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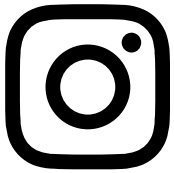

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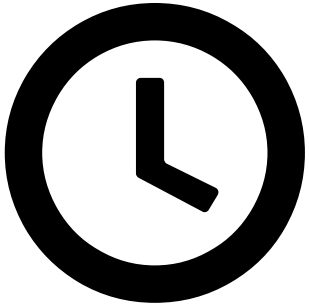


Nov 19, 2024

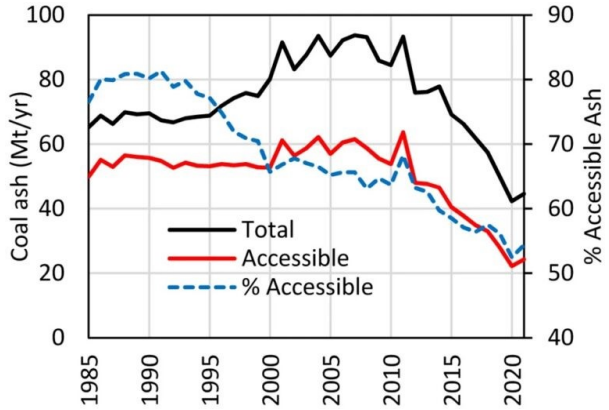
Enormous Cache of Rare Earth Elements Hidden Inside Coal Ash Waste


Super E

AUSTIN, Texas — Coal ash — the chalky remnants of coal that has been burned for fuel — has been piling up across the United States for decades. But new research led by The University of Texas at Austin has found that the national coal ash supply contains enough rare earth elements to significantly bolster the national supply without any new mining.

“This really exemplifies the ‘trash to treasure’ mantra,” said co-lead author Bridget Scanlon, a research professor at UT’s Bureau of Economic Geology at the Jackson School of Geosciences. “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.”

Rare earth elements are a group of 17 elements that are essential for modern technology. They are also necessary for the energy transition to lower carbon fuels, with these elements being put to use in solar panels, batteries, magnets and other energy technologies.



Total and potentially accessible coal ash reported by the electric power sector during 1985–2021. Credit: Reedy, et al.

However, the United States relies almost entirely on imports for its rare earth element supply. About 75% come from China — which poses potential problems in a world of complex supply chains and geopolitical tensions.

The new research found that there could be as much as 11 million tons of rare earth elements in accessible coal ash in the United States, which is nearly 8 times the amount that the U.S. currently has in domestic reserves, according to the researchers.

The study is the first study to tally up national coal ash resources. The researchers estimate that $8.4 billion worth of rare earth elements could be extracted from the accessible supply of coal ash.

The results were published in the International Journal of Coal Science & Technology. The U.S. Department of Energy is also applying the study’s

methodology to conduct its own national assessment of coal ash resources.

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, said co-author Davin Bagdonas, a research scientist at the University of Wyoming.

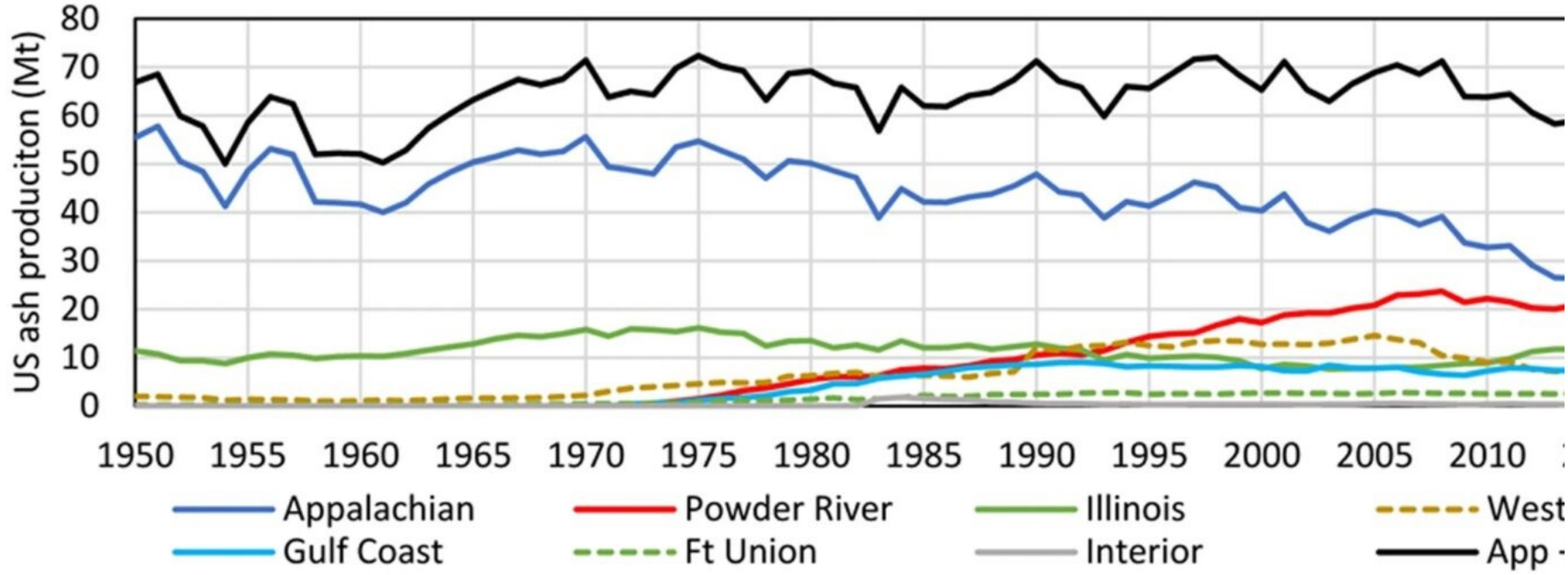
“There’s huge volumes of this stuff all over the country,” Bagdonas said. “And the upfront process of extracting the (mineral host) is already taken care of for us.”

The researchers found that about 70% of the coal ash produced from 1985 to 2021 — a total of about 1,873 million tons — is potentially recoverable, with the material stored in landfills, ponds and offsite storage areas. The rest of the coal ash has been sold and used by other industries, such as cement production and road construction.

Coal ash contains different levels of rare earth elements depending on where it originates. Place of origin also affects how much of the rare earth elements can be extracted.

For example, ashes from Appalachian Basin coal contain the highest amounts of rare earth elements, with an average value of 431 milligrams per kilogram. But only 30% of the rare earth elements it contains can be extracted. In contrast, coal from the Powder River Basin has the lowest average value of rare earth elements at 264 milligrams per kilogram, but it has an extractability of about 70%.

Most of the work around rare earth element extraction is still in the research phase. Bagdonas is involved with a pilot project at the National Energy Technology Lab that’s extracting rare earth elements from the Powder River Basin coal ash.



Estimated total associated ash from coal production in the United States by basin. About 83% of all ash produced during the period was from t
Powder River, and Illinois basins combined. Credit: Reedy, et al.

Scanlon said that the foundational data provided in this study can help with building a broader market for coal ash as a resource.

“This kind of broad reconnaissance-level analysis has never been done,” Scanlon said. “It provides a foundation for others to go into more detail.”

Chris Young, the chief strategy officer at Element USA, a company that extracts critical minerals from mineral and metallic waste, said that the study underscores the great potential of coal ash as a resource. He said the challenge now for industry is developing the workforce and operations needed to extract rare earth elements and other materials from coal ash and other mining byproducts.

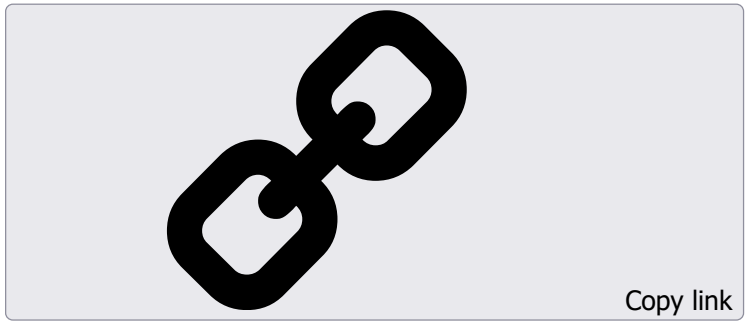
“The idea of getting rare earth elements out of tailings (mining by-products) just makes a lot of sense. It’s a common-sense approach,” he said. “The challenge is to convert that common-sense approach to an economic approach.”

To that end, Element USA is in the process of moving its analytical lab and pilot equipment to Austin to leverage the mineral expertise at The University of Texas at Austin and offer critical mineral experience to students interested in critical mineral research and careers.

“We’re excited about building that relationship with The University of Texas around mineral processing and mineral separation,” Young said.

The research was funded by the U.S. Department of Energy Office of Fossil Energy and Carbon Management, and the Jackson School of Geosciences.

The additional study co-authors are bureau researchers Robert Reedy (the other co-lead author), J. Richard Kyle and Kristine Uhlman, University of Kentucky research professor James Hower, and independent consultant Dennis James.



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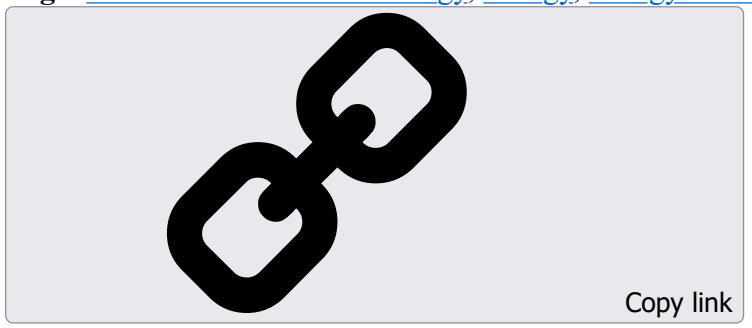

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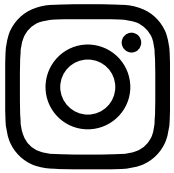

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