Coal Ash Holds Unexpected Wealth in Rare Earth Elements

By Haley Zaremba - Jul 01, 2025, 3:00 PM CDT

- Scientists have discovered that US coal ash reserves contain substantial amounts of rare earth elements, potentially worth billions of dollars and representing a significant domestic resource.
- This discovery could help the United States reduce its heavy reliance on Chinese supply chains for critical minerals, which are vital for various technological and infrastructural industries.
- Extracting these elements from coal ash offers a "trash to treasure" opportunity, providing both national security benefits by diversifying critical mineral sources and environmental benefits by repurposing waste.

Millions of tons of coal ash are currently sitting in ponds and landfills across the United States. The U.S. alone produces around 110 million tons of this coal mining byproduct each and every year. The ponds that house this ash pose a major threat to the environments that host them, but they might also hold the secret to homeshoring vital supply chains for critical minerals.

Last year, scientists at the University of Texas (UT) at Austin analyzed coal ash samples collected from power plants across the United States and found that domestic coal ash reserves could contain up to 11 million tons of rare earth elements. These elements are central to a number of technological and infrastructural supply chains from batteries and solar panels to high-performance magnets.

The significant presence of these materials in coal ash is therefore a major discovery that could shake up global supply chains for these increasingly in-demand materials. If the UT Austin calculations are accurate, those 11 million tons would represent nearly eight times the amount of rare earths that the United States currently has in reserve, and could be worth a whopping $8.4 billion.

“This really exemplifies the ‘trash to treasure’ mantra,” said Bridget Scanlon, co-lead author of the UT Austin study and a research professor at the university’s Bureau of Economic Geology. “We’re basically trying to close the cycle and use waste and recover resources in the waste, while at the same time reducing environmental impacts.”

Perhaps even more importantly, this domestic cache of critical minerals could help the United States break free of its reliance on Chinese supply chains. China provides about 38 percent of the world’s raw rare earth minerals, and accounts for 85-90 percent of the world’s rare earth mine-to-metal refining. What is more, Chinese refineries supply 68 percent of the world’s cobalt, 65

percent of nickel, and 60 percent of EV-battery-grade lithium. As a result, 75 percent of all EV batteries are made in China.

All this means that disentangling from Chinese supply chains will be difficult, if not impossible, making tariffs painfully pyrrhic for United States manufacturers. According to the United States Geological Survey, the United States imported nearly 100 percent of the rare earth elements it consumed in 2018, with 80 percent sourced from China. Furthermore, Department of Energy data shows over 50 percent import reliance for the rest of its designated "critical minerals," and complete reliance for 14 of them.

And China is already clamping down on some rare earth supply chains in response to Trump's continued trade war. All of this serves to make coal ash a potential godsend for U.S. energy sovereignty and security in an era of increasingly protectionist trade policy. "Even though the level of rare earth elements in coal ash is relatively low when compared with those mined from geological deposits, the fact that the ash is readily available in large quantities makes it an attractive resource," the University of Texas at Austin News reports.

However, not all coal ash is created equal. The concentration of rare earth elements is higher in the coal ash from some regions than from others, with coal ash from the Appalachian Basin having the richest concentrations at 431 milligrams per kilogram. However, higher concentrations doesn't mean higher extraction rates. Interesting Engineering reports that within Appalachian Basin coal ash, only 30 percent of the critical minerals are easily recoverable. Meanwhile, coal ash from the Powder River Basin only has 264 milligrams per kilogram, but 70 percent extractability, making it a more economically viable option.

Ramping up a domestic refining industry to recover critical minerals from coal ash would yield multiple benefits, both economic and environmental. "By modifying existing treatment processes, we can address multiple problems," says Sarma Pisupati, director of the Center for Critical Minerals at Penn State. Those include "getting the material we need for national security and remediating long-standing environmental problems at the same time."

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