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Chairman Stauber, Ranking Member Ocasio-Cortez, and distinguished members of the subcommittee, good morning. Thank you for inviting me to discuss critical minerals policy.

My testimony represents my views only and reflects my decades of scholarship as a Professor of Environmental Studies at Macalester College in Minnesota. My background is in environmental policy, with a focus on energy and water issues. For more than 25 years, my research has focused on energy infrastructure development and public engagement in technology design. For the last ten years, I have studied critical minerals with attention to both the challenges of increasing primary extraction and the opportunities that come with greater investments in a circular economy approach. I'm grateful that my research has been supported by federal agencies including the National Science Foundation, NOAA, the Department of Energy, and private foundations. My testimony draws in particular on my experience in Minnesota.

Adequate supplies of critical minerals are key to achieving the climate policy goals asserted by the Biden-Harris Administration. H.R. 8446 amends the Energy Act of 2020 to include critical materials in the list of critical minerals. The lists maintained by USGS and the Commerce, State and Energy Departments, have been designed for different purposes, and draw on different methodologies and forecasting techniques. The DOE critical materials list is specifically aimed at the energy sector and agency priorities; it is not interchangeable with the economy-wide critical minerals list.

These lists matter because they inform strategic national policy and agency investments. They have justified Executive Orders, new grants programs and tax credits. In effect, they have been used to privilege primary extraction.

I do not believe that categorization and classification is where Congress should be focusing its critical minerals policy attention. Despite the interventions of the last three Presidential administrations to categorize minerals to stimulate development, there has been little success in re-establishing a U.S. critical mining sector. Primary extraction may not be the most responsible method for sourcing minerals for important technologies including batteries, solar panels, and wind turbines. Instead, I urge Congress to prioritize development of a robust circular economy of metals.

Critical minerals mining is often posed as a necessary requirement for the clean energy transition. The challenges to opening up new mines have been well documented, including how and why local communities respond adversely to new mining proposals.[1] This challenge is partly rooted in the mining sector's poor sustainability record globally, and in the U.S. Mining is one of the world's most carbon-intensive sectors. In 2019, the Rocky Mountain Institute estimated that the production of industrial metals accounted for over 10% of global greenhouse gas emissions.[2] Similarly, the International Energy Agency found that the waste generated per unit of mineral produced increased by over 20% from 2019 to 2022, and water consumption increased by around 25% during this period.[3] In 2022, the EPA reported that the mining sector accounted for 44% of reported national toxic releases.[4] Cleanup of the approximately half million abandoned hardrock mines in the U.S. is estimated by the EPA to cost more than $35 billion.[5]

This immense environmental footprint, combined with the challenges incumbent in building out new mines, suggests it's high time to shift critical minerals policies toward more responsible sourcing that does not rely on primary mining. Far less attention and investment has been given to the recovery and recycling of metals from waste streams, including consumer electronics, landfills and legacy mines. While the Department of Energy has begun investing in R&D work in this area, it is paramount that Congress continue to support these efforts.

In the testimony that follows, I describe how circular economy and demand side management strategies can create resilient supply chains by limiting import dependence, while also reducing the negative impacts on air, soil and water from primary extraction. This approach can also produce new employment opportunities while upholding the sovereignty of Tribes whose lands are in close proximity to mining operations.

The below sections focus on: 1) Developing robust circular economy systems and demand side approaches, 2) Reforming the Mining Law of 1872, and 3) Strengthening FPIC (Free, Prior and Informed Consent) requirements, especially as it relates to Tribal communities.

1) Developing robust collection systems and demand side approaches

The abundance of critical minerals in our waste streams challenges arguments on scarcity. The UN's fourth Global E-waste Monitor reported that the world's generation of e-waste, including mobile phones, home appliances and anything else powered by electricity, is rising five times faster than documented e-waste recycling. They estimate the annual generation of e-waste is

[1] Owen, J. et al. 2022. "Fast track to failure? Energy transition minerals and the future of consultation and consent," *Energy Research & Social Science*, 89: 102665.

[2] https://rmi.org/insight/low-carbon-metals-for-a-low-carbon-world

[3] https://www.iea.org/reports/global-critical-minerals-outlook-2024/market-review

[4] https://www.epa.gov/trinationalanalysis/metal-mining

[5] https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=20004GRW.TXT

rising by 2.6 million tons annually, on track to reach 82 million tons by 2030.[6] The global average annual e-waste generated per capita is 16.8 lbs, but in the U.S. it's a staggering 46 lbs per capita.

Urban mining and landfill mining can make a critical contribution to the circular economy of metals. Whereas "urban mining" has been used to describe the process of recovering e-waste found above ground in our homes and communities, landfill mining recovers materials from both active and inactive waste facilities. A report from the highly regarded Belgian university KU Leuven argued that "Recycling is Europe's main opportunity to improve its long term self-sufficiency and could provide 45-65% of Europe's base metal needs by 2050". They also write that metals recycling, on average, saves between 35% and 95% of the CO2 compared with primary metals production.[7]

When e-waste isn't properly disposed of it ends up in landfills, where the EPA estimates it contributes 70% of all toxic metals pollution, despite making up 2% of the total weight present in landfills. My home state of Minnesota can provide a case study. Though we are considered among the top states in terms of e-waste recycling, the Minnesota Pollution Control Agency's 2022 SCORE data suggests we collect only 20% of our e-waste. Most of the rest ends up in landfills where it leaches toxins into soil and water.

There is also a cost to this inaction. Improperly collected e-waste totals millions of dollars each year in lost business income and local tax expenditures. In 2018, the U.S. Consumer Product Safety Commission reported more than 25,000 battery fire or overheating incidents involving consumer products in a five-year period.[8] Waste industry leaders report devastating infrastructure losses each year to battery fires. In Minnesota, the city of Blaine lost a $20 million transfer station due to a battery fire in 2018. In another Minnesota example, the Rice County landfill had a battery fire that burned for almost a week straight last year. Similar examples exist nationwide.

This is a tremendous lost opportunity because there is economic value in this waste, whether it comes from consumer devices, landfills or legacy mine waste. The fourth Global E-waste Monitor reported that the economic value of the metals contained in the e-waste generated globally was estimated at US$91 billion in 2022.[9] In 2020, they had calculated that value at $57 billion.

In 2018, the International Labor Organization reported that six million jobs could be created globally by transitioning towards a circular economy which includes activities like recycling, repair, rent and remanufacture - replacing the traditional economic model of "extracting, making, using and disposing". As previously mentioned, the global average annual e-waste

[6] https://ewastemonitor.info/the-global-e-waste-monitor-2024/
[7] KU Leuven. 2022. "Metals for Clean Energy: Pathways to solving Europe's raw materials challenge." Accessed at: bit.ly/MetalsCleanEnergy
[8] U.S. CPSC. 2018. "Status Report on High Density Batteries Project". Accessed at: https://www.cpsc.gov/s3fs-public/High_Energy_Density_Batteries_Status_Report_2_12_18.pdf
[9]https://unitar.org/about/news-stories/press/global-e-waste-monitor-2024-electronic-waste-rising-five-times-faster-documented-e-waste-recycling

generated per capita is 16.8 lbs, but is 46 lbs per capita in the U.S. Last year my colleagues and I used this statistic in a pilot study to estimate the value of our Minnesota e-waste. We calculated that the average 267 million pounds of e-waste generated annually in our state could create 1,700 direct jobs.[10] According to the Coalition for American Electronics Recycling Jobs report, e-waste collection, de-manufacturing, shredding and information technology asset collection/refurbishing activities generate one full time job for each 172,000 pounds of e-waste processed. In Minnesota, the e-waste firm Repowered reported that for every additional 98,600 pounds of e-waste accepted in their facility, they were able to add 1 full-time position to their recycling team. Repowered focuses on providing post-release opportunities and extensive training for those who have spent time in corrections.

Given the lack of comprehensive e-waste recycling rules in the U.S, states are starting to fill the vacuum. Of the 25 states with e-waste laws, 17 states have banned e-waste from landfills. In 2024, an ambitious 100% Electronic Waste Recycling Bill (SF 3940/HF 3566) was introduced in Minnesota with the goal of reducing pollution, inspiring economic activity, and recovering valuable metals.

Federal support for e-waste recycling takes the form of agency programs. In 2013, the Department of Energy created the Critical Materials Institute with a $120 million budget to research alternatives, reduce waste and diversify production. With funding from the Infrastructure Investment and Jobs Act, the DOE has initiated two new grant programs: the Battery Material Processing Grant Program ($3 billion for FY 2022-26) and the Battery Manufacturing and Recycling Grant Program ($3 billion for FY 2022-26). The DOE's $125 million Battery and Critical Mineral Recycling Program is designed to award grants for research, development and demonstration projects to create innovative and practical approaches to increase the reuse and recycling of batteries. The DOE has argued that these investments are essential to advancing a domestic supply chain of critical materials for the energy transition.

Consumer education and responsible collection are aspects of a circular economy strategy to reduce mineral demand. The EU estimates that such strategies can reduce 58% of critical minerals demand between 2022 and 2050 compared to a business as usual scenario, with recycled cobalt, nickel and manganese potentially supplying 80-90% of demand.[11] A similar report by an Australian think tank found that circular economy policies have the potential to reduce mining demand for cobalt, copper, lithium, and nickel by 25-55 percent of total demand by 2040.[12]

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[10] Jensen, M. et al. 2023. "The Economic Potential of E-Waste Recycling in Minnesota," Iron Range Partners for Sustainability. Accessed at: https://www.irpsmn.org/ewaste-recycling

[11] Environmental Justice Foundation. 2024. "Critical minerals and the green transition". Accessed at: https://ejfoundation.org/resources/downloads/EJF_critical-minerals-and-the-green-transition.pdf

[12] Dominish, E. et al. 2020. "The potential of avoidance, reuse and recycling solutions to minimise mining for lithium-ion batteries for electric vehicles". Institute for Sustainable Futures, University of Technology Sydney. Accessed at: https://www.earthworks.org/publications/ recycle-dont-mine/

The Rocky Mountain Institute has argued that the evolution of battery designs may initiate dramatic shifts in energy systems as early as 2030. They report that new battery chemistries are expected to compete with the prevailing lithium-ion (Li-ion) technology. For example, RMI recently reported that solid state batteries are "poised to massively disrupt the storage industry by unlocking new opportunities for cheap, safe, and high-performing batteries".[13] Reduced battery sizes will also impact demand for nickel, cobalt, manganese and lithium.[14] Tesla reported that almost half of their EVs manufactured in the first quarter of 2022 had nickel and cobalt-free lithium iron phosphate batteries.[15] According to the IEA's Global Critical Minerals Outlook 2024, cobalt demand is expected to decrease by 30-45% in 2024.

Transit planning and technology design strategies can also reduce demand. Research by the UK group Transport & Environment found that combined policies that incentivize smaller EVs, innovate battery chemistries and reduce private car journeys could cut demand for key metals lithium, nickel, cobalt and manganese by 36-49% by 2050 in the European Union. This finding is also supported by the University of California Davis' Climate and Community Project. Their innovative modeling of material flows and socioeconomic policies showed that three key strategies can reduce U.S. lithium demand by 90 percent in the next 3 decades: decreasing car dependency, right-sizing EV batteries, and creating a robust recycling system.[16]

2) Reforming the General Mining Act of 1872

It will take time to establish the circular economy infrastructures that can meet critical minerals demands. The EU Metals for Clean Energy 2022 report suggests that gap could be as short as 2035 before sufficient metals from first generation products enter the recycling loop. If the U.S. adopted policies similar to the EU, including securing sustainable imports from reliable partners, we could imagine a similar bridge period. During this time, it is paramount that terrestrial, or land-based, mining proceed with improved and enforced human rights and environmental due diligence to reduce harms. This requires Congress reform the General Mining Act of 1872.

In 2023, the Biden-Harris administration released a comprehensive report providing guidance to Congress and federal agencies for mining reform. The Bipartisan Infrastructure Law directed the Department of Interior and the USDA to identify legislative and regulatory recommendations to increase "the timeliness of permitting activities for the exploration and development of domestic critical minerals". This also followed a rulemaking petition from Tribes, Indigenous led

[13] https://rmi.org/insight/breakthrough-batteries/

[14] Transport & Environment. 2023. "Clean and lean: Battery metals demand from electrifying cars, vans and buses". Accessed at: https://www.transportenvironment.org

[15] https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/energy-transition/042122-almost-half-of-tesla-evs-produced-in-q1-had-no-nickel-cobalt-in-battery#:~:text=Electric%20vehicle%20maker%20Tesla%20equipped,quarter%20results%20presentation%20April%2020.

[16] https://www.climateandcommunity.org/more-mobility-less-mining

organizations and conservation groups.[17] After eliciting 26,000 public comments and engaging in dozens of "listening sessions" with stakeholders, the Department of the Interior-led Interagency Working Group on Mining Laws, Regulations and Permitting (IWG) released 65 recommendations. Among these recommendations are the need for a programmatic environmental impact statement that identifies good sites for mining while allowing for "meaningful, robust, and early consultation between the federal and tribal governments". They also suggest a reclamation fee structure to help pay for abandoned mine cleanup. And, connected to my previous section, the recommendations encourage mining and reprocessing at previously disturbed sites.

3) Consent and consultation

Decarbonization and climate action shouldn't be pitted against Indigenous sovereignty. Globally, Indigenous communities bear the brunt of the mining industry's adverse effects, including on their health, environment, livelihood and culture, yet they share minimally in the benefits and have little input in decision-making.[18] A 2021 Morgan Stanley Capital International report found that 97 percent of nickel, 89 percent of copper, 79 percent of lithium, and 68 percent of cobalt reserves and resources in the U.S. are located within 35 miles of Native American reservations.[19] This has deep implications for the need for Tribal consultation and consent.[20]

The IWG report cited above concluded that fundamental reform of the Mining Law of 1872 is necessary to "achieve the best outcomes for communities and Tribes impacted by mining, America's clean energy and climate goals, and certainty for industry".[21] They also argue that agencies must be required to expand engagement with Tribes toward more meaningful, robust and early consultation. Congress should act in accordance with these recommendations.

Without such measures and protections, Tribes will continue to use legal means to block new mining. Indigenous sovereignty is being expressed through legal challenges across the U.S., including by evoking environmental quality standards that supersede federal standards. Almost exactly a year ago, the NewRange copper nickel mine in northeastern Minnesota had its Army Corps water permit revoked because it did not comply with the water quality standards set by a sovereign downstream tribe, the Fond du Lac Band of Lake Superior Chippewa. The Fond du Lac Band had EPA-approved water quality standards of their own in place, nearly twice as strict as Minnesota's, to protect their wetlands from mercury contamination. In August 2023, the Minnesota Supreme Court agreed with the Army Corps decision, and suspended the mining

[17] MRIWG Final Report. 2023. "Recommendations for Improving Mining on Public Lands". Accessed at: https://www.doi.gov/media/document/mriwg-report-final-508-pdf

[18] Deonandan et al. 2024 "Social License to Operate (SLO): Private governance and barriers to community engagement," *The Extractive Industries and Society*, 17: 101404.

[19] Block, S. 2021. "Mining Energy-Transition Metals: National Aims, Local Conflicts," Morgan Stanley Capital International. Accessed at: https://www.msci.com/www/blog-posts/mining-energy-transition-metals/02531033947

[20] See Owen et al. 2022.

[21] https://www.doi.gov/pressreleases/biden-harris-administration-report-outlines-reforms-needed-promote-responsible-mining

permit. Their ruling found that state regulators failed to fully consider the threats to water quality. This may be the first time that a Tribe objected to a federal permit on the basis of their rights under the Clean Water Act. The approach taken by the Fond Du Lac Band, not only to establish standards through local science but to defend their sovereignty at the agencies and in court, may be the tactic pursued by other tribes.

Tribes may also choose to challenge mining development through the granting of rights to nature. In the U.S., five Tribes have passed rights of nature resolutions, including the Menominee Indian Tribe of Wisconsin's adoption of a resolution to recognize the rights of the Menominee River. The White Earth Band of the Ojibwe nation in Minnesota adopted a *Rights of Manoomin* law in 2019 to protect wild rice (*manoomin*).[22] The resolution specifies that no government entity can approve a permit that would allow for these rights to be threatened. Legal scholars Warner and Lillquist have written that while municipalities may face substantial obstacles to claiming rights for nature, in the form of vagueness, preemption and potential sanctions, Tribal claims may be more successful because they have both inherent sovereignty and different environmental ethics from most other communities within the U.S. [23]

While I am not Indigenous, my research has brought me close to those communities on the edge of new mining development. I've had the opportunity to listen to their concerns in their homes, and to harvest wild rice from their threatened lakes. It's become abundantly clear to me that without Indigenous leadership and Indigenous solutions to future minerals development, U.S. society will reinscribe a new era of unjust extraction.

In conclusion, a clean energy economy requires the federal government to invest in the circular economy of critical minerals because it is the most pragmatic, just and timely way to ensure responsible supply policies. This is achieved by reducing demands on critical minerals and supporting recycling and reuse. The Biden-Harris administration is investing in this work, and we need more time to see the results. In particular, Congress should follow the guidance of the IWG on reforms to the Mining Law of 1872. This can help usher in an era of responsible mining that not only avoids the worst harms to people and the environment, but builds a new model of industrial ecology where waste is seen as a resource for sustainable livelihoods.

I appreciate this opportunity to provide this statement and I look forward to engaging with the Committee.

[22] See the White Earth press release dated Feb 6, 2019. Available at https://celdf.org/2019/02/press-release-white-earth-band-enacts-first-of-its-kind-rights-of-nature/

[23] Warner, E.K. and J. Lillquist. 2023, "Laboratories of the Future: Tribes and Rights of Nature", California Law Review Vol.111:325. Accessed at https://doi.org/10.15779/Z38599Z292