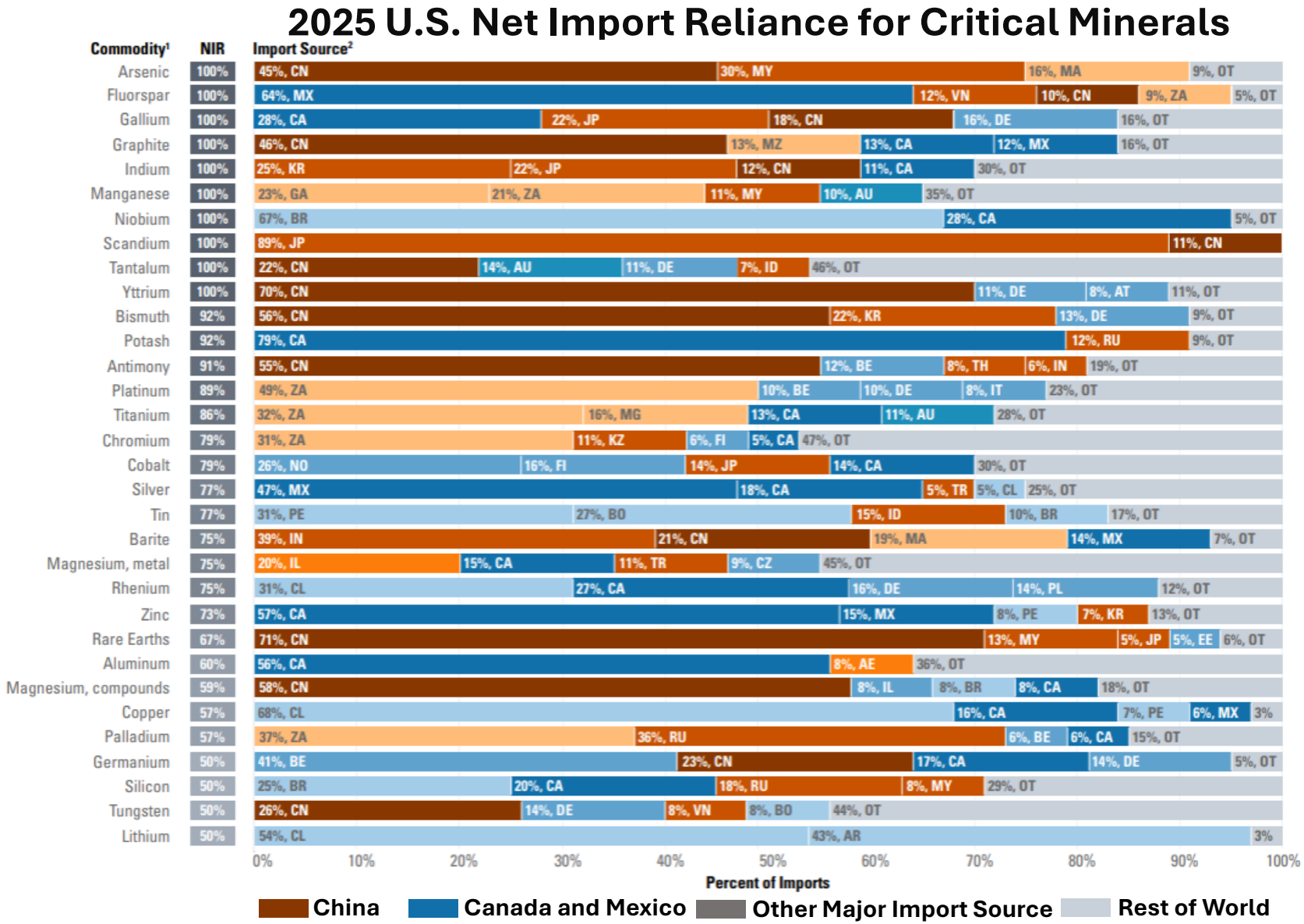
USGS

U.S. Geological Survey, 2026, Mineral commodity summaries 2026: U.S. Geological Survey, 222 p., https://doi.org/10.3133/mcs2026.

The U.S. has become highly import reliant for a growing number of mineral commodities… on a limited number of countries

Top Importers:

- China, Canada, and Mexico were the leading import sources (2021–24) of nonfuel mineral commodities.
- 12 critical minerals that were net import reliant had >50% of imports come from one country.
- 11 commodities that were net import reliant had >75% of imports come from two countries.



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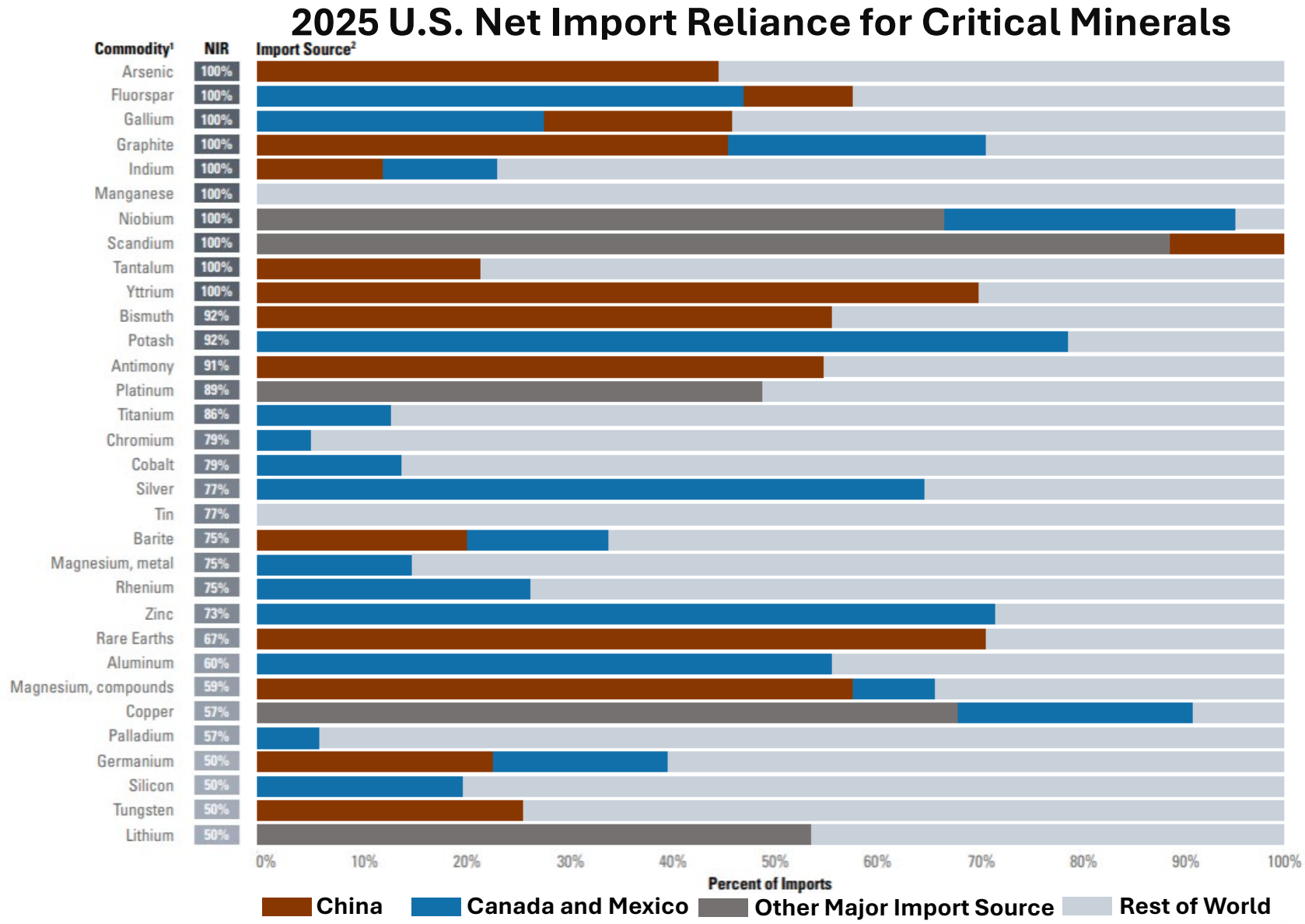

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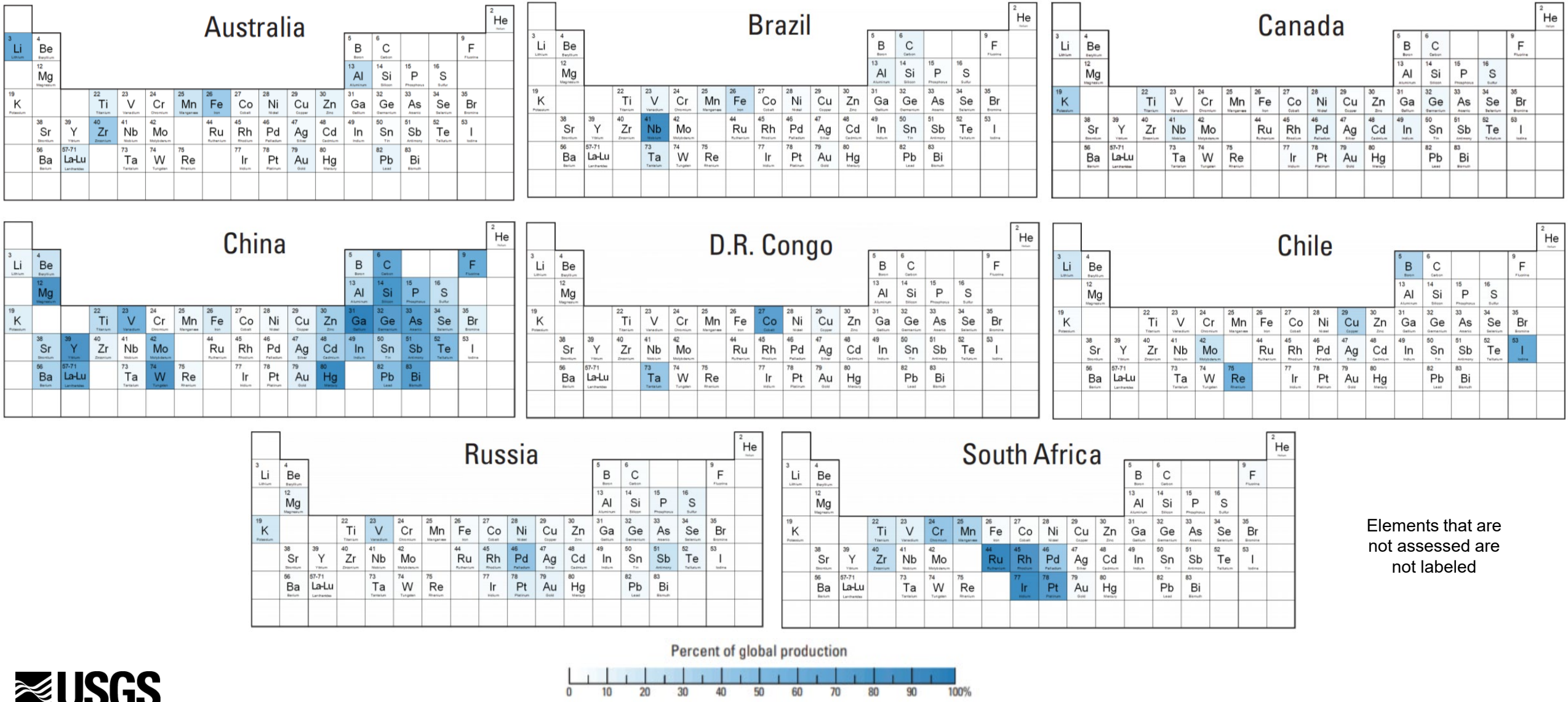
The production of many mineral commodities is highly concentrated in a few countries



USGS

Nassar, N.T., Alonso, E., and Brainard, J.L., 2020, Investigation of U.S. Foreign Reliance on Critical Minerals—U.S. Geological Survey Technical Input Document in Response to Executive Order No. 13953 Signed September 30, 2020 (Ver. 1.1, December 7, 2020): U.S. Geological Survey Open-File Report 2020–1127, 37 p., https://doi.org/10.3133/ofr20201127.

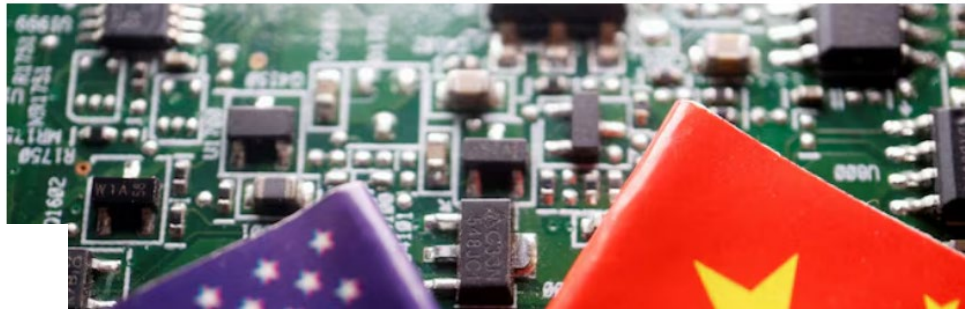
Mineral commodity supply cannot be taken for granted

Export Controls

China to restrict exports of chipmaking materials as US mulls new curbs

By **Reuters**

July 3, 2023 9:08 PM EDT · Updated a year ago



Logistics Delays

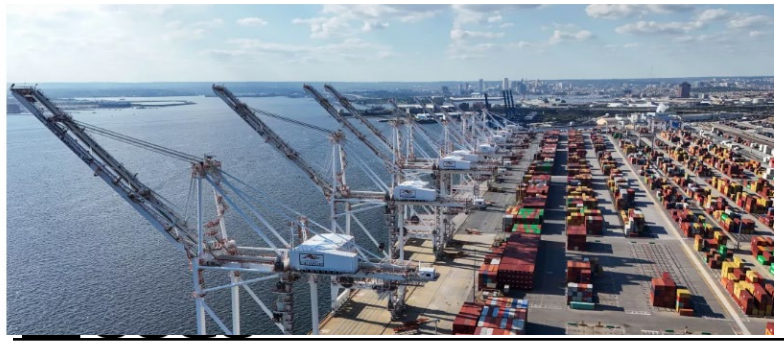
Port strikes end with deal on wages, averting economic disaster

UPDATED OCTOBER 4, 2024 · 8:03 AM ET

HEARD ON ALL THINGS CONSIDERED

Andrea Hsu

4-Minute Listen + PLAYLIST



Cost Uncertainty

LME benchmark nickel jumps 15%, hits price limit in thin market

By **Eric Onstad**

March 24, 2022 9:23 AM EDT · Updated 3 years ago



Geopolitical Disruptions

Iran war threatens global helium supply

Attacks on Qatar and the Strait of Hormuz remove one-third of the world's helium from the market

by **Craig Bettenhausen**

March 6, 2026 • 4 min read

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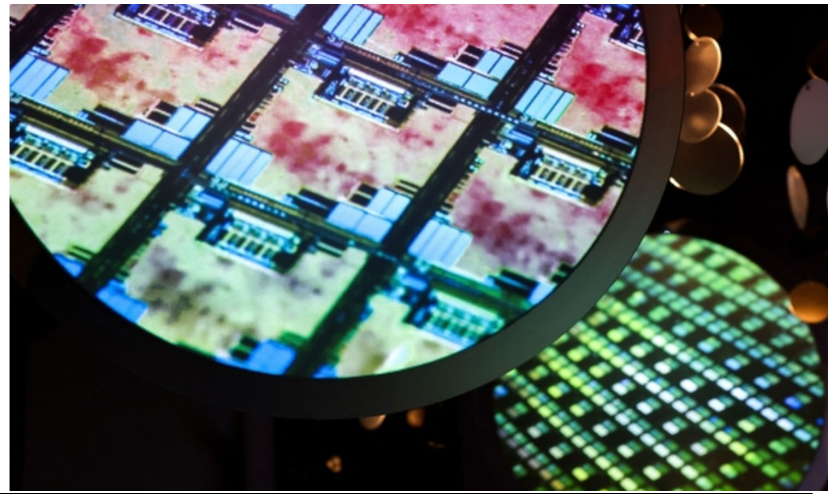


Sources: https://www.npr.org/2024/10/03/nx-s1-5139450/dockworkers-port-strike-deal, https://www.reuters.com/markets/commodities/china-restrict-exports-chipmaking-materials-us-mulls-new-curbs-2023-07-04/, https://www.reuters.com/world/china/lme-benchmark-nickel-jumps-15-hits-price-limit-thin-market-2022-03-24/, https://cen.acs.org/business/specialty-chemicals/Iran-war-threatens-global-helium/104/web/2026/03, and https://en.sedaily.com/international/2026/03/05/qatar-helium-halt-threatens-global-chip-supply.

China's recent critical mineral export restrictions heightened the need to quantify and reduce the associated risks

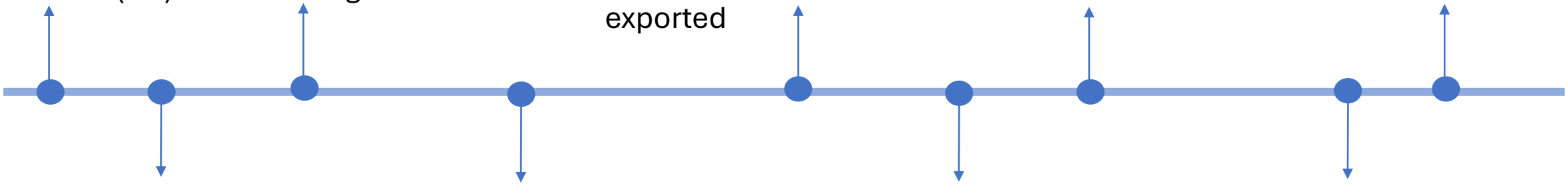
July 2023: China announces export controls on Gallium (Ga), Germanium (Ge)

Dec. 2023: China announces export ban on rare earth processing technologies

Dec. 2024: China announces export bans for Sb, Ga, Ge. Stricter review of graphite items exported

April 2025: China announces export controls on 7 rare earths and RE magnets

Nov. 2025: China suspends/pauses export restrictions on REEs, Li-ion battery materials, Ga, Ge, Sb, superhard materials



October 2023: China announces export controls on certain graphite products

August 2024: China announces export controls on Antimony (Sb)

Feb. 2025: China announces export controls on Bismuth (Bi), Indium (In), Molybdenum (Mo), Tellurium (Te), Tungsten (W)

Oct. 2025: China announces additional controls on heavy REEs and the devices that use them

https://www.reuters.com/markets/commodities/china-restrict-exports-chipmaking-materials-us-mulls-new-curbs-2023-07-04/

https://www.csis.org/analysis/what-chinas-ban-rare-earths-processing-technology-exports-means

https://www.reuters.com/markets/commodities/what-is-antimony-why-is-china-curbing-its-exports-2024-08-16/

https://www.reuters.com/world/china/china-expands-critical-mineral-export-controls-after-us-imposes-tariffs-2025-02-04/

https://cset.georgetown.edu/publication/china-export-control-catalog-july-2025/

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https://www.reuters.com/world/china/china-require-export-permits-some-graphite-products-dec-1-2023-10-20/

https://www.reuters.com/markets/commodities/china-bans-exports-gallium-germanium-antimony-us-2024-12-03/

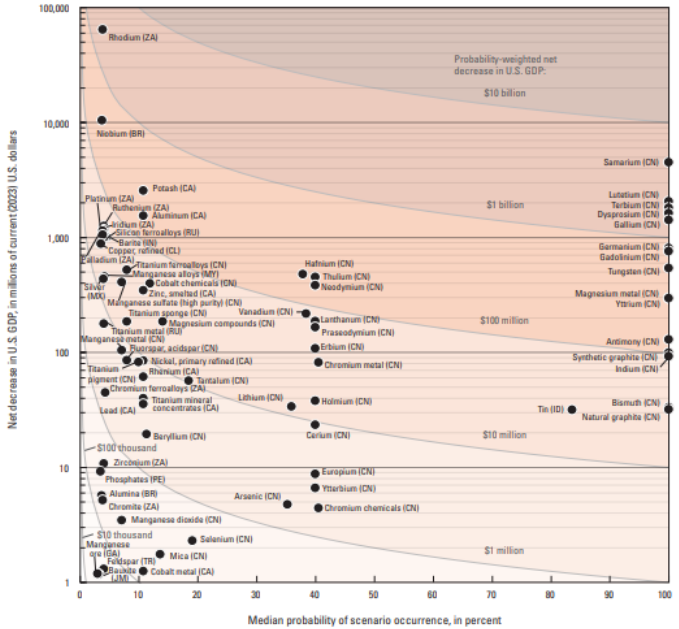
https://cset.georgetown.edu/wp-content/uploads/t0656_china_rare_earth_controls_2025_61_EN.pdf

https://www.cnbc.com/2025/11/10/china-suspends-some-critical-mineral-export-curbs-to-the-us-as-trade-truce-takes-hold.html

What makes a mineral commodity critical?
Supply disruption risk and importance to the U.S. economy and defense

USGS science for a changing world

Methodology and Technical Input for the 2025 U.S. List of Critical Minerals—Assessing the Potential Effects of Mineral Commodity Supply Chain Disruptions on the U.S. Economy



Open-File Report 2025–1047

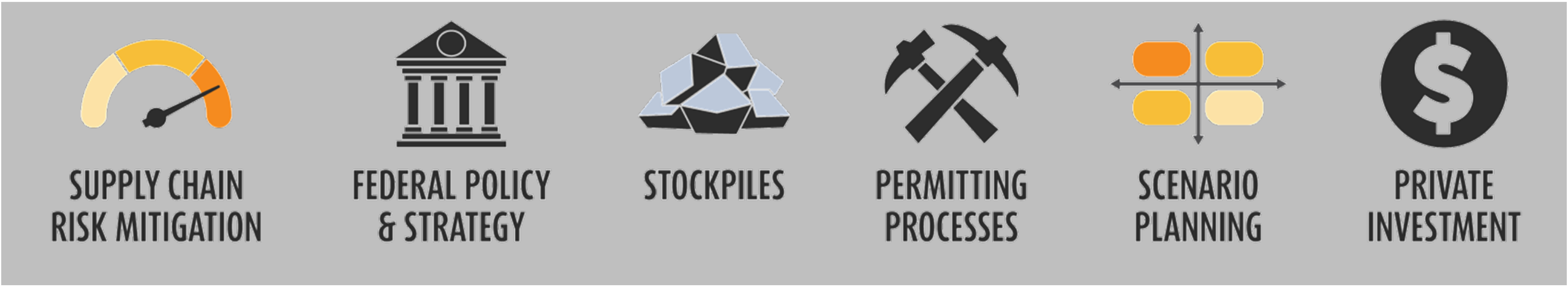
The Energy Act of 2020 defines a "critical mineral" as a non-fuel mineral or mineral material that:

- is **essential to the economic or national security of the U.S.**
- has a supply chain **vulnerable to disruption**
- serves an **essential function** in the manufacturing of a product, the absence of which would have significant **consequences for the economy** or **national security**.

Nassar, N.T., Pineault, D., Allen, S.M., McCaffrey, D.M., Padilla, A.J., Brainard, J.L., Bayani, M., Shojaeddini, E., Ryter, J.W., Lincoln, S., and Alonso, E., 2025, Methodology and technical input for the 2025 U.S. List of Critical Minerals—Assessing the potential effects of mineral commodity supply chain disruptions on the U.S. economy: U.S. Geological Survey Open-File Report 2025–1047, 32 p., https://doi.org/10.3133/ofr20251047.

How the List is Used

- Assess Risks to the Nation's Economy and National Security
- Guide Federal Policies to Strengthen Mineral Commodity Supply Chains
- Inform Tax Incentives, Accelerated Permitting, and Government Investment
- Prioritize Resource Mapping and Development Efforts



Mineral criticality is not static. The List of Critical Minerals is dynamic and will be updated to reflect changes in mineral supply chain risk at least every 3 years.

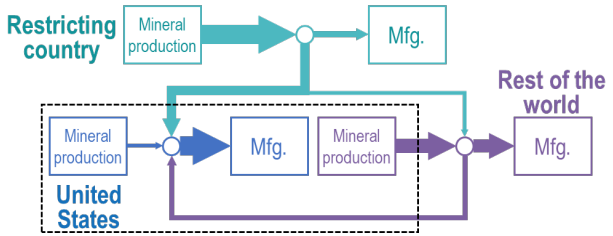
USGS

Nassar, N.T., Shojaeddini, E., Alonso, E., Jaskula, B., and Tolcin, A., 2024, Quantifying potential effects of China's gallium and germanium export restrictions on the U.S. economy: U.S. Geological Survey Open-File Report 2024–1057, 66 p., https://doi.org/10.3133/ofr20241057.

Assessment provides a stress test that quantifies the impacts of mineral commodity supply chain disruption scenarios on the U.S. economy

Scenario quantification

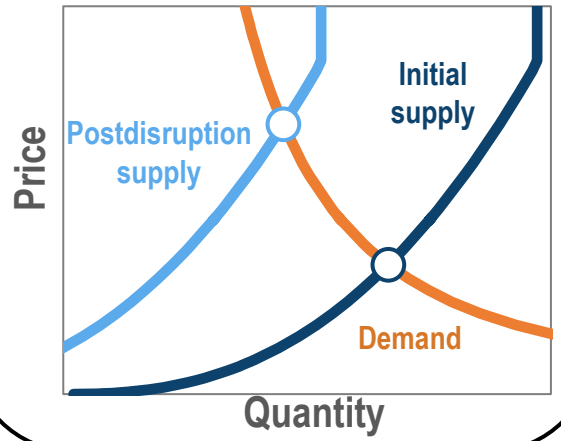
Defines a scenario as a yearlong disruption of U.S. net imports from a single trading partner



84 mineral commodities
1200+ scenarios

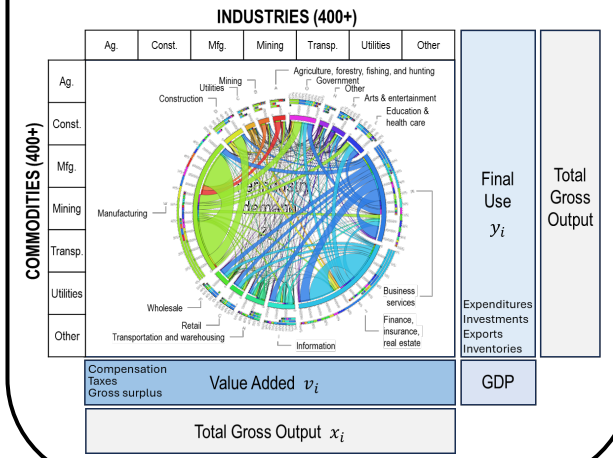
Equilibrium displacement module

Calculates the mineral commodity's post-disruption price and quantity for each scenario



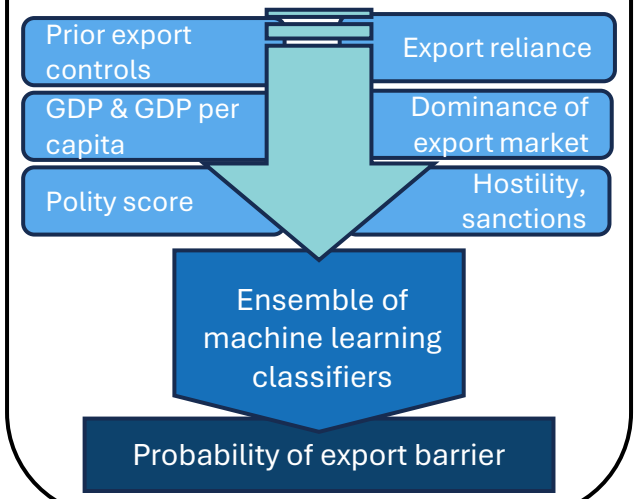
Economic impacts module

Models the impacts of the disruptions on the U.S. economy



Scenario probability module

Estimates the probability of each scenario's occurrence



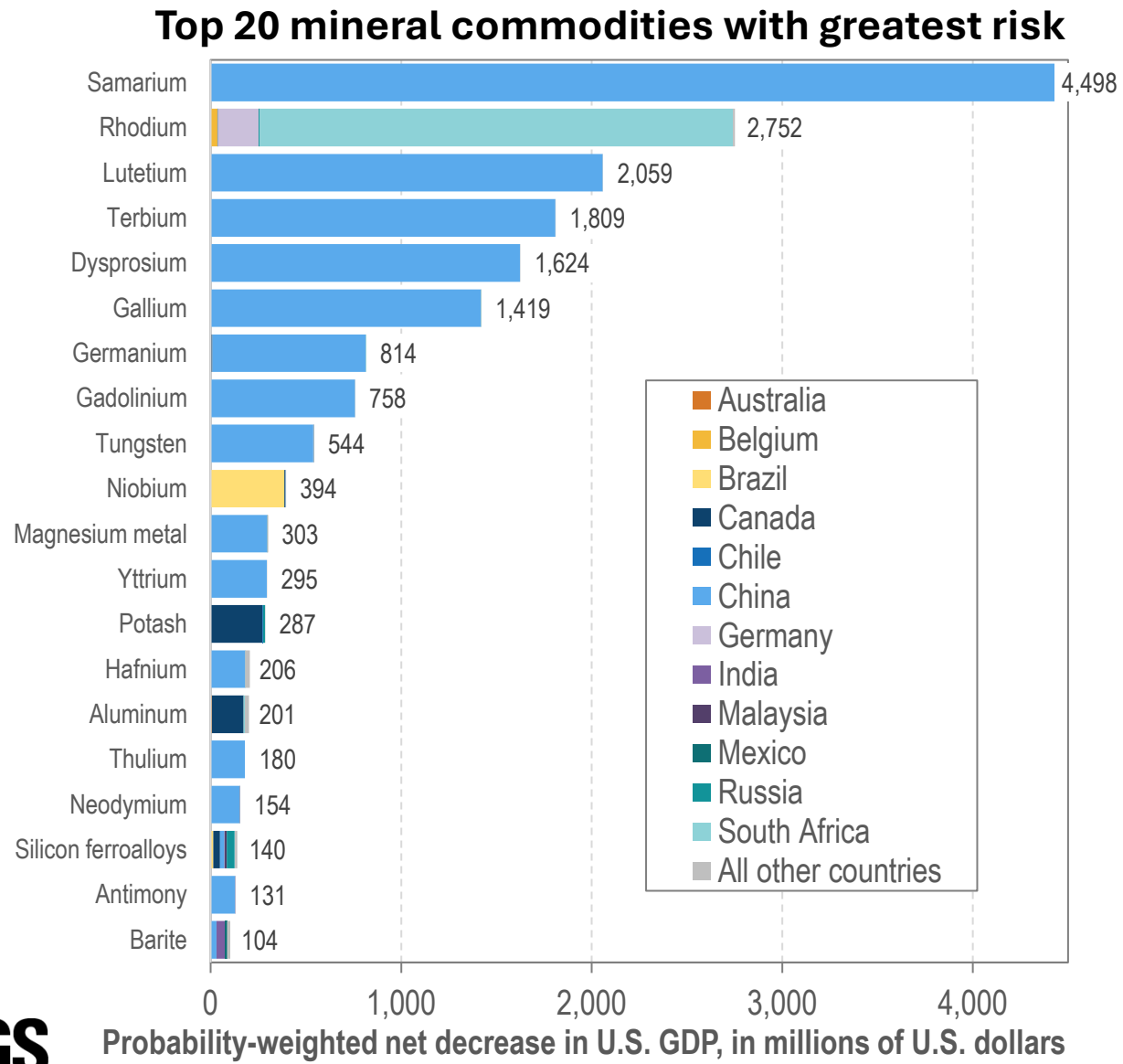
Exposure **Vulnerability** **Hazard**

Overall **RISK** is the probability-weighted sum of impacts across all scenarios

USGS

Nassar, N.T., Pineault, D., Allen, S.M., McCaffrey, D.M., Padilla, A.J., Brainard, J.L., Bayani, M., Shojaeddini, E., Ryter, J.W., Lincoln, S., and Alonso, E., 2025, Methodology and technical input for the 2025 U.S. List of Critical Minerals—Assessing the potential effects of mineral commodity supply chain disruptions on the U.S. economy: U.S. Geological Survey Open-File Report 2025–1047, 32 p., https://doi.org/10.3133/ofr20251047.

The modeled impacts were weighted by the probability of each scenario's occurrence to provide an overall risk evaluation for each mineral commodity.



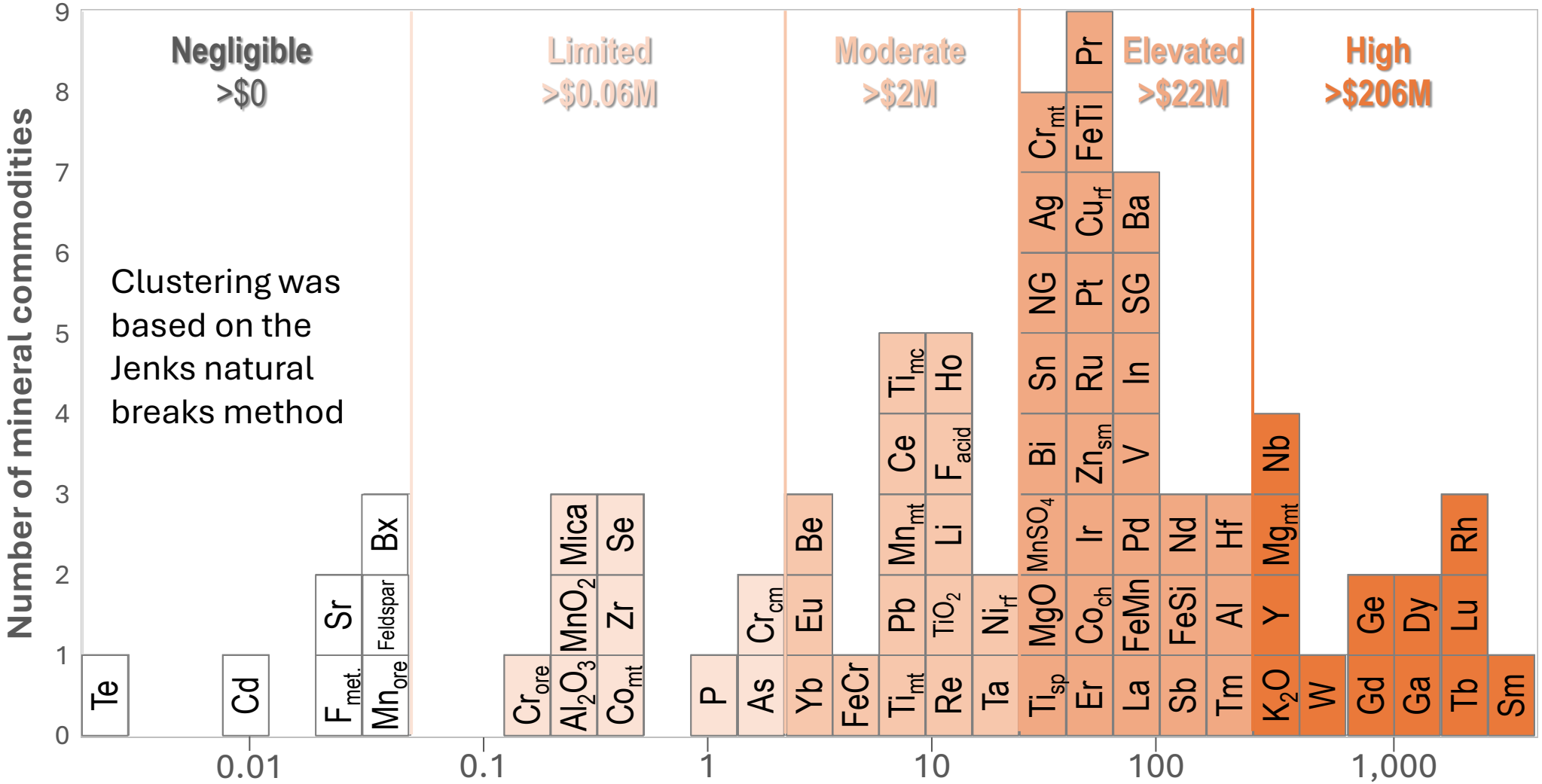
- A number of Rare Earth Elements were identified with greatest risk
  - Overreliance on single producer and low price elasticity of demand
- Consuming industries would be forced to reduce their output or pay higher prices resulting in additional downstream impacts
- Many of the scenarios were tied to high import reliance on China with few alternatives of other suppliers

USGS

Nassar, N.T., Pineault, D., Allen, S.M., McCaffrey, D.M., Padilla, A.J., Brainard, J.L., Bayani, M., Shojaeddini, E., Ryter, J.W., Lincoln, S., and Alonso, E., 2025, Methodology and technical input for the 2025 U.S. List of Critical Minerals—Assessing the potential effects of mineral commodity supply chain disruptions on the U.S. economy: U.S. Geological Survey Open-File Report 2025–1047, 32 p., https://doi.org/10.3133/ofr20251047.

Mineral commodities were classified into risk categories using a Jenks Natural Breaks Optimization Method

Histogram and clustering of overall risk assessment



Mineral commodities with negative risk

Nickel (mined)
Copper (mined)
Zinc (mined)
Iron ore
Helium
Silicon metal
Molybdenum
Gold

Mineral commodities evaluated qualitatively

Cesium
Rubidium
Scandium

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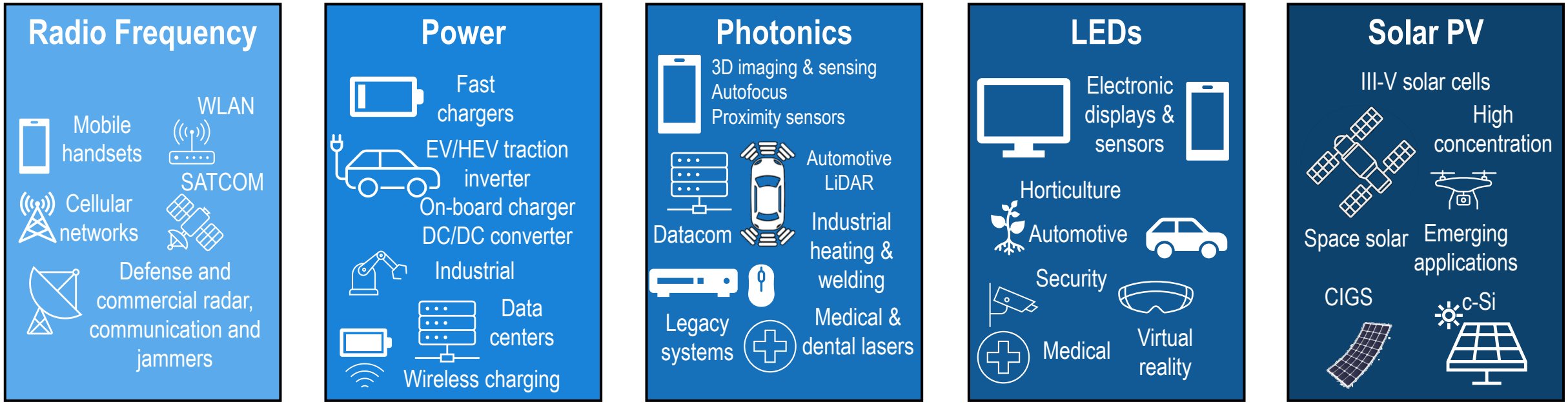
Probability-weighted net decrease in U.S. GDP, in millions of U.S. dollars (log scale)

Nassar, N.T., Pineault, D., Allen, S.M., McCaffrey, D.M., Padilla, A.J., Brainard, J.L., Bayani, M., Shojaeddini, E., Ryter, J.W., Lincoln, S., and Alonso, E., 2025, Methodology and technical input for the 2025 U.S. List of Critical Minerals—Assessing the potential effects of mineral commodity supply chain disruptions on the U.S. economy: U.S. Geological Survey Open-File Report 2025–1047, 32 p., https://doi.org/10.3133/ofr20251047.

Gallium export controls were announced in July 2023; China produces 98% of the world's primary low-purity gallium

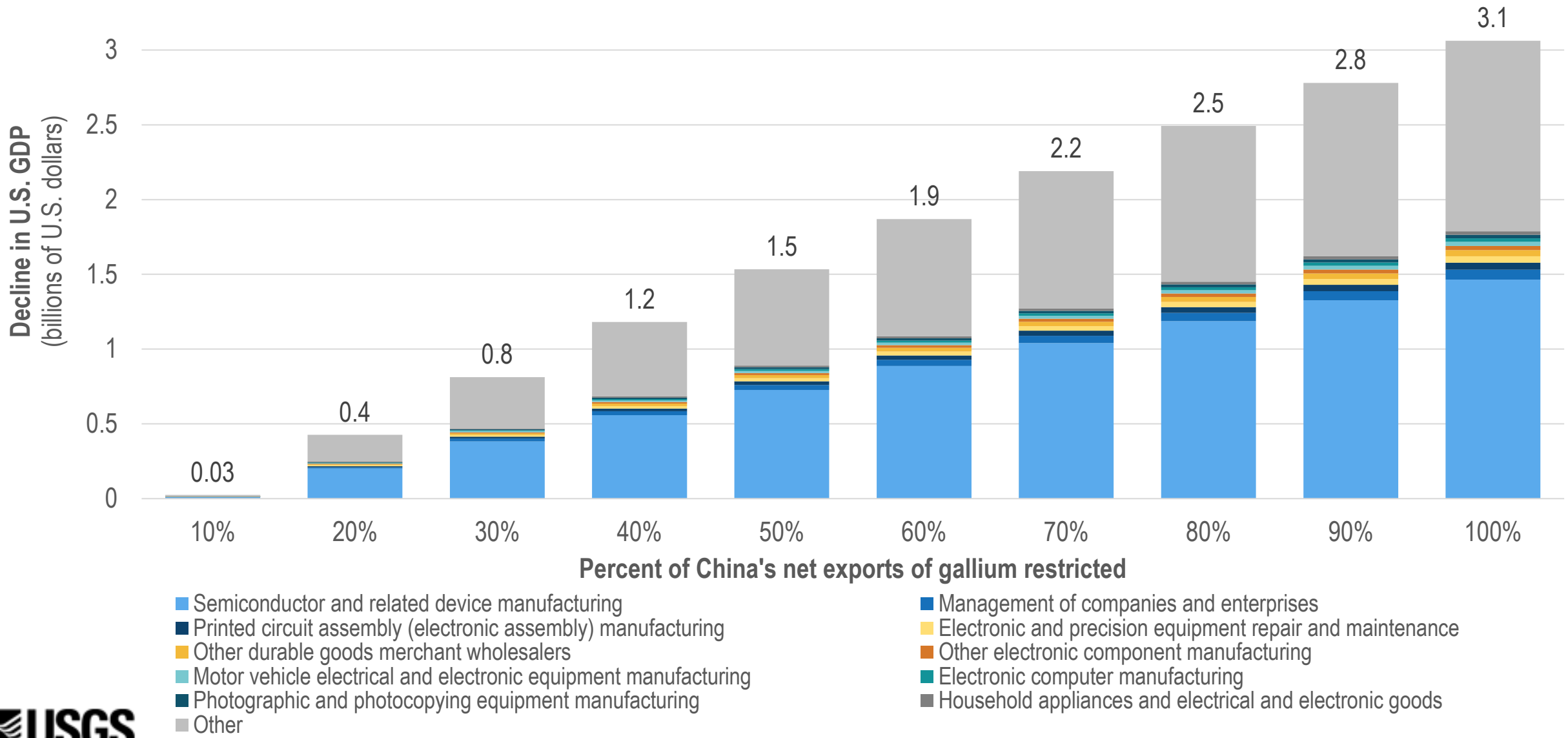
Gallium



USGS

Nassar, N.T., Shojaeddini, E., Alonso, E., Jaskula, B., and Tolcin, A., 2024, Quantifying potential effects of China's gallium and germanium export restrictions on the U.S. economy: U.S. Geological Survey Open-File Report 2024–1057, 66 p., https://doi.org/10.3133/ofr20241057.

A scenario modeling a complete restriction of Chinese exports of gallium estimated a potential U.S. GDP decline of just over $3 billion

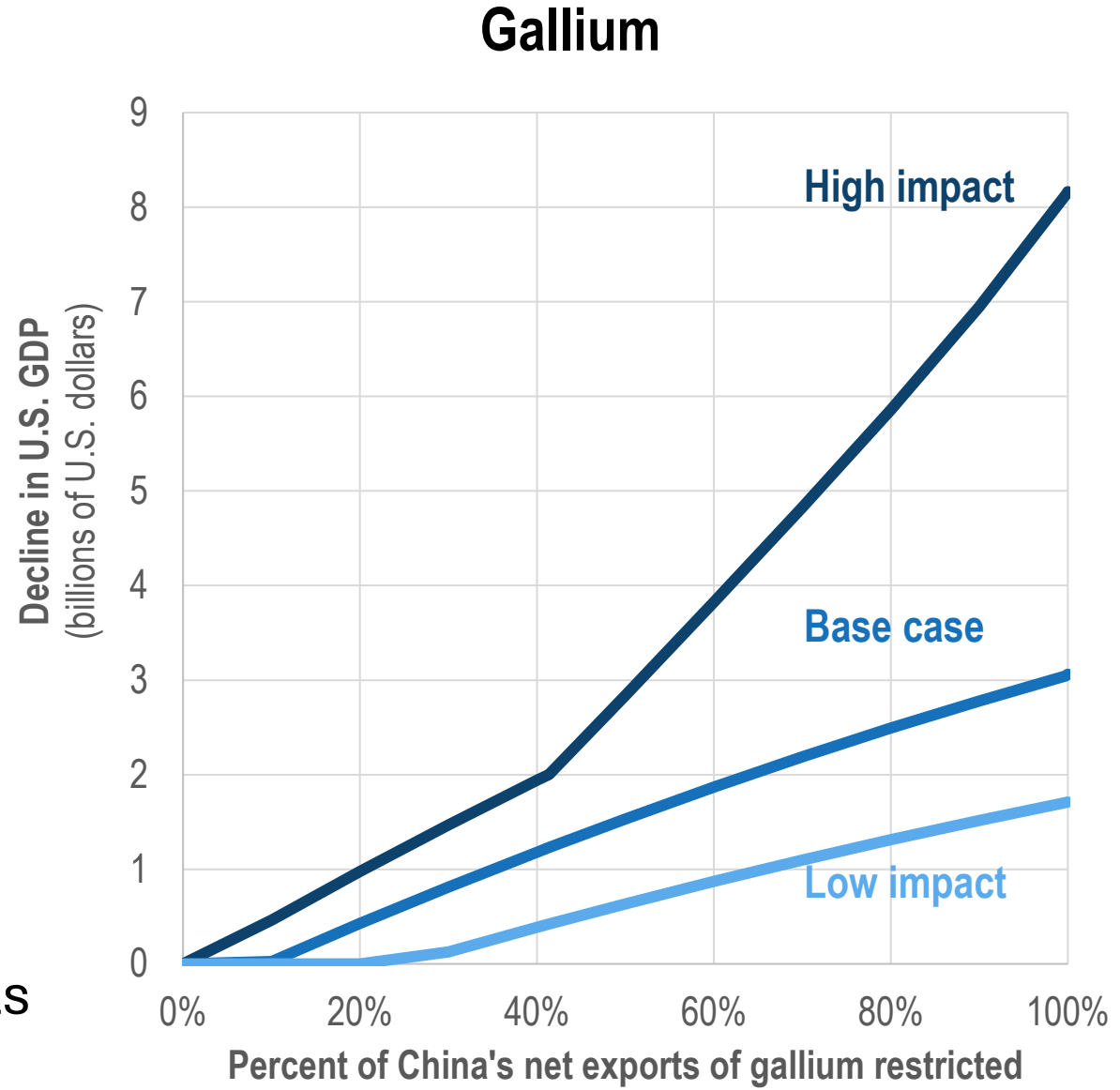


USGS

Nassar, N.T., Shojaeddini, E., Alonso, E., Jaskula, B., and Tolcin, A., 2024, Quantifying potential effects of China's gallium and germanium export restrictions on the U.S. economy: U.S. Geological Survey Open-File Report 2024–1057, 66 p., https://doi.org/10.3133/ofr20241057.

But rather than predict the future, various scenarios can be compared to obtain a likely range of impacts at different disruption levels, ex: Gallium

- Here, 3 sensitivity cases were evaluated to address high uncertainty in the parameters used for the model:
  - China's net exports
  - Inventory levels in the rest of the world before the restriction is applied
  - Excess capacity levels in the rest of the world
  - U.S. apparent consumption
  - Unit value of U.S. apparent consumption
  - % of semiconductor industry that uses gallium
- Different scenarios were used for the technical input for the List of Critical Minerals

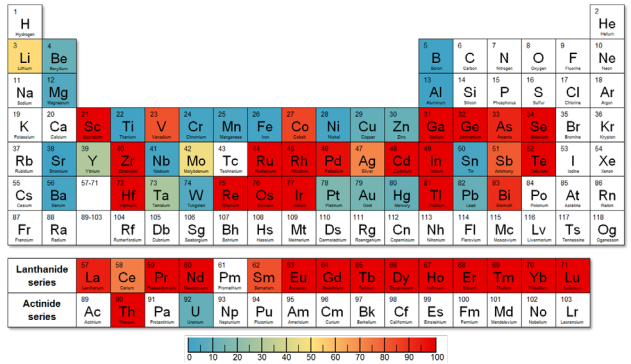


USGS

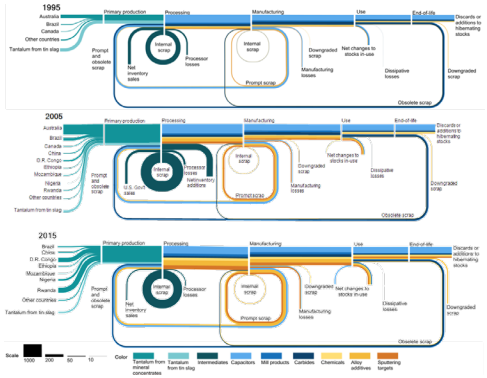
Nassar, N.T., Shojaeddini, E., Alonso, E., Jaskula, B., and Tolcin, A., 2024, Quantifying potential effects of China's gallium and germanium export restrictions on the U.S. economy: U.S. Geological Survey Open-File Report 2024–1057, 66 p., https://doi.org/10.3133/ofr20241057.

USGS is building a suite of models and tools to track and assess mineral commodity supply chains

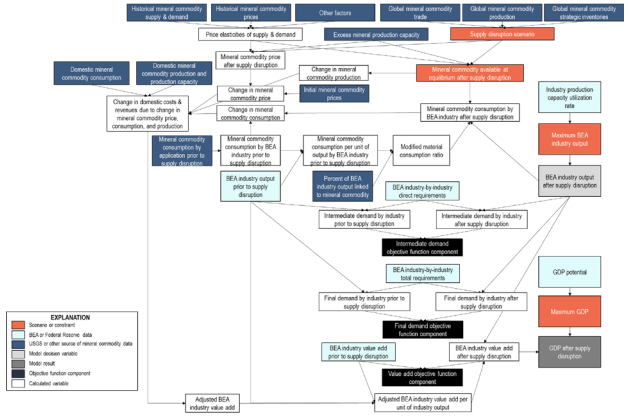
Byproduct element recovery potential



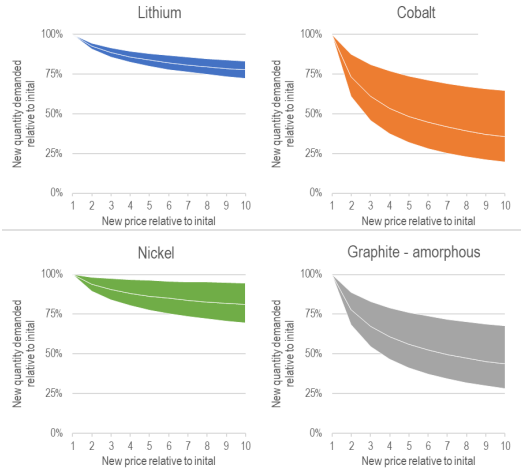
Global and national material flow analyses



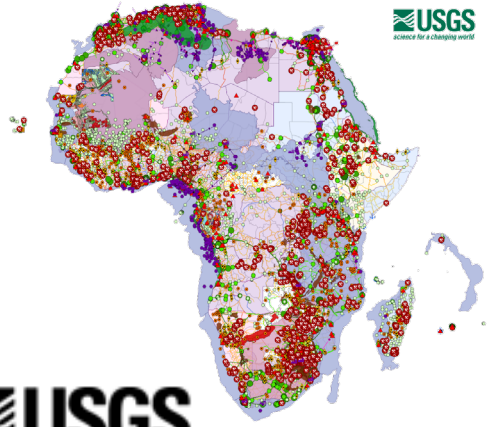
Supply risk assessment



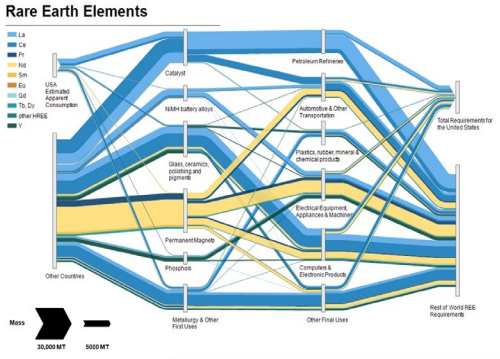
Mineral commodity economic analyses



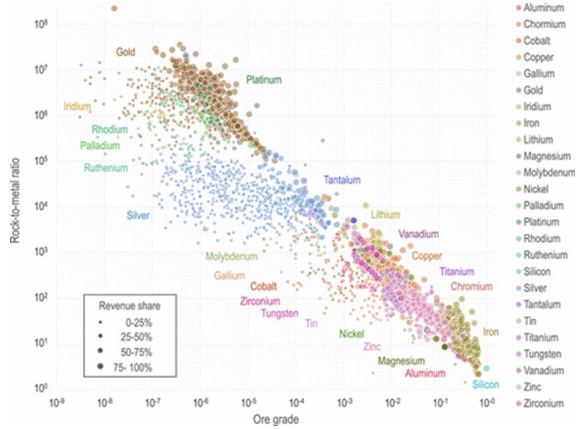
Asset-level mine and facility information



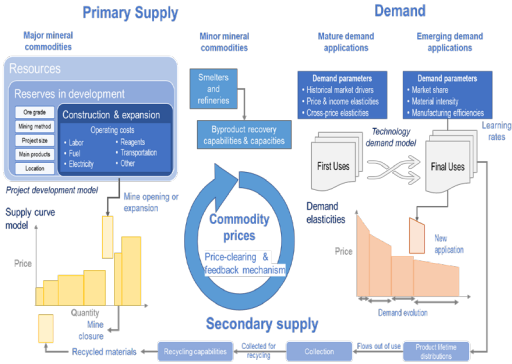
Embedded and indirect trade flows



Assessment of externalities



Supply & demand scenarios



USGS

World Minerals Outlook

Where will world production capacity be in 2029? Country by country, commodity by commodity.

- Forward-looking capacity outlooks through 2029
- Country-level detail: where capacity is growing, idled, or at risk (independent of market-price forecasts)
- Complements the MCS (today's snapshot) and the Yearbook (the historical record) with the forward view

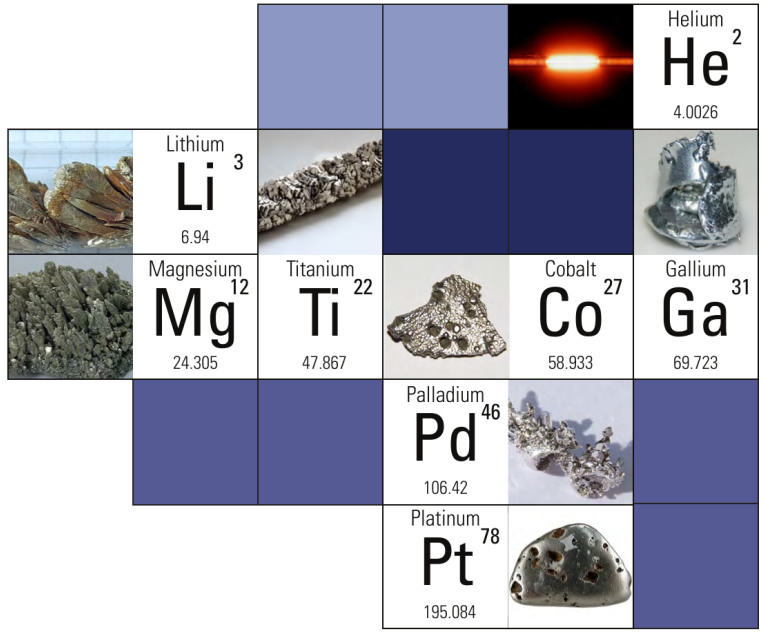
EIGHT COMMODITIES IN THE FIRST EDITION

He	Li	Mg	Ti	Co	Ga	Pd	Pt

cobalt · gallium · helium · lithium · magnesium · palladium · platinum · titanium sponge

USGS
science for a changing world

World Minerals Outlook—Cobalt, Gallium, Helium, Lithium, Magnesium, Palladium, Platinum, and Titanium Through 2029



Scientific Investigations Report 2025–5021
Version 1.1, March 2025

U.S. Department of the Interior
U.S. Geological Survey

USGS

Alonso, E., Brioche, A.S., Schulte, R.F., Trimmer, L.M., Kim, J.-E., Gulley, A.L., and Pineault, D.G., 2025, World minerals outlook—Cobalt, gallium, helium, lithium, magnesium, palladium, platinum, and titanium through 2029 (ver. 1.1, March 14, 2025): U.S. Geological Survey Scientific Investigations Report 2025–5021, 19 p., https://doi.org/10.3133/sir20255021.

Earth Mapping Resources Initiative (Earth MRI)

Re-mapping the Nation, Above and Below Ground

The USGS launched Earth MRI in 2019 because the Nation was under mapped. Earth MRI was accelerated by the Infrastructure Investment and Jobs Act (IIJA) to deliver national assessments of critical mineral resources.

Current focus

Critical mineral resources:

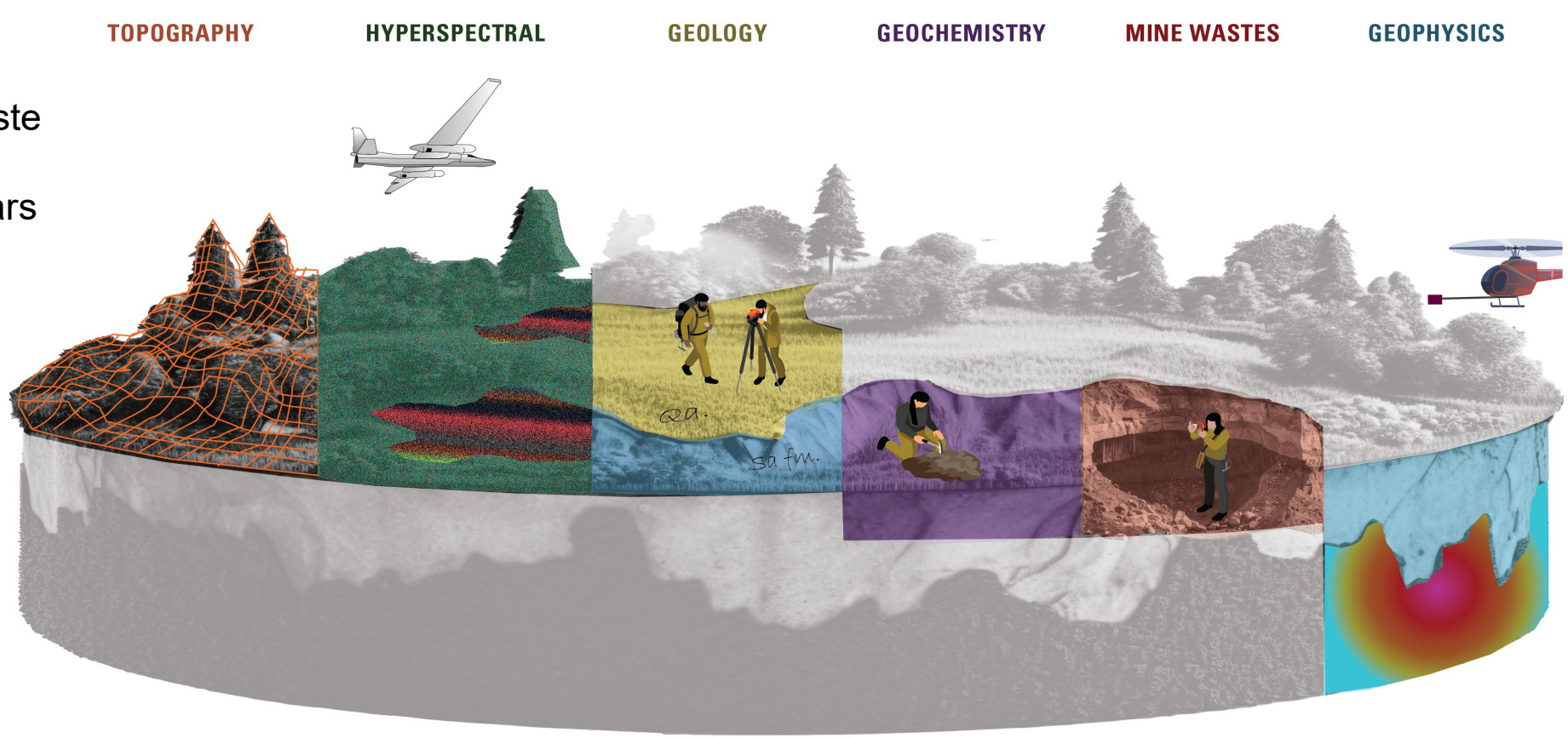
- Still in the ground
- Above ground in mine waste
- IIJA direction for national maps completed in 10 years
- Construction resources

Additional applications

Energy and water resources, natural hazards, land use planning, infrastructure

Data Types

Geologic Mapping
Geochemistry
Airborne Geophysics
Hyperspectral Remote Sensing
High Resolution Topography

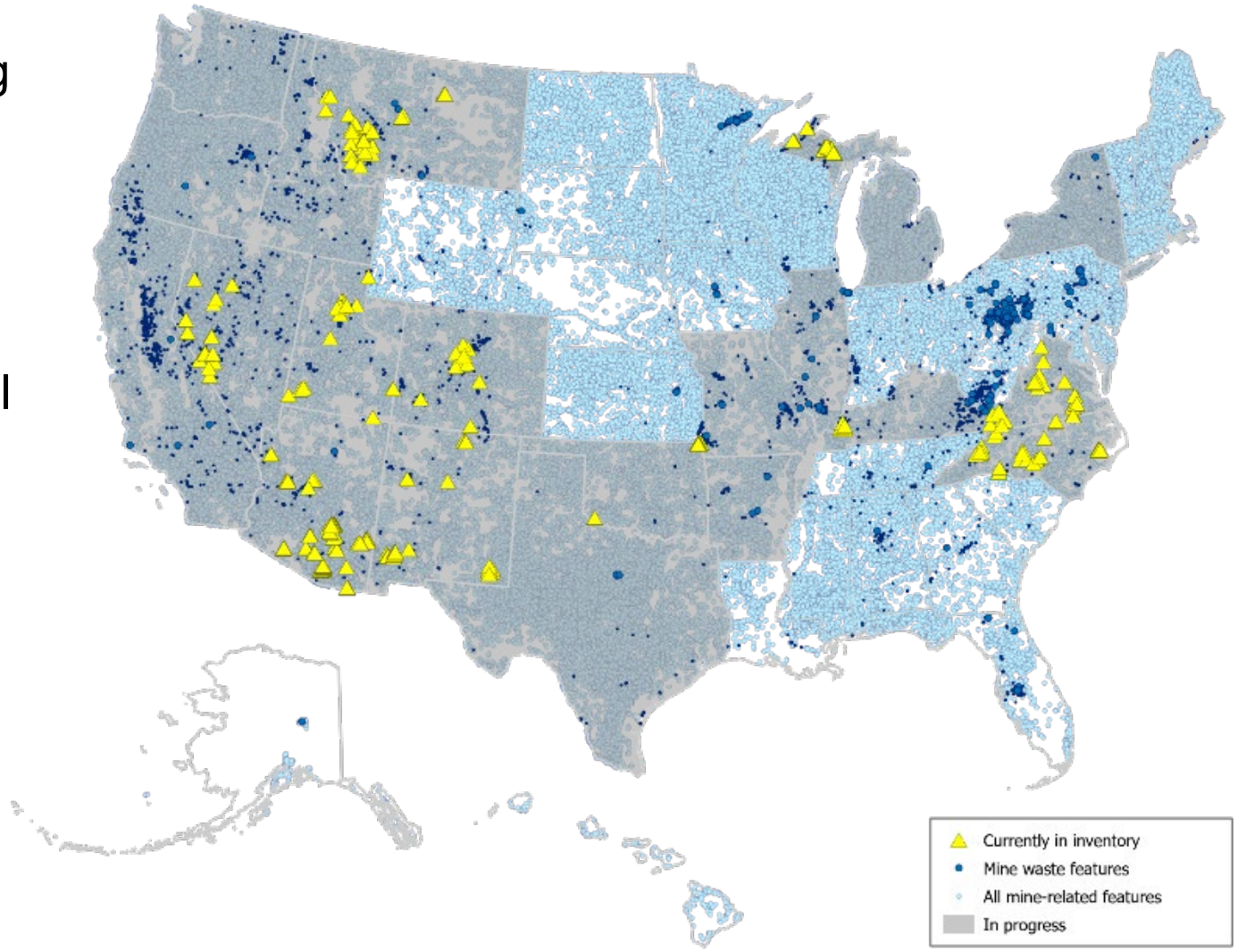


USGS

Mine Waste as an Emerging Resource

- More than half of critical minerals are byproducts or co-products of other mining processes
- USGS has spent a decade identifying mine features nationwide
- The USGS is developing the first National Mine Waste Inventory
- Insight into the volume, location, and potential of mine-waste materials for recovery
- Supports land managers and identifies highest-value recovery opportunities

National Mine Waste Inventory



USGS

U.S. Geological Survey, 2026, National mine waste inventory: U.S. Geological Survey data release, https://doi.org/10.5066/P148EEUA.

Questions?



Photo credit: USGS

Contact Information:

- Robert Goodin
- rgoodin@usgs.gov
- Mineral Commodity Specialist
- National Minerals Information Center
- U.S. Geological Survey

NMIC Website

https://www.usgs.gov/centers/national-minerals-information-center