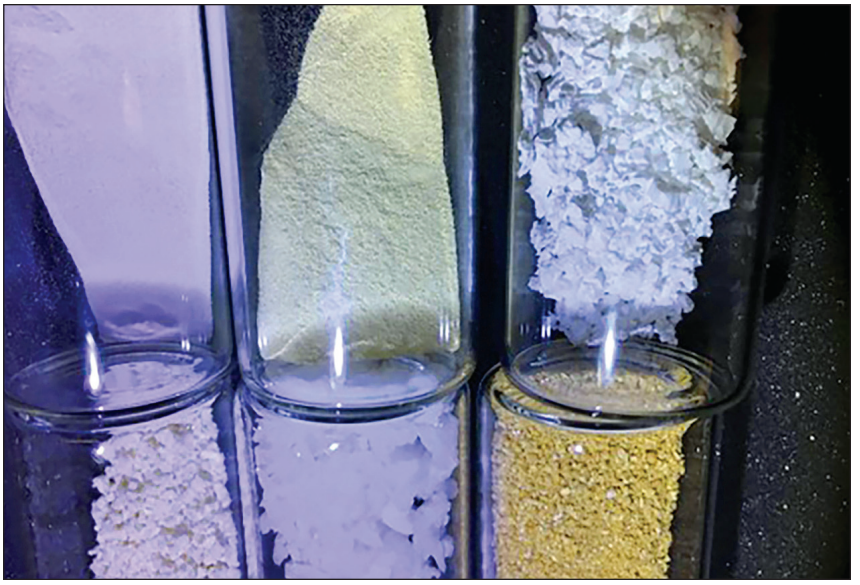
# COVID-19 pandemic highlights need for US policies that increase supply chain resilience

Shortages of masks, personal protective equipment (PPE), and ventilators characterized the early days of the COVID-19 pandemic crisis in the United States. As supply deficiencies strained healthcare systems across the country, national attention focused on the Strategic National Stockpile (SNS), overseen by the US Department of Health & Human Services—specifically, its inability to significantly alleviate rapidly deteriorating conditions in hospitals. While nominally a "stockpile," the SNS does not possess, operate, or restock a vast system of federally owned warehouses filled with enough medical equipment to weather a crisis. Instead, as summarized in a June 2020 RAND Corporation report and testimony to the US Congress, the program is primarily a logistics service that coordinates the flow of materials between state and local entities, and its own small stockpile was quickly overwhelmed by the demands of the pandemic.

The shortcomings of the SNS are but one symptom of the numerous, systemic problems that plague supply chain resiliency in the United States. In an effort to avoid repeating the breakdowns that accompanied the first stage of the COVID-19 pandemic response, the RAND report further recommended integrating an expanded SNS into a reformed nationwide supply chain system that is adequately funded, properly coordinated, and independent of suppliers from outside the United States. All of this and more will be required to address supply chain shortages and prepare for future emergencies. But, until long-term holistic changes to the national strategy take effect, stockpiles hold promise for immediate relief during future crises.



Yttria-stabilized zirconia ceramic oxide serves a critical role in US aerospace and defense industries, as thermal barrier coatings made from this material deliver superior heat resistance and thermal control in jet engines. The Defense Logistics Agency maintains a strategic stockpile of the rare-earth element yttrium. Credit: Nicholas Burlingame/Defense Logistics Agency.

The US economic, healthcare, manufacturing, and national security sectors source significant amounts of materials and products from other countries. According to the Congressional Research Service, the United States is 100% import-reliant for graphite, manganese, niobium, and tantalum, and over 75% import-reliant for uranium, tin, titanium, and many other minerals. In fact, some materials—like rare-earth elements (REEs)—critical for advanced manufacturing of products including wind turbine magnets and electric vehicle batteries—are unavailable on or prohibitively expensive to extract from US soil. The risks that accompany the United States' reliance on non-US suppliers received increased attention in 2010, when China—the key supplier of most REEs—curtailed REE shipments to Japan following a maritime dispute. The incident highlighted the precarious position of the United States, as political conflicts and military standoffs risk cutting off routes for strategically essential materials. The COVID-19 crisis introduced a new threat: as the pandemic shuttered mines, refineries, and factories across the world, it severed supply chains of critical materials, and manufacturers—including those that produced PPE and life-saving equipment—causing crippling materials shortages.

Despite the obvious risks to economic, healthcare, and national security enterprises, the United States does not possess an integrated, nationwide strategy to address shortages. Rather, the US Government charges certain agencies with discrete tasks related to that agency's mission.

Several federal agencies aim to monitor available resource levels and support resource extraction. The US Department of Energy (DOE) Critical Materials Hub conducts R&D to support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many critical materials challenges. Its Advanced Research Projects Agency-Energy (ARPA-E), self-styled as a "high-risk, high-reward" division, funds programs that use biological and microbial routes to extract REEs from mine tailings. Additionally, the US Department of the Interior has tasked its US Geological Survey (USGS) and Bureau of Land Management (BLM) divisions to develop lists of critical materials and available quantities. Notably, the USGS lists zero reserves for 33 out of 35 of its identified critical minerals, and it explains that only tungsten, lithium, vanadium, and uranium have resource potential (i.e., can be mined) in the United States. The US Government's standing prohibition on obtaining supplies of certain materials from Russia, China, North Korea, and Iran—all countries with large natural reserves of many critical materials, including REEs—adds to the complexity of maintaining adequate supplies.

The United States has some limited stockpile resources designed to weather unanticipated shortages. For example, since 1989, the Defense Logistics Agency (DLA), administered by the Department of Defense (DoD), has managed a materials stockpile essential to military and national security interests. The DLA stockpile contains 37 different materials valued at USD$1.152 billion. Its sought-after materials and required stockpile levels receive annual updates and include a wide array of metals, REEs, ores, and certain nonmetals. The 2019 revision, for example, called for acquisition of carbon fibers, metal carbides, REEs, and RDX explosives. Yet the US Government is in the process of dismantling some of its other successful stockpile programs. Since the 1920s, the Bush Dome geologic formation in Texas stored over a billion cubic meters of helium, comprising the federal helium reserve. Helium is a critical material; initially used as a lift gas, it is currently used in welding, as a coolant for supercomputers, in rocketry, and in nuclear magnetic resonance machines in universities and hospitals. In April of 2020, BLM announced that this reserve—the only one in the world for this highly scarce material—will be dissolved and auctioned off to private enterprises, in accordance with the Helium Stewardship Act of 2013 (see *MRS Bulletin*, doi:10.1557/mrs.2013.299).

To be sure, in emergencies such as the COVID-19 pandemic, the Executive Branch may invoke the Defense Production Act (DPA) to marshal available resources to address supply chain and manufacturing shortages. Passed in 1950, the DPA enables the US president to compel businesses to accept contracts that prioritize products of national security and public interest importance. The current administration has used the authority granted in the DPA over 80 times since the start of the COVID-19 pandemic, dedicating USD$3.5 billion in federal funds to address shortages of ventilators and PPE, increase testing, and develop infrastructure for R&D of vaccines and therapeutics. Most recently, the DPA was invoked to provide a USD$760 million loan to Kodak to manufacture chemical precursors to pharmaceuticals. But even the extraordinary legal authority conferred in the DPA is limited by practical realities: neither allocated funds nor prioritized contracts can mitigate absences of critical minerals, appropriate production facilities, or an available workforce.

National emergencies, like the COVID-19 pandemic, are hardly the only threat to critical materials supply chains in the United States. Due to the potential for insertion of defective products or compromised data security, the DoD deems components supplied by other countries, especially political adversaries, to present a critical risk to its weapons systems, deployed platforms such as ships and aircraft, and computer infrastructures. Yet, according to a report prepared for the DoD by Govini Corporation, Chinese manufacturer presence in the DoD supplier base increased by 420% between 2010 and 2019, and non-US companies indirectly supplied 70% of the goods and materials on which the DoD presently relies. In an effort to counteract this concern, the 2019 National Defense Authorization Act (NDAA) includes a section that prohibits government agencies from using materials and products supplied by five Chinese manufacturers, including tech giants Huawei and ZTE. This provision, effective August 2020, labels these companies as high-risk vendors that threaten the economic and national security of the United States. In a Catch-22, the challenge to secure the national security enterprise's supply chain coincides with its growing demand for microelectronics and REEs.

Congress has yet to enact legislation to address the vulnerability of the US REE supply chain or mitigate it with a substantial stockpiling effort. Congress' previous attempts to pass the Critical Minerals Policy Act in 2013 and 2014 both stalled (see *MRS Bulletin*, doi:10.1557/mrs.2014.18). More recently, however, the shutdowns of the COVID-19 pandemic generated support for the American Mineral Security Act, now pending before both the US House of Representatives (H.R. 7061) and the US Senate (S.1317). This legislation promotes domestic exploration, research, development, and processing of critical minerals to ensure the economic and national security of the United States. The House version of this bill further tasks the DOE with additional R&D of new recycling and extraction methods and directs it to find alternatives to existing materials; and it charges the National Science Foundation and the US Department of Labor with research and education efforts that would accelerate these technological breakthroughs. While neither version of this legislation has received a floor vote in Congress, the Senate version has been incorporated into the most recent version of the COVID-19 relief package (HEALS Act). Moreover, provisions of this year's NDAA (H.R. 6395 and S. 4049) call for expanded domestic defense manufacturing and aim to address supply chain vulnerabilities. Specifically, the Senate version of the NDAA directs the DoD to fully secure its strategic mineral supply by 2030. According to analysis by the Akin Gump firm, owing to the fact that both versions of the NDAA passed their respective floor votes with critical materials amendments intact, the supply chain provisions will likely find bicameral support and remain critical components of the final bill. And, in the



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interim, federal agencies will continue to work to alleviate supply chain vulnerabilities. In addition to research pursued by ARPA-E, the DLA's strategic stockpile charter includes a provision for R&D into domestic sources for all of its sought-after materials.

Scientific societies, including the Materials Research Society (MRS), have long advocated on behalf of concerted national policies that alleviate the precarious supply of essential materials. Damon Dozier, Director of Government Affairs for MRS, says, "The importance of the materials supply chain cannot be overstated, especially when it comes to REEs. MRS has worked with Congress and key policymakers in recent years to help our nation acquire and protect these resources, and we will continue to do so in the future."

As outlined in a 2019 US Department of Commerce (DOC) report entitled *A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals*, the state of the supply chain of critical materials and REEs in the United States remains vulnerable. The country's cache of natural resources simply cannot provide a domestic source equal to the country's growing needs for consumer electronics, electric automobiles, high-tech weaponry, and life-saving instruments. Recent DOC, USGS, and DOE reports on critical minerals and rare earths all highlight the fact that the United States has a single REE mining and reprocessing facility—in Mountain Pass, Calif.—which had been mostly mothballed since 2002 due to economic and environmental constraints. In order to minimize risks of future supply chain disruptions, the DOE 2020 "Critical Materials Rare Earths Supply Chain" white paper points to future R&D of materials alternatives, recycling approaches, and manufacturing methods in order to wean the United States off its dependence on non-US-sourced REEs and other scarce materials. In the meantime, however, a system of well-maintained, well-managed stockpiles of critical materials and products, coupled with nimble operations that rapidly adapt to evolving crises, remains the US Government's best—and only—line of defense against pandemic-induced shutdowns and similar breakdowns of its supply chains.

**Boris Dyatkin**

## EC announces actions to increase security and sustainability of Europe's raw materials supply

Currently, the coronavirus crisis is leading many parts of the world to look critically at how they organize their supply chains, especially where public safety or strategic sectors are concerned. In September, the European Commission (EC) released its "Action Plan on Critical Raw Materials," the "2020 List of Critical Raw Materials," and a foresight study on critical raw materials for strategic technologies and sectors from the 2030 and 2050 perspectives. The Action Plan looks at the current and future challenges and proposes actions to reduce Europe's dependency on third countries, diversifying supply from both primary and secondary sources, and improving resource efficiency and circularity while promoting responsible sourcing worldwide.

The actions will foster the EU transition toward a green and digital economy, and at the same time, bolster Europe's resilience and open strategic autonomy in key technologies needed for such transition. The List of Critical Raw Materials has been updated to reflect the changed economic importance and supply challenges based on their industrial application. It contains 30 critical raw materials. Lithium, which is essential for a shift to e-mobility, has been added to the list for the first time.

Maroš Šefčovič, Vice-President for Interinstitutional Relations and Foresight, says, "A secure and sustainable supply of raw materials is a prerequisite for a resilient economy. For e-car batteries and energy storage alone, Europe will, for instance, need up to 18 times more lithium by 2030 and up to 60 times more by 2050."

The Action Plan on Critical Raw Materials is aimed at:

- developing resilient value chains for EU industrial ecosystems;
- reducing dependency on primary critical raw materials through circular use of resources, sustainable products, and innovation;
- strengthening domestic sourcing of raw materials in the EU; and
- diversifying sourcing from third countries and removing distortions to international trade, fully respecting the EU's international obligations.

To achieve these objectives, the EC plans to establish a European Raw Materials Alliance. By bringing together all relevant stakeholders, the alliance will primarily focus on the most pressing needs, namely to increase EU resilience in the rare-earth and magnet value chains, as this is vital to most EU industrial ecosystems, such as renewable energy, defense, and space. Later, the alliance could expand to address other critical raw material and base metal needs over time.

Thierry Breton, Commissioner for Internal Market, says, "By diversifying the supply from third countries and developing the EU's own capacity for extraction, processing, recycling, refining, and separation of rare earths, we can become more resilient and sustainable."

To make better use of domestic resources, the EC will work with member states and regions to identify mining and processing projects in the EU that can be operational by 2025. In line with the European Green Deal, other actions will address the circularity and sustainability of the raw materials value chain. The EC will also develop strategic international partnerships to secure the supply of critical raw materials not found in Europe. Pilot partnerships with Canada, interested countries in Africa, and across Europe will start as of 2021. In these and other fora of international cooperation, the EC will promote sustainable and responsible mining practices and transparency. □


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