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*INDUSTRY DIRECTIONS*

# World coal refuse: garbage, environmental disaster or hidden treasure

The history of coal mining goes back thousands of years with early mines documented as having existed in ancient China and the Roman Empire. It became relevant in the 19th and 20th centuries when it was used primarily to power steam engines and generate electricity.

Today, due to mining practices of the past, there is a tremendous amount of coal refuse causing environmental problems, worldwide. Due to the cost and laborious task of removal, these refuse piles remain scattered across the Appalachian mountain chain in states such as West Virginia, Virginia, and Pennsylvania. During the 1970s, U.S. Congress sought to diversify the nation's electric generation mix by promoting alternative fuels. Congress enacted PURPA, (Public Utility Regulatory Act) as a means of promoting energy conservation and greater use of domestic and renewable energy.

This act in 1978 was crucial in encouraging developers to invest in innovative and speculative ventures such as generating electricity from coal refuse through the innovative use of CFB technology (circulating fluidized bed). The timing was perfect and a new technology was born; providing economic incentive in the productive burning of coal refuse, producing usable fly ash, as well as environmental benefit of removing piles of coal refuses sites.

Since 1987, more than 221 million tonnes of coal refuse in Pennsylvania alone has been repurposed to fuel the energy industry, restoring more than 1,200 miles of streams and restoring more than 7,200 acres of abandoned mine lands (AML) to beneficial use as a result of the production of fly ash as a byproduct. In addition to the environmental benefits, much needed employment opportunities to rural communities are the result.

The Department of Energy (DOE) and the National Energy Technology Laboratory's (NETL) Feasibility of Recovering Rare Earth Elements program is currently heavily focused on developing cutting edge extraction, separation and recovery technologies for the production of rare earth elements (REEs) and critical materials (CMs) from coal and coal refuse piles. This RD&D program consists of developing process and production technologies, environmental management, and field materials, sampling and characterization. Along with systems integration, optimization and efficiency improvements, it aims to produce REEs and CMs from coal and coal by-products streams, such as coal and coal refuse, clay/sandstone over/under-burden coal seam materials, power generation ash and aqueous effluents as acid mine drainage (AMD) sludge.The United States vast coal refuse reserves in geographic areas such as the Appalachian coal basin contain quantities of REEs that offer the potential to reduce our dependence on foreign sources (such as China) for these critical materials and to create new industries where coal plays a more vital economic role than ever.

The new program offers an exciting gateway to enormous economic opportunities while reducing the environmental impact of coal refuse sites. The development of an economically competitive supply of REEs and CMs is essential to securing and maintaining our National Security and continued economic growth.