Project Pipeline

Current location and target developing countries	Company	Technology area or project	Project description	Targeted technologies	Status and expected timelines	Outcomes and impact on the mid- and downstream segments of critical minerals value chains	Impacts on SDG achievement
France; early stages in South Africa.	Genomines.[1] [2] [3]	Engineered hyper-accumulator plants for critical minerals extraction.	Utilising synthetic biology to enhance plants' ability to extract critical minerals from soil and mining tailings, thus remediating the land.	Advanced bioleaching techniques through optimised plant growth and microbiome enhancement.	Project TRL 6. It secured USD 2.2 million in seed funding from BPI France.	Potential for projects in developing countries focusing on critical mineral recovery from tailings using bioengineered plants. No public information exists on project timelines.	This project aligns with SDG 15 (Life on Land) by restoring degraded lands and removing toxic metals from contaminated soils, promoting healthier ecosystems. It also supports SDG 12 (Responsible Consumption and Production) by enabling the recovery of critical minerals from these plants, fostering a circular economy, and reducing the need for traditional, environmentally damaging mining methods. Furthermore, the project contributes to SDG 9 (Industry, Innovation, and Infrastructure) by advancing biotechnological research and creating sustainable solutions for resource recovery, thus supporting the transition toward greener industrial processes. When implemented in a developing country, it has the potential to impact SDG 1 (eradicating poverty) and 5 (gender equality) by providing a safer, greener alternative to artisanal mining, which is often unsafe, uncontrolled, and unregulated.

1) https://www.genomines.com/post/genomines-mining-nickel-absorbed-by-plants-on-polluted-land.

2) https://www.genomines.com/post/green-metals-and-mining-the-race-to-decarbonise.

3) https://www.sciencedirect.com/science/article/abs/pii/S1360138598012837.

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Australia, Namibia, United Arab Emirates	Lepidico.[1]	Proprietary L-Max® and LOH-Max® technologies to extract lithium from lepidolite and other lithium micas.	Ore from the brownfield, open-pit Karibib mines in Namibia is initially processed using conventional flotation technology, producing a lepidolite-rich concentrate (upstream). This concentrate is then transported to the United Arab Emirates, where patented, non-thermal conversion technologies (unlike those used for spodumene) are employed (midstream). The resulting lithium hydroxide is subsequently supplied to customers under a binding offtake agreement with Traxys.	The patented, non-thermal (unlike those used for spodumene), conversion technologies L-Max® and LOH-Max® technologies enable lithium extraction from diverse sources, including lepidolite, other lithium-rich mica minerals, and high-grade lithium phosphate mineral amblygonite. These technologies offer an attractive alternative to the current lithium supply chain from traditional extraction from spodumene and brine.	TRL 8–9. Financing completed and construction commenced in 2023.	The company is a vertically integrated lithium developer with a patented set of clean technologies that also produce other critical minerals from mica minerals. Concentrate commissioning & production chemical plant commissioning and production is expected in 2025. Potential for application at the site of upstream extraction in Namibia.	The company's approach aligns with SDG 12 (Responsible Consumption and Production) by enabling the efficient use of previously untapped mineral resources, reducing waste, and minimising the environmental impact of lithium extraction. Additionally, Lepidico supports SDG 9 (Industry, Innovation, and Infrastructure) by advancing innovative extraction methods that offer a more sustainable alternative to traditional hard-rock and brine lithium sources. The company's technology also contributes to SDG 13 (Climate Action) by providing essential materials for EVs and renewable energy storage, which are key to reducing global carbon emissions.

1) https://lepidico.com/technology.

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South Africa	Cwenga Lib.[1] [2]	Lithium-ion battery recycling process: modular technology using safer chemicals and processes.	This is the first lithium-ion battery recycling company in South Africa. Modular recycling stations.	Disassembly, sorting, hydrometallurgy, and products.	Project TRL 9; recently implemented.	Significant impact on both mid- and downstream processing. South Africa is a top producer of PGMs, with significant mid- and downstream PGM processing infrastructure. Battery recycling is a significant milestone for the region for other critical minerals. The attractive feature of Cwenga technology is that it is modular and uses safer chemicals.	By focusing on the recovery of critical minerals like lithium, cobalt, and nickel from used batteries, the program aligns with SDG 12 (Responsible Consumption and Production), promoting a circular economy and reducing the need for new resource extraction. Additionally, the program supports SDG 13 (Climate Action) by minimising the environmental impact of battery waste, lowering greenhouse gas emissions through the reuse of materials, and reducing the carbon footprint associated with new mining activities. Moreover, it contributes to SDG 8 (Decent Work and Economic Growth) by fostering sustainable jobs in the recycling industry and supporting green economic activities. As this recycling technology grows it will begin to have a positive impact on SDG 1 (No Poverty) and SDG 5 (Gender Equality) because of its modular nature and safer process.

1) https://medium.com/@colinwindell/first-li-ion-recycling-plant-opens-in-south-africa-9113a2c82d74.

2) https://recyclinginternational.com/technology/technology-news/south-africa-gears-up-battery-recycling/51657.

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India	Amara Raja.[1] [2] [3] [4] [5]	Advanced cell technologies, battery cell manufacture, battery recycling, and e-waste recycling.	Collaboration with Gotion High-Tech for licensing advanced Lithium Iron Phosphate (LFP) technology for manufacturing lithium-ion cells in cylindrical and prismatic forms. Also battery packs and charging solutions for light EVs and the telecom industry.	Downstream operations include the Manufacture of lithium-ion cells and battery packs. It is one of the first companies to invest in lithium-ion technologies in India, with a state-of-the-art Gigafactory inaugurated in 2024.	Project TRL 8–9.	Gigafactory capacity to increase from 16 GWh to over 25 GWh annually. The project's first phase, with a capacity of 2 GWh, is expected to be operational soon. Cell types: lithium iron phosphate (LFP) cells and NMC-based 2170 cylindrical cells primarily for two-wheelers. Partnerships: Gotion High-Tech and InoBat to access cell performance and production efficiency improvements. MOU with Piaggio Vehicles to develop and supply lithium batteries and EV chargers for Piaggio India EVs. Customer Qualification Plant (CQP) operational in 2025–2026.	The company actively promotes, monitors, and supports SDG 3 (Good health and well-being), SDG 4 (Quality education), SDG 5 (Gender equality), SDG 6 (Clean water and sanitation), SDG 7 (Affordable and clean energy), SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation, and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 13 (climate action). The company has won many awards and accolades for its efforts. The company is engaged in a wide range of clean energy solutions and recycling technologies.

1) https://www.amararaja.com/press_release/amara-raja-announces-strategic-technology-collaboration-with-gotion-inobat-batteries-gib.
2) https://www.equitymaster.com/detail.asp?date=08/14/2024&story=3&title=Will-Amara-Raja-Cash-in-on-the-EV-Boom-Through-an-IPO.
3) https://timesofindia.indiatimes.com/business/india-business/amara-raja-breaks-ground-for-customer-qualification-plant-for-ev-cell-manufacturing-eyes-lead-acid-battery-plant-up-north/articleshow/112448426.cms.
4) https://economictimes.indiatimes.com/industry/renewables/amara-raja-batteries-plans-1-billion-capex-in-5-7-years-to-focus-more-on-new-age-energy-storage-systems/articleshow/85176696.cms?from=mdr.
5) https://www.amararajaeandm.com/images/certificates/ARE&ML%20Sustainability%20Report%20FY23%20Low%20Resolution.pdf.

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India	Attero.[1] [2] [3] [4] [5]	Battery-grade salts from recycled lithium-ion batteries and e-waste.	Attero has developed an advanced, eco-friendly recycling process for lithium-ion batteries and eWaste, combining mechanical and hydrometallurgical technologies to recover lithium, nickel, cobalt, and graphite at high efficiency, while minimising CO2 emissions. Attero aspires to establish leadership in responsible e-waste management in India.	Mechanical and hydrometallurgical recycling technologies.	In progress TRL 7. Extraction of 22 critical minerals important for green chemistry with purity greater than 99.5%. Efficiency of 98% in extracting critical minerals from e-waste and lithium-ion batteries.	Current capacity: 250,000 tons annually, with plans to increase to 1 million tons by 2030.	The company actively promotes, monitors, and supports SDGs and has received many certifications. Its battery recycling e-waste recycling operations to recover critical minerals align with SDG 12 (Responsible Consumption and Production), promoting a circular economy and reducing the need for new resource extraction, SDG 13 (Climate Action) by minimising the environmental impact of battery and e-waste, lowering greenhouse gas emissions through the reuse of materials, and reducing the carbon footprint associated with new mining activities. Overall, the company contributes to SDG 8 (Decent Work and Economic Growth) by fostering sustainable jobs in clean energy technologies including recycling, and supporting green economic activities. As its technology grows, it will begin to have a positive impact on SDG 1 (No Poverty) and SDG 5 (Gender Equality).

1) https://attero.in/about-us.
2) https://www.amararaja.com/press_release/amara-raja-announces-strategic-technology-collaboration-with-gotion-inobat-batteries-gib.
3) https://attero.in/edge/li-ion-battery-recycling.
4) https://attero.in/Lithium-ion-battery-management.
5) https://attero.in/sustainability.

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India	Tata Chemicals.[1] [2] [3] [4] [5] [6] [7] [8] [9]	Battery recycling and recovery of critical minerals; production of nickel hydroxide cake; battery energy storage systems.	Providing battery storage solutions and recycling lithium-ion batteries for the recovery of valuable materials and metals such as lithium carbonate (Li_2CO_3). Collaborating with Indian R&D centres, including ISRO, CSIR-CECRI, and CMET, to support the indigenous development of battery materials, cell production, and recycling technologies Innovation Centre in Pune working on multiple chemistries as well as cell design and active manufacturing technologies. launched recycling operations to recover key materials.	Lithium Carbonate Recovery, Recycling of Lithium-Ion Batteries.	Project TRL 8–9.	Lithium-ion cell manufacturing factory: In June 2023, Tata Chemicals signed an MOU with the Gujarat government to build a factory in Sanand, Gujarat, with an initial capacity of 20 GWh with the potential for doubling capacity. Tata Chemicals has also launched its new recycling process line for Lithium-ion battery, the Battery Pack Engineering Centre in Pune, and the Innovation Centre to develop cell and active manufacturing technologies. Reduce dependency on virgin lithium mining and promote sustainable battery production.	The company, adhering to Tata Group's sustainability ambition, has very strong SDGs and they actively promote, monitor and support SDGs 1 (Eradicating poverty), 5 (Gender equality), 6 (Clean water and sanitation), 7 (Affordable and clean energy), 9 (Industry, Innovation, and Infrastructure), 11 (Sustainable cities and communities), 12 (Responsible Consumption and Production), 13 (climate action), 14 (Life below water), and 15 (Life on Land). The company has won awards for their efforts. By focusing on the recovery of valuable metals like lithium, cobalt, and nickel from used batteries, the program aligns with SDG 12 (Responsible Consumption and Production), promoting a circular economy and reducing the need for new resource extraction. Additionally, the program supports SDG 13 (Climate Action) by minimising the environmental impact of battery waste, lowering greenhouse gas emissions through the reuse of materials, and reducing the carbon footprint associated with new mining activities. Moreover, it contributes to SDG 8 (Decent Work and Economic Growth) by fostering sustainable jobs in the recycling industry and supporting green economic activities. As this recycling technology grows, it will begin to have a positive impact on SDG 1 (No Poverty) and SDG 5 (Gender Equality) because of its modular nature and safer process.

1) https://www.tatachemicals.com/applications/Lithium-ion-dry-cell-and-other-batteries.
2) https://www.ndtvprofit.com/markets/tata-chemicals-shares-gain-the-most-in-eight-months-on-plans-to-build-ev-battery-plant.
3) https://www.reuters.com/business/autos-transportation/indias-tata-group-signs-16-bln-ev-battery-plant-deal-2023-06-02.
4) https://www.equitymaster.com/detail.asp?date=09/20/2023&story=3&title=Tata-Groups-Next-Big-Leap-in-the-EV-Battery-Sector.
5) https://ir.tatachemicals.com/2019-20/material-sciences-and-energy-sciences.php.
6) https://ir.tatachemicals.com/2022-23/environmental-towards-a-sustainable-future.php.
7) https://www.tatachemicals.com/news-room/articles/green-chemistry-for-sustainability.
8) https://www.tatachemicals.com/news-room/press-release/tata-chemicals-awarded-sustainable-plus-world%27s-first-sustainability-label.
9) https://www.tatachemicals.com/Asia/News-room/Press-release/tata-chemicals-promotes-sustainable-development-while-empowering-communities.

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India, Singapore, United States (Texas)	Ace Green Recycling.[1]	Battery materials from recycled batteries.	Innovative battery recycling technology platform offering sustainable end-of-life solutions. Some R&D and plants in India; bulk of R&D in the United States and Singapore.	ACE's LithiumFirst process to extract battery metals.	TRL 8–9. ACE's lithium battery recycling technology has been assessed and validated by global consulting firm Arthur D Little.	Implementing Scope 1 emissions-free technology to efficiently recycle diverse chemistries of lead and lithium batteries across sectors such as electronics, automotive, and energy storage. This approach aims to minimise environmental impact while recovering critical materials for reuse. Plans are underway to expand the battery recycling facility in Taiwan, equipping it with the capability to process up to 20,000 tons of lead batteries annually, further strengthening regional circular economy efforts and reducing dependency on new raw material sources.	The company aligns with SDG 12 (Responsible Consumption and Production) by promoting a circular economy, minimising waste, and reducing the environmental footprint of battery disposal through its innovative, pollution-free recycling processes. Ace Green Recycling also supports SDG 9 (Industry, Innovation, and Infrastructure) by investing in advanced, eco-friendly technologies for battery recycling, which enhance resource recovery efficiency and reduce the need for primary extraction. Additionally, their efforts contribute to SDG 13 (Climate Action) by ensuring that critical materials are reused in a way that lowers carbon emissions compared to traditional recycling methods. Their operation in India positively impacts SDG 5 (Gender Equality).

1) https://www.acegreenrecycling.com.

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China (GEM), Indonesia (QMB; PT QMB New Energy Materials), South Africa.	PT QMB, PT QMB New Energy Materials, and GEM – Green Eco Manufacture. [1] [2] [3]	Battery grade nickel, cobalt and manganese salts from laterite ores.	PT QMB operation involves laterite processing (upstream) and production of battery grade products (midstream) which will eventually be used in planned domestic battery cell manufacture (downstream). PT QMB is located in Qingshan Park, China-Indonesia Comprehensive Industrial Park, Morowali, Central Sulawesi; the Operation is 63% Chinese-owned, while the rest is owned by Indonesia, Japan, and South Korea. GEM has significant activity in South Africa	Advanced HPAL (high pressure acid leaching) technology for nickel laterite processing (upstream) and production of Ni-Co MHP (mixed hydroxide precipitate) andhigh-purity nickel, cobalt and manganese sulphate crystals.	Project TRL 9; recently implemented.	PT QMB and GEM have already deployed this technology since 2021; design capacity of 96,000 tons of nickel metal equivalent. The Ni-Co-Mn products will eventually be used domestically when the battery cell plant is commissioned.	These projects have a significant impact on SDG 9 (Industry, innovation, and infrastructure) and SDG 12 (Responsible Consumption and Production) by strengthening and expanding production of battery-grade Ni and Co materials from the country's rich Ni ore resources, and by promoting the recovery and recycling of valuable metals such as gold, silver, and rare earth elements from discarded electronics, reducing the demand for new raw materials and minimising waste. The projects also support SDG 7 (Affordable and clean energy) by strengthening midstream and promoting downstream processing for clean energy applications. GEM's urban mining efforts also support SDG 11 (Sustainable Cities and Communities) by addressing e-waste challenges in urban areas, reducing pollution, and improving waste management practices. Additionally, the projects contribute to SDG 13 (Climate Action) by lowering the carbon footprint associated with traditional mining and refining processes, as recycling requires significantly less energy. The company also has a role in SDG 8 (Decent Work and Economic Growth) by providing employment opportunities and contributing to the local economy. The huge infrastructure development leading to additional midstream and downstream processing support SDG 5 (Gender equality) and SDG 1 (Eradicating poverty).

1) https://en.gem.com.cn/Products/list.aspx?lcid=268.

2) https://en.gem.com.cn/About/index.aspx.

3) http://en.gemindonesia.com/gsjs/index.aspx.

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Indonesia, China	Liqin Nickel (Hamahera) Co., Ltd. (Indonesia),[1][2] Ningbo Liqin (China), and Halida Group Indonesia.	Battery-grade nickel-cobalt compounds from laterites.	Hydrometallurgical nickel laterites processing (upstream) to produce battery-grade nickel, cobalt, and nickel-cobalt products (midstream processing). The project (in Obi Island, Indonesia) has an annual design capacity of 120,000 metal tons of nickel-cobalt compounds including 14,250 metal tons of cobalt.	HPAL (high pressure acid leaching) of laterites; production of nickel-cobalt Mixed Hydroxide Precipitate (MHP), refined nickel sulphate and cobalt sulphate from leach solutions.	Commissioned in 2021 with two lines. Now 6 lines are operating with a total capacity of 120000 metal tons per year.	A significant positive impact on both midstream and downstream processing. Two nickel-cobalt compound production lines with a total design capacity of 37,000 metal tons were put into operation at the end of 2021. Second phase was completed at the end of 2022. Third phase was completed at the end of 2023 with a capacity of 65,000 metal tons of nickel-cobalt compounds.	These projects have a significant impact on SDG 9 (Industry, innovation, and infrastructure) and SDG 12 (Responsible Consumption and Production) by strengthening and expanding production of battery-grade nickel and cobalt materials from the country's rich nickel ore resources. The projects also support SDG 7 (Affordable and clean energy) by strengthening midstream and promoting downstream processing for clean energy applications. The huge infrastructure development leading to additional midstream and downstream processing support SDG 5 (Gender equality) and SDG 1 (Eradicating poverty).

1) https://www.lygend.com/industries/5.html.

2) https://www.lygend.com/product.html.

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Indonesia	PT Freeport Indonesia.[1]	Copper smelting and refining to produce high-purity cathode copper.	PT Freeport Indonesia launched the Gresik Smelter & Refinery (majority owned by Indonesia) in Java in June 2024 with a design capacity of processing 1.7 million metric tons of copper concentrate, from PTFI operations in Papua, to produce 650,000 tons of copper cathode and 50 to 60 tons of gold. Smelting uses Mitsubishi continuous process technology and refining uses ISA technology to produce LME Grade A copper (99.99% pure). Byproducts such as slag and sulphuric acid will be used locally.	Downstream operations to process copper concentrate using Mitsubishi continuous smelting and converting process to produce anode copper and ISA technology for refining to produce high-purity cathode copper (LME Grade A).	Project TRL 9.	This new smelter is a major milestone for Indonesia to build midstream and downstream processing capabilities and is the result of the country's ban of exports of all raw minerals from June 2023. This facility will have a significant impact on several SDGs. The Mitsubishi smelter meets the environmental regulatory limit of 280 ppm of SO2 stack emission with a sulphur capture level of approximately 97%. Another new smelter may likely be built in Papua, close to the mine site. The valuable and useful byproducts from this facility are sulfuric acid, copper slag, gypsum, anode slime, and copper telluride, all of which can be used or further processed in Indonesia.	The company's activities are significant for SDG 9 (Industry, Innovation, and Infrastructure), as it contributes to local infrastructure development and economic growth in the region through job creation and investments in community projects. However, PT Freeport Indonesia faces challenges with SDG 12 (Responsible Consumption and Production), as mining operations can generate significant environmental impacts, including waste management and water use. Addressing these challenges is crucial for improving sustainability in the mining sector. The company also has a role in SDG 8 (Decent Work and Economic Growth) by providing employment opportunities and contributing to the local economy, although maintaining high safety and labour standards is essential for long-term sustainable development.

1) https://www.reuters.com/markets/commodities/freeport-indonesia-launches-37-bln-gresik-copper-smelter-2024-06-27/.

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Türkiye	Kalyon PV Group.[1,2]	High-purity silicon ingot, wafer and solar cell production, and solar panel manufacture.	First and only fully integrated R&D and technology starting from the production of high-purity silicon ingot to wafer and solar cell production followed by solar panel manufacture using established and innovative technologies. Obtained quality, performance, and efficiency certificates from internationally recognized institutions for technology and solar PV modules.	Cell Factory: Mono-PERC technology, Bifacial Technology. Commitment to Clean Energy.	TRL 8–9. First integrated plant outside of China, bringing solar energy technology to Türkiye and around the world. Started its operations in 2020; established R&D Centre; completed Phase 3 Production Line in 2023.	Kalyon Holding has realised numerous Photovoltaic Panel Factory and Solar Power Plant investments in Türkiye and the world. Expected to generate clean, green power for two million households in Türkiye, where 20% of total power comes from solar energy. The country expects to eliminate at least 1.5 million tons of annual fossil fuel waste and harmful carbon emissions.	The company's efforts align with SDG 7 (Affordable and Clean Energy) by increasing the availability of solar energy solutions and supporting the transition to clean and sustainable power sources. Kalyon PV also contributes to SDG 9 (Industry, Innovation, and Infrastructure) through its state-of-the-art solar panel manufacturing facility, promoting technological advancement and local production capabilities in the renewable energy industry. Additionally, their projects support SDG 13 (Climate Action) by significantly cutting the reliance on fossil fuels and decreasing greenhouse gas emissions, helping to mitigate climate change.

1) https://kalyonpv.com/en.

2) Multiply Group 2023 ESG Report, Page 11, https://www.kalyonenerji.com/documents/Multiply-Group-ESG-2023-Report.pdf.

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France, Argentina, and Indonesia	Eramet Group.[1]	Lithium extraction from salar brines and production of battery-grade lithium carbonate.	Upstream plus midstream processing. Eramet in association with IFPEN (French Institute of Petroleum and New Energies) and the company Seprosys developed an advanced, highly automated, DLE (Direct Lithium Extraction) process at Centenario, in Salta Province, to produce new battery-grade lithium carbonate. Aluminium-based adsorbent material is used to capture lithium from the brines. Also exploring direct reinjection of the brine into the salt flat to further reduce water consumption. The process also includes nanofiltration and membrane separation (overall efficiency ~87%).	DLE (Direct Lithium Extraction) process to produce new battery-grade lithium carbonate. Aluminium-based adsorbent material is used to capture lithium from the brines. Also exploring direct reinjection of the brine into the salt flat to further reduce water consumption. Unlike other processes, it doesn't use acid, and also can operate at ambient temperature. The whole process also includes nanofiltration and membrane separation (overall efficiency ~87%).	TRL 8-9. Commissioned in July 2024. First production run in November 2024. A feasibility study is underway to achieve production of around 30 additional kilotonnes.	Recently commissioned. 1,600 people working at site; the highest health & safety standards (delivering a TRIR1<2 for roughly 7 million hours of construction activity) and at the highest standards of responsible mining (IRMA guidelines), including all environmental, social and governance aspects. The process, unlike other processes, does not use acid and can operate at ambient temperature with ~90% extraction yield and 60% recycled water. Potential for growth in midstream processing to produce battery-grade materials, and eventually battery manufacture, assembly, and recycling.	The company aligns with SDG 12 (Responsible Consumption and Production) by emphasising sustainable mining practices, including recycling and resource efficiency, to minimise environmental impacts and reduce waste. Eramet also supports SDG 9 (Industry, Innovation, and Infrastructure) through its investment in advanced technologies for extracting and refining minerals, improving efficiency, and reducing the ecological footprint of its operations. Furthermore, the company contributes to SDG 13 (Climate Action) by supplying materials essential for the renewable energy sector, including EVs and energy storage systems, which are crucial for reducing global carbon emissions.

1) https://www.eramet.com/en/news/2024/07/eramet-inaugurates-its-direct-lithium-extraction-plant-in-argentina-becoming-the-first-european-company-to-produce-battery-grade-lithium-carbonate-at-industrial-scale.

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Argentina, South Korea	Posco Argentina.[1,2]	Lithium extraction from salar brines and lithium hydroxide production.	Posco Argentina's large lithium extraction project called Sal de Oro is located in Salar del Hombre Muerto, between Salta and Catamarca provinces began operation in 2024. This is Argentina's first commercial lithium hydroxide plant with an annual production capacity of 25,000 tons. The upstream processing produces lithium phosphate, and the downstream operation produces lithium hydroxide.	Lithium phosphate production from salar brines followed by lithium hydroxide production using electrodialysis membrane separation.	TRL 8–9. Posco (South Korea) developed the electrodialysis membrane separation process for the production of lithium hydroxide. The first phase of the operation began operations with an annual production capacity of 25,000 tons. The second phase is expected to be completed in 2025 and will produce an additional 25,000 tons. Posco is considering a third plant with capacity of 50,000 tons enough to make batteries for 1.2 million EVs.	Significant potential for positive impact on both mid- and downstream processing. Implemented in 2023. This operation is one of many in Argentina processing Salars. Potential for growth in midstream processing to produce battery grade materials, and eventually battery manufacture, assembly, and recycling.	The company supports SDG 7 (Affordable and Clean Energy) by supplying high-quality lithium, a key component in lithium-ion batteries that power EVs and renewable energy storage systems. Posco Argentina also aligns with SDG 9 (Industry, Innovation, and Infrastructure) by using innovative direct lithium extraction (DLE) technologies, which aim to increase the efficiency and sustainability of the extraction process. Additionally, the company contributes to SDG 12 (Responsible Consumption and Production) by emphasising resource efficiency and minimising the environmental impact of its operations, particularly concerning water use in sensitive ecosystems.

1) https://koreajoongangdaily.joins.com/news/2024-10-31/business/guestReports/Posco-has-eye-on-supply-with-Argentina-lithium-plant/2167737.

2) http://www.poscoargentina.com/en.

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Argentina, China	Lithium Argentina Corp joint venture with Ganfeng Lithium).[1] [2]	Battery-grade lithium carbonate salar brines.	Well-known technology for the production of Lithium carbonate from salar brines. Ganfeng Lithium, a leading Chinese lithium producer, is actively involved in downstream processing and aims to integrate Argentina's lithium into its global supply chain.	Salar brine evaporation, impurity removal and battery-grade lithium carbonate precipitation.	TRL 7–9. In 2023, the Cauchari-Olaroz Salt Lake Project was put into operation. As of March 2024, the company has received USD 70 million to expand the project in Argentina.	Significant impact on both mid- and downstream processing. Implemented in 2023. This operation is one of many in Argentina processing salars. Potential for growth in midstream processing to produce battery grade materials, and eventually integrated with battery manufacture, assembly, and recycling.	The company supports SDG 7 (Affordable and Clean Energy) by providing a critical raw material for lithium-ion batteries, which are essential for EVs and renewable energy storage solutions. This, in turn, supports the transition to cleaner energy systems. The company's initiatives also align with SDG 12 (Responsible Consumption and Production) by implementing sustainable mining practices aimed at minimising water use and reducing environmental impacts in their operations. Additionally, the company contributes to SDG 8 (Decent Work and Economic Growth) by creating jobs and promoting economic development in the Jujuy region.

1) https://lithium-argentina.com/our-projects/cauchari-olaroz/default.aspx.

2) https://lithium-argentina.com/our-projects/pastos-grandes-basin/default.aspx.

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Multinational company with many locations globally; Argentina	Arcadium Lithium (merger of Allkem and Livent Lithium).[1][2]	Production of lithium metal products from Salar brine: Direct Lithium Extraction and LIOVIX® technology. This midstream technology is for making Lithium metal sheets for batteries.	Development and scale-up of LIOVIX, a lithium product enhancing battery output and lifespan.	Direct Lithium Extraction from salar brines; development and scale-up of LIOVIX, a lithium product enhancing battery output and lifespan.	Direct Lithium Extraction is at TRL 9. Additional projects are the development phase. LIOVIX is at a TRL of 8; it is slowly being integrated commercially.	Lithium carbonate production was about 18000 tons. With additional production from expansion projects the capacity is reported to increase to 40000 tons, and eventually reaching 100,000 tons by 2030.	This process supports SDG 12 (Responsible Consumption and Production) by using fewer raw materials and energy resources, reducing waste, and minimising the environmental impact of lithium extraction. LIOVIX® technology also contributes to SDG 9 (Industry, Innovation, and Infrastructure) by fostering innovation in battery manufacturing, enabling more sustainable and cost-effective solutions for the growing EV market. Additionally, it aligns with SDG 13 (Climate Action) by supporting the expansion of EVs and energy storage solutions, which are critical for reducing greenhouse gas emissions and transitioning to a low-carbon economy.

1) https://arcadiumlithium.com/innovation.

2) https://arcadiumlithium.com/operations-projects.

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Brazil, Indonesia.	Vale.[1] [2] [3] [4]	Production of battery-grade nickel and cobalt products from nickel laterites.	Indonesia Growth Project (IGP) Pomalaa nickel laterite processing is being developed by a partnership between Vale Indonesia (supplying the ore) and Zhejiang Huayou Cobalt Company (operating HPAL) in Southeast Sulawesi.	Hydrometallurgical process involving High-Pressure Acid Leach (HPAL), partial neutralisation of leach solution and jarosite precipitation, residual iron removal using lime and air, followed by nickel-cobalt Mixed Hydroxide Precipitate (MHP) using magnesia.	Project TRL 8–9.	Pomalaa plant is expected to produce 120,000 tonnes of nickel and approximately 15,000 tonnes of cobalt contained in MHP product per year by 2026. The project will include solid waste treatment facilities, sedimentation ponds and wastewater treatment, leachate treatment, air emission processing, and toxic and hazardous waste management. The project is expected to generate around 12,000 construction jobs in the area. It will also support further midstream and downstream processes.	Brazilian mining company Vale actively promotes, monitors, and supports these in its global operations. Its nickel operations in Indonesia support SDGs 7 (Affordable and clean energy), 9 (Industry, Innovation, and Infrastructure), 12 (Responsible Consumption and Production), 13 (Climate Action), and 15 (Life on Land).

1) https://www.mining-technology.com/news/vale-huayou-huali-nickel-indonesia/?cf-view.

2) https://www.mining.com/web/vale-indonesia-eyes-2026-completion-for-nickel-hpal-plant.

3) https://www.reuters.com/article/markets/currencies/vale-indonesia-eyes-2026-completion-for-nickel-hpal-plant-idUSKBN2G40HU.

4) https://vale.com/pt/esg/nossos-compromissos.

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Canada, United States, Brazil	South Star Battery Metals.[1]	Production of flake graphite for battery anodes.	Santa Cruz Graphite Mine in Brazil. Current plan is upstream conventional processing to produce graphite concentrate with a strategy to move into midstream and downstream processing in the future.	Conventional mining and beneficiation to produce graphite concentrate.	Project TRL 8–9.	Brazil is the largest graphite producer of high-quality natural graphite outside of China. Brazil is focused on new mines and growth of graphite production (upstream processing) and is gradually moving on to mid- and downstream processing.	The company's efforts support SDG 9 (Industry, Innovation, and Infrastructure) by developing additional graphite production capacity which can then promote domestic midstream and downstream operations for clean energy transition. Graphite is a crucial material for battery technologies and therefore its production and processing are fully developed, supporting SDG 7 (Affordable and Clean Energy), SDG 5 (Gender Equality).

1) https://www.southstarbatterymetals.com.

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Mexico	Bacanora Lithium.[1] [2] [3] [4] [5] [6] [7]	Lithium extraction from clay deposits and production of high-purity lithium carbonate.	Bacanora' s greenfield operations in the Sonora Lithium Project involve extraction of lithium from clay deposits into an aqueous medium (upstream processing) and then midstream processing to produce battery-grade lithium carbonate. They have a strategic partnership with Ganfeng which will play a significant role in the development of the Sonora Lithium Project.	Bacanora's process involves several important unit operations: preconcentration, flotation, sulphation roasting, grinding, leaching, purification, evaporation, ion exchange, and precipitation. The process is a combination of upstream and midstream processing.	TRL 6-8. Bacanora has constructed a lithium carbonate pilot plant in Hermosillo to demonstrate the viability of the developed flow sheet and production of high-quality, battery-grade lithium carbonate samples, which can be distributed to potential customers in Asia as needed. The deposit has significant lithium resources with a low strip ratio, and all necessary permits in place.	The original flow sheet was developed by Ausenco Services in Australia. This has been upgraded to include flotation. The pilot plant plays a crucial role in training local operators in preparation for full-scale operations. In addition to lithium carbonate, the process can generate other byproducts such as cesium-rubidium salt cake and high grade potassium sulphate.	The company supports SDG 12 (Responsible Consumption and Production) in the production of battery-grade Lithium carbonate and subsequently lithium hydroxide from a large Lithium deposit, by promoting the efficient use of natural resources and reducing the environmental footprint. This project aligns with SDG 15 (Life on Land) through the implementation of initiatives and partnerships with local communities and stakeholders, and by promoting continuous monitoring and assessing plans to ensure minimal impact on the environment. The project also contributes to SDG 8 (Decent Work) by fostering sustainable jobs, supporting local planning, commitment to education in the community, and economic development.

1) https://www.ganfenglithium.com.
2) https://www.mining-technology.com/news/bacanora-lithium-project-mexico.
3) https://www.mining-technology.com/news/ganfeng-signs-deal-with-bacanora-for-sonora-lithium-project-in-mexico.
4) https://www.mining.com/bacanora-lithium-to-reopen-plant-at-sonora-project.
5) https://bacanoralithium.com/_userfiles/pages/files/documents/bacanora2020agmqa.pdf.
6) https://dialogue.earth/en/business/58718-mexico-lithium-bacanora-sonora-a-mirage-in-the-desert.
7) https://bacanoralithium.com/sustainability.

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Mexico	Grupo México.[1] [2] [3]	Production of refined copper products for various clean energy technologies.	Grupo Mexico is a global conglomerate and is the largest producer of copper in Mexico and the 4th largest in the world. They have operations in Mexico, the United States, Peru, Spain, Argentina, Chile, and Ecuador. Its operations in Mexico include conventional processing copper ores to produce flotation concentrates (upstream processing) and smelting and refining (midstream operations) for production of copper products.	Conventional and mature technologies include flotation, smelting, heap leaching, solvent extraction, electrowinning and electrorefining.	TRL 9.	The copper industry is mature, and plants have been operating for a very long time. Midstream and downstream processing are mature. Mexico is a significant copper producer. The country has excellent infrastructure, and trained workforce, all of which provide a great opportunity to build and grow additional midstream and downstream processing for other critical minerals.	The company has well-developed SDG policies and management. It promotes and supports many of the SDGs in its operations. It promotes SDG 5 (Gender equality) and has a good track record of managing this. The company has contributed significantly to SDG 9 (Industry, Innovation, and Infrastructure) through the development and operation of a massive Cu industry, large-scale infrastructure, green energy production, and adopting innovations in the mature Cu operations. The company makes a large contribution to SDG 8 (Decent Work and Economic Growth) by fostering sustainable jobs and economic growth not only in the communities around operations but also nationwide. Its SDG policies fully support SDG 12 (Responsible Consumption and Production) by actively promoting and monitoring sustainability, health, and safety, natural resource management, environmental impact, and community development. The company also has policies to support SDG 13 (Climate Action) by striving to reduce energy consumption and greenhouse gas emissions associated with conventional extraction techniques, helping to mitigate the impact of mining on climate change. Through their policies regarding respect for the rights of communities and indigenous peoples and environmentally friendly development, they promote and support SDG 15 (Life on Land).

1) https://www.geeksforgeeks.org/electrolytic-refining.

2) https://www.gmexico.com/en/Pages/Politicsds.aspx.

3) https://www.copper.org/publications/newsletters/innovations/2001/08/hydrometallurgy.html.

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Australia, Germany, Thailand	Neometals Ltd. & Primobius.[1]	Battery-grade salts from recycled lithium-ion batteries.	Developing projects focused on recycling lithium-ion batteries to recover valuable materials such as lithium, nickel, cobalt, and vanadium. The company is also involved in recovering vanadium from steel slag.	Closed-loop hydrometallurgical recycling processes that enhance material recovery and reduce waste.	Project TRL 9. Neometals is commercially deploying their battery recycling technology with key partners like Mercedes-Benz.	Neometals process was implemented by Primobius in the first recycling plant at Mercedes-Benz in Germany. Primobius has partnership with Neo Mobility Asia for battery recycling business in Thailand and potentially in other parts of the ASP region. Neometals secured USD 3 million for battery recycling expansion.	The company's projects align with SDG 12 (Responsible Consumption and Production) by focusing on recycling lithium-ion batteries and recovering valuable metals like lithium, nickel, and cobalt, reducing the need for new mining. Neometals also supports SDG 9 (Industry, Innovation, and Infrastructure) through innovative technologies for efficient metal recovery, such as vanadium from slag. Additionally, their efforts align with SDG 13 (Climate Action) by providing critical materials for clean energy technologies, supporting the transition to low-carbon solutions.

1) https://www.neometals.com.au/en/business-units/core-divisions/lib.

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Belgium	Umicore.[1] [2]	Battery materials, recycling, and critical minerals recovery.	Implementation of advanced recycling processes to recover valuable metals such as cobalt, nickel, and lithium from spent batteries. Umicore's New Business Incubator (NBI) is designed to operate like a start-up to foster innovation and to develop and deploy new technologies.	Umicore has significant activities and a comprehensive portfolio of technologies, both midstream and downstream, in battery materials, recycling, and specialty materials.	Project TRL 9. Technologies already implemented.	There is potential for collaboration with partners in developing countries to enhance local battery recycling capabilities. Their processes are reported to be 20%–30% more cost-efficient with high recovery; over 95% for nickel, copper, and cobalt, and over 70% for lithium. In 2024, Umicore secured a USD 350 million EIB loan to open a recycling factory in Belgium.	By focusing on the recovery of valuable metals like lithium, cobalt, and nickel from used batteries, the program aligns with SDG 12 (Responsible Consumption and Production), promoting a circular economy and reducing the need for new resource extraction. Additionally, the program supports SDG 13 (Climate Action) by minimising the environmental impact of battery waste, lowering greenhouse gas emissions through the reuse of materials, and reducing the carbon footprint associated with new mining activities. Moreover, it contributes to SDG 8 (Decent Work and Economic Growth) by fostering sustainable jobs in the recycling industry and supporting green economic activities.

1) https://www.umicore.com/en.

2) https://www.umicore.com/en/sustainability/sustainable-development-goals.

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Canada	Electra Battery Materials (formerly First Cobalt Corp.).[1]	Cobalt sulphate and other battery materials production.	Midstream and downstream processing to produce battery materials. Building a cobalt refinery to produce cobalt sulphate for the EV market. The project also includes battery recycling to recover lithium, nickel, cobalt, manganese, copper, and graphite. s. Future plan to build a nickel sulphate plant. Recent developements and plans for a battery precursor cathode active materials (PCAM) plant adjacent to cobalt refinery and recycling plant. Also planning to develop a Co-Cu deposit in the U.S (Idaho).	Hydrometallurgical processes for production of battery grade cobalt sulphate and recovery of lithium, nickel, manganese, cobalt,, copper, and graphite from recycled batteries.	Project TRL 7-9. A large-scale cobalt refinery construction in progress in Ontario; estimated operation by 2026. Other plans include a refinery in Quebec, battery materials park with recycling and nickel sulphate production.	When the planned operations are commissioned, they will have a significant positive impact on the North American battery materials supply chain and the EV market. Development of the Co-Cu deposit in Idaho will also have a positive impact in North America.	Electra's initiatives advance SDG 9 (Industry, Innovation, and Infrastructure) through its investment in North America's first fully integrated battery materials park. This facility aims to refine cobalt and nickel and recycle battery materials, strengthening regional supply chain resilience for critical minerals. Additionally, the company's focus on ethically sourced cobalt supports SDG 8 (Decent Work and Economic Growth), ensuring a safe work environment and more responsible sourcing practices compared to traditional mining operations in other regions.

1) https://www.electrabmc.com/projects/projects-overview.

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United States	Allonia.[1] [2]	Bioleaching and recovery of critical minerals.	Development of engineered microbes and products including bioleaching and hydrometallurgical processing.	Novel Engineered microbes and products for bioleaching of a variety of feedstocks and critical mineral recovery from leach solutions.	The company has technologies at the TRL 6–8 range. Allonia received USD 30 million Series A Extension funding from Bison Ventures. The current focus is upstream, but can be extended to mid- and downstream processing.	Projects are still in the development stage. The company has Secured partnerships with several mining stakeholders for demonstration of feasibility. One of the outcomes would be the production of higher quality feedstock for mid- and downstream processing. Another outcome would be reducing or eliminating the use of hazardous chemicals and harsh conditions, which could reduce the environmental footprint.	The company's approach aligns with SDG 12 (Responsible Consumption and Production) by promoting resource-efficient mining practices and reducing waste through advanced recovery and recycling technologies by replacing hazardous chemicals. This focus ensures that valuable minerals are extracted more efficiently while minimising environmental impacts. The company also supports SDG 13 (Climate Action) by implementing carbon-reducing technologies and practices that lower the greenhouse gas emissions associated with traditional mining operations, helping to combat climate change. Furthermore, Allonia contributes to SDG 9 (Industry, Innovation, and Infrastructure) by investing in cutting-edge technologies that modernise mining processes, making them more sustainable and resilient. When implemented in a developing country, it has the potential to impact SDG 1 (No Poverty) and 5 (Gender Equality) by providing a safer, greener alternative to artisanal mining, which is often unsafe, uncontrolled, and unregulated.

1) https://allonnia.com/about-us.

2) https://allonnia.com/saff.

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United States	Phoenix Tailings (PT).[1] [2] [3] [4]	Extraction of critical minerals, especially rare earth metals, from tailings and other waste and CO2 GONE Process.	Individual Rare Earth Metal Reduction and domestic Rare Earth Oxide Separation. Zero-waste technology that uses CO2 to extract nickel and magnesium from iron-rich ores.	A proprietary process for separation of REOs and production of rare earth metals through selective halogenation and molten salt electrolysis using mixed halide salts to separate and purify rare earth metals. This process can be powered by renewable energy sources. CO2 GONE Process uses CO2 to extract nickel and magnesium from iron-rich ores. These processes are described as carbon-negative and zero-waste.	In the development and scale-up stage. Focused on U.S. domestic sources and products. Currently producing REEs at a smaller scale. Making efforts to scale up. Also looking at REEs from tailings in Adirondack. "PT CO_2 GONE" process is at TRL 7. It has received USD 39 million in U.S. DOE funding in early 2023.	There is potential for implementation in developing countries with tailings and other waste streams containing rare earth elements. The company has secured funding from several sources and has a strategic partnership with Tridelta Magnetsysteme, a German company, in late 2023 to establish a reliable and sustainable supply chain for their recycled metals. The project timeline is unavailable.	This process contributes to SDG 13 (Climate Action) by capturing and storing CO_2 emissions through a mineralization process that converts carbon dioxide into stable mineral forms, thereby reducing the carbon footprint of industrial activities. It also supports SDG 12 (Responsible Consumption and Production) by using discarded materials from mining tailings as feedstock for the mineralization process, promoting resource efficiency and lowering the dependence on newly sources and raw materials. Additionally, the CO2 GONE process aligns with SDG 9 (Industry, Innovation, and Infrastructure) as it developes cutting-edge technologies that transform mining waste into valuable products, fostering innovation within the resource recovery sector.

1) https://www.phoenixtailings.com.
2) https://www.phoenixtailings.com/products.
3) https://www.accesswire.com/932584/the-massachusetts-startup-leading-the-push-for-domestic-critical-metal-refining.
4) https://www.patch.com/massachusetts/burlington/1-4-million-state-grant-supports-work-burlington-facility.

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United States	Rare Earth Salts Separations & Refining, LLC.[1] [2] [3]	REE separation and recovery from concentrate and recycled materials.	Proprietary technology for REE separation and recovery from concentrate, recycling end-of-life products and industrial waste. The focus is on producing high-purity REEs for use in clean energy technologies.	Advanced recycling processes that recover REEs efficiently from waste streams.	Project TRL 9. The company has commissioned a commercial-scale production of heavy and light REE factories in Nebraska, United States, with U.S DOE funding.	Potential for projects in developing countries focusing on REE recycling and refining. The launch date of the factory is unclear, but likely to occur in 2025. It will specialise in REE recycling.	The company's focus on reducing waste and optimising resource use supports SDG 12 (Responsible Consumption and Production), as it promotes a circular approach to rare earth materials, making the most of limited resources while minimising environmental impact. Its electrochemical process is an innovative technology that reduces process intensity and hazardous steps and supports SDG 9 (Industry innovation, and infrastructure). Additionally, by contributing to a stable supply of REEs crucial for EVs, wind turbines, and other green technologies, the company helps to further SDG 7 (Affordable and Clean Energy), facilitating the transition to a low-carbon economy and the adoption of renewable energy.

1) https://www.rareearthsalts.com/whatwedo.

2) https://www.rareearthsalts.com/ourteam-1-1.

3) https://www.businesswire.com/news/home/20230822581586/en/Rare-Earth-Salts-Announces-Commercial-Scale-Production-of-Heavy-Light-Rare-Earth-Elements-Using-Breakthrough-Technology.

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United States	American Battery Technology Company (ABTC).[1]	Battery metals extraction from recycled lithium-ion batteries.	Recycling, novel extraction, and primary resource development. Proprietary technology for recycling lithium-ion batteries and extracting battery metals such as lithium, cobalt, nickel, and manganese from primary and secondary sources.	Advanced recycling and extraction technologies that improve efficiency and sustainability.	Project TRL 9. The company has established a commercial-scale battery recycling facility and has secured domestic buyers of recycled materials.	Potential for collaboration with developing countries to establish local recycling capabilities. Their commercial recycling plant is in operation as of 2023. Currently expanding recycling operations of black mass refining into critical minerals.	The company's efforts align with SDG 12 (Responsible Consumption and Production) by focusing on the efficient recycling of lithium-ion batteries to recover critical minerals like lithium, nickel, and cobalt, reducing waste and the need for new mining. ABTC also supports SDG 9 (Industry, Innovation, and Infrastructure) through innovative processes that enhance the sustainability of battery materials extraction. By contributing to a domestic supply of these critical materials, ABTC also aids SDG 13 (Climate Action), facilitating the growth of EVs and renewable energy storage, which are essential for reducing carbon emissions and promoting a cleaner energy future.

1) https://www.americanbatterytechnology.com/solutions/Lithium-ion-battery-recycling.

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United States	Maverick Biometals.[1]	Biological extraction of critical minerals from ores.	Development of bioextraction technology using enzymes to break down minerals in ores and concentrates to extract critical minerals such as lithium, nickel, and cobalt.	Proprietary engineered enzymes designed to break down crystal structures of minerals, especially silicate minerals, thereby releasing critical metals; for e.g., breakdown of spodumene, an important lithium silicate mineral, to release lithium. This technology is an alternative to acid-roasting of spodumene, and has the potential to offer high extraction efficiency with minimal environmental impact.	Project TRL 6, in the R&D stage and promising. Its current focus is upstream, but it can be extended to mid- and downstream processing. It has recently received USD 9.6 million in seed funding from VC funds.	Potential for technology transfer and demonstration projects in developing countries. The company is currently trying to secure U.S. DOE SBIR/STTR grants to run a pilot program. No public information exists on timelines.	This initiative supports SDG 12 (Responsible Consumption and Production) by promoting the efficient use of natural resources and reducing the environmental footprint of traditional mining operations. By utilising microorganisms for metal recovery, the project minimises waste generation and enables the recycling of valuable minerals. It also contributes to SDG 13 (Climate Action) by reducing the energy consumption and greenhouse gas emissions associated with conventional extraction techniques, helping to mitigate the impact of mining on climate change. Additionally, the initiative aligns with SDG 9 (Industry, Innovation, and Infrastructure) by promoting and cultivating innovation in biotechnology and creating new, sustainable methods for resource recovery, paving the way for a more eco-friendly and resilient mining industry. When implemented in a developing country, it has the potential to impact SDG 1 (eradicating poverty) and 5 (gender equality) by providing a safer, greener alternative to artisanal mining, which is often unsafe, uncontrolled, and unregulated.

1) https://www.maverickbiometals.com/technology.