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Introduction

In the pursuit of a cleaner and more sustainable energy landscape, lithium-ion batteries have emerged as pivotal players, powering electric vehicles, energy storage systems, and a host of eco-friendly innovations. However, the extraction of lithium and cobalt, the key components of these batteries, has been shrouded in concerns about environmental deprivation, human rights violations, and unsustainable practices. Furthermore, most of the current manufacturing of lithium-ion batteries is concentrated in China, South Korea, and Japan, where electricity generation remains dependent on coal and other polluting sources of power. The rapid expansion of the lithium-ion battery market has placed immense pressure on the supply of lithium and cobalt, driving up demand and putting strain on existing extraction practices. This demand surge has led to increased mining activity in often remote and ecologically sensitive regions, raising concerns about the potential environmental degradation caused by mining operations.

The environmental impacts associated with lithium and cobalt extraction include water pollution from acid mine drainage and saline waste disposal, soil contamination from heavy metals, and air emissions of harmful pollutants. These consequences can have detrimental effects on ecosystems, human health, and local livelihoods. Beyond environmental concerns, the extraction of lithium and cobalt has been linked to human rights abuses and labor exploitation.

Definition of Key Terms

Critical minerals - Minerals that are essential to produce high-technology products and are in high demand but have limited supply. Lithium and cobalt are two examples of critical minerals.

Saline waste disposal - The disposal of salty wastewater from mining operations. This can contaminate soil and groundwater.

Circular Economy Principles - A set of principles that aim to minimize waste, optimize resource use, and foster sustainable production and consumption patterns.

Artisanal Mining - Artisanal and Small-scale mining (ASM) refers to informal mining activities conducted using low technology or with minimal machinery. It is estimated that more than one hundred million people rely on this sector for income, in developing nations.

General Overview

The history of lithium and cobalt mining is deeply intertwined with the evolution of technology and the global economy. Lithium mining dates back to the early 19th century, but it wasn't until the latter half of the 20th century that demand for lithium increased significantly, primarily due to its use in rechargeable batteries for portable electronic devices, electric vehicles (EVs), and energy storage solutions. The largest reserves of lithium are found in South America's "Lithium Triangle," which includes parts of Argentina, Bolivia, and Chile, as well as in Australia and China. Cobalt mining, on the other hand, has a longer history, with its use dating back to ancient civilizations for coloring glass and ceramics. The modern demand for cobalt surged with the development of the aerospace industry and the advent of lithium-ion batteries, where it is used as a key component to improve energy density and battery life. The Democratic Republic of the Congo (DRC) is the largest producer of cobalt, accounting for more than half of the global supply. Both lithium and cobalt mining have raised environmental and ethical concerns, including water usage, habitat destruction, and human rights issues, leading to increased interest in recycling and finding alternative materials for battery production.

The environmental fallout from lithium mining is clear and far-reaching. Massive quantities of fresh water, classified as a precious resource in these arid regions, are diverted for lithium mining operations, fueling the salt flats brine. This leaves local communities and wildlife parched. Sulfuric acid and sodium hydroxide used in lithium extraction penetrate the soil and water, poisoning ecosystems, and endangering species. Research from the journal Proceedings of the Royal Society shows that two flamingo species in Chile are threatened because of lithium mining.

Deforestation, habitat destruction, and water pollution further exacerbate the ecological toll. The delicate balance of nature is disrupted, which leaves long-lasting damage that takes generations to heal. The carbon dioxide and other greenhouse emissions that come with the process of lithium mining, extraction, and overall production are worse for the climate than the production of fossil fuel-powered vehicles. A study from The Wall Street Journal in 2019 revealed that 40% of the total climate impact caused by the production of lithium-ion batteries

comes from the mining process itself. Furthermore, lithium mining requires a lot of water. Extracting one ton of lithium requires about 500,000 liters of water and can result in the poisoning of reservoirs and related health problems.

On the other hand, cobalt is quickly becoming the defining example of the mineral conundrum at the heart of the renewable energy transition. As a key component of battery materials that power electric vehicles (EVs), cobalt is facing a sustained surge in demand as decarbonization efforts progress. The world's largest cobalt supplier is the Democratic Republic of Congo (DRC), where it is estimated that up to a fifth of the production is produced through artisanal miners.

The International Energy Agency's (IEA) "Net Zero by 2050" report notes that roughly 75% of current greenhouse gas emissions are produced by the energy sector. As such, decarbonizing the energy sector has dominated both technological and social innovation efforts, with electric vehicles being just one example.

Major Parties Involved

Australia: Australia is the world's leading producer of lithium, with an estimated output of 61,000 metric tons in 2022. The country's lithium extraction is primarily focused on hard rock mines, which extract lithium from spodumene, a lithium-bearing mineral. While Australia has made efforts to regulate lithium mining and promote sustainable practices, environmental concerns persist, including water pollution from acid mine drainage, soil contamination from heavy metals, and air emissions of harmful pollutants. In 2017, the Australian government launched the Murray-Darling Basin Plan, which aims to protect the Murray-Darling Basin, a major source of water for both mining and agriculture. The plan includes measures to reduce water pollution from mining operations.

China: China is the world's largest consumer of lithium, accounting for over 50% of global demand. While China does not produce significant amounts of lithium itself, it is a major player in the lithium-ion battery market, both as a manufacturer and a consumer. China has been criticized for its lack of transparency and regulation of lithium mining operations, particularly in regions where environmental standards are less stringent. In the past two years, Chinese companies have spent $4.5 billion acquiring stakes in twenty lithium mines, most of them in Latin America and Africa.

Democratic Republic of the Congo (DRC): The Democratic Republic of the Congo (DRC) holds a pivotal position in global cobalt mining, contributing over half of the world's cobalt production, a critical component in lithium-ion batteries. The Katanga Copperbelt region in the DRC is especially significant, with more than 50% of global cobalt mine production

originating from this area. This dominance is further emphasized by the fact that 15-20% of cobalt in the DRC is extracted through artisanal mining, which has raised concerns about sustainable and ethical extraction practices. However, the DRC's role in lithium mining is not as prominent as its cobalt production. The DRC's centrality in the cobalt market underscores its strategic importance in the global supply chain for battery production and renewable energy technologies.

Chile: Chile is a leading player in the global lithium market, significantly contributing to the world's lithium production. With approximately nine million tons of lithium deposits, Chile is one of the top lithium-producing countries. Its lithium reserves are concentrated in the Atacama Desert, which is known for having some of the highest quality and concentration of lithium brine deposits globally. This makes Chile a key supplier for the booming lithium-ion battery market, vital for electric vehicles and renewable energy storage systems. However, Chile's role in cobalt mining is not as prominent. Unlike its major position in lithium, Chile does not rank among the top producers of cobalt, which is mined in the Democratic Republic of the Congo, Australia, and other countries.

Argentina: Argentina is a significant player in global lithium production, holding approximately seventeen million tons of lithium reserves. It forms part of the "Lithium Triangle," a region including neighboring Chile and Bolivia, which collectively hold a large portion of the world's lithium resources. Argentina's lithium deposits are primarily found in salt flats, known as salars, in the northwest regions of the country. These salars are renowned for their high-quality lithium brine deposits, essential for lithium-ion battery manufacturing, crucial in electric vehicles and renewable energy storage. Despite this prominence in lithium, Argentina's presence in cobalt mining is minimal.

Bolivia: Bolivia holds a critical position in global lithium mining, particularly as part of the "Lithium Triangle" along with Argentina and Chile. This region is home to some of the world's most substantial lithium reserves. Bolivia's lithium reserves are estimated at around twenty-one million tons, located in the Salar de Uyuni, the world's largest salt flat. This makes Bolivia one of the top countries in terms of lithium reserve size, crucial to producing lithium-ion batteries, which are essential in electric vehicles and renewable energy storage systems. However, Bolivia's actual lithium production is currently limited compared to its vast potential, partly due to infrastructural and technological challenges. In terms of cobalt mining, Bolivia does not have a significant presence. Bolivia's primary role in the global mining sector is as a major holder of lithium reserves, with significant potential for future development in lithium extraction.

United States of America (USA): The United States holds a strategic yet developing position in both lithium and cobalt mining, crucial for lithium-ion battery production. While not among the largest producers, the USA is actively working to strengthen its role in these critical mineral markets. For lithium, the U.S. has notable reserves, particularly in Nevada's Clayton Valley, home to the only operating lithium mine in the country. This positions the U.S. as a growing player in the global lithium supply chain, aiming to reduce reliance on imports and support its burgeoning electric vehicle (EV) and renewable energy sectors. There are initiatives and exploration projects underway to increase domestic cobalt production, particularly in states like Idaho, to secure supply chains for battery manufacturing and other technological applications. The U.S. government has also classified both lithium and cobalt as critical minerals, underscoring their importance to national security and economic prosperity, and is investing in research and development to enhance recovery and recycling processes for these metals.

Timeline of Events

1912 - American chemist Gilbert N. Lewis begins exploring the possibility of lithium batteries.

1923 - German industrial conglomerate Metallgesellschaft produces the first commercial quantities of lithium metal.

2016 - The Washington Post reports that electric cars typically contain "20 to 30 pounds" worth of cobalt in them.

2021 - Researchers at Saudi Arabia's King Abdullah University of Science and Technology experimentally validate a device that can cheaply extract lithium from seawater, while desalinating it and producing more than enough hydrogen and chlorine gases to pay its power bills.

Previous Attempts to Solve the Issue

U.S. MINING LAW REFORM

The U.S. Department of the Interior's Mining Law Reform initiative represents a forward-thinking approach to modernizing mining laws, incorporating sustainability standards for the extraction of essential minerals, including lithium and cobalt. By recommending these reforms,

the department aims to ensure that mining practices not only contribute to economic prosperity but also adhere to environmental sustainability and social responsibility. This initiative underscores the government's commitment to balancing the nation's mineral resource development with the imperative of preserving ecological integrity and promoting a sustainable future. Through such measures, the U.S. seeks to set a benchmark in responsible mineral sourcing critical for the green economy and technological advancement.

COP28

The article from UNECE discusses the urgent need for coordinated action to manage the soaring demand for Critical Raw Materials (CRMs) like lithium, nickel, cobalt, copper, manganese, graphite, and rare earth elements, which are essential for renewable energy technologies and battery production. This demand is driving the global shift towards electrification but comes with significant environmental and social impacts due to geopolitical uncertainties affecting supply and the extraction and use of these materials. At COP28, all five United Nations Regional Commissions and international experts emphasized the importance of international coordination and urgent action to ensure that the massive expansion of CRM does not undermine sustainable development.

Possible Solutions and Approaches

SUSTAINABLE ARTISANAL MINING (SAM)

Sustainable Artisanal Mining (SAM) aims to make small-scale mining operations environmentally friendly, socially responsible, and economically viable. It particularly addresses the challenges in regions like the Democratic Republic of Congo (DRC), a major source of cobalt, where mining is often performed by local, independent miners under hazardous conditions. SAM focuses on reducing environmental degradation and improving the health and safety conditions of the miners. The key aspect of SAM is the implementation of safer, more efficient mining techniques that minimize environmental harm. This includes reducing toxic emissions and waste, managing water use effectively, and rehabilitating mined areas. SAM also promotes the use of equipment and technologies that are both affordable and appropriate for small-scale miners.

COBALT-LOW AND COBALT-FREE ALTERNATIVES

Cobalt-low and cobalt-free alternatives represent a shift in battery technology, aiming to reduce or eliminate the use of cobalt in lithium-ion batteries. Cobalt, primarily sourced from the

Democratic Republic of Congo, is associated with ethical and environmental concerns, including child labor and significant ecological impact. By reducing or removing cobalt from battery cathodes, these alternatives seek to address these issues and improve the sustainability of battery production. Cobalt-free alternatives often involve using other metals like nickel, manganese, or aluminum in cathode materials. For instance, Lithium Iron Phosphate (LFP) batteries completely omit cobalt, offering a more ethical and environmentally friendly option. Although these alternatives might have trade-offs in terms of energy density or lifespan compared to traditional cobalt-containing batteries, ongoing research is focused on enhancing their performance to meet or surpass current standards.

Another approach is to develop cathode materials with significantly reduced cobalt content. These cobalt-low batteries use innovative chemical compositions that maintain performance while minimizing cobalt use. This not only mitigates the ethical and environmental issues but also reduces dependence on cobalt, which is a rare and expensive material.

Bibliography:

https://www.amnesty.org/en/latest/press-release/2019/03/amnesty-challenges-industry-leaders-to-clean-up-their-batteries/

https://earth.org/lithium-and-cobalt-mining/

https://ijemr.vandanapublications.com/index.php/ijemr/article/view/149/149

https://www.nature.com/articles/s41893-018-0139-4

https://onlinelibrary.wiley.com/doi/10.1002/aenm.202102028

https://earth.org/cobalt-mining/

https://earth.org/cobalt-mining-in-congo

https://dialogochino.net/en/climate-energy/55816-chile-green-state-new-ecological-constitution/

https://www.linkedin.com/pulse/hidden-environmental-cost-battery-production-examination-ch-ong/

https://unece.org/climate-change/press/cop28-un-urges-coordinated-action-align-soaring-critical-raw-materials

https://www.doi.gov/ocl/mining-law-reform