Ethically Sourcing Raw Materials for Technological Trends

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

The world is advancing very quickly and the rate that it will continue to advance is also going to increase. This is because as more technology becomes available, the same amount of people can accomplish the same amount of work that they did a year ago but in much less time. This applies to everything from STEM related topics to the rate of art being produced using generative AI. The problem with everything moving so fast is that progress is what gets optimized while some social problems will get covered up. Batteries have gotten significantly better in terms of capacity, stronger electromagnetic potential, safety, and rate of production. The volition in every consumer for a rechargeable device is the driving force behind all of this quick advancement. Sometimes, entities such as corporations use the fancy new battery tech to sell products that are supposedly better than their competitors, and then within a year the tech will be outdated. When people ask where the materials for batteries come from, a marketing manager will say something about ethical mining practices and environmentally friendly initiatives. A lot of these are just concrete lies.

There are more sustainable and ethical ways to utilize batteries whether it is related to recycling them or just changing how the raw material is collected. Batteries are staples of the future and they will continue to advance rapidly. By looking at them from different lenses, they can advance and benefit the generally underrepresented classes of the population rather than hurt them like they do currently. This is not negotiable as so many countries are investing in electrical technology as the next step over harnessing power from traditional fuel. One big reason is power efficiency. Big power factories can squeeze out more energy from a specific unit volume of fuel. In contrast, combustion engines in automobiles only capture around 65% of the energy from gasoline. For this reason, it would make a lot of sense to centralize power production at a large plant with high efficiency, and then distribute the power by putting it into a battery to use. This would lead to less energy waste to heat and friction. The only limiting factor

is the batteries themselves, they would need to be able to hold a comparable amount of power to a traditional automobile to be effective enough to fully implement

Battery History

Up till now, any battery that is rechargeable likely uses Lithium Ion cells. In order to make the same size battery hold more power, Cobalt is introduced to increase capacity. However, cobalt is considered a rare Earth metal and it is not widely available. The recent sudden increase in battery demand can be drawn parallel to the first automotive revolution that started in the rust belt of the United States. At that time, the resource in demand was rubber needed for tires. The resource was outsourced to Africa as well where most of the country was still under colonial control and a similar situation happened where African people were forced to work for nonexistent pay to feed the resource demand. A very similar thing is happening now with cobalt instead of rubber.

Battery advancements come at an environmental and ethical cost. High GDP countries prioritize energy generation, but only batteries provide effective storage to transport that energy where it needs to go. China leads in electric vehicles (EVs), disrupting the conventional car market. India follows suit. The rush for batteries relies on cheap, problematic raw materials, particularly from Africa, where cobalt extraction harms the environment and uses slave labor. Spreading awareness may encourage ethical sourcing and reduce the impact on the planet.

India and China, two heavily populated nations, are shifting toward embracing electric and battery technology as part of broader sustainability efforts (IEA, 2019). Their motivation stems from the urgent need to combat air pollution and address climate change. Fossil fuels' adverse impact on their environment drives their commitment to reducing carbon emissions (Li Q, 2022). Electric power and advanced batteries are key solutions. Rapid urbanization has raised energy demand, making battery technology vital for efficient electricity storage, particularly in urban areas (IEA, 2019). Economic

incentives drive the transition, with both countries aiming to lead the global clean energy market by investing in battery manufacturing, creating jobs, and reducing reliance on costly energy imports. Government policies, EV incentives, and international collaborations accelerate battery technology development in India and China.

China at one point owned seven out of eight cobalt mines. The eighth cobalt mine in question was American owned, but it is being phased out because they cannot keep up with the Chinese mines in terms of rate of output and profit. China's involvement in African cobalt mining has raised concerns over labor practices, environmental impacts, and the ethical sourcing of minerals. Reports have alleged that Chinese companies operating in African countries may not always adhere to the highest labor standards (Kara, S. 2023). This has raised concerns about the use of forced or coerced labor. Cobalt is a crucial component in the production of lithium-ion batteries, which power many electronic devices and electric vehicles. China, as a major player in the battery and electric vehicle industries, has a vested interest in securing a stable cobalt supply (Li, Q. 2022). To meet this demand, Chinese companies have invested in cobalt mining operations in African nations with substantial cobalt reserves, such as the Democratic Republic of Congo. Cobalt mining in the DRC has been associated with child labor and unsafe working conditions, leading to widespread concerns about unethical mining practices. Initiatives like the Responsible Cobalt Initiative are aimed at promoting ethical cobalt sourcing practices and improving working conditions in the industry (Kara, S. 2023). It is essential to keep in mind that addressing these complex issues requires collaboration between governments, corporations, and the people. This is about finding a balance which will not happen overnight.

Growing battery demand, particularly in electric vehicles and renewable energy storage, emphasizes the importance of proper disposal and reducing environmental impact (Zhao, G 2022). Battery recycling is on the rise due to valuable materials like lithium, cobalt, and nickel (Harper, G. 2019). Recycling conserves resources, lessens the need for environmentally harmful mining, and reduces the environmental footprint. It also mitigates hazardous waste and contamination risks. Investments in recycling infrastructure, driven by EV and renewable tech growth, are exploding in popularity in China

and India (Singh, Y. 2022). Numerous regions promote recycling through policies, and companies work on extending battery life. Battery recycling is integral to clean energy and environmental sustainability.

The three previously mentioned paragraphs provide great examples of how society and technology mutually shape each other. Sometimes, technology influences the society, and other times the effect is reversed. For example, the destruction of farmland for mines is only really because more raw materials were needed. Then, it switched so that the low cost of labor practices encouraged political bodies to increase the rate at which they produce and use batteries. There is no sense in playing the blame game and deciding which came first. A better idea would be to change every party involved in the mutual shaping to encourage more ethical, fair, and sustainable outcomes for any network.

I believe looking at the problem through these lenses would highlight why unethical practices exist. The Chinese government wants the material for technological advancements, at the same time, they are very cutthroat with the methods to acquire that material. The consumers aren't strictly Chinese people. Most of them live in first world countries. So the actions that the consumers take will affect the supply chain that is mainly controlled by China. At the same time, in the DRC, the artisanal miners are technically the backbone of this supply chain, theoretically, if at one point in time, they all revolted, this entire supply chain would be disrupted. I don't think that is a good idea because those kind of revolts get very violent, but it highlights the fact that the miners are critical to the operation. And then lastly the environment. When cobalt mines are built, they terraform the land which includes filling lakes, cutting down trees, or digging through fertile fields. When they do this, the ecosystem there is destroyed. Once a lake gets filled with toxic metals, the fishing that was previously done to acquire food will not come back. And so the mines are coming as a direct result of the environment. There is only so much abuse the environment can take before the ground gets too loose, or it starts getting too expensive to feed the workers.

Case Study

As the world moves into a new age of electricity, the technological demands will start to increase. As it stands, the current technological demands are being met with less than sustainable fuel sources. One of the main fuel sources here is the artisanal labor used to acquire battery materials. Some of the largest deposits sit in Africa and many Chinese mining companies are trying to extract them (Swanson, 2022). The labor laws are considered unethical and the effect of the mining on the surrounding environment and ecosystem is also very destructive. Although it is China who is in the field setting up the mines, this does not mean that other first world countries are completely innocent. If you follow the supply chain up to the consumers of any device with rechargeable batteries, it will be apparent that most of the corporations that buy these rare earth metals for their products actually market to most of the world's affluent populations. Companies in the United States, India, China, South Korea, and Japan, all use this unethically sourced material for their own benefit. To go even further, these companies are only generating revenue because consumers are actually buying them. This does not have to be the case if there is some sort of consensus. Every link of the supply chain is being greedy and if consumers would stop buying unnecessary new tech every year, and if corporations stopped chasing profits so hard, then perhaps the world governments could start working together to try and focus on R & D without needing the large economic incentive that leaves destruction in its wake.

China's dominance in the rare earth metal market is a pivotal aspect of the global supply chain, significantly influencing technological innovation, energy transition, and national security strategies worldwide. Rare earth elements (REEs) are a group of 17 metals critical for manufacturing a wide array of high-tech devices, including smartphones, electric vehicles (EVs), wind turbines, and advanced defense systems (IEA, 201). With its strategic foresight, China has established a commanding presence in the REE sector, controlling about 70% of the world's rare earth production and an even larger share of the processing capacity. This hegemony didn't occur overnight; it was the result of decades of calculated

investments, environmental regulatory tolerance, and the development of specialized technology and expertise that other countries have found challenging to replicate at competitive scales. This is because of aggressive strategies and cutthroat methods employed by China to secure its dominant position. These methods range from lax environmental regulations, which allow for cheaper and faster extraction processes at the expense of ecological degradation, to strategic pricing practices that undercut competitors, making it economically impossible for other nations to sustain their own mining operations. China's approach to consolidating control over rare earth supplies also involves significant investments in acquiring mining rights and processing facilities worldwide, further extending its influence over the supply chain.

The way companies get the materials for products like smartphones and electric cars can be pretty hidden and complicated. This makes it hard to know if these materials are coming from places that treat workers fairly and take care of the environment. Even though people are starting to care more about buying products that are made in a good way, a lot of companies still focus on making things cheaper and faster (Harper, G. 2019). This means they sometimes ignore where and how materials are sourced. The worst is when they know and they still lie as a marketing lure to make customers feel better about purchasing their products.

When mines are created, they can destroy large areas of land, making it unusable for anything else. This means animals lose their homes and local plants can be wiped out, which messes up the balance of the environment. One of the biggest problems with mining is pollution. Mines can release harmful chemicals into the air and water. These chemicals can make it dangerous to breathe the air or drink the water for people living close to the mine. For children, this is especially bad because their bodies are still growing, and exposure to these toxic substances can lead to serious health problems. For example, some of the chemicals can make it harder for kids to learn or cause diseases that might affect them for their whole lives.

The supply chain that brings us everything from our smartphones to our electric cars is like a big network, with workers, companies, governments, and consumers all playing different roles. Imagine it as

a chain where each link depends on the one before it. Workers mine the materials, companies design and make the products, governments set the rules, and consumers decide what to buy. Right now, this process can be pretty rough, with a lot of pressure to keep costs low and profits high, which can lead to not-so-great working conditions or harm to the environment.But it doesn't have to be this way. If every part of the chain decides to make some changes, things can get better. Workers could get fair pay and safer conditions. Companies might make less profit by choosing ethical sources for materials and making products that are easier to recycle. Governments could create stricter rules to protect people and the planet. And we, as consumers, can help by choosing products that are made in a good way, even if they cost a bit more or we have to wait longer to get them.

Results and Analysis

At this current moment, it is not feasible to just stop the whole operation and address the issues head on. The casual parties involved can be reduced to State Governments, Technology Companies, Consumers, and Supply Chain workers. The environment does play a big role but it is not really possible to alter where the big material deposits just happen to lie. While the focus of the bottom of the supply chain was the artisanal miners, the research was limited due to the size of the paper but the supply chain does not stop at the raw materials. The raw materials still have to go through multiple refinement stages as well as transportation stages. If the first step of the supply chain is so corrupt and broken, it is unlikely that the rest of the supply will be much different. Once again, the reason for this is profit for the tech companies that buy the materials, and the State Governments that turn a blind eye to sell the materials. China was mentioned as a big player because they purchased the land from African Governments. They developed the land to gather resources to benefit their own country but Japan, South Korea, and the United States also buy these unethically sourced materials. Additionally, while the mines are owned by Chinese companies, the enforcement of labor and regulation of rules is often tied to a specific politician.

The local politicians get a lot of money in bribes to keep the operation running quietly and under wraps so the enforcers at these mines are usually local armed militia who also happen to just work for a politician. Then, the materials will be bought by very big tech companies like Samsung, Apple, Google, or Tesla to make a consumer product, that a consumer will then pay for. Oftentimes, these goods are just commodities, not necessities. Examples include buying new flagship phones every year which use the DRC sourced Cobalt in the batteries. But from the consumer's side, a phone and laptop is about as necessary as wearing clothes to even function in a modern workplace or school. Additionally, a country like South Korea might just not have Cobalt deposits within country borders. Or a company like Tesla will compete with global electric vehicle manufacturers which would not be possible without an abundance of material for Research & Development as well as the quantity needed for mass production. All of these points are just a handful of arguments behind the actions of parties involved and it is difficult to navigate through all of the issues without being monumentally unfair.

One point that could be interesting to consider again is the analogy to rubber during the automotive revolution. Some of the leading factors that stopped the atrocities then were the development of synthetic rubber compounds, recycling of old tires, and ethics initiatives. In time, it is very possible to figure out how to get high capacity batteries without using strictly Cobalt. One such example can be found in Tesla's research of using Iron Phosphate instead of Cobalt. As batteries start to become more commonplace, it will be easier to find small stockpiles of old batteries that can be recycled to harvest some of the desired materials. While both options are great, the ethics initiatives would be the most direct option. As of now the supply chain party that is most in the dark is the consumers. It is evident that companies will proliferate this unethical supply chain as well as state governments, so the ethics initiatives will fall onto the consumers. The first step to solving a problem is to identify the problem. Spreading awareness about the issue is a good first step just so everybody knows where their batteries are really coming from. Child labor in particular seems to strike a chord as many first world countries do not allow that labor practice. Additionally, the concept of sustainability should be presented. This mining is bad for the environment but it is also just a finite resource. If the Congo runs out of the material, it can be

expected that mines will just be set up somewhere else. In the long run, this will use up the fixed amount of land on this planet and leave a destructive trail everywhere it goes. Not just to the environment, but the heavy metals will literally leach into the ecosystem and people through the natural water tables that all life lives off of.

Conclusion

The future of energy will probably be electricity. Even if it is not, too many countries have already invested so much in that direction that this trend will influence every that is adjacent to a battery such as automobiles, phones, and power grids. In order for this to be a benefit to everybody, there cannot be a dichotomy between the exploiters and the exploited. The amount of people who make decisions inside the supply chain pales in comparison to everything else. That is the consumers and workers. By spreading awareness about the ailments, a tighter cohesion of understanding about the process will form. This is the problem exactly as many of the big companies and countries that benefit take heavy measures to keep details secret. Once consumers all get on the same page, choices can be made through the choice of purchases as well as legislation to help those that are being exploited. It is important to stress that this is not just blanket virtue signaling, this would be a benefit to everybody, especially if electricity is the future as the current approach is very short sighted. The current system is not renewable at all and thus cant be sustained over a long period of time. If we want the health of the planet as well as the inhabitants to to thrive, everybody needs to start casting votes, not necessarily through a ballot, but with the decisions they make on who to support, what they spend their time and money on, and making an effort to question how artifacts in their life affect not only them, but others around them.

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