USAMP
UNITED STATES AUTOMOTIVE MATERIALS PARTNERSHIP

Critical Materials in Light-Duty Vehicle Manufacturing

Recommendations

The U.S. automotive industry relies on a range of critical materials to manufacture safe, efficient, and affordable vehicles. Having reliable and economically viable sources for these materials is essential to maintaining the industry's global competitiveness. Unstable supply chains expose the industry to risk of production disruptions and price volatility. The United States Automotive Materials Partnership (USAMP) suggests that, going forward, the four core tenets below guide our country's strategy toward critical materials.

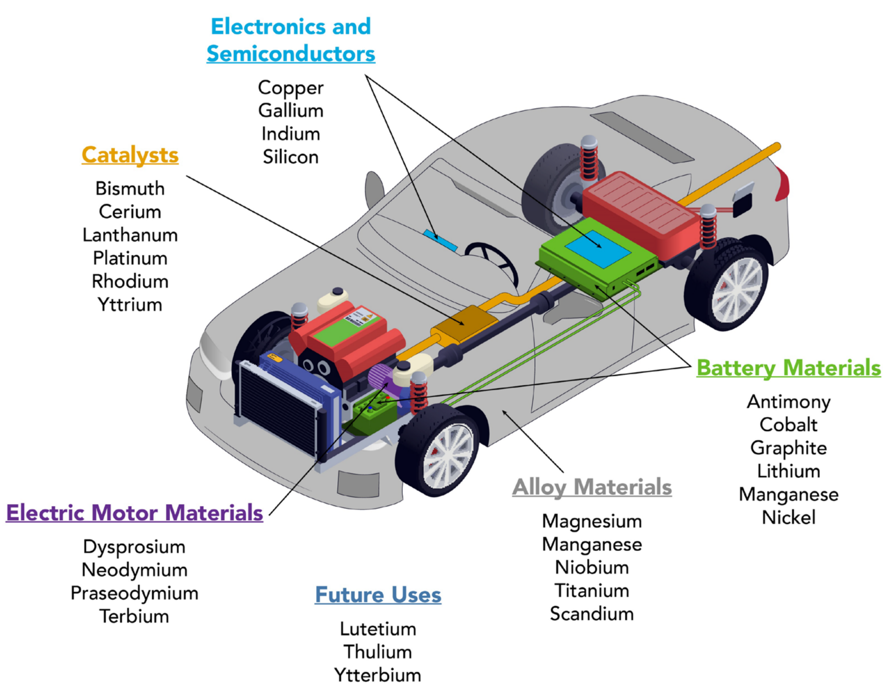
- **Sufficient Materials Availability:** Ensure that 90% of material volume needed can be readily sourced domestically or from reliable trading partners.
- **Reduced Price Volatility:** Reduce risks related to price volatility. Develop new materials, identify substitute/alternative materials and technologies, and explore the availability of an established supply chain.
- **Resilient Materials Supply Chain:** Procure automotive critical materials and non-critical alternatives from domestic sources and friendly trade partners; ensure these critical materials are scalable, recyclable, and affordable. Develop the technology to recycle and upcycle imported critical materials, which expands domestic sources and supports a circular economy.
- **Safe Automotive Critical Materials:** Ensure materials in use are not harmful to the health and safety of workers or the environment, establishing the U.S. industry's role as good stewards of workers and the environment and minimizing the likelihood that critical materials will be subject to legislative/regulatory bans or require offshore production.

CRITICAL MATERIAL: Any non-fuel mineral, element, substance, or material that the Secretary of Energy determines: (i) has a high risk of supply chain disruption; and (ii) serves an essential function in one or more energy technologies, including technologies that produce, transmit, store, and conserve energy;

Energy Act of 2020 (P.L. 116-260)

Automotive critical materials are "critical" because they are necessary components of a range of components.

Significant technical and business progress has been made to develop new technologies and partnerships. However, a long-term vision and commitment is critical in both the private and public sectors to ensure continued innovation and a secure supply chain.



Typical automotive critical materials - The "criticality" of materials to automobiles fundamentally depends on their importance to various vehicle systems, viable alternative technologies, and how risky the supply is.

USAMP (United States Automotive Materials Partnership is a subsidiary of USCAR (United States Council for Automotive Research).

Background Information

The critical material supply chain has five stages:

- **Exploration and discovery:** Identifying sources in the earth, mining waste, or discarded end-use products
- **Extraction**: Mining deposits or removing them from secondary sources
- **Processing**: Separating the critical material from other matter, such as gangue
- **Refining**: Removing any remaining impurities to produce the purest possible form of the critical material
- **Manufacturing**: Incorporating the critical material into an alloy or manufactured part

These stages can take place in one country or several, making the supply chain susceptible to delays (e.g., from the COVID-19 pandemic) and price volatility (e.g., in response to geopolitical issues). Currently, **the United States relies heavily on imports**; for example, China is the top producer of 30 critical materials on the U.S. Geological Survey list.

However, developing a fully domestic supply chain has its own challenges. Such an undertaking is complex and requires large capital investments and lengthy environmental permitting. In parallel, countries such as China can leverage long-established dominance across multiple supply chains, establishing cost and scale advantages, entrenched networks, and control over critical resources.

Alternative critical material sources include recycling and secondary recovery, i.e., extracting critical materials from sources such as mine tailings and discarded products. These approaches avoid many harmful impacts, conserve resources, and promote a circular economy. As large-scale solutions, however, **recycling and secondary recovery face barriers**, including significant cost, limited supportive systems and infrastructure, and lack of technical expertise. Continued technical innovation is needed along with both public and private industry support.

Another supplementary route is to **identify substitute materials that provide the same function as critical materials**. However, known substitutes often involve compromise in terms of cost or performance. Considerably more research and development will be required to commercialize alternative materials and/or develop new composites that can serve as critical material replacements without detrimental tradeoffs.

CRITICAL MATERIALS IN VEHICLE MANUFACTURING

The automotive industry is one of the largest consumers of raw material in the world. Even a traditional (internal combustion engine - ICE) passenger vehicle uses hundreds of types of materials, several of which are considered critical; for example, catalytic converters rely on critical materials. Advanced transportation technologies require even more critical materials, such as cobalt, graphite, lithium, nickel, dysprosium, neodymium, silicon, and indium. These materials are essential components of sensors, high-performance batteries, electric motor magnets, wiring, and displays. Demand for critical materials will continue to increase as vehicles begin to incorporate cutting-edge capabilities such as automated driving features and increasing amounts of displays in the passenger compartment.

CONCLUSIONS

To move advanced vehicle concepts forward and maintain its competitive edge, the U.S. automotive industry must reduce its reliance on non-allied governments. Critical materials must be readily and reliably available, at more predictable costs, and their procurement and incorporation into products must be less hazardous to the environment and surrounding communities. Working with allied governments will ameliorate some concerns, but even friendly actors add complexities to the supply chain.

Therefore, U.S. sources must be part of a critical materials to implement a safer and more resilient supply chain. The strategy should be an all-of-the-above platform, including increased domestic extraction and refinement, secondary recovery, recycling, and substitute materials. All of these approaches will require research, development, and demonstration (RD&D) on safe and efficient methods for extraction from primary and secondary sources, on ways to improve processing and recycling techniques, and on alternative elements and new compounds to replace critical materials.

APPENDIX

Material	Mining	Refining	Summary
ALLOY MATERIALS			
Magnesium (Mg)	China (85%), Russia (5%), Israel, Kazakhstan, Brazil	Concentrated in China, 85%+	Lightweight structural alloys for engines, transmissions, and body components, which improves fuel efficiency and EV range. Limited alternatives to provide the same combination of strength-to-weight ratio and manufacturability. U.S. dependence on Chinese production and limited domestic refining.
Manganese (Mn)	South Africa, Gabon, Australia (together ~75% of world output)	Concentrated in China. U.S. imports of ore/ferroalloys commonly come from Gabon, South Africa, and Mexico, among others.	Used in high-strength steel, Al alloys, and Li-ion battery cathodes. While some Mn alloys are produced in the U.S., battery-grade Mn is primarily imported, with China and other countries dominating refining. Role in vehicle safety, lightweighting, and EV performance, combined with supply concentration and rising demand.
Niobium (Nb)	Brazil (~90%), Canada	Converted to ferroniobium and specialty oxides, mostly by producers in Brazil and Canada	Used primarily as a steel microalloying element that enables high-strength, lightweight, and safe vehicle components. U.S. relies heavily on Brazil for primary Nb. Essential role in automotive steel performance, crash safety, and fuel efficiency, combined with limited substitutes.
Scandium (Sc)	China, Kazakhstan, Philippines, and Canada	Concentrated in China	Used in select U.S. light-duty automobiles, particularly in Al alloys for lightweighting and structural strength. Minimal U.S. mining. China and Russia dominate production and refining. Strategic role in high-strength alloys, limited substitutes, and supply concentration.
Titanium (Ti)	Australia, South Africa, China	Limited domestic production; relies on imports to meet demand	Used primarily in performance-critical and lightweight components. U.S. is completely import-dependent for Ti sponge, relying on foreign refining. Role in lightweighting and performance, its defense importance , and supply risks due to concentrated foreign production.

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		ELECTRIC MOTOR MATERIALS	
Copper (Cu)	Chile (27%), Congo, Peru, China, U.S.	Concentrated in China	Primarily used in the stator with copper windings and rotor with magnets to generate powerful magnetic fields when electricity flows through them, producing torque. Second in conductivity only to silver; infinitely recyclable.
Dysprosium (Dy)	China (40%), Myanmar (31%), Australia (20%)	Concentrated in China	Essential to high-temperature permanent magnets. Not mined or refined at scale in the U.S., leaving the country highly import-reliant on China. Supply chain risk. Irreplaceable role in magnets and rapidly growing automotive demand.
Neodymium (Nd)	China (70%), Burma (10%), Myanmar, Australia, U.S.	Concentrated in China	Enables the NdFeB permanent magnets essential for traction motors and other high-performance automotive systems. U.S. has limited mining and virtually no refining/magnet-making capacity, leaving it import-dependent, primarily on China. Supply risk, lack of substitutes, and surging EV-driven demand.
Praseodymium (Pr)	China (70%). Australia, Myanmar, other smaller producers	China dominates; limited refining in Malaysia and pilot/expanding capacity in the U.S. and Estonia	Used mainly as part of NdPr alloys in permanent magnets. U.S. mines some Pr-bearing ores but remains dependent on China and a few allies for separation and refined oxide/metal. Central role in EV traction motors, limited substitutes, concentrated supply chain, and expected demand growth.
Terbium (Tb)	China (80%), Myanmar, Australia, and pilot projects in the U.S. and Canada	Concentrated in China	Used as a dopant in NdFeB permanent magnets, enabling high-temperature performance in EV traction motors and auxiliary systems. U.S. has no domestic mining or refining capacity and is nearly entirely dependent on China. Supply concentration, scarcity, lack of substitutes, and growing EV-driven demand.

Appendix

Material	Mining	Refining	Summary
CATALYSTS			
Bismuth (Bi)	China (80%), Laos (10%), South Korea (5%)	Concentrated in China	Non-toxic substitute for lead in paints, coatings, solders, and additives. 100% import reliance and China's dominant production/refining capacity.
Cerium (Ce)	China (~70%), Malaysia (~13%), Japan (~6%), Estonia (~5%)	Concentrated in China. Limited refining exists in the U.S. for research and small-scale production.	Used primarily for catalytic converters and surface finishing. U.S. mines some Ce. Refining and bulk production are dominated by China. Role in emissions reduction, regulatory compliance, and polishing—combined with limited substitutes and concentrated global supply.
Lanthanum (La)	China (~70%), Malaysia (~13%), Japan (~6%), Estonia (~5%)	Concentrated in China	Used for catalytic converters and NiMH battery electrodes. U.S. mines some domestically but relies heavily on China for refined materials. Essential role in emissions reduction, hybrid battery performance, and regulatory compliance, combined with concentrated supply and limited substitutes.
Platinum Group Metals (PGMs)	South Africa Russia, Zimbabwe, Canada	Concentrated in South Africa, Russia, and Canada	Including platinum, palladium and rhodium; used for catalytic converters and fuel cell catalysts. U.S. has negligible domestic production and limited refining capacity, relying heavily on South Africa, Russia, Zimbabwe and Canada. Essential role in emissions control and fuel cell technology concentrated supply and limited substitutes.
Yttrium (Y)	China, Australia, Brazil, India	Concentrated in China	Used in relatively small amounts. Essential in oxygen sensors and emission-control catalysts, making it vital for compliance with emissions standards. U.S. has no domestic mining or refining, relying on Chinese supply chains. Essential role in automotive emissions technology, lack of substitutes, and concentrated foreign supply.

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BATTERY MATERIALS			
Antimony (Sb)	China (74%), Tajikistan (8%), Russia (4%)	Concentrated in China	Vital to light-duty automobile manufacturing, mainly via lead–acid batteries and flame-retardant components. 100% import reliance, concentrated foreign supply, and essential roles in automotive safety and function.
Cobalt (Co)	Democratic Republic of the Congo (70%), Russia, Australia, Canada, Indonesia	Concentrated in China, 75% of refined products suitable for battery manufacturing	Role in Li-ion EV batteries. U.S. has minimal domestic mining and no large-scale refining, creating near-total reliance on imports. Supply is highly concentrated in the DRC (mining) and China (refining). One of the most strategically vulnerable materials.
Graphite (C)	China (78%), Brazil (7%)	China dominates, producing nearly all spherical graphite used in battery anodes.	Indispensable role as the anode in Li-ion EV batteries. U.S. has no current domestic natural graphite mining or refining, leaving it entirely dependent on imports, especially from China. Surging EV demand makes graphite one of the most strategically important and supply-chain-vulnerable materials.
Lithium (Li)	Australia (44%), Chile (20%), China (17%)	China dominates lithium hydroxide production, critical for battery cathodes. Other refiners are Australia, Chile, and Argentina.	Used for Li-ion batteries in EVs and hybrids. U.S. has some domestic mining but relies heavily on imports for processed compounds, especially from China and south America. Essential for high-energy batteries, has few substitutes, and demand is rising sharply with EV adoption.
Manganese (Mn)	South Africa, Gabon, Australia (together ~75% of world output)	Concentrated in China. U.S. imports of ore/ferroalloys commonly come from Gabon, South Africa, and Mexico, among others.	Used in high-strength steel, Al alloys, and Li-ion battery cathodes. While some Mn alloys are produced in the U.S., battery-grade Mn is primarily imported, with China and other countries dominating refining. Role in vehicle safety, lightweighting, and EV performance, combined with supply concentration and rising demand.
Nickel (Ni)	Indonesia (60%), Philippines (9%), Russia (6%)	Battery-grade refining is concentrated in Indonesia, China, Russia, and Canada.	Widely used in battery cathodes for EVs and in stainless steel/alloys for conventional vehicle components. U.S. produces some Ni; battery-grade refining is mostly foreign-dependent, with supply concentrated in Indonesia, China, and Russia. Role in energy-dense batteries, corrosion-resistant alloys, and EV adoption.

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Material	Mining	Refining	Summary
FUTURE USES			
Lutetium (Lu)	China, Australia, Russia and India (small production)	Concentrated in China	No significant role in U.S. light-duty automobile manufacturing. While Lu is mined as a trace element in REE deposits and refined primarily in China, its automotive applications are negligible, and it is not considered a critical material for automotive production.
Thulium (Tm)	China, Australia, India, Brazil	Concentrated in China	No current role in U.S. light-duty automobile manufacturing. Tm is mined mainly in China, refined there as part of heavy rare earth separation, and used in medical and laser technologies.
Ytterbium (Yb)	China, Brazil, India	Concentrated in China	No current role in U.S. light-duty automobile manufacturing. Yb is mined mainly in China and Myanmar, refined almost entirely in China, and used primarily in lasers, optics, and research applications.

References

Alliance for Automotive Innovation. Letter to the Office of Energy Efficiency and Renewable Energy, re: Request for Information on 2026 Energy Critical Materials Assessment. July 25, 2025. https://www.autosinnovate.org/posts/agency-comments/energy-environment/2025-energy-environment/DOE%20on%20Critical%20Materials%20Assessment%207-25-2025.

Ortego, Calvo, Valero, et al. "Assessment of strategic raw materials in the automobile sector." *Resources, Conservation and Recycling* 161 (October 2020). https://doi.org/10.1016/j.resconrec.2020.104968.

Pouy, Nicole. "Issue Brief | Critical Minerals and the U.S. Clean Energy Transition." *Environmental and Energy Study Institute (EESI)* (website). July 14, 2025. Issue Brief | Critical Minerals and the U.S. Clean Energy Transition | White Papers | EESI.

U.S. Department of Energy. "Critical Materials Assessment." July 2023. https://www.energy.gov/sites/default/files/2023-07/doe-critical-material-assessment_07312023.pdf.

U.S. DRIVE Materials Technical Team. "Roadmap for Lightweight, Sustainable, and Critical Automotive Materials." Draft. January 2024.

U.S. Geological Survey, Department of the Interior. "2022 Final List of Critical Minerals." February 22, 2022. https://d9-wret.s3.us-west-2.amazonaws.com/assets/palladium/production/s3fs-public/media/files/2022%20Final%20List%20of%20Critical%20Minerals%20Federal%20Register%20Notice_2222022-F.pdf.