

The Biorecover Project: Re-mining biotechnologies to create novel critical raw material value chains

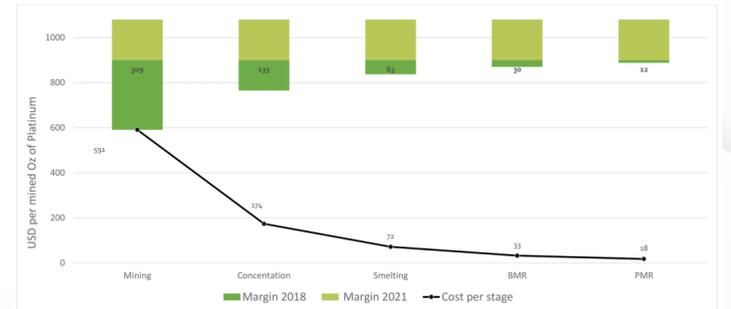
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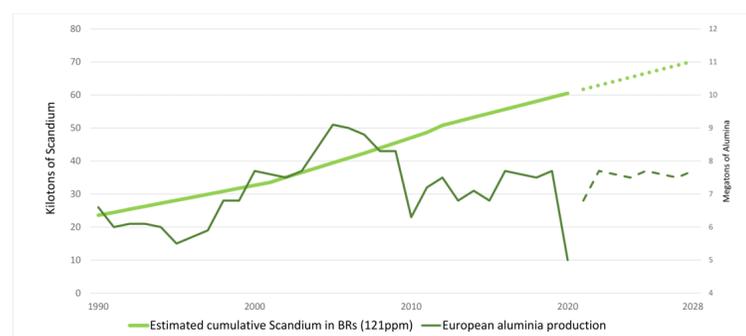
BIORECOVER aims at developing and piloting integrated biotechnological processes capable of treating mining waste streams and selectively extracting target metals with the goal of developing a new sustainable re-mining process essentially based on biotechnology. Specifically, the project is investigating techniques to recover rare earth elements from bauxite residues, magnesium from low grade magnesite ores, and platinum group metals from low grade platinum ores. The EU H2020 project involves fourteen international partners from mining, microbiology, chemistry, engineering, metallurgy, sustainable process development, as well as CRM end-users.

The PGM Value Chain

Due to the concentration of PGM reserves in South Africa, re-mining will likely not create an entirely new European PGM value chain. Rather, the Biorecover process could enable process upgrading by marginally reducing the amount of PGM lost by existing industrial firms during extraction, processing, and manufacturing. Since mining waste has already been extracted, and bioleaching avoids chemical and energy intensive processing methods, reprocessing using Biorecover has the potential to offer an economically viable means of PGM production to help cover the cost of mine closure. Increasing global PGM production, and driving down costs, can in turn help drive the emergence of a new green hydrogen economy in Europe.



	Exploration	Process Design	Extraction & concentration	Refining/ Recovery	Logistics & Sale	Manufacturing	Consumer Appliance	Recycling
Product	Reserve estimates, orebody and indigenous microbe characterisation	Process flow, design, and construction	PGM concentrate	Pure metal	Delivered pure metal	Catalyst	Spent catalyst	Pure metal
Activity description	Testwork - assaying and genetic sequencing	Selecting microbial consortia, designing and building out heap leach and bioreactor process flow	Inoculating low grade ore heaps with cyanogenic microbial consortia and collecting leachate then treating waste rock for use in backfilling during mine reclamation	Treatment of concentrate with additional biotechnologies (microalgae and/or proteins engineered from E. Coli) in bioreactors onsite	Flown directly to client under high security	Pure PGM's are transformed into commercial applications (used as automotive and industrial catalysts, with growing demand for Hydrogen fuel cells and electrolyzers) via existing manufacturing process. Byproduct materials from industrial plants are passed through optimized bioleaching system in bioreactors	Consumer appliances eco-designed for material recovery at end of life	Recovery from consumer appliances using conventional routes
Responsible actor	Geological consulting firm(s) hired by mine	Engineering consultant hired by mine	PGM mining company	PGM mining company	Air cargo company	PGM Chemical manufacturer	Automotive industry	PGM Chemical Manufacturer



The REE Value Chain

The European aluminum industry faces major sustainability challenges due to the production of large amounts of bauxite residues as a waste product from the Bayer process. Biorecover has the ambitious goal of using bioleaching to find a solution to this environmental challenge, while also unlocking the untapped reserves of Rare Earth Elements within the residues. If deployed as a waste processing technology at scale, Biorecover has the potential to create a new European value chain for Scandium. This can drive the birth of a novel industry based on high strength, light weight, Scandium Aluminium master alloys, which could dramatically improve the sustainability of the mobility sector.

	Exploration	Process Design	Extraction & concentration	Refining/ Recovery	Logistics & Sale	Manufacturing	Consumer Appliance	Recycling
Product	Reserve estimates and Bauxite Residue characterisation	Process flow, design, and construction	REE concentrate and neutralized Bauxite Residue for use in construction	Pure Scandium	Delivered pure metal	Sc-Al master alloys	3D printed alloys and high performance aerospace equipment	Recovered metals
Activity description	Feedstock from Bauxite Residues is readily available, eliminating the need for further exploration	Depending on the selectivity of the bioleaching, the process will be tailored to optimize Scandium recovery	Leaching in bioreactors could take place as an integrated step after the Bayer process	Concentrate will be shipped offsite to refiner, who will separate and refine metals	Treated bauxite residue can be used by the cement industry, while REE concentrate will be sold directly to processor, and Scandium will be returned to aluminium producer	Alloys can be produced through casting or electrolysis	Aerospace industry may tailor high performance alloys to their needs	Recycling alloys poses challenges due to diffuse application of Scandium and other elements
Responsible actor	Aluminium producer	Engineering consultant hired by aluminium processor	Aluminium producer	Refiner	Shipping and trucking company	Aluminium producer and Cement industry	Aerospace industry	Recycling company