The Decarbonization Divide:

Problems and How To Move Forward

A Thesis Prospectus

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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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The Decarbonization Divide: Problems and How to Move Forward

E-waste is the fastest growing waste sector and is of increasing concern as it has become a global issue directly responsible for hazardous environmental pollution, human health concerns, labor exploitation, and unsustainable industry practices. The world produced 53.6 metric tons of e-waste in 2019 (excluding photovoltaic panels), and that is only expected to increase by 2.5 million metric tons each year (Forti et al., 2020). Solar PV waste could potentially be more than 10% of global e-waste streams by 2050 after our transition (Sovacool et al., 2020). This is an *astronomical* amount of resources due to the decarbonization processes that are projected to be undertaken by countries over the next few decades. This decarbonization however, has ethical considerations that have been severely overlooked. This is in reference to the phenomenon of the "decarbonization divide" which is the occurrence of how the global south is essentially paying for the global north's sustainable transition through the extraction of precious metals and resources as well as the allowance of toxic waste from discarded wind turbines, electric vehicle batteries, solar panels, heat pumps, and e-waste being dumped and informally recycled in the global south. This is because, as it stands, cobalt mining and e-waste processing is crucial to low-carbon energy transitions but this will ultimately lead to the degradation of local environmental health, disempowerment of women and increased gender discrimination, the exploitation of children, and the worsening of ethnic discrimination in the localities that must bear the brunt of the decarbonization divide.

Research Question

What are the current recommended solutions available to the Global North and Global South to close the gap between them through e-waste management policies?

Technical Project Description

I plan on interviewing UVA Facilties Management and the Environmental Institute on what UVA currently does to minimize its e-waste impact, as well as APEX Clean Energy and other local solar panel businesses to discuss what they do with their current end-of-life solar panels once they are decommissioned, and how they go about making decarbonization itself – sustainable. I also plan on deep diving into the current solar panel recycling industry, how it plans to be profitable, and their current projections and advocacy for solar panel recycling globally as of right now the projections are bleak as it is not mandatory for solar panel designs to be easily recycled.

Methods

The methods used for this prospectus were a systematic review, concept mapping, and the application of Actor Network Theory. Concept mapping was done to show how the various relationships between the Global North and Global South due to the decarbonization divide and how different policies within the Right to Repair movement and minimum universalized electronic standards could induce change and decrease generation of e-waste. A systematic review was done in order to compare and contrast current e-waste, formalization processes for current informal recycling sectors within the global south, what critiques have been made, and what consensus seems to be about how to carry out formalization processes in the future.

Preliminary Literature Review

Biophysical Relationships

The astronomical amount of E-waste generated per year is an issue of environmental and human health. Within the developing countries that undertake the process of recycling this waste through unorganized sectors (such as e-waste collection from consumer’s houses and manual dismantling of it at unauthorized/backyard workshops), there is pervasive usage of improper

recycling methods which lead to many environmental and human health concerns. This is due to manual handling of the waste, crude recycling methods, open burning of the material, open disposal of the waste, and acid leaching after the use of acid baths (Awasthi et al., 2018).

During the dismantling of e-waste, toxic pollutants are usually released into the air from open burning and can be inhaled, causing reproductive and developmental problems, immune system damage, damage to central and peripheral nervous systems, kidney damage, lung cancer, chronic damage to the brain, etc. (Annamalai, 2015; Kumar & Singh, 2019). After dismantling, the leftovers are usually disposed of in open land and residual toxins can leach into the ground causing soil pollution as well as contaminated waterways. These metals may also be taken up through plants or vegetables and may then be transferred to the human body and other living organisms' bodies through food consumption. PBDEs are one of the most concerning pollutants, as they have endocrine disrupting properties and can also bioaccumulate through organisms which will result in biomagnification through food chains (Zeng et al., 2017; Kumar & Singh, 2019).

The long lasting health effects of these sites is going to impact generations down the line, as e-waste possesses high environmental persistence capabilities because its pollutants have longer half-lives (Awasthi et al., 2018; Perkins et al., 2014). Kumar and Singh cited that even attempting to clean the large contaminated sites of e-waste is "unfeasible" and that the most negative effects can be reduced using standard remediation technologies. This means that remediation, or what to do after we try to fix the e-waste problem and stop dumping openly, has not even been looked into yet and won't be for a long time. These sites may be unrecoverable and unlivable in the future (2019).

This means that despite informal sectors being in developing countries, e-waste poses an international health risk. This is because food grown in contaminated soil may be shipped anywhere, along with fish and shellfish contaminated miles away downstream. It's been found that lead from e-waste has already been found in Chinese manufactured jewelry exported to the United States and could be available for human absorption - the same is true for children's toys which contained elevated levels of lead and brominated flame retardants (Kumar & Singh, 2019).

In addition to that, it's been found that many informal sector recycling workers are on a spectrum of knowing the risks of e-waste recycling, with some having a vague idea while the other end of the spectrum is in complete ignorance. Almost 50% of e-waste workers in Agbogbloshie (in Accra, Ghana which is one of the most polluted areas in the world) didn't believe that they could prevent e-waste related hazards, and about half were concerned with immediate injuries they could suffer (burns, job injuries, cuts, etc.) rather than long term health effects like respiratory problems or cancer (Daum et al., 2017). Perkins et al. summarize the problem by saying "Individuals, families, and communities that dismantle e-waste often have made the choice of poison over poverty" (Perkins et al., 2014).

Economic Relationships

The issue directly affects the consumers of technology in that it would expand a consumer's ability to repair or reuse their "old" technology. It would also help the workers across the world who have to deal with the aftermath through increased labor protections and regulations on the informal sector, or potentially harm them from decreased amounts of e-waste if job programs or job displacement programs are not put into place.

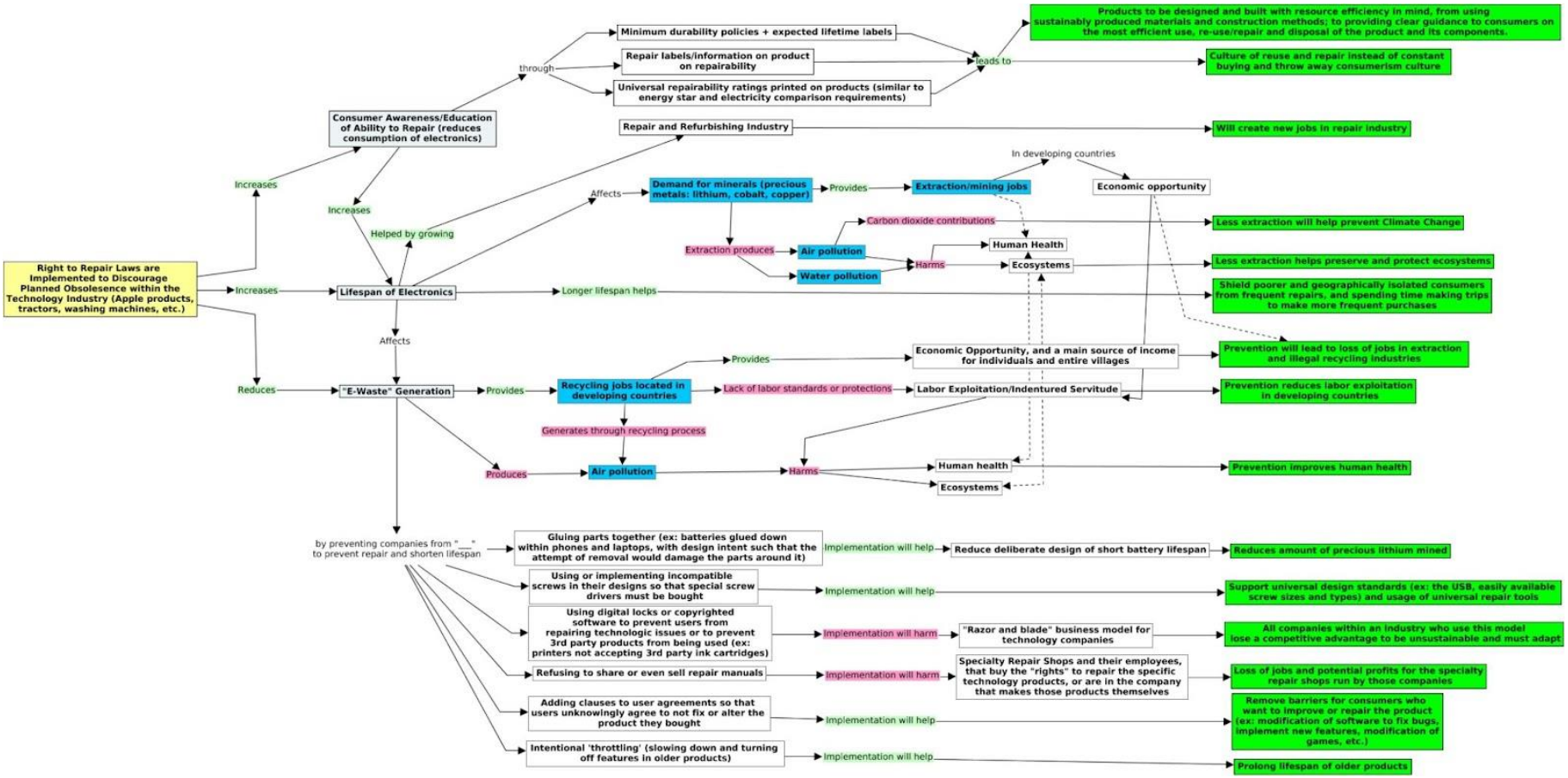
It will directly impact the profits of technologic corporations who do most of their business in developed countries, as it would impact the razor and blade model (i.e. printers and ink cartridges) that a lot of technologic companies rely on. It will also impact their profits by making it more difficult to implement planned obsolescence within their products, or make it harder for users to repair them.

It could also potentially increase profits of companies in the future if most technology that has come to its end is returned back to the company for repairs/recycling. That way, companies could potentially save on buying or making new parts or obtaining more precious metals for their products.

The following is a concept map showing how Right to Repair Laws would affect consumers, technology companies, and informal recycling workers.

Figure 1

Right to Repair Laws Concept Map


Right to Repair Laws are Implemented to Discourage Planned Obsolesence within the Technology Industry (Apple products, tractors, washing machines, etc.)
Increases
Consumer Awareness/Education of Ability to Repair (reduces consumption of electronics)
through
Minimum durability policies + expected lifetime labels
Repair labels/information on product on repairability
Universal repairability ratings printed on products (similar to energy star and electricity comparison requirements)
leads to
Products to be designed and built with resource efficiency in mind, from using sustainably produced materials and construction methods; to providing clear guidance to consumers on the most efficient use, re-use/repair and disposal of the product and its components.
Culture of reuse and repair instead of constant buying and throw away consumerism culture
Increases
Helped by growing
Repair and Refurbishing Industry
Will create new jobs in repair industry
Affects
Demand for minerals (precious metals: lithium, cobalt, copper)
Provides
Extraction/mining jobs
In developing countries
Economic opportunity
Carbon dioxide contributions
Less extraction will help prevent Climate Change
Extraction produces
Air pollution
Water pollution
Harms
Human Health
Ecosystems
Less extraction helps preserve and protect ecosystems
Increases
Lifespan of Electronics
Longer lifespan helps
Shield poorer and geographically isolated consumers from frequent repairs, and spending time making trips to make more frequent purchases
Affects
Reduces
"E-Waste" Generation
Provides
Recycling jobs located in developing countries
Provides
Economic Opportunity, and a main source of income for individuals and entire villages
Prevention will lead to loss of jobs in extraction and illegal recycling industries
Lack of labor standards or protections
Labor Exploitation/Indentured Servitude
Prevention reduces labor exploitation in developing countries
Generates through recycling process
Produces
Air pollution
Harms
Human health
Ecosystems
Prevention improves human health
by preventing companies from "___" to prevent repair and shorten lifespan
Gluing parts together (ex: batteries glued down within phones and laptops, with design intent such that the attempt of removal would damage the parts around it)
Implementation will help
Reduce deliberate design of short battery lifespan
Reduces amount of precious lithium mined
Using or implementing incompatible screws in their designs so that special screw drivers must be bought
Implementation will help
Support universal design standards (ex: the USB, easily available screw sizes and types) and usage of universal repair tools
Using digital locks or copyrighted software to prevent users from repairing technologic issues or to prevent 3rd party products from being used (ex: printers not accepting 3rd party ink cartridges)
Implementation will harm
"Razor and blade" business model for technology companies
All companies within an industry who use this model lose a competitive advantage to be unsustainable and must adapt
Refusing to share or even sell repair manuals
Implementation will harm
Specialty Repair Shops and their employees, that buy the "rights" to repair the specific technology products, or are in the company that makes those products themselves
Loss of jobs and potential profits for the specialty repair shops run by those companies
Adding clauses to user agreements so that users unknowingly agree to not fix or alter the product they bought
Implementation will help
Remove barriers for consumers who want to improve or repair the product (ex: modification of software to fix bugs, implement new features, modification of games, etc.)
Intentional 'throttling' (slowing down and turning off features in older products)
Implementation will help
Prolong lifespan of older products

E-waste is also inextricably tied to labor exploitation. The artisanal sector within the Democratic Republic of Congo (DRC), made up of regular workers who usually have no protective equipment or training, provides 20-30% of global cobalt (Calvão et al., 2021). Cobalt is the main material used to make lithium ion batteries used in most electronics today. Calvão et al. have many criticisms against companies that have tried to formalize mining within the DRC as their recruiting practices are detrimental to workers. The workers are hired on wageless and are paid by output with no base salary or social protections (decent living conditions, as they live in the mines sometimes, guaranteeing healthcare or health protections, job loss, or protections from price fluctuations), all extraction risks are put onto miners and not the corporations themselves. They also point out that formalization, with the additional conditions and access to open markets, may produce "new forms of dispossession and insecure labor" as it creates a narrative of legal and illegal extraction. This only allows corporations to reinforce themselves with private security forces, and allow more industrial companies into the country. It also allows for the complete exclusion of vulnerable miners, such as those who cannot get access to IDs (refugees)(2021).

STS Project Proposal:

The paper will go over how our increased utilization of low-carbon technology to combat climate change (decarbonization) is affecting society and the globe through e-waste (as it causes environmental pollution and exploitative labor conditions).

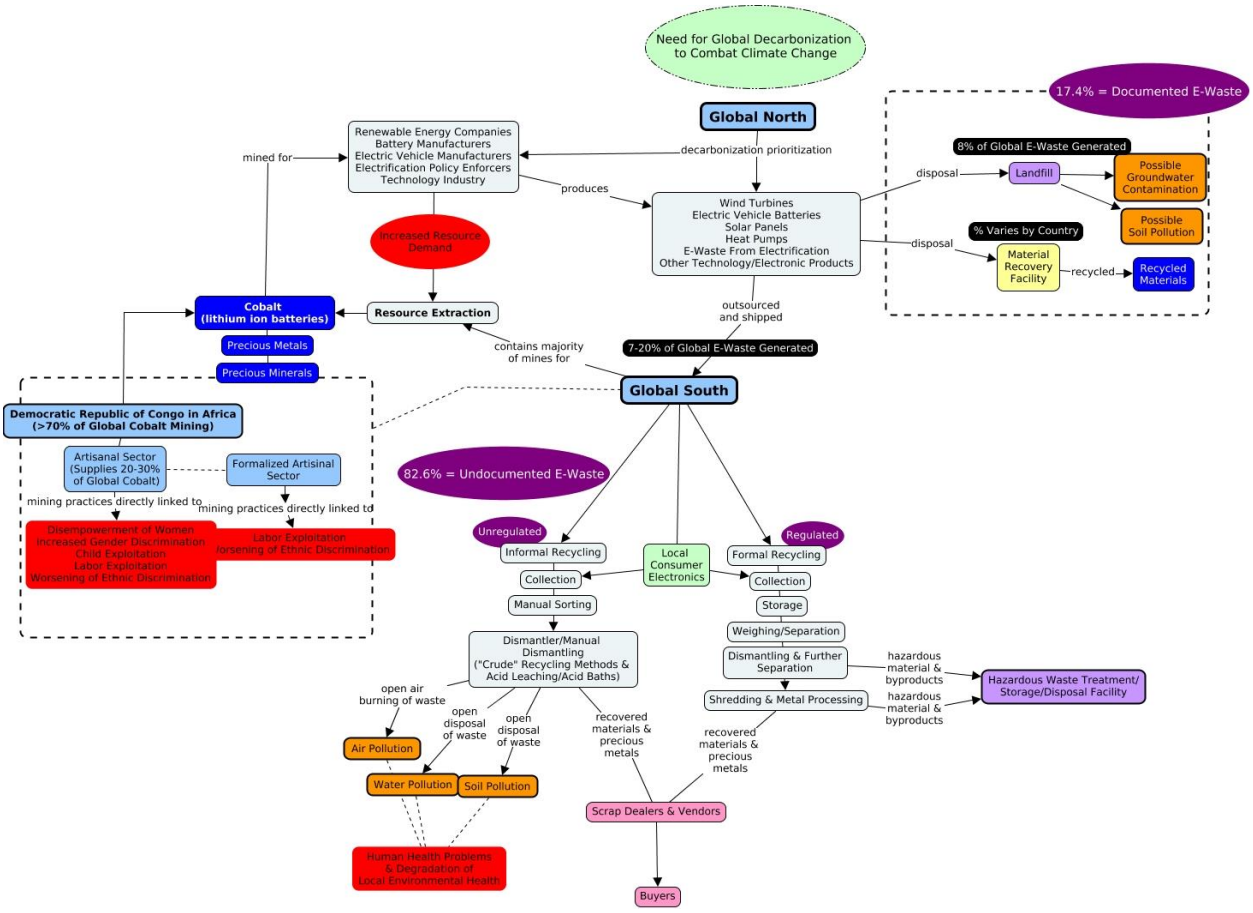
I will be approaching it from a sustainability approach with a focus on environmental equity and policy. One of the keystone authors I will be using is Sovacool et. al. and their works because they were the primary researchers to bring the aftereffects of decarbonization into the limelight and essentially covered how it was impacting communities in Ghana and the

Democratic Republic of Congo. It explained and created the foundation for what is now known as the phenomenon of the decarbonization divide.

The approach that will be used for analysis within my work will primarily be Actor Network Theory (ANT. I chose to use ANT as the primary technique because of how the decarbonization divide is a system that feeds into itself and must be thought of as such. The main actants that will be analyzed are: e-waste, the Global North, Global South, mining industries, informal recycling industries, formal recycling industries, and the labor groups employed within this system. I also chose ANT in order to display just how many relationships are interconnected, as well as to show how e-waste as an actant is integral within those relationships (Figure 2).

Figure 2

The Decarbonization Divide and Its Relationships



I will also use ecological thinking as this is an inherently environmentally focused piece, and its contributions are incredibly important as it centers the future and the rights that future people have. This is integral to my paper, as the health and lands of future peoples will be heavily impacted from the effects of e-waste and the decarbonization divide.

To accomplish all of this, I plan on completing a literature review, and further concept mapping to convey ANT. I also plan to interview relevant actors closer to home such as here at UVA and renewable energy businesses in the area to see they also contribute to e-waste and how we are going about preventing it here in Charlottesville.

Potential Barriers

The major limitation is time. The potential blindspots are my inexperience with the application of ANT as a framework while writing research.

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