

Remining for the energy transition

Potential and pitfalls for sourcing energy transition metals

September 2023

Executive Summary

Governments and companies are increasingly exploring the option to use materials contained in operating, closed or abandoned mine sites via remining. Remining uses mine waste as a source material to extract minerals, metals, or other materials of economic value.

In this joint briefing, Earthworks and Transport & Environment present policy recommendations for safe remining practices, as well as outline remining's associated risks.

The briefing highlights the potential to leverage remining to meet some of the demand for metals and minerals. Preliminary data shows promising potential: in Europe for example remined cobalt could power more than 185,000 EVs.¹ However, significant knowledge gaps remain regarding the availability of metals at mine waste sites.

Benefits associated with remining include:

- Reducing demand for primary mining,
- Building resilient, domestic and low-carbon supply chains, and
- Remediating contamination from legacy or abandoned mine sites.

Risks associated with remining include:

- Potential for new releases of contaminants from waste piles into air, water, and/or land and tailings dam failures from the rehandling of wet, slurried tailings,
- Continuing or recreating the environmental injustices for communities already impacted by mining, and
- Increased need for new smelters, which, if not managed properly, can increase the level of GHGs and pollutants.

Information is still needed to understand the potential benefits of remining, including more detailed characterization of the recovery potential from remined sources. Remining best

¹ Calculation based on 65 kWh battery capacity and NMC 811 chemistry (with a cobalt content of 0.083 kg Co per kWh, according to data from BloombergNEF, "Lithium-Ion Batteries: State of the Industry 2023", published on 18.08.2023).

practices must be developed to ensure effective and safe mineral handling and processing; to safeguard the cultural and spiritual sites of Indigenous Peoples; for environmental, human, and ecological health; for worker protections; for emergency evaluation and preparedness; and for financial bonding and insurance. Remining waste streams will require long-term monitoring and maintenance to avoid ecological disasters. Consultation and consent from impacted communities should be guaranteed at remining sites, and FPIC (Free, prior and informed consent) should be ensured for Indigenous Peoples.

At a minimum, remining facilities should be required to adhere to all relevant mining laws and regulations in their country of operation, and mining regulations and best practices should be updated to reflect the unique circumstances surrounding remining.

Policy Recommendations:

- In the EU, policymakers should prioritize remining projects (as well as metal recycling operations) under the Critical Raw Materials Act (CRMA) strategic project framework, as these will contribute to the EU's strategic autonomy. A specific fund should be set up to ensure that waste characterization efforts are addressed. Furthermore, the EU should urgently review the EU Extractive Waste directive, thereby ensuring national mining codes reflect global best practice.
- In the United States, domestic mining laws and rules must be updated to ensure the highest environmental and social standards for mining and remining operations. Government agencies should ensure better waste characterization, disclosure of transparent preliminary feasibility studies for remining projects, and due diligence and traceability requirements across the supply chain. The U.S. Congress should pass legislation to update mining laws, strengthen the NEPA and Tribal consultation processes and implement circular economy programs.

1. Introduction

July 2023 was the world's hottest month on record. The climate crisis is here, and we must address its impacts now. The world desperately needs a swift transition away from fossil fuels. As we embrace a transition in the energy sources that power our world, from wind turbines to electric buses, regulators globally are looking at how to access the raw materials needed to meet decarbonisation goals.

Whilst recycling will play a role in reducing the pressure from primary mining, governments and companies are increasingly exploring the option to use wastes and other materials contained in operating, closed or abandoned mine sites via remining.

Remining is the use of mine waste as a source material to extract minerals or create other materials with economic value. Sources of mine waste can include solid and liquid waste like tailings, waste rock, smelter slag, etc.

A 2023 study by Dr. Ann Maest, commissioned by Earthworks, Earthjustice and Transport & Environment, looks at remining in the context of metals needed for the energy transition. The study found that there is the potential to leverage remining to meet some of the demand for metals and minerals. However, the greatest barriers to remining are the knowledge gaps regarding the availability and extractability of metals at mine waste sites, the significant risks associated with the remining process, and a lack of best practices to ensure safe remining operations. Additionally, most current remining operations focus on gold recovery. There are very few examples of remining operations that are extracting metals and minerals needed for the energy transition.

This short paper summarizes the findings of Dr. Maest's study, includes some additional information, and outlines recommendations for policymakers globally, with a focus on the United States and the European Union.

2. Remining: what potential and risk?

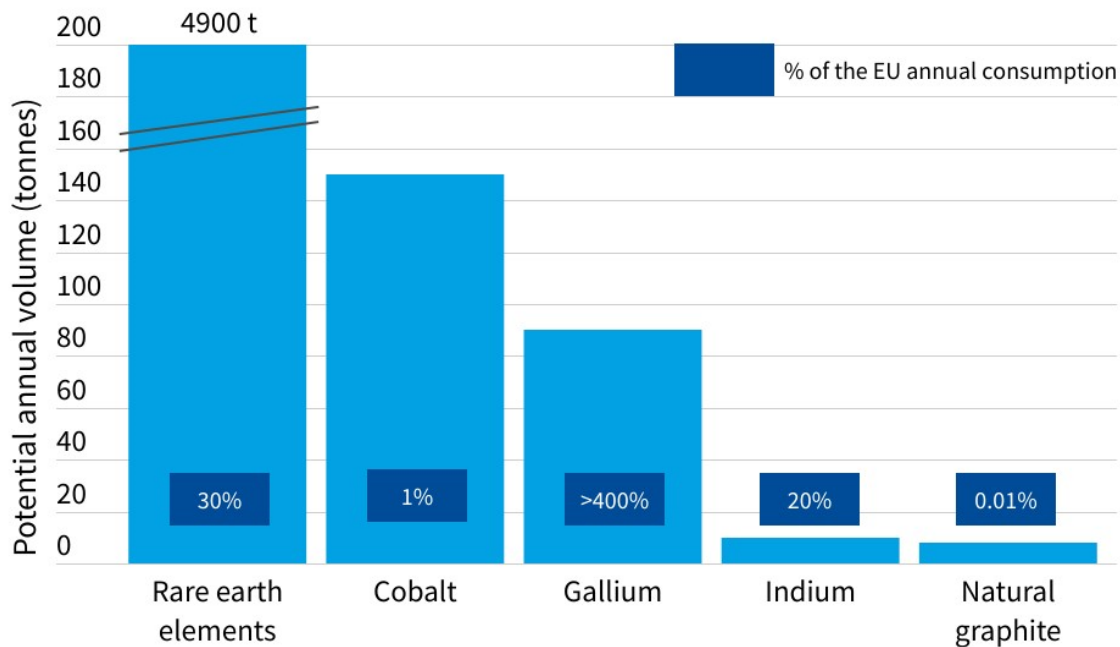
2.1 Potential of remining

The greatest benefit associated with remining is undeniably its potential to reduce demand for primary mining, whilst simultaneously increasing domestic supply. Research and available estimates of the total amount of metals and minerals contained in tailings worldwide point to a promising potential for the recovery of renewable energy metals from mine waste both at legacy and modern mine sites. However, the study highlights the need for more detailed waste characterization to truly understand remining's potential. Waste characterization is the process of determining the concentration, form, and availability or extractability of specific metals in a waste deposit, which informs a mining company's decisions about whether remining a deposit is technically and economically viable. However, other factors besides waste characterization must be assessed to determine the true viability of a project.

With an increasing focus on building resilient, domestic supply chains, and the carbon footprint and environmental impacts of raw materials (as seen in the EU Critical Raw Materials Act), remining presents an opportunity to supply the market with lower carbon materials as

there is no need to extract ore, there is a decreased need to crush and grind the ore, and there are shorter supply chains.

Potential for critical raw materials in extractive waste in the EU to supply annual consumption



Note: Estimated gallium volumes come from bauxite residue produced from the alumina industry. Remaining volumes of cobalt, gallium, indium and natural graphite estimated based on JRC data ("Recovery of critical and other raw materials from mining waste and landfills", Blengini et al., JRC Science for Policy Report, 2019). The volume of rare earth elements was estimated based on publicly available data.

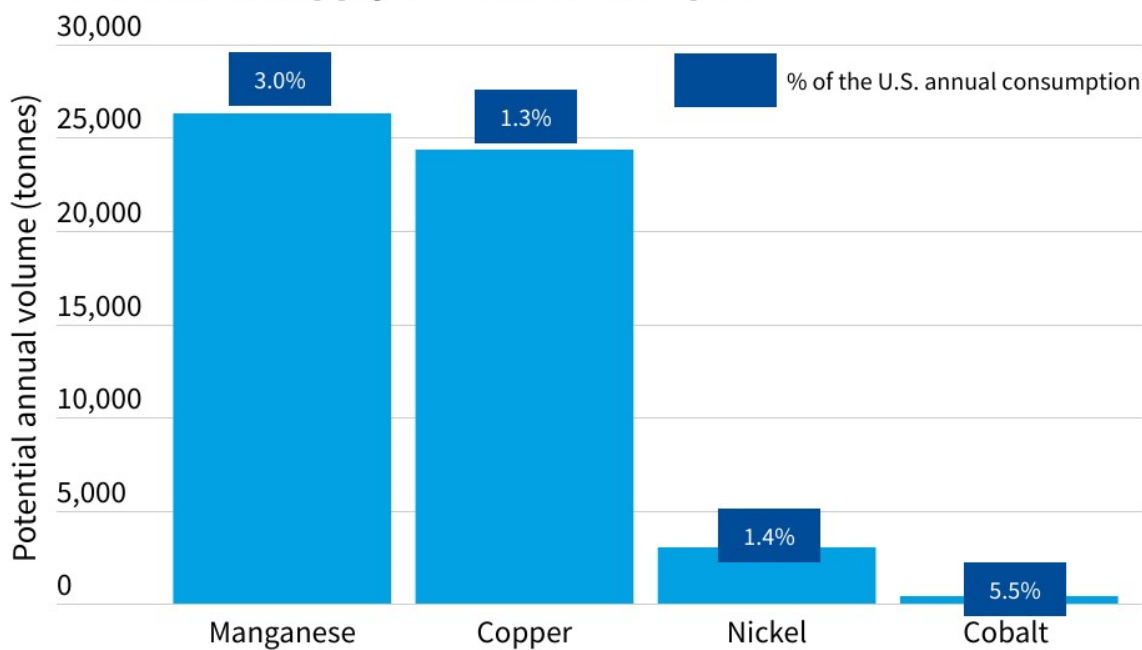
Sources: JRC, LKAB, DERA (Deutsche Rohstoffagentur), Reuters

Figure 1: EU's remaining potential for selected raw materials in extractive waste

Remining could occur at both legacy or abandoned sites and at sites that are still in operation. A benefit associated with the first instance is that, if done correctly, it could help remediate contamination from these sites. If not disposed of correctly, mine waste may contaminate the surrounding air, water, and soil. Remining could provide an economically viable incentive for mining companies to take the steps necessary to contain and remediate pollution from mine waste. However, remining legacy or abandoned sites to achieve environmental remediation is still uncommon. The U.S. Geological Survey, in collaboration with State Geological Survey partners in Colorado, New Mexico, and Florida, is in the process of identifying and characterizing mine sites with energy transition and other minerals in waste streams to gauge their potential for remining projects. Missouri Mining, Inc. purchased the historic Madison/Anschutz Mine, part of the Madison County Mines Superfund Site, in southeastern

Missouri, USA, and is in the process of remediating remnants of historic mining activity. An affiliate, Missouri Cobalt, LLC, has reprocessed historic tailings to recover cobalt, nickel, and copper. Operation of a new underground mine, mill, and hydrometallurgical facility began in 2021. The Chvaletice Manganese Project in the Czech Republic is reprocessing tailings from a mine that operated between 1951 and 1975. The company [claims](#) the project will address the sources of long term water contamination, but it is yet to be seen if they will do so.

Potential for metals disposed or released from metal mines in the U.S. to supply annual consumption



Note: The U.S. Environmental Protection Agency's Toxics Release Inventory (TRI) is not specifically designed for mineral characterization. The TRI reports metal and metal "compounds," where the exact amount of a metal is not known for compounds. The volume referenced here is an estimate calculated by combining the reported amount of metal and 50% of the metal compound amount.

Sources: U.S. EPA, 2023. TRI On-site and Off-site Reported Disposed of or Otherwise Released (in pounds), for facilities in NAICS 2122 - Metal Mining. U.S. Geological Survey, 2023. Mineral Commodity Summaries 2023 (for manganese, copper, nickel, cobalt).

Figure 2: U.S.'s remining potential for selected metals released from metal mines

For operating mines, as is highlighted in the study, efforts to reprocess tailings or waste rock may be able to use existing mine infrastructure. Such is the case at the New Century Resources project in Queensland, Australia, where remined tailings pass through existing facilities to recover zinc. This is undeniably a commercial as well as an environmental opportunity for industry.

2.2 Risks of remining

Remining is mining. It does not come without its risks, which are often similar, if not identical, to those associated with primary mining operations.

When operating a remining site, the key risk is the potential for new releases of contaminants from waste piles into air, water, and/or land. The releases may pose significant risks at sites that have long been closed and abandoned, where documentation of waste materials and their impacts are no longer available. Additionally, the rehandling of wet, slurried tailings in dammed impoundments can lead to tailings dam failures. Such was the case of the 2022 [Jagersfontein failure](#) in South Africa, a remining operation at an idle diamond mine, and the [Baia Mare failure](#) in Romania in 2000, where silver and gold were being recovered.

It is important to avoid viewing remining operations as divorced from the primary mining operation that first took place at the mine site. Mining is an incredibly harmful industry that can have long-lasting environmental, social, public health, and economic impacts for nearby communities. Mining disproportionately harms Indigenous Peoples and peasant communities. One recent [study](#) showed that 54% of energy transition mineral mines worldwide are located on or near Indigenous and peasant territories. In order for the remining sector to avoid continuing and recreating the environmental injustices historically associated with the mining industry, governments must implement specific safeguards to guarantee the rights of Indigenous and peasant communities.

Furthermore, remining operations should be banned at mine sites where community demands regarding reparations and clean up of past mining operations or tailings failures have gone unmet by mining companies, and where those demands would not be adequately addressed by a new remining project. At the proposed Stibnite Project in Idaho, Perpetua Resources is proposing remining operations at a site with legacy mine contamination, including the reprocessing of tailings. However, the remining proposal is combined with a substantial new mining operation, which the U.S. Forest Service has concluded in the Supplemental Draft Environmental Impact Statement would adversely affect tribal rights.² Remining projects should not be used as a way to greenlight new projects that further environmental injustice. Cleanup of historic sites may occur alongside new mining activity, but the overall benefits and cumulative impacts should be evaluated.

² U.S. Department of Agriculture, Forest Service, Stibnite Gold Project, Supplemental Draft Environmental Impact Statement, Volume 1, p. ES-32.
Available at: <https://usfs-public.app.box.com/v/PinyonPublic/file/1052214209080>

Remining has the potential to increase the need for new smelters or facilities designed to extract metals. Smelters are a type of furnace that subjects ore concentrates to high temperatures to release the metal from other substances, including sulfur. If not managed well, smelting of metals can be a major global source of arsenic and sulfur emissions, greenhouse gas emissions, and other toxins. As Europe and the US are looking to onshore some of these processes, which today are mostly conducted in China with carbon-intensive energy sources, it is important that new smelting operations are operated according to the highest environmental and labour standards.

3. Recommendations

This section explores what is needed from a technical and industrial perspective to unlock the potential of remining globally, as well as key recommendations on risk avoidance and mitigation. The latter part of this section presents policy recommendations.

3.1 What is needed to unlock the full potential of remining and minimize the risks

To further understand the potential benefits of remining, a more detailed characterization of the recovery potential from remined sources is needed. For industry, it means better and publicly accessible records that document the waste streams at any given site. Improving transparency will allow for a more robust understanding of remining's potential, as well as an understanding of which waste sources should be prioritized. For policymakers, the recommendations are explored in the following sub-section.

Another remining data gap is the lack of standardized, industry-wide best practices for remining. Best practices are necessary for mineral characterization; evaluation of effective and safe methods for mineral processing (to mitigate environmental damages); and for understanding and safeguarding the cultural, and spiritual sites of Indigenous Peoples. Best practices should include guidelines for environmental, human, and ecological health; worker safety and protections; emergency evaluation and preparedness; and requirements for financial bonding and assurance. At a minimum, remining facilities should be required to adhere to all relevant mining laws and regulations in their country of operation, and mining regulations and best practices should be updated to reflect the unique circumstances surrounding remining.

Companies — especially in regions with less regulation and scrutiny — may use remining as an excuse to avoid reclaiming or safely closing a mine, which can lead to environmental and

stability risks. To avoid these risks, regulators should ensure that proper site closure and tailings disposal are put in place even if remining activities are proposed.

Finally, the waste streams that remain after remining, which can be significant, will require careful disposal, monitoring, and maintenance in perpetuity to avoid additional adverse environmental effects and possible ecological disasters. Remining waste should not be exempt from hazardous waste regulations.

3.2 Policy Recommendations General

Earthworks and Transport & Environment's policy recommendations are as follows:

- **Support waste characterization efforts to better understand the potential of remining.** Without incentivising characterization efforts, investments and technological developments to advance remining will be difficult. For this reason, policymakers should support efforts in this space.
- **Apply strong mining regulations to remining.** At a minimum, mining regulations should apply to remining. These should be based on protective and conservative safety guidelines, like the tailings guidelines outlined in [Safety First: Guidelines for Responsible Mine Tailings Management](#). As mining laws are being reviewed across the globe, they should take into account the risks and opportunities presented by remining, including potential social, environmental and economic impacts.
- **Guarantee consultation and consent at remining sites.** Consultation and consent processes must include the right of communities to say “no,” “yes,” or “yes” with conditions to remining projects that will affect them and/or their territories. As is stipulated in Guideline 2 of the 2022 report, [Safety First: Guidelines for Responsible Mine Tailings Management](#), “consent must be obtained through culturally appropriate processes, time frames and mechanisms that are determined by the Indigenous Peoples or affected communities. These may include customary decision-making processes, local democratic processes and local governance mechanisms, or other processes such as referenda.” The UN Declaration on the Rights of Indigenous Peoples (UNDRIP) codifies the right to Free and Prior Informed Consent for Indigenous Peoples.
- **Mandate Impact Assessments.** Remining is mining. Where not already required by law, proposed remining operations must undergo a rigorous environmental and social impact assessment to provide frontline communities, governments, and regulatory agencies with information about the full range of potential impacts of the remining project. The assessment process must include the opportunity for public comment and appropriate remedies.

3.2.1 Policy Recommendations for the European Union

In March 2023 the European Union proposed a new draft law to ensure a sustainable supply of raw materials, called the Critical Raw Materials Act (CRMA). The proposal is an important step towards characterizing mine waste, and assessing its economic potential. However, more must be done to advance in this area.

Transport & Environment's policy recommendations for the European Union are:

- Prioritise remining projects (as well as recycling ones) under the CRMA strategic project framework as these will contribute to the EU's strategic autonomy.
- Review the EU Extractive Waste directive³, thereby ensuring national mining codes are brought up to the global best practice. The revision should include better waste characterization and composition disclosures, as today each Member State reports very differently. Further, the revision should address tailings management practices from design to management, including for remining operations.
- Create a specific clean technologies fund to support activities linked to the CRMA and the Net Zero Industry Act, including remining, as part of the EU budget (Multiannual Financial Framework) mid-term review. Under the future Strategic Technologies for Europe Platform (STEP), mobilise existing instruments at the EU level to provide financial and technical support to high standards remining operations.

3.2.2 Policy Recommendations for the United States

In order to appropriately regulate potential remining operations, the U.S. must have strong mining laws and regulations in place. The 1872 mining law and its regulations do not include adequate environmental standards, enforcement and oversight powers, financial guarantees, or royalties. The law and rules do not recognize Tribal sovereignty, nor clarify land managers' discretion to deny mines where they do not belong. Congress and the Administration should immediately update the domestic mining law and rules to ensure the highest environmental and social standards for mining and remining operations.

In November 2021, President Biden signed the Investment in Infrastructure and Jobs Act (IIJA). As a result, the U.S. Geological Survey began a 10-year program to create a national mine waste inventory and conduct mine waste characterization at abandoned mines across

³ Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC .

the country. IJJA also funded numerous Department of Energy (DOE) led programs recovering metals from acid mine drainage or other mine wastes.

In August 2022, the President signed the Inflation Reduction Act (IRA). This law created three tax credits related to remining. 1) 45x: Advanced Manufacturing Production tax credit for remining and processing. This credit makes remining more economically viable. 2) 48c: Qualifying Advanced Energy Project tax credit for mineral processing, refining, and recycling. DOE should prioritize this credit for techniques related to recycling, bioleaching, phytomining, hydrometallurgy, and gravity/magnetic separation. 3) 30d: Consumer tax credit may apply if remined minerals are used in electric vehicle batteries.

2023 Administrative Solutions:

- **New mining and remining rules.** In May 2022, President Biden convened an Interagency Working Group on Mining Reform. Their report must finalize improvements to public lands mining rules, in accordance with a rulemaking petition submitted by several Tribes, Indigenous-led organizations, and conservation groups.⁴ All remining projects must plan for circularity, comply with applicable updated mining rules, and undergo a NEPA Environmental Impact Statement. For example, the Golden Sunlight Mine in Montana, USA, has completed an EIS for remining of tailings.
- **Better data.** The Environmental Protection Agency should update their Toxics Release Inventory (TRI) to include identification of the waste sources (e.g., tailings, waste rock); total volume of waste and grade estimates; and basic metallurgical evaluation of wastes, especially mineral liberation and potential processing methods. The TRI metals list should conform to DOE's critical material and USGS's critical minerals lists by adding lithium; REEs; aluminum, and zinc (for releases to land and water).
- **Data disclosures.** The Securities and Exchange Commission (SEC) should update its regulations for disclosure by all registrants engaged in mineral operations to provide transparent preliminary feasibility studies for remining projects.
- **Due diligence.** The US Government must condition all federal remining support, including 48c and 45x subsidies, upon the recipient's commitment to perform ongoing human rights and environmental due diligence across their supply chains, in accordance with internationally accepted standards like Free, Prior, and Informed Consent (FPIC).
- **Traceable mineral supply chains.** The Treasury Department should incorporate minerals tracing and reporting requirements into the implementation of the 30D tax

⁴ Please see <https://www.regulations.gov/document/DOI-2022-0003-14647>

credit to increase transparency in the minerals supply chain while enabling compliance with and verification of the tax credit's mineral sourcing requirements .

2023 Legislative Solutions:

- The Clean Energy Minerals Reform Act, introduced by Rep Grijalva (D-NM) and Sen. Heinrich (D-NM) in 2022, updates the 1872 mining law. Remining is mining. The bill, among other things, creates a royalty to fund IJA's abandoned hardrock mine reclamation program within the Interior Department. This dedicated funding source for mine reclamation could potentially also reduce operating costs for future remining projects associated with reclamation activities.
- The A. Donald McEachin Environmental Justice for All Act, introduced by Reps. Grijalva (D-AZ) and Lee (D-CA) and Senators Booker (D-NJ) and Duckworth (D-IL) would strengthen the NEPA and Tribal consultation processes.
- Legislation directing the Department of Energy and the Environmental Protection Agency to implement collection, recycling, and reuse programs for products containing minerals, modeled after the EU's 2023 Battery Regulation.

4. Conclusion

As governments look to shift economies away from fossil fuels, remining presents unique opportunities to move towards a circular economy, as well as address legacy issues created by past mining projects. However, more information is needed to fully understand the potential of remining, and regulators must take proactive steps to develop best practices and safeguards for remining project and to ensure these projects don't further harm communities, ecosystems and Indigenous Peoples' rights.

Further information:

[Executive Summary:](#) The full technical report by Dr Ann Maest will be published in the fall of 2023, pending approval of publication in a peer-reviewed journal.

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