# Rare Earth Metal DA-NWG 2024

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# Notes and Summary

#### Hello, I hope this DA finds you in good spirits and ready to debate. The story behind this disadvantage is simple. The first part is that Rare Earth Metals and Elements, are a type of material that is naturally occurring within the globe. The issue with these materials is that they are heavily used in many parts of our society and technology. The Uniqueness to the DA is that currently our useage of these metals and elements is stable now- we have sufficient enough amounts to not have to increase mining or otherwise gaining these materials. The link to the affirmative however, is that when we switch to more renewable sources of energy as we cut down on fossil fuel emissions, plenty of our resources and materials needed to build renewable energy technologies such as motors, wind turbines, solar panels and other equipment requires much larger amounts of these resources than are currently available, meaning that we must mine much more of them to meet demand from various industries, governments and other renewable needs. The impact to this is environmental destruction. Most notably in water supplies, but the process to mine these materials is devastating to the environment in a multitude of ways.

# 1NCs

## 1NC - General

#### Decarbonization of our globe requires massive amounts of Rare Earth Metals to build vital technologies and products

Cho 2023 [Renee regular contributor to the Columbia Climate School. She has written over 200 articles for State of the Planet on a broad range of topics. She was previously published by www.insideclimatenews.com, and other environmental magazines. Renee was Communications Coordinator for Riverkeeper, the Hudson River environmental organization. She received the Executive Education Certificate in Conservation and Sustainability from the Earth Institute Center for Environmental Sustainability. The Energy Transition Will Need More Rare Earth Elements. Can We Secure Them Sustainably? <https://news.climate.columbia.edu/2023/04/05/the-energy-transition-will-need-more-rare-earth-elements-can-we-secure-them-sustainably/> Accessed 7/30/2024DMW]

To limit the global temperature increase to 1.5 degrees C or close to it, all countries must decarbonize—cut fossil fuel use, transition to zero-carbon renewable energy sources, and electrify as many sectors as possible. It will require huge numbers of wind turbines, solar panels, electric vehicles (EVs), and storage batteries — all of which are made with rare earth elements and critical metals. The elements critical to the energy transition include the 17 rare earth elements, the 15 lanthanides plus scandium and yttrium. While many rare earth metals are actually common, they are called “rare” because they are seldom found in sufficient amounts to be extracted easily or economically.



Rare earth element table. Image: Ivtorov Elements such as silicon, cobalt, lithium, and manganese are not rare earth elements, but are critical minerals that are also essential for the energy transition. Supplying these vast quantities of minerals in a sustainable manner will be a significant challenge, but scientists are exploring a variety of ways to provide materials for the energy transition with less harm to people and the planet. Demand is growing The demand for rare earth elements is expected to grow 400-600 percent over the next few decades, and the need for minerals such as lithium and graphite used in EV batteries could increase as much as 4,000 percent. Most wind turbines use neodymium–iron–boron magnets, which contain the rare earth elements neodymium and praseodymium to strengthen them, and dysprosium and terbium to make them resistant to demagnetization. Global demand for neodymium is expected to grow 48 percent by 2050, exceeding the projected supply by 250 percent by 2030. The need for praseodymium could exceed supply by 175 percent. Terbium demand is also expected to exceed supply. And to meet the anticipated demand by 2035 for graphite, lithium, nickel, and cobalt, one analysis projected that 384 new mines would be needed. China once supplied 97 percent of the world’s rare earth elements. Government support, cheap labor, lax environmental regulations, and low prices enabled it to monopolize rare earth metal production. Today China produces 60-70 percent of the world’s rare earth elements and is also securing mining rights in Africa. The U.S. produces a little over 14 percent and Australia produces six percent of rare earth elements. In 2018, the U.S. was 100 percent dependent on other countries for 21 critical minerals. After China halted exports of rare earth elements to Japan in a dispute, many countries became concerned about the political and economic implications of depending on one market and began developing their own rare earth element production. The Biden administration has prioritized the development of a domestic supply chain for rare earth metals and critical minerals.

#### Mining for these materials causes mass destruction to the environment

Cho 2023 [Renee regular contributor to the Columbia Climate School. She has written over 200 articles for State of the Planet on a broad range of topics. She was previously published by www.insideclimatenews.com, and other environmental magazines. Renee was Communications Coordinator for Riverkeeper, the Hudson River environmental organization. She received the Executive Education Certificate in Conservation and Sustainability from the Earth Institute Center for Environmental Sustainability. The Energy Transition Will Need More Rare Earth Elements. Can We Secure Them Sustainably? <https://news.climate.columbia.edu/2023/04/05/the-energy-transition-will-need-more-rare-earth-elements-can-we-secure-them-sustainably/> Accessed 7/30/2024DMW]

Mining’s environmental impacts Mining often causes pollution of land, water, and air, spread of toxic wastes, water depletion, deforestation, biodiversity loss, and social disruption. Despite the fact that it is subject to federal and state environmental regulations, metal mining is the number one toxic polluter in the U.S. It’s difficult to mine rare earth elements without causing environmental damage because of how they are extracted. One method involves removing topsoil, then creating a leaching pool where chemicals are used to separate out the rare earth elements from the ore. The toxic chemicals can seep into groundwater, cause erosion, and pollute the air. Another technique is to drill into the ground and use PVC pipes and hoses to pump chemicals into the earth. The resulting mix is then pumped into leaching ponds for separation, creating the same environmental problems. In addition, because rare earth elements are often found near radioactive thorium and uranium, the waste left after rare earth elements are separated from the ore—tailings—contains chemicals, salts, and radioactive materials. Tailings are usually stored in ponds which can leak and contaminate water resources. The Harvard International Review reported that mining to produce one ton of rare earth elements results in nearly 30 poundsof dust, 9,600-12,000 cubic meters of waste gas including substances such as hydrofluoric acid and sulfur dioxide, 75 cubic meters of wastewater, and one ton of radioactive residue—2,000 tons of toxic waste altogether. The world’s largest rare earth element mine, Bayan-Obo in China, produced over 70,000 tons of radioactive thorium waste which is stored in a tailing pond that has leaked into groundwater. The soil and water in Baotouin Inner Mongolia, China— considered the world’s rare earth capital—is polluted with arsenic and fluorite due to mining. This has caused skeletal fluorosis and chronic arsenic toxicity in the population. In Jiangxi Province, which was also polluted by rare earth element mining, experts say it could take 50 to 100 years to clean up the damage and restore the environment. Mining for other minerals such as cobalt (needed for EV batteries) is polluting as well. The extraction process releases sulfides into the air and water, forming sulfuric acid. This acidic water can pollute streams or leach into groundwater. One mine in the Idaho Cobalt Belt that extracted cobalt, silver, and copper ore contaminated the area and a Salmon River tributary; it is now a Superfund site.

#### Biodiversity loss causes extinction

**Torres 16** - founder of the X-Risks Institute, an affiliate scholar at the Institute for Ethics and Emerging Technologies

(Phil, “Biodiversity loss: An existential risk comparable to climate change”, 4/11/16, <http://thebulletin.org/biodiversity-loss-existential-risk-comparable-climate-change9329>, BOTAS) [language modified]

But **there is another existential threat that the Bulletin ~~overlooked~~ [missed] in its Doomsday Clock announcement: biodiversity loss**. This phenomenon is often identified as one of the many consequences of climate change, and this is of course correct. But **biodiversity loss is also a contributing factor behind climate change.** For example, **deforestation in the Amazon rainforest and elsewhere reduces the amount of carbon dioxide removed from the atmosphere by plants, a natural process that mitigates the effects of climate change**. So the causal relation between climate change and biodiversity loss is bidirectional. Furthermore, there are myriad **phenomena that are driving biodiversity loss in addition to climate change.** Other causes include ecosystem fragmentation, invasive species, pollution, oxygen depletion caused by fertilizers running off into ponds and streams, overfishing, human overpopulation, and overconsumption. All of these phenomena **have a direct impact on the health of the biosphere, and all would conceivably persist even if the problem of climate change were somehow immediately solved**. **Such considerations warrant decoupling biodiversity loss from climate change**, **because the former has been consistently subsumed by the latter as a mere effect.** **Biodiversity loss is a distinct environmental crisis with its own unique syndrome of causes, consequences, and solutions**—such as restoring habitats, creating protected areas (“biodiversity parks”), and practicing sustainable agriculture. The sixth extinction. **The repercussions of biodiversity loss are potentially as severe as those anticipated from climate change, or even a nuclear conflict**. For example, according to a 2015 study published in Science Advances, **the best available evidence reveals “an exceptionally rapid loss of biodiversity over the last few centuries, indicating that a sixth mass extinction is already under way.”** This conclusion holds, even on the most optimistic assumptions about the background rate of species losses and the current rate of vertebrate extinctions. The group classified as “vertebrates” includes mammals, birds, reptiles, fish, and all other creatures with a backbone. The article argues that, **using its conservative figures**, **the average loss of vertebrate species was 100 times higher in the past century relative to the background rate of extinction**. (Other **scientists have suggested that the current extinction rate could be as much as 10,000 times higher than normal**.) As the authors write, “**The evidence is incontrovertible that recent extinction rates are unprecedented in human history and highly unusual in Earth’s history**.” Perhaps the term “Big Six” should enter the popular lexicon—to add the current extinction to the previous “Big Five,” the last of which wiped out the dinosaurs 66 million years ago. But the concept of biodiversity encompasses more than just the total number of species on the planet. It also refers to the size of different populations of species. With respect to this phenomenon, **multiple studies have confirmed that wild populations around the world are dwindling and disappearing at an alarming rate**. For example, the 2010 Global Biodiversity Outlook report found that **the population of wild vertebrates living in the tropics dropped by 59 percent between 1970 and 2006**. **The report also found that the population of farmland birds in Europe has dropped by 50 percent since 1980**; bird populations in the grasslands of North America declined by almost 40 percent between 1968 and 2003; and the population of birds in North American arid lands has fallen by almost 30 percent since the 1960s. Similarly, **42 percent of all amphibian species** (a type of vertebrate that is sometimes called an “ecological indicator”) **are undergoing population declines**, and 23 percent of all plant species “are estimated to be threatened with extinction.” Other studies have found that some 20 percent of all reptile species, 48 percent of the world’s primates, and **50 percent of freshwater turtles are threatened**. Underwater, about **10 percent of all coral reefs are now dead, and another 60 percent are in danger of dying.** Consistent with these data, the 2014 Living Planet Report shows that **the global population of wild vertebrates dropped by 52 percent in only four decades**—from 1970 to 2010. While biologists often avoid projecting historical trends into the future because of the complexity of ecological systems, it’s tempting to extrapolate this figure to, say, the year 2050, which is four decades from 2010. As it happens, a 2006 study published in Science does precisely this: It projects past trends of marine biodiversity loss into the 21st century, concluding that, **unless significant changes are made to patterns of human activity, there will be virtually no more wild-caught seafood by 2048**. **Catastrophic consequences for civilization**. The consequences of this rapid pruning of the evolutionary tree of life extend beyond the obvious. **There could be surprising effects of biodiversity loss** that scientists are unable to fully anticipate in advance. For example, prior research has shown that **localized ecosystems can undergo abrupt and irreversible shifts when they reach a tipping point**. According to a 2012 paper published in Nature, there are reasons for thinking that we **may be approaching a tipping point of this sort in the global ecosystem, beyond which the consequences could be catastrophic for civilization.** As the authors write, **a planetary-scale transition could precipitate “substantial losses of ecosystem services required to sustain the human population.”** An ecosystem service is any ecological process that benefits humanity, such as food production and crop pollination. **If the global ecosystem were to cross a tipping point and substantial ecosystem services were lost, the results could be “widespread social unrest, economic instability, and loss of human life.”** According to Missouri Botanical Garden ecologist Adam Smith, one of the paper’s co-authors, **this could occur in a matter of decades—far more quickly than most of the expected consequences of climate change, yet equally destructive. Biodiversity loss is a “threat multiplier”** that, **by pushing societies to the brink of collapse**, **will exacerbate existing conflicts and introduce entirely new struggles between state and non-state actors**. Indeed, **it could even fuel the rise of terrorism**. (After all, climate change has been linked to the emergence of ISIS in Syria, and multiple high-ranking US officials, such as former US Defense Secretary Chuck Hagel and CIA director John Brennan, have affirmed that climate change and terrorism are connected.) **The reality is that we are entering the sixth mass extinction in the 3.8-billion-year history of life on Earth, and the impact of this event could be felt by civilization “in as little as three human lifetimes,”** as the aforementioned 2012 Nature paper notes. Furthermore, **the widespread decline of biological populations could plausibly initiate a dramatic transformation of the global ecosystem on an even faster timescale: perhaps a single human lifetime. The unavoidable conclusion is that biodiversity loss constitutes an existential threat in its own right.** As such, **it ought to be considered** alongside climate change and nuclear weapons **as** one of **the most significant contemporary risks to human prosperity and survival.**

## 1NC – Carbon Pricing

#### Carbon Pricing or Taxes would still incentivize more REE mining – both from renewables and assumed “cleaner” mining in the deep seas and other strategies

Serpell et al 2021 [Oscar is a research associate at the Kleinman Center for Energy Policy. Benjamin Paren is a Ph.D. student in the department of Materials Science and Engineering at the University of Pennsylvania. Wan-Yi “Amy” Chu is an assistant professor at Mills College in Oakland, California and a former postdoctoral researcher in the Goldberg Group, located in the Department of Chemistry at the University of Pennsylvania. RARE EARTH ELEMENTS A RESOURCE CONSTRAINT OF THE ENERGY TRANSITION <https://kleinmanenergy.upenn.edu/wp-content/uploads/2021/05/KCEP-Rare-Earth-Elements.pdf> Accessed 7/30/2024DMW]

One of the most powerful and efficient tools for regulating¶ environmentally risky and large-scale industry operations¶ is the application of a pollution pricing scheme, or tax. In¶ recent policy discussions, this policy tool is commonly¶ discussed in the context of carbon emissions, but a¶ similar scheme could be applied to mine tailing and¶ wastewater from REE mining operations.¶ Efficient and effective policies should tax mine waste¶ according to the environmental and community¶ vulnerability and value within the potentially impacted¶ region. Imposing strict pollution fees for key¶ contaminants of mining operations could create a market¶ incentive for resource producers to take additional steps¶ to limit their pollution and provide a source of funding for¶ federal or regional regulatory efforts. Having geographyspecific pricing also incentivizes mining to take place in¶ areas of lower environmental and community risk.¶ There are several innovative methods mine operators¶ can use to reduce their environmental and community¶ impacts. One possibility is to utilize reserves of¶ unconventional deposits of REE. This includes deep¶ ocean deposits, or waste streams from slag or iron¶ ore tailings (Filho 2016; Xiang 2016; Cook 2016;¶ Peelman 2018).¶ In some studies, iron ore tailings have been found to¶ have relatively high REE concentrations (Peelman 2018).¶ Coal and coal ash, which can contain 68 to 404 ppm¶ rare earth elements, has a similar REE content to clays¶ that are already mined in China (Cook 2016).¶ However, there are still a number of environmental¶ concerns with all of these options, and processes for¶ the extraction of REEs from these sources are still¶ nascent (Filho 2016). It is not yet clear if the costs¶ of these methods will make them worthwhile for REE¶ producers to pursue.

#### Mining deep underwater triggers tons of ecologic disruptions

IEA 2021 [NTERNATIONAL ENERGY AGENCY The IEA examines the full spectrum of energy issues including oil, gas and coal supply and demand, renewable energy technologies, electricity markets, energy efficiency, access to energy, demand side management and much more. Through its work, the IEA advocates policies that will enhance the reliability, affordability and sustainability of energy in its 30 member countries, 8 association countries and beyond.The Role of Critical Minerals in Clean Energy Transitions Executive summary <https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/executive-summary> Accessed 7/30/2024DMW]

Studies also suggest potentially significant environmental impacts. Machines often cause seafloor disturbance, which could alter deepsea habitats and release pollutants. Sediment plumes, which arise from stirring up fine sediments, could also affect ecosystems, which take long time to recover. Ecosystems in some old test sites have not yet recovered after 30 years (Hefferman, 2019). The impacts on biodiversity are largely unknown. Despite the vast opportunities, rigorous assessments would be needed to understand the full extent of environmental damage and develop proper regulatory measures. BMW, Samsung SDI, Volvo and Google recently announced moratorium on materials from deep-sea mining until the risks are fully understood (WWF, 2021). The ISA is developing regulatory frameworks for the international seabed, aiming to promote deep-sea mining while minimising environmental risks.

# Uniqueness

### Global

#### Demand and prices are expected to rise given the increased need for these materials

Serpell et al 2021 [Oscar is a research associate at the Kleinman Center for Energy Policy. Benjamin Paren is a Ph.D. student in the department of Materials Science and Engineering at the University of Pennsylvania. Wan-Yi “Amy” Chu is an assistant professor at Mills College in Oakland, California and a former postdoctoral researcher in the Goldberg Group, located in the Department of Chemistry at the University of Pennsylvania. RARE EARTH ELEMENTS A RESOURCE CONSTRAINT OF THE ENERGY TRANSITION <https://kleinmanenergy.upenn.edu/wp-content/uploads/2021/05/KCEP-Rare-Earth-Elements.pdf> Accessed 7/30/2024DMW]

The history and present state of the REE supply chain¶ exhibits the important role these materials already play¶ in the world economy. Projections of a sharp increase¶ in demand over the coming decades raise several¶ questions about the future environmental impacts and¶ supply risks to this industry. A 2012 MIT study by Alonso¶ et al. thoroughly explores this question of future supply,¶ and projects total global demand out to 2035 under five¶ divergent scenarios.¶ One of these scenarios uses the IEA Blue Map scenario¶ to estimate future wind and automotive electrification¶ (IEA 2010). This model only seeks to reduce global¶ carbon emissions by 50% by 2050. Given our¶ understanding of climate sensitivities in 2021, these¶ projections should be considered far too limited to¶ reach global emissions targets. They provide us with a¶ conservative estimate of demand for the purpose of this¶ analysis (IPCC 2018).¶ Under this scenario the study projects that by 2035¶ global demand for REEs will reach close to 450,000¶ tons per year, compared to approximately 200,000 tons¶ per year today (USGS 2021). This represents more than¶ a doubling in the size of the industry in just 15 years,¶ which is again overly conservative according to present¶ day decarbonization targets.¶ Furthermore, the rate of demand growth in Alonso et al.¶ accelerates rapidly, as do projections of wind turbine¶ and EV production out to 2050, indicating that this¶ increase in industry demand is only the beginning of¶ a pattern of accelerating growth that will likely last for¶ decades (Larson et al., 2020).¶ As technology advances and demand for clean energy¶ solutions intensifies, overall production of REEs will¶ have to scale to accommodate growing demand for¶ only a small handful of elements needed for magnets—¶ specifically neodymium (Nd) and dysprosium (Dy).¶ Whereas Alonso et al. predicts that 2035 demand for¶ yttrium (Y) and terbium (Tb) will only be approximately¶ 250% of 2010 supply, 2035 demand for Dy will be over¶ 2500% the supply of Dy in 2010.¶ REEs are typically co-located in small concentrations,¶ so global mine operations may need to produce a¶ significant excess of many lesser-used elements to¶ produce sufficient Dy. This effort to match production¶ of elements to their relative demand is called mine yield¶ balancing and promises to be a growing challenge in the¶ REE industry. Industrial use of REEs is a relatively recent¶ economic development and uses for these elements¶ developed to accommodate their natural abundance and¶ take advantage of low market prices.¶ It is, therefore, uncertain how the global market will¶ respond to the excess supply and lower prices of REEs¶ not used for magnet production, since uses for many¶ other REEs are still limited. Because production of¶ these minerals is almost always complementary, market¶ demand for each element is important to consider in¶ investment and operational decision-making.¶ If insufficient demand for these other elements emerges,¶ it could significantly increase the long-term cost of¶ critical elements such as neodymium and dysprosium.¶ For emerging and sustainable energy solutions to¶ effectively utilize rare earth elements, a higher premium¶ for these materials will likely be necessary

### Domestic – AT US can Supply

#### The US has exactly 1 mine- we’re dependent on the rest of the globe

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Mining today and tomorrow¶ The MP Materials Mine in Mountain Pass, CA is currently the only rare earth producing mine in the U.S. MP Materials aims to create a complete supply chain for rare earth elements, but still sends its ore to China, which continues to dominate the world’s rare earth element processing.¶ Niobium, which has the potential to make batteries last longer, scandium, titanium, and other rare earth elements may soon be mined in Elk Creek, Nebraska. Many locals there feel it’s their patriotic duty to host the mine so the U.S. can develop its domestic supply of rare earth elements and minerals. Other mines in the works include a site in western Montana near the headwaters of the Bitterroot River, a renowned trout fishery. The U.S. Critical Materials Corp, claims the area has the “highest-grade rare-earth deposit” in the U.S., holds seven square miles of mining claims in the Bitterroot National Forest, and has begun exploratory activities. In southeastern Wyoming, an Australian company, American Rare Earths, believes it has discovered the largest known rare earth element deposit in North America. This company’s goal is to eventually build a processing plant for the ore that will use new, less environmentally harmful methods.

#### Takes a huge time for additional mines to be developed or built

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Long project development lead times: Our analysis suggests that it has taken 16.5 years on average to move mining projects from discovery to first production. These long lead times raise questions about the ability of supply to ramp up output if demand were to pick up rapidly. If companies wait for deficits to emerge before committing to new projects, this could lead to a prolonged period of market tightness and price volatility.¶ Declining resource quality: Concerns about resources relate to quality rather than quantity. In recent years ore quality has continued to fall across a range of commodities. For example, the average copper ore grade in Chile declined by 30% over the past 15 years. Extracting metal content from lower-grade ores requires more energy, exerting upward pressure on production costs, greenhouse gas emissions and waste volumes.

# Links

### AT – Demand No Link

#### Demand for Rare Earth minerals WILL increase due to rapid increase in demand

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Here, governments have a key role to play in reducing uncertainty by sending strong and consistent signals about their climate ambitions and implementing specific policies to fulfil these long-term goals. The recent pickup in new project investments reflects the way that government climate commitments provide market signals for investments, which could help ensure reliable supply of minerals to support an orderly energy transition. The efforts also need to be accompanied by a range of measures to dampen the rapid growth in primary supply requirements such as promoting technology innovation for material efficiency or substitution, scaling up recycling and extending the lifetime of existing assets through better maintenance (see Chapter 3).

### AT – Link Turn

#### Your link turns are wrong- clean energy policy shifts increase demands for REM’s – multiple design techs and materials are needed

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An energy system powered by clean energy technologies differs profoundly from one fuelled by traditional hydrocarbon resources. Solar photovoltaic (PV) plants, wind farms and electric vehicles (EVs) generally require more minerals to build than their fossil fuel-based counterparts. A typical electric car requires six times the mineral inputs of a conventional car and an onshore wind plant requires nine times more mineral resources than a gas-fired plant. Since 2010 the average amount of minerals needed for a new unit of power generation capacity has increased by 50% as the share of renewables in new investment has risen.¶ The types of mineral resources used vary by technology. Lithium, nickel, cobalt, manganese and graphite are crucial to battery performance, longevity and energy density. Rare earth elements are essential for permanent magnets that are vital for wind turbines and EV motors. Electricity networks need a huge amount of copper and aluminium, with copper being a cornerstone for all electricity-related technologies.¶ The shift to a clean energy system is set to drive a huge increase in the requirements for these minerals, meaning that the energy sector is emerging as a major force in mineral markets. Until the mid-2010s, for most minerals, the energy sector represented a small part of total demand. However, as energy transitions gather pace, clean energy technologies are becoming the fastest-growing segment of demand. In a scenario that meets the Paris Agreement goals (as in the IEA Sustainable Development Scenario [SDS]), their share of total demand rises significantly over the next two decades to over 40% for copper and rare earth elements, 60-70% for nickel and cobalt, and almost 90% for lithium. EVs and battery storage have already displaced consumer electronics to become the largest consumer of lithium and are set to take over from stainless steel as the largest end user of nickel by 2040. As countries accelerate their efforts to reduce emissions, they also need to make sure that energy systems remain resilient and secure. Today’s international energy security mechanisms are designed to provide insurance against the risks of disruptions or price spikes in hydrocarbons supply, oil in particular. Minerals offer a different and distinct set of challenges, but their rising importance in a decarbonising energy system requires energy policy makers to expand their horizons and consider potential new vulnerabilities. Concerns about price volatility and security of supply do not disappear in an electrified, renewables-rich energy system.¶ This is why the IEA is paying close attention to the issue of critical minerals and their role in energy transitions. This report reflects the IEA’s determination to stay ahead of the curve on all aspects of energy security in a fast-evolving energy world.

### Decarbonization

#### Decarbonization of our globe requires massive amounts of Rare Earth Metals to build vital technologies and products

Cho 2023 [Renee regular contributor to the Columbia Climate School. She has written over 200 articles for State of the Planet on a broad range of topics. She was previously published by www.insideclimatenews.com, and other environmental magazines. Renee was Communications Coordinator for Riverkeeper, the Hudson River environmental organization. She received the Executive Education Certificate in Conservation and Sustainability from the Earth Institute Center for Environmental Sustainability. The Energy Transition Will Need More Rare Earth Elements. Can We Secure Them Sustainably? <https://news.climate.columbia.edu/2023/04/05/the-energy-transition-will-need-more-rare-earth-elements-can-we-secure-them-sustainably/> Accessed 7/30/2024DMW]

To limit the global temperature increase to 1.5 degrees C or close to it, all countries must decarbonize—cut fossil fuel use, transition to zero-carbon renewable energy sources, and electrify as many sectors as possible. It will require huge numbers of wind turbines, solar panels, electric vehicles (EVs), and storage batteries — all of which are made with rare earth elements and critical metals. The elements critical to the energy transition include the 17 rare earth elements, the 15 lanthanides plus scandium and yttrium. While many rare earth metals are actually common, they are called “rare” because they are seldom found in sufficient amounts to be extracted easily or economically.



Rare earth element table. Image: Ivtorov Elements such as silicon, cobalt, lithium, and manganese are not rare earth elements, but are critical minerals that are also essential for the energy transition. Supplying these vast quantities of minerals in a sustainable manner will be a significant challenge, but scientists are exploring a variety of ways to provide materials for the energy transition with less harm to people and the planet. Demand is growing The demand for rare earth elements is expected to grow 400-600 percent over the next few decades, and the need for minerals such as lithium and graphite used in EV batteries could increase as much as 4,000 percent. Most wind turbines use neodymium–iron–boron magnets, which contain the rare earth elements neodymium and praseodymium to strengthen them, and dysprosium and terbium to make them resistant to demagnetization. Global demand for neodymium is expected to grow 48 percent by 2050, exceeding the projected supply by 250 percent by 2030. The need for praseodymium could exceed supply by 175 percent. Terbium demand is also expected to exceed supply. And to meet the anticipated demand by 2035 for graphite, lithium, nickel, and cobalt, one analysis projected that 384 new mines would be needed. China once supplied 97 percent of the world’s rare earth elements. Government support, cheap labor, lax environmental regulations, and low prices enabled it to monopolize rare earth metal production. Today China produces 60-70 percent of the world’s rare earth elements and is also securing mining rights in Africa. The U.S. produces a little over 14 percent and Australia produces six percent of rare earth elements. In 2018, the U.S. was 100 percent dependent on other countries for 21 critical minerals. After China halted exports of rare earth elements to Japan in a dispute, many countries became concerned about the political and economic implications of depending on one market and began developing their own rare earth element production. The Biden administration has prioritized the development of a domestic supply chain for rare earth metals and critical minerals.

### General

#### Energy policies and industry heavily rely on these REM’s

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#### Minerals and metals1 have played a critical role in the rise of many of the clean energy technologies that are widely used today – from wind turbines and solar panels to electric vehicles and battery storage. As the deployment of clean energy technology rises, the energy sector is also becoming a vital part of the minerals and metals industry. With clean energy transitions, the linkages between minerals and energy are set to strengthen. However, this raises the question: will sufficient sustainable and responsibly sourced mineral supplies be available to support the acceleration of energy transitions? The first step to address this is to understand the potential requirements for minerals arising from clean energy transitions. The type and volume of mineral needs vary widely across the spectrum of clean energy technologies, and even within a certain technology (e.g. wind turbine technologies; EV battery chemistries). In this chapter we assess the aggregate mineral demand from a wide range of clean energy technologies – low-carbon power generation (renewables and nuclear), electricity networks, electric vehicles (EVs), battery storage and hydrogen (electrolysers and fuel cells) – 1This report considers a wide range of minerals and metals used in clean energy technologies, including chromium, copper, major battery metals (lithium, nickel, cobalt, manganese and graphite), molybdenum, platinum group metals, zinc, rare earth elements and others (see Annex for the complete list). Steel and aluminium are not included in the scope for demand assessment, but under two main IEA scenarios: the Stated Policies Scenario (STEPS) and the Sustainable Development Scenario (SDS). ¶ Plan triggers the link- any energy policy inevitably leads to increases in REE regardless of ethics or other planning initiatives

#### Paris agreement goals ensure investment for Rare Earth Minerals and Elements- only way to get materials to meet those goals

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In a scenario that meets the Paris Agreement goals, clean energy technologies’ share of total demand rises significantly over the next two decades to over 40% for copper and rare earth elements, 6070% for nickel and cobalt, and almost 90% for lithium. EVs and battery storage have already displaced consumer electronics to become the largest consumer of lithium and are set to take over from stainless steel as the largest end user of nickel by 2040. As countries accelerate their efforts to reduce emissions, they also need to make sure their energy systems remain resilient and secure. Today’s international energy security mechanisms are designed to provide insurance against the risks of disruptions or price spikes in supplies of hydrocarbons, particularly oil. Minerals offer a different and distinct set of challenges, but their rising importance in a decarbonising energy system requires energy policy makers to expand their horizons and consider potential new vulnerabilities. Concerns about price volatility and security of supply do not disappear in an electrified, renewables-rich energy system. This is why the IEA is paying close attention to the issue of critical minerals and their role in clean energy transitions. This report reflects the IEA’s determination to stay ahead of the curve on all aspects of energy security in a fast-evolving energy world.

#### Speed and demands to hit critical cutoff points will increase demand for REM

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Our bottom-up assessment suggests that a concerted effort to reach the goals of the Paris Agreement (climate stabilisation at “well below 2°C global temperature rise”, as in the IEA Sustainable Development Scenario [SDS]) would mean a quadrupling of mineral requirements for clean energy technologies by 2040. An even faster transition, to hit net-zero globally by 2050, would require six times more mineral inputs in 2040 than today. Which sectors do these increases come from? In climate-driven scenarios, mineral demand for use in EVs and battery storage is a major force, growing at least thirty times to 2040. Lithium sees the fastest growth, with demand growing by over 40 times in the SDS by 2040, followed by graphite, cobalt and nickel (around 20-25 times). The expansion of electricity networks means that copper demand for power lines more than doubles over the same period. The rise of low-carbon power generation to meet climate goals also means a tripling of mineral demand from this sector by 2040. Wind takes the lead, bolstered by material-intensive offshore wind. Solar PV follows closely, due to the sheer volume of capacity that is added. Hydropower, biomass and nuclear make only minor contributions given their comparatively low mineral requirements. In other sectors, the rapid growth of hydrogen as an energy carrier underpins major growth in demand for nickel and zirconium for electrolysers, and for platinum-group metals for fuel cells.

### Clean Energy Transitions

#### Clean energy transitions motivate mobilization and strains REM resources, demanding increased mining and investment

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Climate change is presenting humans with an unprecedented challenge: the need to wean ourselves off of a group of valuable natural resources; not because of scarcity or cost, but because of their long-term global pollution impacts. Although the combined capabilities of wind, solar, hydropower, and geothermal technologies have the potential to harness near limitless amounts of energy from our environment, they are not free from the limitations of resource availability. On the contrary, the clean energy transition will require economic mobilization on a scale not seen since the industrial revolution, and will strain the global production of silicon, cobalt, lithium, manganese, and a host of other critical elements (Behr 2019). One group of natural resources that may prove essential for the next generation of electric motors and turbines are the rare earth elements (REEs)—17 elements consisting of scandium, yttrium, and the 15 lanthanides (Institute of Rare Earths and Strategic Metals, n.d.). We note that elements such as lithium and cobalt are frequently referred to as “rare earth metals” due to their relative scarcity, but do not belong to this chemical classification and are not the subject of this digest (Motavalli 2010). The long-term sustainability of lithium and cobalt mining is itself a significant economic and political challenge of the energy transition, but is beyond the scope of this research. Despite their global importance, the production or REEs has become increasingly concentrated in China over recent years. Not only does this present a geopolitical and economic risk to most of the developed world, but it is also indicative of possible future supply constraints which could interrupt progress toward a decarbonized future. In this digest, we explore how and why this consolidation of the REE market occurred, and what the tradeoffs are of increased global production. We also discuss several policies to ensure that future production of REEs does not slow the adoption of clean energy technology.

#### REE huge part to multiple Clean energy shifts

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The global clean energy transitions will have far-reaching consequences for mineral demand over the next 20 years. By 2040 total mineral demand from clean energy technologies double in the STEPS and quadruple in the SDS. EVs and battery storage account for about half of the mineral demand growth from clean energy technologies over the next two decades, spurred by surging demand for battery materials. Mineral demand for use in EVs and battery storage grows nearly tenfold in the STEPS and around 30 times in the SDS over the period to 2040. By weight, mineral demand in 2040 is dominated by copper, graphite and nickel. Lithium sees the fastest growth rate, with demand growing by over 40 times in the SDS. The shift towards lower cobalt chemistries for batteries helps to limit growth in cobalt, displaced by growth in nickel. Electricity networks are another major driving force. They account for 70% of today’s mineral demand from the energy technologies considered in this study, although their share continues to fall as other technologies – most notably EVs and storage – register rapid growth. Mineral demand from low-carbon power generation grows rapidly, doubling in the STEPS and nearly tripling in the SDS over the period to 2040. Wind power plays a leading role in driving demand growth due to a combination of large-scale capacity additions and higher mineral intensity (especially with growing contributions from mineralintensive offshore wind). Solar PV follows closely, with its unmatched scale of capacity additions among the low-carbon power generation technologies. Hydropower, biomass and nuclear make only minor contributions given their comparatively low mineral requirements and modest capacity additions. The rapid growth of hydrogen use in the SDS underpins major growth in demand for nickel and zirconium for use in electrolysers, and for copper and platinum-group metals for use in fuel cell electric vehicles (FCEVs). Despite the rapid rise in FCEVs and the decline in catalytic converters in gasoline and diesel cars, demand for platinum-group metals in internal combustion engine cars remains higher than in FCEVs in the SDS in 2040. Demand for REEs – primarily for EV motors and wind turbines – grows threefold in the STEPS and around sevenfold in the SDS by 2040. For most minerals, the share of clean energy technologies in total demand was minuscule until the mid-2010s, but the picture is rapidly changing. Energy transitions are already the major driving force for total demand growth for some minerals. Since 2015 EVs and battery storage have surpassed consumer electronics to become the largest consumers of lithium, together accounting for 30% of total current demand. This trend is set to accelerate as countries step up their climate ambitions. Clean energy technologies become the fastestgrowing segment of demand for most minerals, and their share of total demand edges up to over 40% for copper and REEs, 60-70% for nickel and cobalt and almost 90% for lithium by 2040 in the SDS.

### Renewables

#### Development of renewable energy uses huge amounts of REE

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An energy system powered by clean energy technologies differs profoundly from one fuelled by traditional hydrocarbon resources. Building solar photovoltaic (PV) plants, wind farms and electric vehicles (EVs) generally requires more minerals than their fossil fuelbased counterparts. A typical electric car requires six times the mineral inputs of a conventional car, and an onshore wind plant requires nine times more mineral resources than a gas-fired power plant. Since 2010, the average amount of minerals needed for a new unit of power generation capacity has increased by 50% as the share of renewables has risen. The types of mineral resources used vary by technology. Lithium, nickel, cobalt, manganese and graphite are crucial to battery performance, longevity and energy density. Rare earth elements are essential for permanent magnets that are vital for wind turbines and EV motors. Electricity networks need a huge amount of copper and aluminium, with copper being a cornerstone for all electricity-related technologies. The shift to a clean energy system is set to drive a huge increase in the requirements for these minerals, meaning that the energy sector is emerging as a major force in mineral markets. Until the mid-2010s, the energy sector represented a small part of total demand for most minerals. However, as energy transitions gather pace, clean energy technologies are becoming the fastest-growing segment of demand.

### Tax/Pricing Link

#### Carbon Pricing or Taxes would still incentivize more REE mining – the challenge is in the shift to renewables, not just how we do it

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One of the most powerful and efficient tools for regulating¶ environmentally risky and large-scale industry operations¶ is the application of a pollution pricing scheme, or tax. In¶ recent policy discussions, this policy tool is commonly¶ discussed in the context of carbon emissions, but a¶ similar scheme could be applied to mine tailing and¶ wastewater from REE mining operations.¶ Efficient and effective policies should tax mine waste¶ according to the environmental and community¶ vulnerability and value within the potentially impacted¶ region. Imposing strict pollution fees for key¶ contaminants of mining operations could create a market¶ incentive for resource producers to take additional steps¶ to limit their pollution and provide a source of funding for¶ federal or regional regulatory efforts. Having geographyspecific pricing also incentivizes mining to take place in¶ areas of lower environmental and community risk.¶ There are several innovative methods mine operators¶ can use to reduce their environmental and community¶ impacts. One possibility is to utilize reserves of¶ unconventional deposits of REE. This includes deep¶ ocean deposits, or waste streams from slag or iron¶ ore tailings (Filho 2016; Xiang 2016; Cook 2016;¶ Peelman 2018).¶ In some studies, iron ore tailings have been found to¶ have relatively high REE concentrations (Peelman 2018).¶ Coal and coal ash, which can contain 68 to 404 ppm¶ rare earth elements, has a similar REE content to clays¶ that are already mined in China (Cook 2016).¶ However, there are still a number of environmental¶ concerns with all of these options, and processes for¶ the extraction of REEs from these sources are still¶ nascent (Filho 2016). It is not yet clear if the costs¶ of these methods will make them worthwhile for REE¶ producers to pursue.

# Impact

## Environment Destruction Scenario

### 1NC – Environment/Pollution

#### Mining for REE causes huge amount of water and environmental pollution

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Regional ecosystems can be significantly altered by the¶ presence of mines, both physically and chemically. Site¶ preparation, access roads, and ancillary facilities lead to¶ direct—and often absolute—destruction of the proximate¶ environment, while pollution from mine processes and¶ storage of residual tailings can lead to widespread¶ chemical imbalances and toxic contamination (Filho¶ 2016; Xiang 2016; Ganguli 2018).¶ REE mine tailings contain processing chemicals, salts,¶ and radioactive materials. Tailings are particularly¶ problematic in REE mining, because of the significant¶ waste-to-yield ration. (Filho 2016; Xiang 2016).¶ For every ton of REEs that are produced, there are¶ 2,000 tons of mine tailings, including 1 to 1.4 tons of¶ radioactive waste (Filho 2016).¶ Tailings are most commonly stored in isolated¶ impoundment areas called tailing ponds. These ponds¶ require complex management, especially if the tailings¶ contain high concentrations of uranium or thorium.¶ Poor construction or catastrophic failure can lead to¶ long-term and widespread environmental damage and¶ contamination of surface or groundwater (Filho 2016).¶ Other significant sources of pollution include aerosols¶ and fugitive dust from tailing impoundments, which¶ are created from cutting, drilling, and blasting rock.¶ This pollution can accumulate in surrounding areas¶ (Filho 2016), causing respiratory issues and also¶ contaminating food sources—as plants absorb the¶ airborne pollutants.¶ An example of this is the tailing pond for the Bayan¶ Obo mine in China. Villages in the surrounding area¶ have experienced elevated rates of both cancer and¶ respiratory illness, indicating that the tailings are not¶ being properly stored (Xiang 2016). While many of¶ these issues exist for other types of mining, they are¶ particularly problematic for REEs, because of the large¶ volume and radioactivity of tailings.

#### Water is the literal underpinning of civilization. Without clean water the earth would collapse.

Laura Rabinow (deputy director of research at the Rockefeller Institute of Government) “The Shape of Water Regulations The Disputed Waters of the United States” October 2020 https://rockinst.org/wp-content/uploads/2020/10/10-22-20-WOTUS-Report-web.pdf

Water is not only necessary for the millions of types of organisms on earth to exist, it is a central component of the physical habitats that structure our ecosystems. It provides for plant growth, the delivery of nutrients and minerals, and habitats for many species. Water further cycles through our ecosystems, in what is called the hydrological cycle— the continuous movement of water through different states (as vapor, liquid, or ice), on, above, and below the earth’s surface in precipitation, groundwater, surface water, water vapor, etc. (see Figure 1). Water also cycles through related human systems like stormwater, wastewater, and drinking water systems that in turn draw on and empty into other water bodies. In this way, water is an important, and in many ways literal, link between different life on this planet. And, consequently, what affects water in one place, can affect water in another, sometimes even very distant, place.

### Environment - Block – Yes Internal Link

#### Mining in these processes devastates the environment on multiple levels

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Mineral development affects the local and regional environment in different ways. Related interactions must be managed carefully to mitigate negative impacts and reduce associated risks. In this section, we focus on three chief challenges that are present throughout the mining value chain: • Land use change – This is the main source of direct and immediate impacts on people, biodiversity and ecosystems. It can result in the displacement of communities and the loss of habitats that are home to endangered species. • Water use – Mining generally requires large volumes of water for its operations. It can also be a source of water contamination, be it through acid mine drainage, wastewater discharge or the disposal of tailings. • Waste generation – Mineral development results in massive amounts of residues, both during extraction and after utilisation, some of which are hazardous to human health. Mineral development also entails other environmental aspects and impacts, including air pollution from particulate matter (e.g. mine dust) and gaseous emissions (e.g. sulfur and nitrogen oxides), and noise pollution due to blasting and transporting activities. Experience suggests that it is possible to manage these impacts effectively via a combination of policy measures, robust project management and technological solutions. In particular, integrating environmental concerns at the early stages of project planning can go a long way to ensuring sustainable practices do not come at a high cost. In this context, employing a holistic approach enables an integrated assessment of the drawbacks and benefits of different project alternatives. Often there are trade-offs between different environmental objectives. Open-pit mining, for example, has lower energy requirements than underground mining, generally leading to lower emissions, but results in more land use change. However, there are also cases where an alternative presents synergistic outcomes. The recovery of minerals from waste streams (e.g. reclaimed copper production) illustrates this, as it can reduce the amount of waste that needs to be disposed of, lessen the ecotoxicity of effluents and lead to lower GHG emissions (Hong et al., 2018). Furthermore, taking an integrated approach to sustainability can enable better resource use and systemic innovation, often resulting in lower overall energy needs (Lèbre and Corder, 2015). For example, extracting multiple minerals from the same ore or reworking tailings to maximise recovery rates are ways to increase production, reduce pollution and often minimise other risks in parallel.

#### Mining leads to mass pollution and other harms to the environment

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Mining is generating increasing volumes of waste. This includes overburden (materials covering mineral resources), waste rock (uneconomic materials removed in ore extraction), and tailings (finegrained materials left after separating the valuable fraction of the ore). The total amount of residues generated during mining can vary depending on the extracted commodity, methods employed and resource conditions (e.g. ore grade), but is usually quite significant. In 2018 the mining and quarrying sector accounted for over a quarter of the total waste generated in Europe (Eurostat, 2021). Typically, the volume of waste rocks is governed by the stripping ratio, which refers to the amount of material removed to extract one unit of ore. This ratio spans from 2:1 to 8:1 in surface extraction and is much lower in underground mining (EC JRC, 2018). Waste rocks are often stored close to the mine, in piles or heaps. Meanwhile, the amount of tailings is related to the ore grade (i.e. the share of valuable minerals in the ore). For copper and nickel, of which ore grades are low, the waste rock and tailings generated to produce one tonne of product amounted to almost 700 tonnes in 2017, 30% more than in 2010 due to deteriorating ore quality and the predominance of surface mining. Tailings are usually transported through pipes to a tailings storage facility. The number of these facilities are estimated at around 32 000 globally – among active, inactive and abandoned facilities – containing around 223 billion tonnes of tailings (World Mine Tailings Failures, 2020). The most common type is an embankment dam that is designed to retain tailings and the associated water. These facilities pose contamination risks for nearby soil and water bodies and the hazard of dam failure. The locally called Rare Earth Lake, for example, covers over 10 square kilometres of Bayan Obo, a mining town in China, and the soil surrounding it is highly enriched with heavy metals (Pan and Li, 2016). In 2019 the collapse of the tailings storage facility at Vale’s mine in Brumadinho, Brazil, led to mining waste surging across the surrounding areas and the death of over 270 people (see Box 4.6). In 2015 Brazil had already seen the collapse of the Fundão dam, which released 43 million cubic metres of iron ore tailings, polluting 668 km of watercourses from the Doce River to the Atlantic Ocean (Carmo et al., 2017). Mining and mineral processing also generates hazardous waste, an output related not only to the metals and chemicals handled in these activities, but also to the presence of naturally occurring radioactive material (NORM) in some ores. NORM can be further concentrated during mineral processing and end up in waste, with the highest activity concentrations having been found in scales from wet chemical processes and in precipitator dust from high-temperature processes (IAEA, 2005).

Waste: The impact of mining operations on residues Activities, impacts and risks of mineral development related to waste Segment Activities Impacts Risks Production • Excavation removes overburden, while initial processing generates waste rock and tailings • Seabed mining might discharge plumes of contaminated waste sediments and slurry in the seafloor • Formation of waste piles, often with the potential to result in acid drainage • Generation of hazardous waste, including heavy metals and, in some cases, radioactive material (NORM) • Soil contamination due to the leaching of waste piles • Pollution of downstream water bodies, including adjacent aquifers Processing • The beneficiation of minerals frequently requires the use of chemicals and the comminution of ores (e.g. grinding) • Processing equipment can concentrate NORM, resulting in technically enhanced substances (TENORM) • These processes generate waste streams with fine metal particles and, in many cases, high toxicity • Waste with higher radioactivity (TENORM) generally must be disposed of through permanent storage in specialised facilities • Hazardous waste poses health threats to workers as well as environmental contamination potential Distribution and use • Products that reach their end of life are discarded by users • Generation of hazardous waste, often with mixed substances, such as a combination of plastics and metals • Improperly managed waste can end up being handled in unsafe environments or contaminating ecosystems

### Water Pollution – Block – Yes Internal Link

#### Rare earth mining leads to mass water pollution

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Mining is a water intensive activity. Copper facilities alone withdrew over 1.3 billion cubic metres of water in 2006 (Gunson et al., 2012). Water is used along the production value chain, from exploration to processing (e.g. flotation uses water to concentrate mineral ores) and transport. It is a major input of many standard operations, such as cleaning, cooling, dust control and pumping. Energy transition minerals often have higher water needs than other commodities, although this varies according to the production process. Water consumption levels for nickel and copper production, for example, are more than double in hydrometallurgy compared with the more common pyrometallurgical method (Northey et al., 2014). However, the most long-lasting impacts from mining do not come from water consumption. Acid mine drainage, resulting from water flows coming into contact with sulfide-rich materials, can persist long after a mine has been closed. Moreover, tailings ponds pose a risk of contamination to downstream water bodies, including extensive damage resulting from potential dam failure. Meanwhile, mines that employ dewatering operations (when groundwater inflows are pumped out to maintain access to the site) can cause a decrease in the surrounding water table or contaminate communicating aquifers. Water pollution is particularly worrisome in the processing stage, where grinding, milling and concentration methods generate toxic effluents loaded with heavy metals and chemicals. The associated contamination potential varies significantly among different resources, processing routes and means of disposal. Lithium production involves the highest eco-toxicity risks, mostly due to its leaching process. Moreover, the shift from traditional brinebased production to rock-based lithium leads to an almost tenfold increase in eco-toxicity values (Jiang et al., 2020). Water pollution is especially problematic in China, where REE production was conducted illegally or in unregulated small-scale activities until recently. There are numerous wastewater ponds, formerly used for leaching activities, abandoned near mining sites. China is taking steps to change this picture by remediating polluted areas and enacting stricter regulations to prevent new sources of contamination. Mineral development can also affect the marine environment. Seabed mining can lead to significant water pollution through the release of dewatering waste or side cast sediment with fine particles and heavy metals (Miller et al., 2018). Deep-sea tailings placement, which involves the dumping of tailings in the ocean, also poses high contamination risks. Indonesia is one of the few remaining countries with mining activities that still use this disposal method. Legislation from 2001 outlawed marine tailings disposal, but two copper developments that already used deep-sea disposal before this remain in operation and a new nickel project is applying for a permit despite the existing regulatory framework (BloombergNEF, 2020).

#### REM key to energy development and risks pollution

Gramling 2023 [Carolyn is the earth & climate writer. She has bachelor’s degrees in geology and European history and a Ph.D. in marine geochemistry from MIT and the Woods Hole Oceanographic Institution. Rare earth mining may be key to our renewable energy future. But at what cost? <https://www.sciencenews.org/article/rare-earth-mining-renewable-energy-future> Accessed 7/30/2024DMW]

Rare earths are now integral to the manufacture of many carbon-neutral technologies — plus a whole host of tools that move the modern world. These elements are the building blocks of small, super­efficient permanent magnets that keep smartphones buzzing, wind turbines spinning, electric vehicles zooming and more. Mining U.S. sources of rare earth elements, President Joe Biden’s administration stated in February 2021, is a matter of national security.¶ Rare earths are not actually rare on Earth, but they tend to be scattered throughout the crust at low concentrations. And the ore alone is worth relatively little without the complex, often environmentally hazardous processing involved in converting the ore into a usable form, says Julie Klinger, a geographer at the University of Delaware in Newark. As a result, the rare earth mining industry is wrestling with a legacy of environmental problems.¶ Rare earths are mined by digging vast open pits in the ground, which can contaminate the environment and disrupt ecosystems. When poorly regulated, mining can produce wastewater ponds filled with acids, heavy metals and radioactive material that might leak into groundwater. Processing the raw ore into a form useful to make magnets and other tech is a lengthy effort that takes large amounts of water and potentially toxic chemicals, and produces voluminous waste.¶ “We need rare earth elements … to help us with the transition to a climate-safe future,” says Michele Bustamante, a sustainability researcher at the Natural Resources Defense Council in Washington, D.C. Yet “everything that we do when we’re mining is impactful environmentally,” Bustamante says.

### Block - Yes – Deep Sea Mining Scenario

#### REM development motivates research into deep sea mining- that’s almost ready now and wrecks ocean biodiversity

Cho 2023 [Renee regular contributor to the Columbia Climate School. She has written over 200 articles for State of the Planet on a broad range of topics. She was previously published by www.insideclimatenews.com, and other environmental magazines. Renee was Communications Coordinator for Riverkeeper, the Hudson River environmental organization. She received the Executive Education Certificate in Conservation and Sustainability from the Earth Institute Center for Environmental Sustainability. The Energy Transition Will Need More Rare Earth Elements. Can We Secure Them Sustainably? <https://news.climate.columbia.edu/2023/04/05/the-energy-transition-will-need-more-rare-earth-elements-can-we-secure-them-sustainably/> Accessed 7/30/2024DMW]

Under the sea and in space¶ Deepsea mining could soon be given the go-ahead, as the International Seabed Authority is working on finalizing regulations for mining the ocean floor of the deep sea. Nauru Ocean Resources Inc., a subsidiary of a Canadian metals company, wants to mine polymetallic nodules from the ocean floor between Hawaii and Mexico. These nodules contain the cobalt, nickel, copper, and manganese essential for making batteries. Collecting them would require large machines that scrape the ocean floor, generating clouds of sediment and potentially disrupting marine ecosystems. Some experts say this could jeopardize the ecosystem services provided by marine microbes, the basis of the food web and the ocean’s ability to store carbon, before scientists even understand the full extent of their benefits. A new report by Fauna & Flora International, a conservation organization, says that deep sea mining would cause extensive and irreversible damage.¶ But Toledano maintains that the science about deep sea mining is unclear.¶ “The science that could tell us that some part of it is not dangerous is not getting a lot of coverage, because everyone is really scared to go there,” she said. One expert who worked on a large ocean mineral survey that also assessed the environmental impacts of deep-sea mining told her that there is not a lot of life at that depth. Moreover, the nodules can be retrieved without digging, so the creatures that live in the sediments may not be greatly affected. Germany, France, Spain, Chile, New Zealand, Costa Rica, several Pacific Island nations, and others, however, have called for a ban on deepsea mining until the impacts on the marine environment can be fully assessed.

#### Mining deep underwater triggers tons of ecologic disruptions

IEA 2021 [NTERNATIONAL ENERGY AGENCY The IEA examines the full spectrum of energy issues including oil, gas and coal supply and demand, renewable energy technologies, electricity markets, energy efficiency, access to energy, demand side management and much more. Through its work, the IEA advocates policies that will enhance the reliability, affordability and sustainability of energy in its 30 member countries, 8 association countries and beyond.The Role of Critical Minerals in Clean Energy Transitions Executive summary <https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/executive-summary> Accessed 7/30/2024DMW]

Studies also suggest potentially significant environmental impacts. Machines often cause seafloor disturbance, which could alter deepsea habitats and release pollutants. Sediment plumes, which arise from stirring up fine sediments, could also affect ecosystems, which take long time to recover. Ecosystems in some old test sites have not yet recovered after 30 years (Hefferman, 2019). The impacts on biodiversity are largely unknown. Despite the vast opportunities, rigorous assessments would be needed to understand the full extent of environmental damage and develop proper regulatory measures. BMW, Samsung SDI, Volvo and Google recently announced moratorium on materials from deep-sea mining until the risks are fully understood (WWF, 2021). The ISA is developing regulatory frameworks for the international seabed, aiming to promote deep-sea mining while minimising environmental risks.

### Water = Yes Impact

#### Collapse of freshwater leads to extinction

Dudgeon 6 - University of Hong Kong Ecology & Biodiversity professor (David, spent 30 years researching the ecology, biodiversity and conservation of the animals that inhabit streams and rivers, author of over 150 papers in international journals, with Angela H. Arthington, Mark O. Gessner, Zen-Ichiro Kawabata, Duncan J. Knowler, Christian Le´veˆque, Robert J. Naiman, Anne-He´le`ne Prieur-Richard, Doris Soto, Melanie L. J. Stiassny, and Caroline A. Sullivan, "Freshwater biodiversity: importance, threats, status and conservation challenges," *Biological Reviews*, 81.2)

Abstract

Freshwater biodiversity is the over-riding conservation priority during the International Decade for Action – ‘Water for Life’ – 2005 to 2015. Fresh water makes up only 0.01% of the World’s water and approximately 0.8 % of the Earth’s surface, yet this tiny fraction of global water supports at least 100 000 species out of approximately 1.8 million – almost 6 % of all described species. Inland waters and freshwater biodiversity constitute a valuable natural resource, in economic, cultural, aesthetic, scientiﬁc and educational terms. Their conservation and management are critical to the interests of all humans, nations and governments. Yet this precious heritage is in crisis. Fresh waters are experiencing declines in biodiversity far greater than those in the most aﬀected terrestrial ecosystems, and if trends in human demands for water remain unaltered and species losses continue at current rates, the opportunity to conserve much of the remaining biodiversity in fresh water will vanish before the ‘Water for Life’ decade ends in 2015. Why is this so, and what is being done about it? This article explores the special features of freshwater habitats and the biodiversity they support that makes them especially vulnerable to human activities. We document threats to global freshwater biodiversity under ﬁve headings : overexploitation; water pollution ; ﬂow modiﬁcation; destruction or degradation of habitat; and invasion by exotic species. Their combined and interacting inﬂuences have resulted in population declines and range reduction of freshwater biodiversity worldwide. Conservation of biodiversity is complicated by the landscape position of rivers and wetlands as ‘receivers ’ of land-use eﬄuents, and the problems posed by endemism and thus non-substitutability. In addition, in many parts of the world, fresh water is subject to severe competition among multiple human stakeholders. Protection of freshwater biodiversity is perhaps the ultimate conservation challenge because it is inﬂuenced by the upstream drainage network, the surrounding land, the riparian zone, and – in the case of migrating aquatic fauna – downstream reaches. Such prerequisites are hardly ever met. Immediate action is needed where opportunities exist to set aside intact lake and river ecosystems within large protected areas. For most of the global land surface, trade-oﬀs between conservation of freshwater biodiversity and human use of ecosystem goods and services are necessary. We advocate continuing attempts to check species loss but, in many situations, urge adoption of a compromise position of management for biodiversity conservation, ecosystem functioning and resilience, and human livelihoods in order to provide a viable long-term basis for freshwater conservation. Recognition of this need will require adoption of a new paradigm for biodiversity protection and freshwater ecosystem management – one that has been appropriately termed ‘reconciliation ecology’. I. INTRODUCTION In December 2003, the United Nations General Assembly adopted resolution 58/217 proclaiming 2005 to 2015 as an International Decade for Action – ‘Water for Life’. The resolution calls for a greater focus on water issues and development eﬀorts, and recommits countries to achieving the water-related goals of the 2000 Millennium Declaration and of Agenda 21: in particular, to halve by 2015 the proportion of people lacking access to safe drinking water and basic sanitation. These are vitally important matters, yet their importance should not obscure the fact that the ‘Water for Life’ resolution comes at a time when the biodiversity and biological resources of inland waters are facing unprecedented and growing threats from human activities. The general nature of these threats is known, and they are manifest in all non-polar regions of the Earth, although their relative magnitude varies signiﬁcantly from place to place. Identifying threats has done little, however, to mitigate or alleviate them. This article explores why the transfer of knowledge to conservation action has, in the case of freshwater biodiversity, been largely unsuccessful. The failure is related to the special features of freshwater habitats – and the biodiversity they support – that makes them especially vulnerable to human activities. We start by elucidating why freshwater biodiversity is of outstanding global importance, and brieﬂy describe instances where humans have caused rapid and signiﬁcant declines in freshwater species and habitats. If trends in human demands for water remain unaltered and species losses continue at current rates, the opportunity to conserve much of the remaining biodiversity in fresh water will vanish before the ‘Water for Life’ decade ends. Such opportunity costs will be magniﬁed by a signiﬁ- cant loss in option values of species yet unknown for human use. In addition, these vital ecological and potential ﬁnancial losses may well be irreversible. Importantly, eﬀective conservation action will require a major change in attitude toward freshwater biodiversity and ecosystem management, including general recognition of the catchment as the focal management unit, and greater acceptance of the trade-oﬀs between species conservation, overall ecosystem integrity, and the provision of goods and services to humans. At the same time, it is incumbent upon scientists to communicate eﬀectively that freshwater biodiversity is the over-riding conservation priority during the ‘Water for Life’ decade and beyond ; after all, water is the fundamental resource on which our life-support system depends ( Jackson et al., 2001; Postel & Richter, 2003 ; Clark & King, 2004).

### Water = Brink

#### We’re on the brink of global water tipping points that risk catastrophic impacts

Johan Rockström 14, professor in environmental science at the Stockholm Resilience Centre, Stockholm University, et al., October 2014, “The unfolding water drama in the Anthropocene: towards a resilience-based perspective on water for global sustainability,” Ecohydrology, Vol. 7, No. 5, p. 1249-1261

Indications show that humanity may be pushing exploitation of finite natural resources and the use of the living biosphere too far, putting at risk the future stability of the Earth system (Steffen et al., 2011a, 2011b), which is tightly coupled to the regional and global use of freshwater (Meybeck, 2003; Vörösmarty et al., 2004). This may trigger water-related tipping points with potentially disastrous and long-term implications for human civilization.

To address the new human predicament in the Anthropocene (Steffen et al., 2011a), science has advanced the planetary boundary framework, which aims at defining the dynamic boundaries for critical Earth System processes beyond which humanity is at high risk of crossing major tipping points, or fundamentally changing the environmental preconditions for social and economic development (Rockström et al., 2009c; Rockström et al., 2009b). This provides humanity with a ‘safe operating space’ within which the risk of large-scale abrupt changes is deemed very low. Water use has been identified as one of the nine planetary boundaries. The Freshwater Boundary is defined as the maximum additional consumptive blue water use in the world beyond the preindustrial situation, and set at 4000–6000 km3 year−1. Global consumptive use of blue water has been estimated at 2600 km3 year−1 (Shiklomanov and Rodda, 2003). Several regions already suffer from the widespread impacts of the overuse of blue water, and global projections indicate an increase in blue water use to a level approaching the global boundary by 2050 (Liu et al., 2009; Rockström et al., 2009a; Gerten et al., 2011).

The global water boundary is defined on the basis of the evidence of the role water plays in providing resilience through wetness of landscapes, providing water for ecological functions and services, and preventing water scarcity (Rockström et al., 2014). For example, evidence shows that river basins, with withdrawals exceeding more than 40–60% of available water resources, experience severe water scarcity (Oki and Kanae, 2006; Grafton et al., 2012). Ongoing research aims at downscaling the global planetary boundary for water to the local and regional scale, e.g. river basins and watersheds, by applying an environmental water flow approach (Pastor et al., 2013), where thresholds are defined on the basis of the amount of freshwater that needs to be maintained in rivers in order to maintain their stability and capacity to deliver key ecological functions. Applying this ‘bottom-up’ approach to estimate a global water boundary based on local environmental water flow requirements results in a boundary estimate of an average maximum allowed blue water withdrawal of 2800 km3 year−1, with a large uncertainty range of 1100–4500 km3 year−1 (Gerten et al., 2013).

### Biodiversity = Yes Impact

#### Biodiversity loss causes extinction

**Torres 16** - founder of the X-Risks Institute, an affiliate scholar at the Institute for Ethics and Emerging Technologies

(Phil, “Biodiversity loss: An existential risk comparable to climate change”, 4/11/16, <http://thebulletin.org/biodiversity-loss-existential-risk-comparable-climate-change9329>, BOTAS) [language modified]

But **there is another existential threat that the Bulletin ~~overlooked~~ [missed] in its Doomsday Clock announcement: biodiversity loss**. This phenomenon is often identified as one of the many consequences of climate change, and this is of course correct. But **biodiversity loss is also a contributing factor behind climate change.** For example, **deforestation in the Amazon rainforest and elsewhere reduces the amount of carbon dioxide removed from the atmosphere by plants, a natural process that mitigates the effects of climate change**. So the causal relation between climate change and biodiversity loss is bidirectional. Furthermore, there are myriad **phenomena that are driving biodiversity loss in addition to climate change.** Other causes include ecosystem fragmentation, invasive species, pollution, oxygen depletion caused by fertilizers running off into ponds and streams, overfishing, human overpopulation, and overconsumption. All of these phenomena **have a direct impact on the health of the biosphere, and all would conceivably persist even if the problem of climate change were somehow immediately solved**. **Such considerations warrant decoupling biodiversity loss from climate change**, **because the former has been consistently subsumed by the latter as a mere effect.** **Biodiversity loss is a distinct environmental crisis with its own unique syndrome of causes, consequences, and solutions**—such as restoring habitats, creating protected areas (“biodiversity parks”), and practicing sustainable agriculture. The sixth extinction. **The repercussions of biodiversity loss are potentially as severe as those anticipated from climate change, or even a nuclear conflict**. For example, according to a 2015 study published in Science Advances, **the best available evidence reveals “an exceptionally rapid loss of biodiversity over the last few centuries, indicating that a sixth mass extinction is already under way.”** This conclusion holds, even on the most optimistic assumptions about the background rate of species losses and the current rate of vertebrate extinctions. The group classified as “vertebrates” includes mammals, birds, reptiles, fish, and all other creatures with a backbone. The article argues that, **using its conservative figures**, **the average loss of vertebrate species was 100 times higher in the past century relative to the background rate of extinction**. (Other **scientists have suggested that the current extinction rate could be as much as 10,000 times higher than normal**.) As the authors write, “**The evidence is incontrovertible that recent extinction rates are unprecedented in human history and highly unusual in Earth’s history**.” Perhaps the term “Big Six” should enter the popular lexicon—to add the current extinction to the previous “Big Five,” the last of which wiped out the dinosaurs 66 million years ago. But the concept of biodiversity encompasses more than just the total number of species on the planet. It also refers to the size of different populations of species. With respect to this phenomenon, **multiple studies have confirmed that wild populations around the world are dwindling and disappearing at an alarming rate**. For example, the 2010 Global Biodiversity Outlook report found that **the population of wild vertebrates living in the tropics dropped by 59 percent between 1970 and 2006**. **The report also found that the population of farmland birds in Europe has dropped by 50 percent since 1980**; bird populations in the grasslands of North America declined by almost 40 percent between 1968 and 2003; and the population of birds in North American arid lands has fallen by almost 30 percent since the 1960s. Similarly, **42 percent of all amphibian species** (a type of vertebrate that is sometimes called an “ecological indicator”) **are undergoing population declines**, and 23 percent of all plant species “are estimated to be threatened with extinction.” Other studies have found that some 20 percent of all reptile species, 48 percent of the world’s primates, and **50 percent of freshwater turtles are threatened**. Underwater, about **10 percent of all coral reefs are now dead, and another 60 percent are in danger of dying.** Consistent with these data, the 2014 Living Planet Report shows that **the global population of wild vertebrates dropped by 52 percent in only four decades**—from 1970 to 2010. While biologists often avoid projecting historical trends into the future because of the complexity of ecological systems, it’s tempting to extrapolate this figure to, say, the year 2050, which is four decades from 2010. As it happens, a 2006 study published in Science does precisely this: It projects past trends of marine biodiversity loss into the 21st century, concluding that, **unless significant changes are made to patterns of human activity, there will be virtually no more wild-caught seafood by 2048**. **Catastrophic consequences for civilization**. The consequences of this rapid pruning of the evolutionary tree of life extend beyond the obvious. **There could be surprising effects of biodiversity loss** that scientists are unable to fully anticipate in advance. For example, prior research has shown that **localized ecosystems can undergo abrupt and irreversible shifts when they reach a tipping point**. According to a 2012 paper published in Nature, there are reasons for thinking that we **may be approaching a tipping point of this sort in the global ecosystem, beyond which the consequences could be catastrophic for civilization.** As the authors write, **a planetary-scale transition could precipitate “substantial losses of ecosystem services required to sustain the human population.”** An ecosystem service is any ecological process that benefits humanity, such as food production and crop pollination. **If the global ecosystem were to cross a tipping point and substantial ecosystem services were lost, the results could be “widespread social unrest, economic instability, and loss of human life.”** According to Missouri Botanical Garden ecologist Adam Smith, one of the paper’s co-authors, **this could occur in a matter of decades—far more quickly than most of the expected consequences of climate change, yet equally destructive. Biodiversity loss is a “threat multiplier”** that, **by pushing societies to the brink of collapse**, **will exacerbate existing conflicts and introduce entirely new struggles between state and non-state actors**. Indeed, **it could even fuel the rise of terrorism**. (After all, climate change has been linked to the emergence of ISIS in Syria, and multiple high-ranking US officials, such as former US Defense Secretary Chuck Hagel and CIA director John Brennan, have affirmed that climate change and terrorism are connected.) **The reality is that we are entering the sixth mass extinction in the 3.8-billion-year history of life on Earth, and the impact of this event could be felt by civilization “in as little as three human lifetimes,”** as the aforementioned 2012 Nature paper notes. Furthermore, **the widespread decline of biological populations could plausibly initiate a dramatic transformation of the global ecosystem on an even faster timescale: perhaps a single human lifetime. The unavoidable conclusion is that biodiversity loss constitutes an existential threat in its own right.** As such, **it ought to be considered** alongside climate change and nuclear weapons **as** one of **the most significant contemporary risks to human prosperity and survival.**

## Turns Case

### 2NC/1NR – Turns Case

#### Link and Impact turns the case- any increase in demand forces governments to mine more, increasing environmental destruction OR undermines the transition to renewable energy

Serpell et al 2021 [Oscar is a research associate at the Kleinman Center for Energy Policy. Benjamin Paren is a Ph.D. student in the department of Materials Science and Engineering at the University of Pennsylvania. Wan-Yi “Amy” Chu is an assistant professor at Mills College in Oakland, California and a former postdoctoral researcher in the Goldberg Group, located in the Department of Chemistry at the University of Pennsylvania. RARE EARTH ELEMENTS A RESOURCE CONSTRAINT OF THE ENERGY TRANSITION <https://kleinmanenergy.upenn.edu/wp-content/uploads/2021/05/KCEP-Rare-Earth-Elements.pdf> Accessed 7/30/2024DMW]

Global prices have remained relatively affordable in¶ recent years only because of China’s lax environmental¶ regulations and illegal mining operations. But China is¶ now reckoning with the true costs of toxic, acidic, and¶ radioactive run-off and leaching.¶ If demand for REEs continues to grow as expected, the¶ pressure on nations to increase domestic production¶ at the expense of the environment will increase. For¶ example, there is growing interest in expanding U.S.¶ production of REEs beyond Mountain Pass (Garcia and¶ Smith 2020).¶ Failure to avoid an increase in environmental impacts¶ from larger-scale production would jeopardize the¶ sustainability of renewable energy technologies utilizing¶ REEs and could partially offset their emissions benefits.¶ This would in many ways undermine the goals of¶ decarbonization and would further stress ecosystems¶ and communities that have already been affected by¶ climate change.¶ In order to assure that the transition to carbon-free¶ energy minimizes environmental costs and promotes¶ global sustainability, policy support for clean energy¶ solutions should be coupled with streamlined¶ environmental regulation and sustainability incentives.¶ Fundamentally, all human development carries¶ environmental impacts.¶ In the case of rare earth elements, policies intended¶ to encourage the production and sale of wind turbines¶ and electric vehicles should be designed in a way that¶ encourages continued innovation in sustainable motor¶ designs and REE recycling. These policies should¶ also be coupled with environmental regulations and incentives to ensure REEs are secured in a sustainable¶ and relatively benign way.

#### Turns case- increases costs and lack of material increases delays on critical tech

IEA 2021 [NTERNATIONAL ENERGY AGENCY The IEA examines the full spectrum of energy issues including oil, gas and coal supply and demand, renewable energy technologies, electricity markets, energy efficiency, access to energy, demand side management and much more. Through its work, the IEA advocates policies that will enhance the reliability, affordability and sustainability of energy in its 30 member countries, 8 association countries and beyond.The Role of Critical Minerals in Clean Energy Transitions Executive summary <https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/executive-summary> Accessed 7/30/2024DMW]

The prospect of a rapid rise in demand for critical minerals – in most cases well above anything seen previously – poses huge questions about the availability and reliability of supply. In the past, strains on the supply-demand balance for different minerals have prompted additional investment as well as measures to moderate or substitute demand, but these responses have come with time lags and have been accompanied by considerable price volatility. Similar episodes in the future could delay clean energy transitions and push up their cost. Given the urgency of reducing emissions, this is a possibility that the world can ill afford.¶ Raw materials are a significant element in the cost structure of many technologies required in energy transitions. In the case of lithium-ion batteries, technology learning and economies of scale have pushed down overall costs by 90% over the past decade. However, this also means that raw material costs now loom larger, accounting for some 50-70% of total battery costs, up from 40-50% five years ago. Higher mineral prices could therefore have a significant effect: a doubling of lithium or nickel prices would induce a 6% increase in battery costs. If both lithium and nickel prices were to double at the same time, this would offset all the anticipated unit cost reductions associated with a doubling of battery production capacity. In the case of electricity networks, copper and aluminium currently represent around 20% of total grid investment costs; higher prices as a result of tight supply could have a major impact on the level of grid investment.¶ Our analysis of the near-term outlook for supply presents a mixed picture. Some minerals such as lithium raw material and cobalt are expected to be in surplus in the near term, while lithium chemical, battery-grade nickel and key rare earth elements (e.g. neodymium, dysprosium) might face tight supply in the years ahead. However, looking further ahead in a scenario consistent with climate goals, expected supply from existing mines and projects under construction is estimated to meet only half of projected lithium and cobalt requirements and 80% of copper needs by 2030.¶ Today’s supply and investment plans are geared to a world of more gradual, insufficient action on climate change (the STEPS trajectory). They are not ready to support accelerated energy transitions. While there are a host of projects at varying stages of development, there are many vulnerabilities that may increase the possibility of market tightness and greater price volatility:

### 2NC/1NR – Turns Case – Environment

#### Turns case- increase environmental destruction & undermines developments- the aff doesn’t have protections that are needed

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The growth of mineral supply not only plays a vital role in enabling clean energy transitions, but also holds great promise to lift some of the world’s poorest people out of poverty. Mineral wealth can, if exploited responsibly, contribute to public revenue and provide economic livelihoods for many. However, if poorly managed, mineral development can lead to a myriad of negative consequences, including: • Significant greenhouse gas (GHG) emissions arising from energy-intensive mining and processing activities. • Environmental impacts, including biodiversity loss and social disruption due to land use change, water depletion and pollution, waste-related contamination and air pollution. • Social impacts stemming from corruption and misuse of government resources, fatalities and injuries to workers and members of the public, human rights abuses including child labour and unequal impacts on women and girls. In addition, these risks may lead to supply disruption, which could slow the pace of clean energy transitions. It is therefore imperative for both companies and governments to manage the environmental and social impacts of mineral production. Companies have a clear business case to address these harms to reduce risk and maintain a social licence to operate. Consumers and investors are increasingly demanding that companies take these issues seriously. Failure to respond to these social demands could not only undermine reputation, but also lead to difficulties in raising capital or even to legal liability. Companies have increasingly implemented responsible practices over the years. The adoption of corporate responsibility policies and processes at company level and via industry-wide initiatives has led to improvements throughout mineral supply chains. However, performance varies significantly among industry actors, with some segments showing limited effort and more progress being needed across the board. Challenges are more substantial where regulatory safeguards are inadequate, and where systemic issues such as labour informality, weak fiscal capacity and high inequalities are persistent, such as in artisanal and small-scale mining (ASM). Governments play an important role in promoting improvements in environmental and social performance. As supply chains become more global, international co-operation to apply appropriate standards will be critical to ensuring that the extraction and trade of minerals are carried out sustainably and responsibly, and that the supply of energy transition minerals remains uninterrupted.

### 2NC/1NR – Turns Case – Warming

#### REM causes more warming emissions

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The process of producing various commodities, such as fossil fuels and steel, is a significant contributor to global emissions. For the moment, emissions from producing minerals vital for clean energy technologies are relatively small, due to their low production volumes. However, these minerals require much more energy to produce per unit of product, which results in higher emissions intensity than other commodities. For example, emissions from producing the average tonne of lithium carbonate and Class 1 nickel are three and ten times higher, respectively, than those from producing a tonne of steel. The higher emissions relate to the fact that most energy transition minerals have a lower metallic concentration in ore. While the metal content in iron ore is typically 50-70% (IEA, 2020c), the average ore grade for nickel is less than 2% and under 1% for copper. Lower grade ores require more energy to extract the valuable fraction, and to move and treat the waste fraction (the “gangue”). The effects are aggravated by deteriorating ore quality. The average ore grade for copper in Chile declined from 1.25% in 2001 to 0.65% in 2017. As a result, fuel and electricity consumption per unit of mined copper increased by 130% and 32% respectively over the same period (Azadi et al., 2020). Given their large electricity consumption, refining and smelting operations are also a major contributor to emissions, especially when relying on coal-based electricity. Future production is likely to gravitate towards more energy-intensive pathways. Lithium production has been moving from brine-based recovery (mostly in Chile) to mineral concentrate production from hardrock (mostly in Australia). The emissions intensity of hardrockbased lithium carbonate production is three times higher than that of brine production. This is due in part to higher energy requirements in mining and also in refining, the latter being mainly carried out in China where coal plays a dominant role in the power mix. In this context, several companies in Australia are looking to integrate projects within the country to lower these emissions. There is also additional pressure from changing demand patterns for lithium. Demand is moving from lithium carbonate towards lithium hydroxide, as the latter is more suitable for batteries with higher nickel cathode chemistries. However, lithium hydroxide involves more emissions as it requires an additional processing step to convert lithium carbonate to lithium hydroxide (when produced from brine resources). Battery-grade nickel faces a similar situation. While sulfide resources played a major role in the past, future growth is increasingly coming from laterite resources, which require more energy to produce. These underlying pressures highlight the need for companies to take stronger action to address emissions across their value chains.

## AT – Generic Defense

### Block – AT Recycling

#### Recycling prior tech doesn’t work- not enough available nor do we have the technology to do so efficiently

Cho 2023 [Renee regular contributor to the Columbia Climate School. She has written over 200 articles for State of the Planet on a broad range of topics. She was previously published by www.insideclimatenews.com, and other environmental magazines. Renee was Communications Coordinator for Riverkeeper, the Hudson River environmental organization. She received the Executive Education Certificate in Conservation and Sustainability from the Earth Institute Center for Environmental Sustainability. The Energy Transition Will Need More Rare Earth Elements. Can We Secure Them Sustainably? <https://news.climate.columbia.edu/2023/04/05/the-energy-transition-will-need-more-rare-earth-elements-can-we-secure-them-sustainably/> Accessed 7/30/2024DMW]

But e-waste recycling remains hampered by insufficient infrastructure, and expensive and inefficient collection processes.¶ “For e-waste, first of all you need the collection infrastructure and it has not been properly developed, and you need incentives for the producer to be obliged and mandated to retrieve the electronic waste,” said Toledano. “If, at the beginning, the producer knows that there will be some obligation to recover the consumer goods then it will start designing the product in a way that is recyclable. In Europe, there is this related idea that you should be mandated to develop electronics that are not designed for obsolescence to limit the waste. The circular economy [where all resources are recycled and reused] is about avoiding waste in the first place before you go into recycling, because recycling is much more technology-intensive and expensive.”¶ The magnets in EVs and wind turbines could be recovered and recycled relatively easily, but because they are designed to last many years, it will be decades before there are enough recycled magnets to meet the growing demand. There are, however, companies preparing to recycle the batteries from the first generation of retiring EVs. For example, Canadian Li-Cycle Corps is building its third facility to recycle lithium-ion batteries, and there are dozens of new recycling battery projects starting up around the world.¶ Purdue University researchers have developed an innovative and inexpensive way to recycle coal ash to recover rare earth elements. Coal ash is as rich in rare earth elements as some ores, say the scientists. They have discovered a new method of separating out rare earth elements from other impurities, using materials that are inexpensive and efficient. If the technique can be scaled up, it could theoretically recover valuable materials from the 129 million tons of coal ash the U.S. produces annually.

#### Takes decades to recycle parts to reduce mining needs

Serpell et al 2021 [Oscar is a research associate at the Kleinman Center for Energy Policy. Benjamin Paren is a Ph.D. student in the department of Materials Science and Engineering at the University of Pennsylvania. Wan-Yi “Amy” Chu is an assistant professor at Mills College in Oakland, California and a former postdoctoral researcher in the Goldberg Group, located in the Department of Chemistry at the University of Pennsylvania. RARE EARTH ELEMENTS A RESOURCE CONSTRAINT OF THE ENERGY TRANSITION <https://kleinmanenergy.upenn.edu/wp-content/uploads/2021/05/KCEP-Rare-Earth-Elements.pdf> Accessed 7/30/2024DMW]

Retired wind turbines and EV motors are a source of¶ recyclable REEs, since their magnets are relatively¶ large and can be recovered without too much difficulty.¶ In some cases, large magnets can simply be reused¶ and do not need to undergo the recycling process¶ (Binnemans 2013). However, clean energy applications¶ of REEs face another roadblock to scalable recycling:¶ insufficient stock material.¶ Recycled REEs can only ever make up a portion of¶ demand equivalent to the total stock of REEs in currently¶ available retired equipment. Recycling in industries such¶ as wind power and electric vehicles, where demand is¶ increasing exponentially and manufactured equipment¶ is designed for a decade of use or more, are inherently¶ limited in this way. Therefore, it will be decades before¶ the stock of retiring magnets is sufficient to meet a¶ considerable share of new demand.

### Block – AT Sustainable Mining

#### Too many roadblocks- no sustainable mining exists

Cho 2023 [Renee regular contributor to the Columbia Climate School. She has written over 200 articles for State of the Planet on a broad range of topics. She was previously published by www.insideclimatenews.com, and other environmental magazines. Renee was Communications Coordinator for Riverkeeper, the Hudson River environmental organization. She received the Executive Education Certificate in Conservation and Sustainability from the Earth Institute Center for Environmental Sustainability. The Energy Transition Will Need More Rare Earth Elements. Can We Secure Them Sustainably? <https://news.climate.columbia.edu/2023/04/05/the-energy-transition-will-need-more-rare-earth-elements-can-we-secure-them-sustainably/> Accessed 7/30/2024DMW]

How can we supply the energy transition more sustainably?¶ With the growing demand for rare earth elements and critical minerals, mining practices that harm the environment will likely continue, if not increase.¶ “The pressure is such that that the first thing that might be disregarded and marginalized are the safeguards in order to fast track the process—environmental safeguards and social safeguards,” said Perrine Toledano, director of research and policy at the Columbia Center on Sustainable Investment, a joint center of the Columbia Climate School and Columbia Law School. “We know that there is a lot of pressure going on in some countries, in Africa and elsewhere, meaning that the governments may not have time to use due process. So that might set us back on sustainability.”¶ Fortunately, researchers are working on ways to make mining more sustainable or unnecessary. Here are some examples — most of which are still experimental and not yet ready for large-scale application.

# Aff Answers

## Uniqueness

### 2AC – REM Sufficient Now

#### REE are sufficient now

BORENSTEIN 2023 [SETH is an Associated Press science writer, covering climate change, disasters, physics and other science topics Study: Enough rare earth minerals to fuel green energy shift <https://apnews.com/article/science-green-technology-climate-and-environment-renewable-energy-141761657a8e7a5627a0e49e601dd48e> Accessed 7/30/2024DMW]

¶ The world has enough rare earth minerals and other critical raw materials to switch from fossil fuels to renewable energy to produce electricity and limit global warming, according to a new study that counters concerns about the supply of such minerals.¶ ¶ With a push to get more electricity from solar panels, wind turbines, hydroelectric and nuclear power plants, some people have worried that there won’t be enough key minerals to make the decarbonization switch.¶ ¶ Rare earth minerals, also called rare earth elements, actually aren’t that rare. The U.S. Geological Survey describes them as a “relatively abundant.” They’re essential for the strong magnets necessary for wind turbines; they also show up in smartphones, computer displays and LED light bulbs. This new study looks at not only those elements but 17 different raw materials required to make electricity that include some downright common resources such as steel, cement and glass.¶ ¶ A team of scientists looked at the materials — many not often mined heavily in the past — and 20 different power sources. They calculated supplies and pollution from mining if green power surged to meet global goals to cut heat-trapping carbon emissions from fossil fuel.

#### REE sufficient in numbers

BORENSTEIN 2023 [SETH is an Associated Press science writer, covering climate change, disasters, physics and other science topics Study: Enough rare earth minerals to fuel green energy shift <https://apnews.com/article/science-green-technology-climate-and-environment-renewable-energy-141761657a8e7a5627a0e49e601dd48e> Accessed 7/30/2024DMW]

Much more mining is needed, but there are enough minerals to go around and drilling for them will not significantly worsen warming, the study in Friday’s scientific journal Joule concluded.¶ “Decarbonization is going to be big and messy, but at the same time we can do it,” said study co-author Zeke Hausfather, a climate scientist at the tech company Stripe and Berkeley Earth. “I’m not worried we’re going to run out of these materials.”¶ Much of the global concern about raw materials for decarbonization has to do with batteries and transportation, especially electric cars that rely on lithium for batteries. This study doesn’t look at that.¶ Looking at mineral demands for batteries is much more complicated than for electric power and that’s what the team will do next, Hausfather said. The power sector is still about one-third to half of the resource issue, he said.¶ A lot depends on how fast the world switches to green energy.¶ There will be short supplies. For example, dysprosium is a mineral used for magnets in wind turbines and a big push for cleaner electricity would require three times as much dysprosium as currently produced, the paper said. But there’s more than 12 times as much dysprosium in reserves than would be needed in that clean energy push.¶ Another close call is tellurium, which is used in industrial solar farms and where there may be only slightly more estimated resources than what would be required in a big green push. But Hausfather said there are substitutions available in all these materials’ cases.

## Link

### No Link - Generic

#### Innovation and tech adjustment while improving our energy sector ensure REM don’t devastate the world

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1. Ensure adequate investment in diversified sources of new supply. Strong signals from policy makers about the speed of energy transitions and the growth trajectories of key clean energy technologies are critical to bring forward timely investment in new supply. Governments can play a major role in creating conditions conducive to diversified investment in the mineral supply chain.¶ 2. Promote technology innovation at all points along the value chain. Stepping up R&D efforts for technology innovation on both the demand and production sides can enable more efficient use of materials, allow material substitution and unlock sizeable new supplies, thereby bringing substantial environmental and security benefits.¶ 3. Scale up recycling. Policies can play a pivotal role in preparing for rapid growth of waste volumes by incentivising recycling for products reaching the end of their operating lives, supporting efficient collection and sorting activities and funding R&D into new recycling technologies.¶ 4. Enhance supply chain resilience and market transparency. Policy makers need to explore a range of measures to improve the resilience of supply chains for different minerals, develop response capabilities to potential supply disruptions and enhance market transparency. Measures can include regular market assessments and stress-tests, as well as strategic stockpiles in some instances.¶ 5. Mainstream higher environmental, social and governance standards. Efforts to incentivise higher environmental and social performance can increase sustainably and responsibly produced volumes and lower the cost of sourcing them. If players with strong environmental and social performance are rewarded in the marketplace, it can lead to greater diversification among supply.

#### No Link- demands based on production massively change

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Demand projections are subject to large variations, which lead to a wide range of possible futures. According to our analysis of the scenarios and alternative cases, lithium demand in 2040 may be 13 times higher (if vanadium redox flow batteries rapidly penetrate the market in the STEPS) or 51 times higher (if all-solid-state batteries commercialise faster than expected in the SDS) than today’s levels. Likewise, cobalt and graphite may see 6- to 30-times higher demand than today depending on the scenario that unfolds. Among nonbattery materials, demand for REEs grows by seven times in the SDS, but growth may be as low as three times today’s levels should wind companies tilt more towards turbines that do not use permanent magnets in the STEPS context. These large uncertainties around possible futures may act as a factor that hampers companies’ investment decisions, which could in turn cause supply-demand imbalances in the years ahead. Despite the promise of massive demand growth, mining and processing companies may be reluctant to commit large-scale investment given the wide range of possible demand trajectories. However, the biggest source of demand variance does not come from technology. It comes instead from the uncertainty surrounding announced and expected climate ambitions – in other words, whether clean energy deployment and resulting mineral demand follows STEPS or SDS trajectories.

#### No link- industries adapt as demand grows

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Solar PV plants are mainly composed of modules, inverters, trackers, mounting structures and general electrical components. For utilityscale solar PV plants, differences in mineral intensities come primarily from differences in module types. Crystalline silicon (c-Si) modules have become the dominant PV technology, followed by the “thin-film” alternatives: cadmium telluride (CdTe), copper indium gallium diselenide (CIGS) and amorphous silicon (a-Si). By weight, c-Si PV panels typically contain about 5% silicon (solar cells), 1% copper (interconnectors), and less than 0.1% silver and other metals (IRENA, 2016). Thin-film technologies require more glass but less minerals overall than c-Si. CdTe and CIGS panels use no silver or silicon, but instead require cadmium and tellurium (CdTe) or indium, gallium and selenium (CIGS). Distributed solar PV systems tend to have string inverters or microinverters, requiring about 40% more copper than utility-scale projects, which typically use central inverters. Other mineral intensities are similar between utility-scale and distributed applications. Innovation in the manufacturing and design of c-Si panels over the past decade has contributed to large reductions in materials intensity. Since 2008 silicon intensity has more than halved as wafer thickness diminished substantially (Fraunhofer ISE, 2020), while silver intensity fell by 80% thanks to more efficient and less silver-intensive metallisation pastes (ITRPV, 2020). Since silicon and silver are among the most expensive elements in solar PV cells, advances in material intensity are expected to continue, with further assumed reductions of around 25% and 30% in 2030 for silicon and silver respectively. The intensities of other minerals are also expected to decrease as overall efficiency improves, including through the use of new technologies such as bifacial, n-type or half-cut cells, multi busbars, dual-glass modules and string inverters.

#### Market mechanisms and other policies lead to reduction on harms from mining- makes it cleaner

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Market mechanisms Trading platforms and metal purchasers can also play an important role in encouraging companies to adopt voluntary approaches to reduce emissions. The London Metal Exchange (LME) trading platform is aiming to provide consumers with greater transparency of the carbon footprint of traded metals, building on recent efforts to incorporate responsible sourcing standards into its brand listing requirements. The new voluntary disclosures will be introduced in 2021 starting with aluminium, in the form of an “LME passport” and a spot-trading platform so that producers can substantiate their carbon emission claims. This digital passport will then be phased in for all LME’s physically settled metals requiring certificates of analysis, including cobalt and nickel from 2023 (LME, 2020). Public disclosure of sustainability metrics can incentivise producers to measure emissions in a credible manner, and ultimately lower their carbon footprint to meet consumer demands. This in turn may eventually support a price premium for low-emission metals. It can also act as an indicator to policy makers to assess industry and consumer buyin (IGF, 2018a). These industry initiatives actively support greater disclosure of emissions data, but it will take time for them to mature enough to provide consistent data and indicators. Moreover, further effort is needed to develop standardised accounting frameworks to ensure emissions data is comparable across companies. So far, industry sustainability standards remain voluntary, and thus their impact is limited to companies that choose to implement them. Although governments can encourage companies to adopt these standards – as Canada does for TSM – policy support will be needed to provide incentives for further uptake of transparency norms. PAGE | 205 The Role of Critical Minerals in Clean Energy Transitions Sustainable and responsible development …while regulatory approaches to reduce mining emissions are often incomplete Once an industry standard is broadly accepted, governments can play a key role in turning voluntary commitments into legal requirements. For example, the EU Batteries Regulation will mandate disclosure of key sustainability metrics already reported on a voluntary basis under industry standards (see Box 3.5). Voluntary climate-related financial disclosures, such as the Task Force on Climate-related Financial Disclosures, are also being progressively incorporated into law, for instance in the United Kingdom and New Zealand (Davies et al., 2020).

### 2AC – Energy Policy L/T

#### Climate policies increase efficiencies in mining operations and guarantees that REM can happen- the investments are key

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Inconsistent reporting frameworks Governments also have a role to play in driving standardisation among emissions accounting frameworks. Although companies are increasingly expected to disclose GHG emissions, including any indirect emissions in the value chain (Scope 3), the lack of consistency in reporting makes it challenging to compare data. Even under the Greenhouse Gas Protocol, which is designed explicitly to create a corporate standard allowing comparable reporting, companies are free to choose which values to report, emission category boundaries and relevant categories. Empirical research on the copper supply chain demonstrated that GHG accounting protocols were often lacking and differed dramatically between companies (Lee et al, 2020). As such, policy support to standardise accounting principles is necessary to bolster emission disclosures. A suite of policy options for mining emissions Government policies can drive companies to adopt emission reduction strategies across their operations, including fuel switching and investing in low-carbon electricity and energy efficiency. These can be addressed through a suite of policies such as renewable portfolio standards, energy efficiency mandates, emission regulations and carbon pricing. In particular, allowing independent power producers to enter the market could facilitate less emissionintensive power generation. For instance, in 2015 Chile mandated power distribution companies to conduct tender processes to provide energy to regulated customers, thus facilitating the successful development of renewable-powered mines (CCSI, 2018). R&D and innovation support is also key to lowering emissions in mining. For instance, in the context of the European Battery Alliance, the European Union financially supports a “Zero Carbon Lithium” project in Germany to find less water- and carbon-intensive ways to extract the mineral (Energy Storage News, 2020). The Australian Renewable Energy Agency and other government entities also provided financial support for solar-powered energy generation at the DeGrussa copper mine in Western Australia, which has the potential to meet up to 90% of the mine’s daytime demand (CCSI, 2018). Clean fuel standards can also impact mining operations given their use of liquid fossil fuels and freight services (Government of Canada, 2020).

### 2AC – Carbon Pricing L/T

#### Carbon pricing ensures increases in mining without environmental destruction- enables funding and support for more efficient mining decisions

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Carbon pricing holds potential to become an important component of climate governance, at both national and international levels. Carbon taxation and emissions trading schemes can be an effective tool for driving reductions in emissions in line with the “polluter pays” principle while encouraging innovation. However, so far the impact of carbon pricing mechanisms on the minerals sector has been limited to only a handful of contexts. In many cases, the impact of carbon pricing mechanisms on minerals has been limited to the indirect effects of carbon pricing applied to electricity or fuel use. This indirect effect is small as long as carbon prices remain low. The carbon tax in Chile is a good example of these limits. The tax applies to power generation, which may ultimately be passed on to mineral producers in electricity contracts. The actual impact is minimal due to the low level of the price: USD 5 per tonne CO2-eq (ICAP, 2021). Further, the mining sector has sometimes been exempted or received free allocation of allowances due to carbon leakage and competitiveness concerns. However, there are encouraging efforts to apply carbon pricing directly to mining and mineral processing operations. Canada’s output-based pricing system, which applies to provinces and territories that do not have their own carbon pricing systems with comparable stringency and coverage, targets large industrial emitters. Among the sectors covered, the system puts a price on emissions occurring from mining and refining base metals such as nickel, copper, zinc, lead and cobalt, in addition to a charge on fossil fuels (Government of Canada, 2019). By combining direct and indirect carbon pricing, such schemes can provide further incentives to lower emissions. For carbon pricing to have a more widespread impact on the mining sector's emissions, rigorous implementation will be needed and governments should send clear policy signals to this effect. For instance, the Canadian government has proposed increasing the federal carbon price by CAD15 per year from 2023, reaching CAD170 per tonne CO2-eq in 2030 (Government of Canada, 2021a). Such policies can incentivise investment in emissions reduction measures in project planning. However, uncertainty over carbon pricing in different jurisdictions complicates the picture for companies. Some companies have established an internal carbon price within corporate account systems. For instance, BHP has established a “shadow” carbon price ranging from USD 10 to USD 110/t CO2-eq. It uses the price in scenario modelling to determine the competitiveness of fuels across sectors, to inform investment decisions and asset valuations (BHP, 2020). The use of shadow prices within company decision-making is a positive step to track and reduce emissions, but clear signals from governments on carbon pricing remain crucial.

## Impact Answers

### 1AR – AT Turns Case – Climate

#### Emissions from developing mineral resources is tiny and can be reduced further

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Emissions from mineral development can be significantly reduced by a shift in fuel sources and by using low-carbon electricity. A simulation of an indicative refined copper production project under different energy consumption profiles reveals a wide variation in emissions intensity depending on the type of fuel used and the intensity of electricity supplied by the grid. Shifting all fuels to natural gas would bring emissions down by 10%, while using renewable-based electricity reduces CO2 intensity by about two-thirds. Further reductions could be achieved through the electrification of fuel use. When combined, electrification and renewable-based electricity have the potential to reduce emissions intensity by almost 80%. Similar trends are also visible in nickel production.

### 2AC – AT Environment – Water Pollution

#### Tech exists to reduce pollution from mining operations in water sources

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Sustainable waste management can ensure that instead of causing environmental harm, mining residues are used as resources and support economic development. This usually follows a “reduce, reuse and recycle” hierarchy, with disposal as a last resort. Policies and plans to manage waste Effective waste management policies ensure that companies take action to reduce the risks to the environment and public health from waste streams, take steps to reduce waste generation and undertake proper disposal or recovery. The European Union’s Directive on Management of Waste from Extractive Industries, 2006/21/EC, for example, requires the use of best available techniques, including techniques to reduce the volume of extractive waste and use of residues for backfilling or construction purposes. In addition, the EU directive requires operators to develop waste management plans that cover all aspects of waste management, including waste reduction, storage, transport, monitoring and reporting, for each phase of production. Waste management plans typically involve establishing procedures for each type of residue. The International Finance Corporation indicates measures for management of key mining waste categories in their Environmental, Health and Safety Guidelines for Mining. Dewatering tailings to reduce waste volumes and risks Tailings dewatering techniques offer several benefits, including less land use, lower risk of dam failure and reduced scope for acid drainage. Thickened or dried tailings can be disposed of as a paste or through dry-stacking, both of which create more stable disposal structures and allow water recovery. Many methods exist to dewater tailings, including pressure filtering and thickening agents, but until recently, these methods had been used primarily at high-grade, lowthroughput operations due to technical limitations and high capital costs. However, a recent pilot project in the Escondida copper mine in Chile demonstrated their feasibility at higher-throughput projects, indicating that the economics of these technologies are improving. Furthermore, increasing water scarcity and safety requirements created in the wake of the Brumadinho disaster may provide the push needed to scale up tailings dewatering (Leonida, 2020). Thickened tailings can also facilitate tailings reprocessing and support a more recovery-focused management strategy. This enables waste reduction while also increasing mineral supply. Most types of waste generated by mining can be used by other sectors, for example, in cement production. Moreover, metals contained in products that reach their end of life can generally be recycled, even if this potential is still widely underexplored (see Chapter 3).

### 2AC – AT Environment – Air Pollution

#### Tech and status squo regulations also prevents air pollution’s largest impacts

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Sources of air pollution are concentrated in mine exploration and development, but also present further down the value chain during smelting, refining and distribution. The main sources of air pollution include (ELAW, 2010): • Particulate matter mobilised due to excavations, blasting, ore crushing, transport of materials and wind erosion. It is also present in fugitive dust from tailings facilities, stockpiles, waste dumps and haul roads – as well as in exhaust emissions from mobile sources (e.g. trucks). • Gaseous emissions from fuel combustion in stationary sources (e.g. drying and smelting operations) and mobile sources, explosions and mineral processing. Particle emissions contribute to the majority of air quality problems at mines, whereas gaseous emissions can affect a broader area and be more problematic in smelting and refining. Gaseous emissions include sulfur, nitrogen and carbon oxides; photochemical oxidants; volatile organic compounds and hydrocarbons. These pollutants have detrimental health effects and cause environmental impacts, such as those associated with acid rain. Of note, some pollutants present in mineral deposits are released into the air during mining activities, such as heavy metals and radioactive emissions in REE extraction, posing occupational hazards. Typically, each source of emissions requires a different control technology. Dust control can be addressed during mine planning with the aid of air dispersion modelling and the development of wind barriers. During operations, dust management may involve the use of containment measures, including soil stabilisation and vegetation growth, as well as moisture control (e.g. by spraying water onto stockpiles and roads). Stationary sources can reduce emissions by using filters, wet scrubbers, electrostatic precipitators and other treatment technologies. Meanwhile, mobile sources can benefit from increased electrification and the use of clean fuels (e.g. low-carbon hydrogen), which enable both lower gaseous emissions and a reduced overall carbon footprint. Air pollution can be tackled by many of the same policy instruments presented earlier in this section. For example, ESIAs and EMPs can affect project design and ensure the implementation of measures to control particulates and stationary sources. Additionally, jurisdictions often set requirements for pollutant emissions, define overall air quality standards and monitor pollution levels. In this context, the Initiative for Responsible Mining Assurance outlines requirements related to the management of air contaminants in its Standard for Responsible Mining and references the European Union’s Air Quality Standards.

### 2AC – AT Environment – Deep Sea Mining

#### Not feasible- won’t happen

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Deep-sea mining is the process of exploiting mineral resources from the area of the ocean below 200 metres. There are three main types of deposits: (i) cobalt-rich crust that contains manganese, iron, cobalt, copper, nickel and platinum; (ii) polymetallic nodules which are rich in manganese, nickel, copper, cobalt, molybdenum and REEs; and (iii) sea-floor massive sulphides which contain copper, gold, zinc, lead, barium and silver. In an area of 4.5 million square kilometres in the eastern Pacific Ocean, reserves of polymetallic nodules are estimated at 274 Mt for nickel and 44 Mt for cobalt, multiple times the global terrestrial reserves (Hefferman, 2019). However, there are economic, technical and environmental hurdles. The technologies required are different from onshore mining or deepwater oil and gas extraction. Cutting machines and collecting vehicles need to work remotely under high water pressure, and pumping a mixture of ore and slurry requires different skills from the extraction of oil and gas. While a pilot ore lifting for massive sulfide succeeded in Japan in 2017, further technology development is needed to make the process commercially viable (METI, 2017).

### 2AC – AT Environment – Sustainable

#### New Sustainable technologies exist to prevent pollution and destruction of the environment

Cho 2023 [Renee regular contributor to the Columbia Climate School. She has written over 200 articles for State of the Planet on a broad range of topics. She was previously published by www.insideclimatenews.com, and other environmental magazines. Renee was Communications Coordinator for Riverkeeper, the Hudson River environmental organization. She received the Executive Education Certificate in Conservation and Sustainability from the Earth Institute Center for Environmental Sustainability. The Energy Transition Will Need More Rare Earth Elements. Can We Secure Them Sustainably? <https://news.climate.columbia.edu/2023/04/05/the-energy-transition-will-need-more-rare-earth-elements-can-we-secure-them-sustainably/> Accessed 7/30/2024DMW]

Biomining A variety of labs around the world are looking at ways to put biology to use in mining. Cornell University scientists are developing “biomining,” programming microbes to produce organic acids that leach rare earth elements from ores or recycled e-waste. They are studying which genes are the best at bioleaching, then forcing mutations on those genes to make the microbes even more efficient. Researchers at Harvard are using bacteria from marine algae on a filter, then pouring a solution of several rare earth elements through it. The bacteria absorb all the elements. The filter is then washed with solutions of different pH balances, each of which enables different rare earth elements to detach. In Germany, researchers are using new species of cyanobacteria to absorb rare earth elements from mining wastewater or recycled e-waste. This method can be used even with low concentrations of rare earth elements. Electricity Chinese researchers are using electrical currents to free heavy rare earth elements — those with high atomic numbers like dysprosium and terbium — from ores. The new electrokinetic method creates an electric field above and below the soil, which improves the efficiency of the leaching so that lower amounts of chemicals are needed. The method extracts more rare earth elements than traditional mining and pollutes less. Agromining If soils are rich in nickel, chromium, and cobalt, and lack key nutrients, they may not be able to be used for food agriculture, but they can be mined. Agromining, or phytomining, cultivates “hyperaccumulative” plants that are able to absorb and store minerals and metals from the soil in their plant parts. grainy photo of small shrubs growing in an industrial area Some plants — like these poplar trees growing in an area contaminated by trichloroethene — can clean up contaminated soils. Photo: US DOE In France, scientists are cultivating hyperaccumulating plants to harvest nickel, a critical component of batteries and renewable energy technologies. After the plants are harvested, they are dried and burned. The resulting ash is richer in nickel than any ore. It is washed, then nickel is extracted by an acid at a high temperature; the solution is then filtered to remove the ash and recover the nickel. The overall process uses significantly less energy than traditional mining, and can also be used to decontaminate polluted soils, making them fertile enough to grow crops. Over the years, researchers have discovered about 700 such plants around the world, and more are being discovered and bred to improve their metal-absorbing capacities. Most accumulate nickel, but others have been found to absorb thallium, zinc, copper, cobalt, and manganese. “So far the technology has been available for small scale application,” said Toledano, adding that it’s a way for local communities to earn income and for artisanal miners to mine more sustainably. But some companies, like startup GenoMines, hope to scale up these methods.

#### Replacements for REM in various electrical needs exist now

Cho 2023 [Renee regular contributor to the Columbia Climate School. She has written over 200 articles for State of the Planet on a broad range of topics. She was previously published by www.insideclimatenews.com, and other environmental magazines. Renee was Communications Coordinator for Riverkeeper, the Hudson River environmental organization. She received the Executive Education Certificate in Conservation and Sustainability from the Earth Institute Center for Environmental Sustainability. The Energy Transition Will Need More Rare Earth Elements. Can We Secure Them Sustainably? <https://news.climate.columbia.edu/2023/04/05/the-energy-transition-will-need-more-rare-earth-elements-can-we-secure-them-sustainably/> Accessed 7/30/2024DMW]

Substituting materials One strategy to reduce the demand for rare earth elements is for manufacturers and product designers to engineer products that use less or no rare earth elements, or to replace rare earth elements with new or different materials. For example, BMW and Renault have made some of their EVs without rare earth elements. While this may make batteries less powerful, cars that are mainly driven in cities may not need as long a battery life. Recently Tesla announced that its next generation of electric motors would use no rare earth elements. Moreover, since 2017, the company has reduced its use of heavy rare earths in its Model 3s by 25 percent. Scientists at Northeastern University are developing a substitute material for rare earth magnets called tetrataenite. Tetrataenite is only found in meteorites, but researchers are trying to recreate a process that took nature millions of years by rearranging the atomic structure of the material’s nickel and iron components in the lab. The scientists have a $2.1 million grant from the Department of Energy to understand how magnetic materials made of “non-critical elements”are created in nature. Researchers at the Critical Materials Institute of Ames Laboratory are also studying magnet substitutes. They have developed ways of predicting which materials have the potential to be made into magnets. They identify those with some attraction to a magnetic field, then add alloys to turn the materials into permanent magnets. The scientists found that this process could make forms of cerium cobalt (cerium is an abundant rare earth element) capable of substituting for neodymium and dysprosium used in the strongest rare earth magnets.

### 2AC – AT Environment – Recycling

#### We can recycle parts to reduce mining

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What about recycling e-waste?

The UN Environment Programme estimated that over 53 million tons of e-waste were generated in 2019, including $57 billion worth of raw materials laced with rare earth elements and precious metals such as platinum, gold, and silver. Recycling these valuable elements and metals could reduce the amount of mining that will be needed. For example, according to the Union of Concerned Scientists, recycling could help meet about 30 percent of the future demand for neodymium, praseodymium, and dysprosium. However, a 2018 study found that only about one percent of rare earth elements are recycled from the products that incorporate them. Japan has been recycling its e-waste for rare materials since 2010. The U.S., second to China in producing e-waste, only recycled 15 percent of its e-waste in 2019; in contrast, Europe recycled 42.5 percent of its e-waste the same year. Recycling is done either through acid leaching to separate out rare earth element oxides and salts, heating and melting the metals, or using electricity to separate the materials — hence, recycling has its own environmental impacts. Researchers are exploring new methods such as ultrasonic leaching and bio leaching.

#### Recycling solves

IEA 2021 [NTERNATIONAL ENERGY AGENCY The IEA examines the full spectrum of energy issues including oil, gas and coal supply and demand, renewable energy technologies, electricity markets, energy efficiency, access to energy, demand side management and much more. Through its work, the IEA advocates policies that will enhance the reliability, affordability and sustainability of energy in its 30 member countries, 8 association countries and beyond.The Role of Critical Minerals in Clean Energy Transitions Executive summary <https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/executive-summary> Accessed 7/30/2024DMW]

Recycling relieves the pressure on primary supply. For bulk metals, recycling practices are well established, but this is not yet the case for many energy transition metals such as lithium and rare earth elements. Emerging waste streams from clean energy technologies (e.g. batteries, wind turbines) can change this picture. The amount of spent EV batteries reaching the end of their first life is expected to surge after 2030, at a moment of continued rapid growth in mineral demand. Recycling would not eliminate the need for continued investment in new supply to meet climate goals, but we estimate that, by 2040, recycled quantities of copper, lithium, nickel and cobalt from spent batteries could reduce combined primary supply requirements for these minerals by around 10%. The security benefits of recycling can be far greater for regions with wider deployment of clean energy technologies due to greater economies of scale.

### 2AC – AT Water Impact

#### Squo solves---global freshwater bioD conservation and restoration are happening now

David L. Strayer 10, Cary Institute of Ecosystem Studies; and David Dudgeon, Division of Ecology and Biodiversity, School of Biological Sciences, The University of Hong Kong, 2010, “Freshwater biodiversity conservation: recent progress and future challenges,” Journal of the North American Benthological Society, Vol. 29, No. 1, p. 344-358

Conservationists have spent much effort to identify geographic regions where species richness or endemism is high, and many such hotspots are now well known (Myers et al. 2000, Brooks et al. 2006). This information is used to prioritize areas for protection and as input to formal algorithms that develop optimal networks of protected areas that protect the most species using the least area (Sarkar et al. 2006). Freshwater conservation has lagged behind terrestrial conservation in these subjects, although a recent paper by Abell et al. (2008) describes an ongoing attempt to map global freshwater hotspots. Global biodiversity assessments frequently ignore freshwater species (e.g., Myers et al. 2000, Brooks et al. 2006, Kremen et al. 2008), despite the clear evidence that freshwater organisms are highly imperiled and that terrestrial hotspots do not always overlap with freshwater hotspots. Likewise, formal algorithms for designing optimal networks of protected sites rarely have been used for freshwater species (but see Linke et al. 2007, 2008).

Restoration ecology

The rising interest in protecting or managing natural ecosystems has been paralleled by a rapid rise in interest in using scientific knowledge to restore or rehabilitate damaged ecosystems, including the appearance of professional societies (Society for Ecological Restoration), journals (Restoration Ecology), and textbooks (Perrow and Davy 2002, Cooke et al. 2005, Falk et al. 2006). Interest in restoration or rehabilitation of freshwater ecosystems also has accelerated (e.g., Hart and Poff 2002 [Fig. 2], Buijse et al. 2005, National Research Council 2008). Restoration or rehabilitation of lakes rests on a firm scientific foundation (Cooke et al. 2005) and are routinely and successfully practiced. Scientific restoration and rehabilitation of running waters and wetlands is less well developed. Stream and wetland restoration are widely practiced, but many projects fail to achieve their objectives or are never adequately evaluated (Bernhardt et al. 2005 [Fig. 2], Palmer et al. 2007).

### 2AC – AT Environment Impact

#### Biodiversity loss won’t cause extinction

Peter Kareiva 18, Ph.D. in ecology and applied mathematics from Cornell University, director of the Institute of the Environment and Sustainability at UCLA, Pritzker Distinguished Professor in Environment & Sustainability at UCLA, et al., September 2018, “Existential risk due to ecosystem collapse: Nature strikes back,” Futures, Vol. 102, p. 39-50

The interesting question is whether any of the planetary thresholds other than CO2 could also portend existential risks. Here the answer is not clear. One boundary often mentioned as a concern for the fate of global civilization is biodiversity (Ehrlich & Ehrlich, 2012), with the proposed safety threshold being a loss of greater than 0.001% per year (Rockström et al., 2009). There is little evidence that this particular 0.001% annual loss is a threshold—and it is hard to imagine any data that would allow one to identify where the threshold was (Brook, Ellis, Perring, Mackay, & Blomqvist, 2013; Lenton & Williams, 2013). A better question is whether one can imagine any scenario by which the loss of too many species leads to the collapse of societies and environmental disasters, even though one cannot know the absolute number of extinctions that would be required to create this dystopia.

 While there are data that relate local reductions in species richness to altered ecosystem function, these results do not point to substantial existential risks. The data are small-scale experiments in which plant productivity, or nutrient retention is reduced as species numbers decline locally (Vellend, 2017), or are local observations of increased variability in fisheries yield when stock diversity is lost (Schindler et al., 2010). Those are not existential risks. To make the link even more tenuous, there is little evidence that biodiversity is even declining at local scales (Vellend et al., 2013, Vellend et al., 2017). Total planetary biodiversity may be in decline, but local and regional biodiversity is often staying the same because species from elsewhere replace local losses, albeit homogenizing the world in the process. Although the majority of conservation scientists are likely to flinch at this conclusion, there is growing skepticism regarding the strength of evidence linking trends in biodiversity loss to an existential risk for humans (Maier, 2012; Vellend, 2014). Obviously if all biodiversity disappeared civilization would end—but no one is forecasting the loss of all species. It seems plausible that the loss of 90% of the world’s species could also be apocalyptic, but not one is predicting that degree of biodiversity loss either. Tragic, but plausible is the possibility of our planet suffering a loss of as many as half of its species. If global biodiversity were halved, but at the same time locally the number of species stayed relatively stable, what would be the mechanism for an end-of-civilization or even end of human prosperity scenario? Extinctions and biodiversity loss are ethical and spiritual losses, but perhaps not an existential risk.

#### Marine ecosystems are resilient

Kennedy, 2002 (Victor Kennedy, PhD Environmental Science and Dir. Cooperative Oxford Lab., 2002, “Coastal and Marine Ecosystems and Global Climate Change,” Pew, http://www.pewclimate.org/projects/marine.cfm)

There is evidence that marine organisms and ecosystems are resilient to environmental change. Steele (1991) hypothesized that the biological components of marine systems are tightly coupled to physical factors, allowing them to respond quickly to rapid environmental change and thus rendering them ecologically adaptable. Some species also have wide genetic variability throughout their range, which may allow for adaptation to climate change.