

Mission Impossible

Mineral Shortages and the Broken Permitting
Process Put Net Zero Goals Out of Reach

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AND SARAH MONTALBANO

Energy Transition Policies Create an Enormous Demand for Minerals

- Minerals underpin both renewable and conventional energy, national defense, and the modern economy
- Policymakers are implementing Net Zero Emissions by 2050 (NZE) standards that spur new mineral demand
- Mineral demands outpace mineral supplies
 - Business-as-usual needs must still be met while...
 - Artificial intelligence data center and electrification and renewable energy demands grow
- Public policies impede domestic mining projects needed for net zero goals
- Consequently, the U.S. is dangerously reliant on foreign mineral supplies
- Obtaining minerals from some foreign countries comes with serious environmental and human rights costs



What is “Net Zero by 2050?”

- “Net Zero by 2050” set by the 2015 Paris Climate Agreement
 - 190 signatory nations, including the U.S., after a brief withdrawal in 2020
 - Aims to limit global temperature increase to below 1.5 degrees Celsius above pre-industrial levels by 2100
- NZE is the International Energy Agency’s Scenario that assumes:
 - Global CO₂ emissions are net-zero by 2050
 - Global temperature rise is restricted to 1.5 degrees Celsius above pre-industrial levels by 2100
 - United Kingdom and Germany have enacted laws with similar/more ambitious timelines
 - U.S. states like Minnesota are enacting laws to enforce entirely carbon-free electricity by 2040
- Announced Pledges Scenario (APS)
 - IEA scenario assuming “that all climate commitments made by governments and industries around the world will be met in full and on time”
 - Global temperature rise would be restricted to 1.7 degrees Celsius with a 50% probability



What Do “Business-as-Usual” Mineral Demands Look Like?

- Each American uses 3.02 million pounds of minerals, metals, and fuels during their lifetime
- That’s 40,630 pounds per American *per year*
 - Minerals like copper, cobalt, nickel, and rare earth elements are extensively used in modern electronics, lithium-ion batteries, renewable energy technologies, and national defense
- Copper – the lynchpin of electrification
 - The average single-family home contains 439 pounds of copper
 - To meet even just business-as-usual needs, 115% more copper must be mined in the next 30 years than has been mined in human history through 2018 (Cathles & Simon).
 - BHP is forecasting a 70% surge in copper demand by 2050



Minerals Baby



Every American Born Will Need...
3.02 MILLION POUNDS of minerals,
metals, and fuels in their lifetime

55,461 lbs.
CEMENT

10,685 lbs.
CLAYS

251,998 lbs.
COAL

1,018 lbs.
COPPER

1,832 lbs.
BAUXITE
(ALUMINIUM)

1.34 Troy oz.
GOLD

18,317 lbs.
IRON ORE

814 lbs.
LEAD

1 lb.
LITHIUM

12,720 lbs.
PHOSPHATE ROCK

27,476 lbs.
SALT

4 lbs.
SILVER

1.36M lbs.
STONE, SAND
& GRAVEL

468 lbs.
ZINC

+1.03M lbs.
OTHER MINERALS,
METALS & FUELS

SME
FOUNDATION
MEC
MINERALS EDUCATION
COALITION

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Learn more: [MineralsEducationCoalition.org](https://www.MineralsEducationCoalition.org)

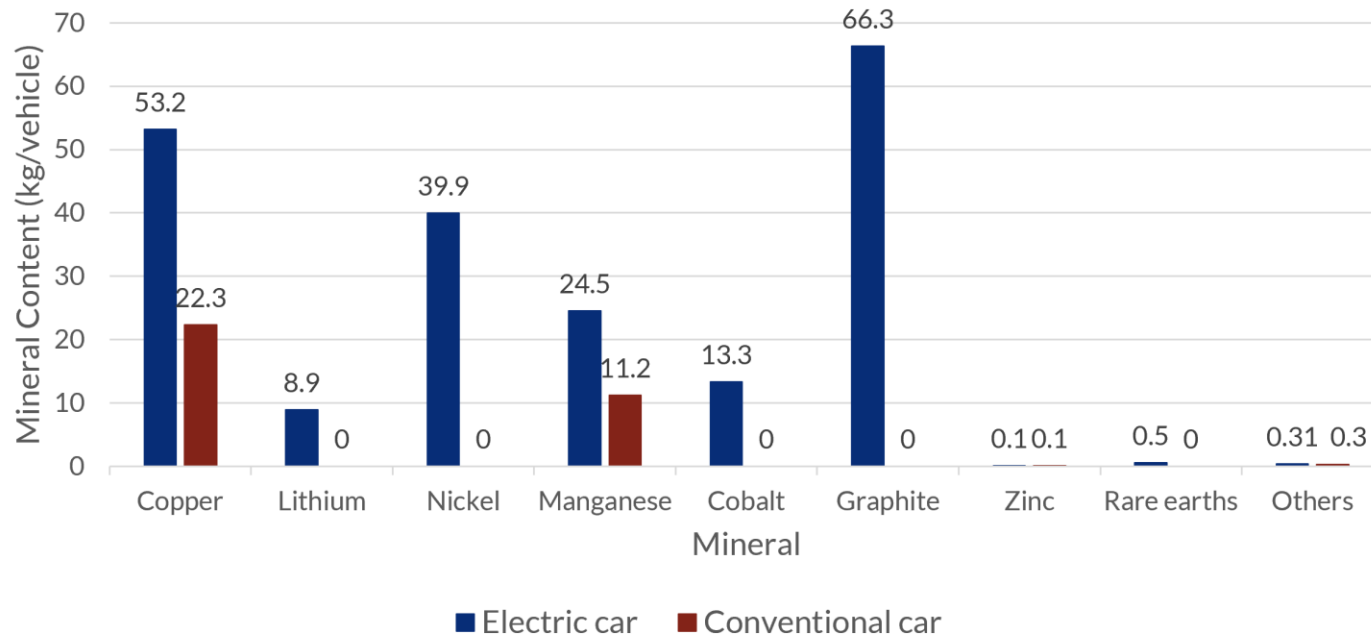


Mineral Demands for Alt-energy and AI Outpace Mineral Supplies

- Manufacturing enough EVs, solar panels, wind turbines, battery storage, and more transmission networks will consume large amounts of lithium, copper, nickel, cobalt, graphite, and rare earths
- Forecasted widespread adoption of battery electric vehicles is a key driver of soaring mineral demand
 - BEVs require far more copper and manganese than internal combustion engines
 - BEV charging networks also require lots of copper
 - ICEs do not require lithium, nickel, cobalt, graphite, and rare earths
- Shortfalls, where demand will exceed supply, are imminent for:
 - Copper — after 2025
 - Cobalt — after 2030
 - Nickel — after 2025
- Technological advancements and recycling will help, but cannot eliminate the 2050 shortfall

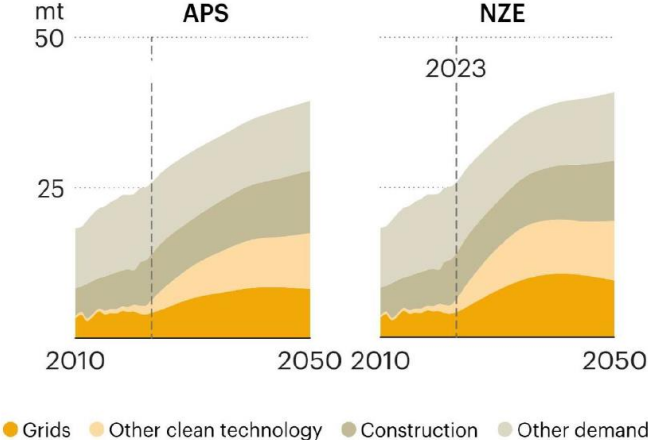


Mineral Requirements BEV vs. ICE vehicles

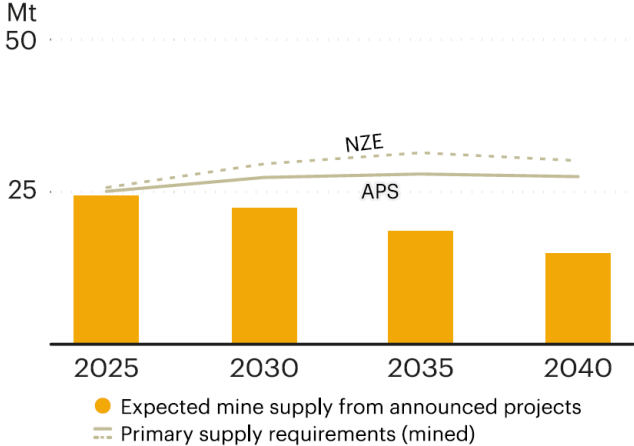


Source: The Role of Critical Minerals in Clean Energy Transitions, IEA. <https://www.iea.org/data-and-statistics/charts/minerals-used-in-electric-cars-compared-to-conventional-cars>

Predicted Copper Shortfall



Projected Copper Demand for All Uses



Projected Copper Supply is Inadequate to Achieve all Energy Transition Goals

Source: International Energy Agency



BHP Copper Demand Forecast

- BHP projects a 70% surge in copper demand by 2050—an increase of 22.1 Mt from 2021 levels
- This increase is equivalent to the output of more than 16 Escondida mines running at full capacity
- Escondida, the world's largest copper mine, produced 1.1 million metric tons of copper in 2023
- Simultaneous surge in copper demand worldwide in next 25 years for worldwide electrification, decarbonization, and digitization, which is happening everywhere at once
- Copper is critical for electric cars and charging networks, renewable energy systems, Artificial Intelligence (AI) data centers, *plus* construction, capital goods, and consumer products
- Renewable energy systems use much more copper than traditional energy grids
- Current copper supplies: Latin America (8.8 Mtpa), Asian-Pacific (4 Mtpa), Africa (3.6 Mtpa), North America (2.3 Mtpa), Russia and Caspian (2.0 Mtpa), and Europe (1.1 Mtpa),



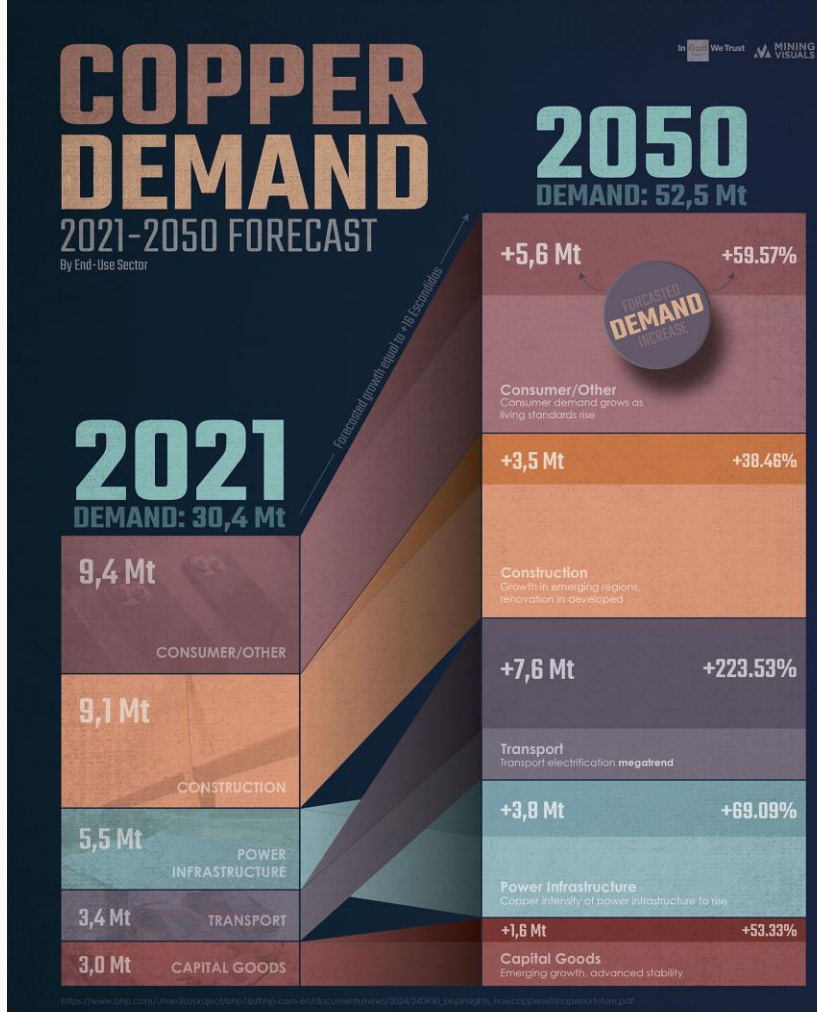
Copper Demand for the Transportation Sector Projected to Increase 223.53%

- Power infrastructure creates the second largest copper demand
- *Does the world contain enough copper to meet these demands?*
- *Can we discover the equivalent of 16 new Escondida Mines in time to avoid widespread shortages?*

Sources:

<https://www.miningvisuals.com/post/bhp-projects-70-rise-in-copper-demand-by-2050-electrification-and-tech-revolution-lead-the-way>

<https://www.bhp.com/news/bhp-insights/2024/09/how-copper-will-shape-our-future>



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AI Power Demand Expected to Grow Eightyfold Over the Next Decade

- Data centers to support the computing power necessary for burgeoning AI uses are being constructed rapidly — with associated demand for reliable and affordable electricity
- Forecasts:
 - Data centers could consume up to 9% of U.S. electricity generation by 2030 (Electric Power Research Institute)
 - Electricity demand to grow from 200 TWh in 2022 to 260 TWh in 2026 (IEA), representing an increase from 4% to 6% of total electricity demand
- AI data centers are exacerbating copper demand because copper is used in power cables, busbars, electrical connectors, heat exchangers and heat sinks, and power distribution



Minerals Import Reliance

- Key industry sectors require many minerals
- Of 50 critical minerals as of 2022:
 - The U.S. is **100%** import reliant for **10** of them
 - >50% import reliant for **31** of them
- The U.S. ranges between 34% import reliant on China (graphite) and 74% (REEs)
- Mineral important reliance/supply chain vulnerabilities threaten national security, energy independence, and other essential sectors
- Canada is the second-most important source of minerals behind China, but relying on Canadian imports is not risk free

Figure 1: The 2022 U.S. list of critical minerals, percentage of the U.S. supply imported in 2022, industries in which each is used, and primary import source

Mineral	Percentage from foreign sources ^a	Key Industries					Primary Import Source (2018-2021) ^b
		Aerospace	Defense	Energy	Telecommunications and electronics	Transportation (non-aerospace)	
Arsenic	100%		●	●	○		China: 57%
Cesium	100%	●	●	●	○		N/A
Fluorspar	100%			●	○		Mexico: 66%
Gallium	100%	●	●	●	○		China: 35%
Graphite	100%	●	●	●	○	●	China: 35%
Indium	100%	●	●	●	○		Republic of Korea: 35%
Manganese	100%	●	●	●		●	Gabon: 67%
Niobium	100%	●	●	●			Brazil: 66%
Rubidium	100%	●	●	●	○		N/A
Tantalum	100%	●	●	●	○		China: 24%
Bismuth	96%		●	●	○		China: 65%
Rare Earth Elements (Cerium, Dysprosium, Erbium, Europium, Gadolinium, Holmium, Lanthanum, Lutetium, Neodymium, Praseodymium, Samarium, Scandium, Terbium, Thulium, Ytterbium, Yttrium)	>95%	●	●	●	○	●	China: 74%
Titanium	>95%	●	●	●			Japan: 89%
Antimony	83%		●	●	○	●	China: 63%
Chromium	83%	●	●	●			South Africa: 37%
Tin	77%		●	●	○		Peru: 25% (refined Tin)
Cobalt	76%	●	●	●	○	●	Norway: 22%
Zinc	76%		●	●			Canada: 66%
Barite	>75%			●			China: 38%
Tellurium	>75%		●	●	○		Canada: 52%
Platinum ^c	66%	●	●	●	○	●	South Africa: 24%
Nickel	56%	●	●	●			Canada: 45%
Aluminum	54%	●	●	●		●	Canada: 50%
Vanadium	54%	●	●	●			Canada: 31%
Germanium	>50%	●	●	●	○		China: 54%
Magnesium	>50%	●	●	●	○	●	Canada: 21%
Tungsten	>50%	●	●	●	○		China: 29%
Zirconium	<50%	●	●	●			China: 89% (Zirconium unwrought, including powder)
Palladium ^c	26%	●		●	○	●	Russia: 34%
Lithium	>25%	●	●	●	○	●	Argentina: 51%
Beryllium	<20%	●	●	●	○		Kazakhstan: 43%
Hafnium ^c	—	●	●	●			Germany: 36%
Iridium ^c	—	●		●	○	●	—
Rhodium ^c	—	●		●	○	●	—
Ruthenium ^c	—	●		●	○	●	—

Source: U.S. Geological Survey (USGS), *Mineral Commodity Summaries 2023* (Reston, Virginia: 2023). | GAO-24-106395

^aU.S. net import reliance expressed as a percentage of apparent U.S. consumption in 2022, a metric developed and calculated by USGS using import data from the U.S. Census Bureau and consumption data from USGS's *Mineral Commodity Summaries 2023*.

^bImport source percentage from 2018 through 2021, calculated by USGS using import data from the U.S. Census Bureau.

^cThis mineral is a part of the platinum group and the key industries shown are for the group.

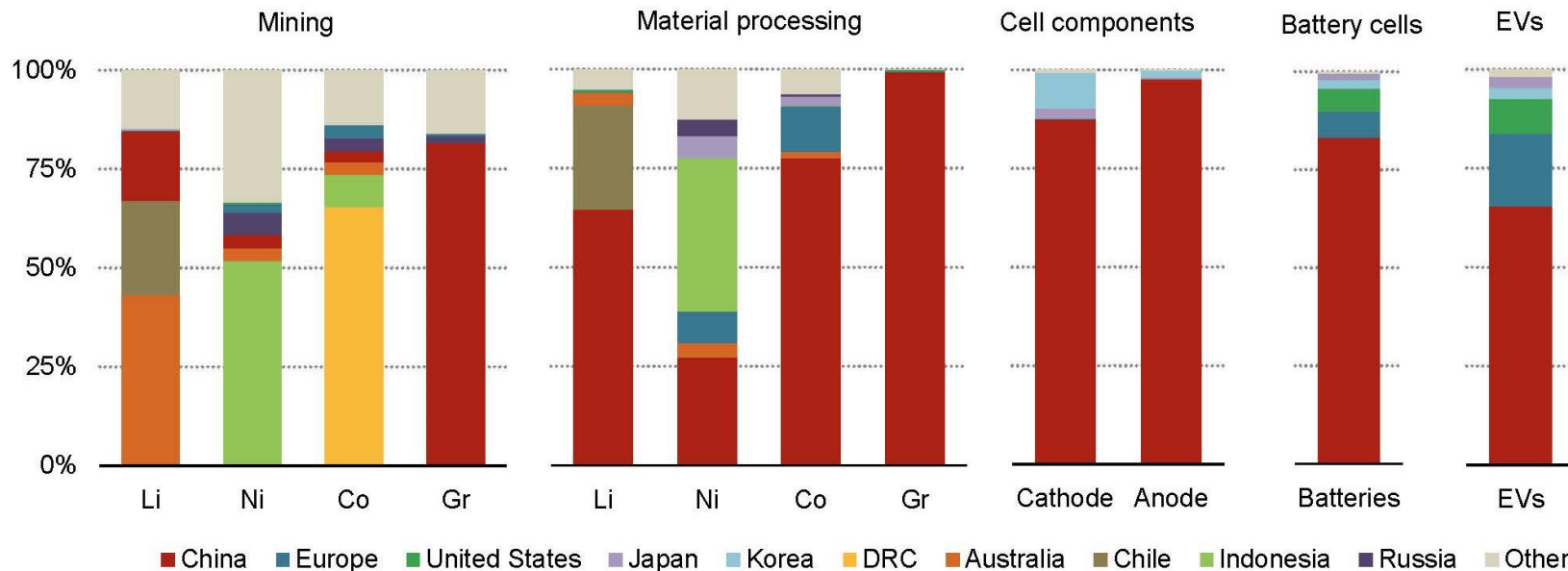
Foreign mineral reliance endangers U.S. national security

- In an armed conflict with China, the Department of Defense predicts shortfalls of 69 minerals, 20 of which are primarily imported from China
- July 2023: China restricts exports of gallium and germanium used in high-tech semiconductor chips
 - Exports dropped from 8.63 metric tons of germanium pre-ban to 1 kilogram in August 2023, and from 5.57 tons of gallium pre-ban to none post-ban
- August 2024: China restricts exports of antimony, key mineral in military applications
 - U.S. is reliant on imports for 83% of its antimony, and 63% comes from China
 - Antimony prices surged to a record high \$25,000/tonne post-ban
- China is currently restricting exports of germanium, gallium, graphite, rare earth elements, and antimony
- The U.S. is reliant on foreign countries for 95% of the rare earth elements we use, with 74% imported from China



China dominates the downstream and midstream global EV battery supply chain

Geographical distribution of the global EV battery supply chain, 2023



IEA. CC BY 4.0.

Notes: Li = lithium; Ni = nickel; Co = cobalt; Gr = graphite; DRC = Democratic Republic of the Congo. Geographical breakdown refers to the country where the production occurs. Mining is based on production data. Material processing is based on refining production data. Cell component production is based on cathode and anode material production capacity data. Battery cells are based on battery cell production capacity data. EVs is based on electric cars production data. For all minerals mining and refining shows total production not only that used in EVs. Graphite refining refers to spherical graphite production only.

Sources: IEA analysis based on EV Volumes; Benchmark Mineral Intelligence; BloombergNEF.

Recent Administrative Rules and Policies Will Reduce Mining on Public Lands

- BLM's Public Lands Rule (June 2024)
- BLM's Western Solar Plan (Final EIS August 2024)
- BLM's Greater Sage-grouse Draft Resource Management Plan and Draft Environmental Impact Statement (Final EIS November 2024)
- Council on Environmental Quality's (CEQ's) Final NEPA Rule (July 2024)
- Mine permit delays, denials, lease revocation, and land withdrawals (2020 – ongoing)

These Policies will Increase our Reliance on Foreign Minerals
and Reduce our Energy Security

BLM's Public Lands Rule Puts More Lands Off-Limits

- Severely restricts resource development in violation of Congress' multiple use mandate in the Federal Land Policy and Management Act (FLPMA)
- 3rd-party mitigation and restoration leases and restrictive ACECs will functionally put lands off limits to mining and other multiple uses
- Creates de facto requirement for compensatory mitigation to offset project impacts
- House passed the Western Economic Security Today Act of 2024 (H.R. 3397) stating this new rule “shall have no force or effect” on April 30th and sent to the Senate
- AK, MT, ND, UT & WY and numerous plaintiffs including AEMA & NMA have filed lawsuits

Unlawfully Ignores FLPMA's Multiple Use Mandate, Elevates Conservation to a Use, and Changes FLPMA into a Non-Use/Limited Use Policy

BLM's Western Solar Plan Makes Solar Energy a Preferred Land Use

- Designates more than 31 million acres in 11 western states suitable for solar development
- Establishes strong preference for solar energy projects over other multiple uses and unlawfully turns FLPMA into a single, preferred-use statute
- Pits solar energy against mineral exploration and mining which are categorically incompatible and mutually exclusive land uses
- Numerous protests filed to administratively challenge the plan
- NV Governor Lombardo's Consistency Review letter states BLM should select No Action Alternative
- Congress requests BLM withdraw this Plan (September 30)

Unlawfully Ignores FLPMA's Multiple Use Mandate by Making Solar Energy a Preferred Use of Public Lands

Distribution of BLM’s Solar Plan Application Acres

State	Acres Authorized for Solar Applications
Arizona	2.82 million
California	187,991
Colorado	594,134
Idaho	1.59 million
Montana	574,593
Nevada	11.84 million
New Mexico	4.02 million
Oregon	1.15 million
Utah	5.01 million
Washington	112,041
Wyoming	3.81 million
Total	31,726,373

Source:
 BLM’s Final Utility-Scale
 Solar Energy
 Programmatic EIS,
 August 2024
 Table 6.1

BLM's New Sage Grouse Draft Plan Amendment Restricts Natural Resource Development in 10 Western States

- BLM's Greater Sage Grouse Draft Resource Management Plan Amendment (RMPA)/Final EIS affects 121 million acres of BLM-administered public lands in 10 western states that contain 69 million acres of GRSG habitat management areas
- The RMPA amends 77 existing BLM RMPs by adding new and stronger conservation requirements
- The Final EIS prohibits wind, solar, and transmission line projects and restricts other multiple use projects on 34.5 million acres
- BLM's Preferred Alternative does not include a locatable mineral withdrawal
- The Nevada paradox: wind and solar are prohibited on 9.6 million acres in northern and central NV and are encouraged on nearly 12 million acres in southern NV

Next Steps: 30-day Protest Period and 60-day Governor's Consistency Review

Council on Environmental Quality's Final NEPA Rule Will Increase Permitting Timelines and Lead to More Litigation

- Rule transforms the National Environmental *POLICY* Act into the National Environmental *PROTECTION* Act
- Changes NEPA from a procedural and disclosure law to an environmental protection law requiring specific environmental outcomes
- Violates the Fiscal Responsibility Act of 2023 directives to streamline NEPA
- Implies agencies must strongly consider selecting the Environmentally Preferred Alternative which will conflict with agencies' permitting programs
- Creates a never-ending NEPA and more litigious process that allows new issues to be raised at any point – even after the agency's NEPA decision
- 20 states are challenging this NEPA rule

Only Congress can change NEPA – CEQ unlawfully used this rule to change NEPA

The Building Chips in America Act of 2023

- Congress passed on September 24, 2024
- President Biden signed on October 2, 2024
- Recognizes the urgency to manufacture domestic semiconductor chips and exempts certain semiconductor projects from NEPA
- *Is this an admission that NEPA is too broken to fix quickly enough to respond to the urgent need to reduce U.S. reliance on Chinese semiconductor chips?*

Congress should enact similar exemptions to eliminate NEPA's chokehold on the economy – especially for the projects needed for the energy transition: critical minerals, transmission lines, and alt-energy





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