The Global Industrial Metabolism of E-Waste Trade

A Marxian Ecological Economics Approach

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Preface

The initial reason that my interest in e-waste developed is personal, having myself dabbled to some degree in informal recycling. There was a period of time in my life when I did not have much in the way of money, and I knew that people in my student apartment complex – many of whom studied at the technical university right next door – would dump ICT equipment in the communal garbage bins. What followed was a long period of me simply dumpster-diving, taking whatever equipment I could find and either stripping it for parts or, to the best of my amateur abilities, repairing and refurbishing it, and then selling whatever was functional on eBay.[1] At the time it was only a way to make some extra cash, and I had no knowledge of the global informal trade or that there was a whole industry dedicated to this. I eventually learned about Agbogbloshie and the global e-waste trade – partly due to the aforementioned nearby university enacting a responsible recycling programme that caused my source of revenue to suddenly dry up, and partly due to documentaries shown on Swedish national TV. I was fascinated with it, and felt compelled to learn more about this phenomenon, and to try and understand it using the lens of political economy.

An issue of *The Economist* from 1992 includes, under the title *Let them eat pollution,* a memo from Lawrence Summers, at the time chief economist of the World Bank, sent to his colleagues. In the memo, Summers argued for an encouragement of increased migration of dirty industries to the least developed countries. He reasons that lower wages translate into lower costs of increased mortality, that lack of development means the countries are under-polluted compared to developed regions, and that health impacts are of less importance in countries where mortality is high already. Summers concludes that trade in air pollution and waste would result in increased global welfare from an economic point of view. He believes that "the economic logic behind dumping a load of toxic waste in the lowest-wage country is impeccable" and that economists should "face up to that". As *The Economist* comments:

> "The language is crass, even for an internal memo. But look at it another way: Mr Summers is asking questions that the World Bank would rather ignore – and, on the economics, his points are hard to answer. The Bank should make this debate public." (1)

Though many years have since passed, open public and frank discussions on these matters are still

[1] Actually, *Tradera*, the Swedish version of Ebay.

wanting. One important purpose of this thesis is to contribute, in whatever small way, to exploring the issue of export of toxic waste. I will investigate a particular form this kind of export takes: the phenomenon of electronic waste, its global movements and the problems related to the informal recycling that takes place largely in developing countries. More specifically, I intend to examine the impact, especially the local impact, on environment and people/communities that the global e-waste flow has, and the nature of capitalist social relations and core-periphery relations in this context. This will entail a case-study of the scrapyard and e-waste dump-site at Agbogbloshie in the Ghanaian capital of Accra, which will be the main focus. In addition, I will also look at the former dump-site Guiyu in Guangdong province of China, and briefly examine a modern state-of-the-art e-waste recycling facility in Katrineholm in Sweden. The latter cases will be relied on for supportive and comparative material in order to deepen the understanding of Agbogbloshie.

The thesis is interdisciplinary and makes use of analytical tools which combine the perspectives of ecological economics, political ecology, human geography, environmental sociology and industrial ecology; placed on the foundation of Ecomarxism. Ecological economics recognizes the economy as a sub-system of the ecology, while political ecology emphasizes the politico-economic aspect of mankind's relationship with the natural world. Through a combination of the two, the economy is placed in both a natural and a political-institutional context. A geographical framework furthermore enables an analysis of the rift in global industrial metabolism that occurs when the recycling of waste materials is geographically displaced from developed (‘core’) to developing (‘periphery’) nations, while a sociological framework considers the associated social and environmental impacts and costs.

The reason for this approach is that the particular problem being studied is not strictly disciplinary in nature, i.e. it does not express itself in the real world in a way that can neatly be divided up between specific disciplines without the loss of comprehension. Rather it touches upon matters that necessitate a diverse approach in order to facilitate understanding of the whole.

Throughout the thesis, a focus on class relations is maintained in order to highlight the ecosystem as a site of social struggle. The environmental and social problems of the dump-sites are framed as inherent problems of capitalism as a historically specific mode of production. The role of the natural world in capitalist production, that is the extent to which capital accumulation is dependent on freely appropriating the natural world in various ways, is not recognized under the capitalist mode of production. It is thus not capable of seeing its own dependence on the natural world, something which a Marxian class analysis rectifies. More specifically, I base myself on the

emergent field of *Marxist Ecological Economics*, meaning that I accept the central claims of ecological economics and political ecology, yet place these claims firmly on the foundation of historical materialism and dialectics.

The thesis is structured in materialist dialectical manner and intends to move between different levels of abstraction. It begins by describing the phenomenon of e-waste at the global level, and then moves down to a description at the national and local context. Then, the context at all levels established, it ascends upwards again with an analysis that thus begins at the local level and moves up to the national and finally global, before analysing the role of the underlying forces of capitalism itself. That is, from the highest level of abstraction to particular conditions, revealing the ongoing processes, and back up again by way of analysis. It is divided into four distinct parts: Part 1 gives an overview of the e-waste problem, Part 2 presents the case-studies, Part 3 analyses the case-studies, and Part 4 presents the analysis on the final level abstraction i.e. the underlying forces.

Chapter 1 begins by introducing the topic and gives a rudimentary overview of currently existing data and approaches to studying e-waste and paints a basic picture of the problems and issues involved and provides the background needed to understand them. It explains what exactly e-waste is and the laws on e-waste trade and the major dumping hubs, but also introduces the conflicting narratives surrounding e-waste and sets up the problems and questions that the thesis will try to answer. Here I also cover the physical properties of e-waste, mostly why it is poisonous and precisely how.

Chapter 2 deals with the methodological approach and my philosophical underpinnings; and argues in favour of a dialectical materialist approach to both the specific issue of electronic waste and to metabolic-ecological research in general. This is done by way of a broader discussion on the materialist dialectic method in the sciences, which continuously descends to touch upon the concrete issues of the thesis and the ways in which the materialist dialectic approach benefits it specifically. Here I also go over the possible shortcomings of non-dialectical approaches to metabolic-ecological research and demonstrate how the materialist dialectical approach avoids those pitfalls.

Chapter 3 is about the global flows of e-waste and Chapter 4 about the e-waste that enters into Ghana and China specifically. In both these chapters, data on e-waste volumes is presented, followed by a discussion of it and problems related to accuracy. Conflicting narratives, and the claims of those denying the commonly accepted narrative surrounding the e-waste issue, and their alternative narratives, are presented along with a discussion of the method and critique thereof in

the differing reports on e-waste volumes.

Chapter 5 introduces the Agbogbloshie situation and gives a basic overview of the local history, organizations and laws needed to understand the issues. Chapter 6 builds on this and details the impressions I gathered while visiting Accra and Agbogbloshie: exploitation, conditions of the working class, conditions of the communities, and so on. It combines a narrative of my observations with impressions from other sources into a sociology of ecologically unequal exchange, showing the actual impacts on the lives and livelihoods of the people involved. Chapter 7 goes over these same matters for Guiyu and focuses on the recent change and development that has occurred there.

Chapter 8 builds on both the case studies so far presented and goes deeper into the health impacts of informal e-waste recycling. It relies heavily on medical and natural-scientific second-hand data which is presented in order to paint an easily understood picture of the health problems and risks involved.

Chapter 9 then contrasts the informal recycling taking place in Agbogbloshie and Guiyu with that taking place in an e-waste recycling facility in Katrineholm in Sweden, in order to highlight the differences. Sweden is a country often regarded as having a close to ideal system for electronic waste management and serves as an inspiration for the ENGOs currently engaged with attempting to bring change to Agbogbloshie.

Chapter 10 begins the analysis by going over the Sweden and Guiyu cases in greater detail, critically examining the data presented in chapters 7 and 9 and placing it in the proper context. Chapter 11 does the same for Agbogbloshie. I go over the local economy, labour, dependency on e-waste and the contradictions involved; the ways in which the people, institutions and infrastructures of dump-sites become adapted to the needs of global capitalism for its recycling services and become stuck in this niche, as well as the history of the development of the dumping site. Chapter 12 ends the analysis of the case-studies by looking at Agbogbloshie and its roots through the lens of historical materialism.

Chapter 13 begins the more abstract analysis by looking at the e-waste problem from the perspective of ecological economics, conceptualising e-waste-caused pollution using an entropic perspective. I also examine the ecological economics theories regarding recycling and their relevance, and the lessons that can be learned from the case-studies.

Chapter 14 deepens the analysis of resource flows, which are here placed in the context of the world system and the metabolism of global industry. The role of capitalism is highlighted, as is

geographical displacement and the 'cost-shifting success' that e-waste represents. The concepts of import/export of waste-sinks, the metabolic rift and unequal ecological exchange are used to analyse global e-waste flows. These concepts are given both a political ecological and an ecological economic dimension. This chapter analyses e-waste on first the national and then global level, tying it together with the preceding local-level analysis.

Chapter 15 moves on to the final class analysis, highlighting the ecosystem as a site of class struggle and the role of the law of value. Although such issues will be of course be present throughout the thesis, it is here that e-waste is contextualised fully within global capitalism. The highest level of abstraction is reached, as we move beyond merely ‘e-waste on the global level’ and look at the underlying forces of capitalism of which the e-waste phenomenon is just a particular expression.

Lastly, Chapter 16 summarises and reflects on the thesis as a whole, ending by discussing the law of value as it pertains to e-waste.

There is, thus, firstly a local context: the impact on health, environment, and so on, but also the way in which local conditions allow for and constitute what occurs; what Marx called the metabolic rift or alienation from nature, and in which Foster and Burkett have found the basis of value creation. Secondly, there is the global context; the world-system and ecological unequal exchange that takes place. Thus, the local and the global are united here, and ecological unequal exchange is revealed as a metabolic rift at a higher level, and as a function of the economic unequal exchange on which the world-system rests – itself a function of the law of value; which is itself rooted in the historical formation of the ecological rift. The system is closed, and the global e-waste stream can thus be conceptualised as a complex, interwoven, co-determined, multi-levelled, dialectical configuration mediated ultimately by the law of value.

The crucial themes that are present throughout the thesis include: the real impacts economic activity has on the natural world, a core insight of ecological economics; the natural world, and the realm of human well-being, as sites of class struggle – the impact on ordinary working-class people, their lives, communities and surroundings; the role of state and supra-state enforced laws and regulations, as well as their limitations given existing incentive structures; the rift in global industrial metabolism that occurs when the recycling of waste materials is geographically displaced; and finally the role of the natural world in capitalist production, and the extent to which capital accumulation is dependent on freely appropriating the natural world in various ways.

Reference

1. The Economist, 'Let them eat pollution', Issue: February 8, 1992

Chapter 1

An Introduction to Informal E-waste Recycling

1. Why study e-waste?

Technological development and social change together have led to an increasing digitalization of society, one which can be traced back to the invention of the transistor and the first shift from analogue to digital electronics that began in the 1950s. This marked the beginning of the Information Age. The digital revolution has completely transformed much of our social, economic, industrial, organizational and even everyday lives and activities, with no sign of it slowing down. From computer power that was once thought impossible easily fitting in our pockets to the presence of *smart*, that is, increasingly computer-like, technology even in our cars, refrigerators, dishwashers and watches, giving rise to the formation of the *Internet of Things*. But as the use of different types of electrical and electronic equipment rises, so does the amount of electronic waste. It is estimated that the global generation of e-waste for 2016 was around 44.7 million tonnes, and that as much as 52.2 million tonnes will be generated by 2021, making it the fastest growing global waste stream. (1) Projections show an estimate a rise to as much as 120 million tonnes by 2050 if the current trend continues. (2)

Increasingly shorter lifespans for electrical and electronic equipment (EEE) products, an increased difficulty in repairing damaged products, as well as rapid innovation that quickly makes older products obsolete, or simply less fashionable, combine to worsen the problem of the growing stream. The rate of proper recycling is low, despite much recent effort, and much of the e-waste stream is not collected or treated in an appropriate way, using environmentally sound methods. Globally, as much as 80% of e-waste is undocumented, much of which is suspected of being exported to developing countries where informal and improper management gives rise to social and environmental problems.

This poses a problem because e-waste contains materials which, according to a United Nations University report, “pose considerable environmental and health risks, especially if treated inadequately”. (3) Simultaneously, economically valuable resources contained within the e-waste

are lost due to such improper handling. (4) Steel, iron, copper, silver, gold, nickel, chromium, platinum, palladium, lead, tin, zinc and various rare earth elements are among the materials used in EEE components. Many of these are considered 'critical' due to a very high degree of importance to the economy combined with various limits and risks in supply. As a report by the IVL Swedish Environmental Research Institute states, “[o]ur economy cannot fully function without certain materials. The bio-medical, transportation, renewable energy and defence sectors (to name a few) rely on products, technologies and infrastructures, which demand an increasing variety of exotic materials that were not essential in the past.” (5) This has major political implications, not only due to the central role of ICT and EEE technology in the modern world, but due to the political control over the resources which are often found in politically volatile or non-democratic regions -- including PR China, Rwanda, and DR Congo. Apart from having economic value, heavy metals (such as mercury, lead, chromium and cadmium) are also hazardous and can “cause risks to human health and the environment by entering into human food chains and ecosystems and bio-accumulating in living tissues”, according to the same report. Additionally, the plastics, rubbers and other petroleum-based materials that e-waste contains can lead to the release of various plastic-derived compounds such as PAHs, PCBs, PCDDs and PCDFs when recycled improperly, exposure to which can cause health problem for humans and contaminate local environments.

Given the economic, social, and environmental impacts of improper e-waste management, it becomes a crucial area of study given the unprecedented growth in EEE and ICT technology and its central role in contemporary society. Delving further, one might also consider e-waste not as a unique problem but a facet of modern capitalism – a result of rampant consumerism, cost-shifting, economic imperialism, environmental degradation and worker exploitation. As such, the e-waste problem can serve as an entry point to wider, and underlying, phenomena which are revealed through a detailed study of e-waste. From the perspective of environmental justice, the issue can, in the simplest terms, be characterised as the dumping of waste by developed countries onto underdeveloped and vulnerable communities in the global periphery -- in particular former colonies and marginalized populations therein. As Amuzu shows in his recent analysis of Agbogbloshie, this can ultimately be questions of democracy and human rights, touching upon issues like “exclusion, eviction, relocation, marginalisation, restriction to resources” and improper governance. (6) Both from the stand-point of a normative striving for ecological justice, and as a social scientific question, there is a demand for in-depth analysis of the global flows of e-waste and its impacts. My central research questions. Therefore, concern the ways in which the informal e-waste industry is

a part of the structure of global capitalism, what role it plays within that structure, and how that structure gives rise to and shapes it.

1.1 A brief overview of the e-waste problem

E-waste, also known as WEEE (Waste Electrical and Electronic Equipment), is the waste material left from various electronic devices such as computers, televisions and mobile phones, which contain both valuable minerals as well as toxic and hazardous materials. The economically valuable metals used in the production of electronic goods can be extracted when e-waste is recycled. However, the combination of prohibitive recycling costs and various environmental protection policies can make such practices uneconomic in developed nations, creating an incentive to export e-waste to developing countries such as China, India, Nigeria or Ghana. Lax environmental laws and/or lack of enforcement of such laws, combined with crude, low-cost methods of recycling at these sites give rise to environmental destruction and have a strongly negative impact on the health of both workers and surrounding communities. My case-study will examine the two largest dump-sites in the world; Guiyu in Guangdong province of China, and Agbobloshie outside the Ghanaian capital of Accra. While Guiyu has recently transformed and began to move away from crude recycling, the situation at Agbobloshie remains the same today as it has for over a decade.

Informal e-waste recycling at these sites is typically done manually, and usually consists of burning electronic scraps in order to melt away the plastic and get to the valuable metals. Various studies demonstrate that manual work with e-waste recycling can lead to exposure to heavy metals, acid gases and plastic-derived compounds such as TPPs, PAHs, PCBs, PCDDs and PCDFs.[2] Exposure to these contaminants “can result in long term, often irreversible, effects such as infertility, miscarriage, tumours, endocrine diseases and birth defects... [t]he workers often suffer from cuts, coughs, headaches, upper respiratory problems, rashes and burns”. (7) Health impact will be dealt with in more detail later in this chapter.

Technically, the Basel Ban Amendment of the Basel Convention forbids the export of hazardous

[2] Note that in the EU, the *Restriction of the Use of Certain Hazardous Substances in EEE (RoHS) Regulations 2006* and the *Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment* prohibits – or at least limits – the use of some materials, including PBDEs, PBBs, lead, mercury, hexavalent chromium, and cadmium (EU, 2005). Also, since the summer of 2004 “commercial penta- and octa-brominated diphenyl ethers (BDEs) have been banned in Europe due to their associated health risks, with the industry also voluntarily ceasing production” (Man et. al., 2013).

waste, which includes e-waste, from OECD countries to non-members. Transboundary movement of hazardous waste, which includes e-waste, is permitted only under certain conditions, chief among them being either a lack of technical capacity for proper disposal on the part of the exporter or a guarantee of environmentally sound management in the importing country (8). However, legal loopholes and the refusal of some countries, the USA being the only OECD member, to ratify the convention means that e-waste export still occurs in practice, often arriving through either illegal shipping or along with shipments of ostensibly functional second-hand electronic goods. (9) Due to this, US law allows for the export of all forms of WEEE for recycling purposes, though export for disposal is still illegal even for the USA. (10)

Used but functional equipment is also legally sold or donated to developing countries, purportedly as a means of aiding ICT development. Yet even legitimate donations can be problematic, even if well-intentioned, since they can not only be exploited as a loophole for the export of broken equipment, but lead to increased accumulation of e-waste, as the second-hand goods rarely have a lifespan longer than two years, after which they typically wind up in the informal recycling sector due to a lack of formal alternatives. What is being donated, in practice, is both the use of the good for the relatively short duration of its remaining lifetime, but also the costs and consequences of recycling and disposing of it after it stops working. (11) This contributes to the complexities and contradictions involved in the e-waste phenomena, since often times donated goods are the only means for people to obtain affordable electronic goods. Several schools in Ghana are able to provide computer science lessons for children due entirely to donated second-hand computers. (12)

The same benefits are true for repaired second-hand goods that are technically illegally dumped. In addition, refurbishment, repair and recycling activities themselves provide an income for many people and are a crucial part of the local economy in both Agbogbloshie and Guiyu. Recovered minerals and recycled plastics feed local industries, small and independent refurbish shops provide affordable electronics, and innovative individuals have even taken to produce household goods such as grills and shelves from bits of recovered e-waste. In this way, e-waste is both waste and resource – both poison and nourishment. The analysis of it must therefore proceed carefully and avoid one-sided or oversimplified narratives, but instead consider the complex and contradictory role that e-waste plays.

2. Composition of WEEE

As mentioned, both the value and hazard of e-waste is due to its material composition, and different ways of recycling not only have different efficiency in terms of recovered minerals but can produce completely different pollutants depending on which chemical reactions take place. An understanding of the impact of e-waste necessitates a look at its composition, and the difference between recycling methods in terms of pollution.

WEEE is, however, a collective term for all the various equipment that is electrical or electronic in nature, making it difficult, if not impossible, to define its exact composition. The results would depend on how products are aggregated and which product categories one examines. Classification of different types of WEEE is not straightforward, and several approaches are arguably valid. For example, the EU changed from a product-oriented definition, the EU-10, which was introduced in Annex I of to the WEEE Directive 2012/19/EU, to a collection-oriented definition, called the EU-6, in Annex III.

Furthermore, as an EU Horizon 2020 report states, “the composition of WEEE has changed and is constantly changing due to rapid development of technological solutions and more understanding of hazardous components”, with some substances having been banned over the years. Nonetheless, a 2015 European Commission report has attempted to broadly categorise WEEE composition, which can be divided into 6 or 7 kinds of components: (13)(14)

EU-10	
1. Large household appliances	
2. Small household appliances	EU-6:
3. IT and telecommunications equipment	1. Temperature exchange equipment
4. Consumer equipment and photovoltaic panels (i.e. solar panels)	2. Screens, monitors, and equipment containing screens
5. Lighting equipment	3. Lamps
6. Electrical and electronic tools	4. Large equipment
7. Toys, leisure and sports equipment	5. Small equipment
8. Medical devices	6. Small IT and telecommunication equipment
9. Monitoring and control instruments	
10. Automatic dispensers	

Table 1.1. *WEEE Categorisation according to the EU-10 and EU-6 approached.*
From the European Commission’s Manual for the use of the WEEE calculation tool, 2017.

- *Base metals.* Most commonly iron, copper and aluminium
- *Precious metals.* Gold, silver and palladium being the most common.
- *Critical Raw Materials* (CRM). Categorised as such by the EU Commission, these include indium, gallium, cobalt, silicon and rare earth elements (REEs).
- *Plastic*s. Many different kinds of plastic are used in different kinds of products.
- *Hazardous substances*. Contained within the WEEE are substances such as brominated flame retardants, aluminium oxides, lead, beryllium, and arsenic.
- *Generated hazardous substances*. Substances produced via the burning of plastics, such as PAHs, PCBs, PCDDs and PCDFs, i.e., substances that are not inherently part of WEEE recycling, and would not occur if burning was avoided.
- *Other materials*. Glass and ceramics make up the bulk of other materials. Much of the glass contains lead and hence cannot be recycled.

Note the category *generated* hazardous substances, which are situational, in other words, not inherently a part of WEEE nor proper recycling. Instead they are generated only where recycling is improperly performed. Chiefly, this tends to refer to the burning of plastic during informal recycling, a common practice in developing countries. When e-waste is exported, it is misleading to speak solely of an export of harm as such; sometimes there is a *generation* of harm that would otherwise not have occurred.

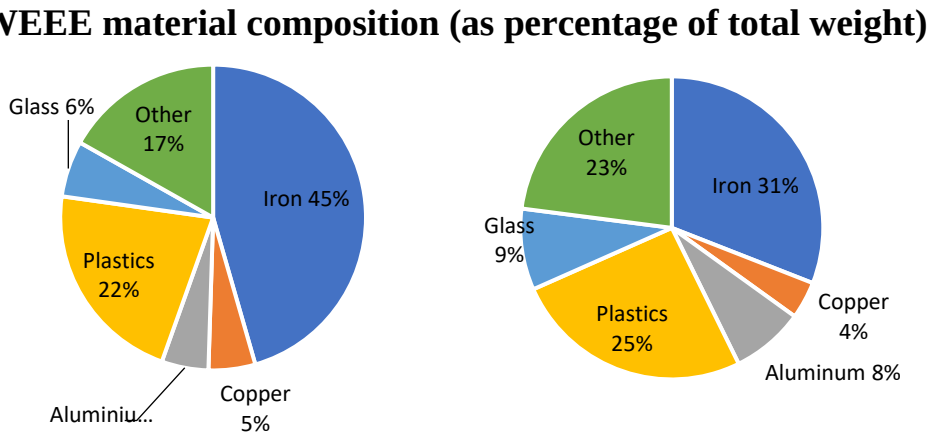

Diagram 1.1 *Left based on European Union's Horizon 2020 research and innovation programme report* Analysis of the WEEE value chain, *2016. Right one based on European Commission report* Study on WEEE recovery targets, preparation for re-use targets and on the method for calculation of the recovery targets, 2015. *Note: weight of the various precious and CRM metals is negligible when compared to total weight, e.g. ca 0.001% for gold, and is therefore not shown in this diagram.*

Composition of older WEEE

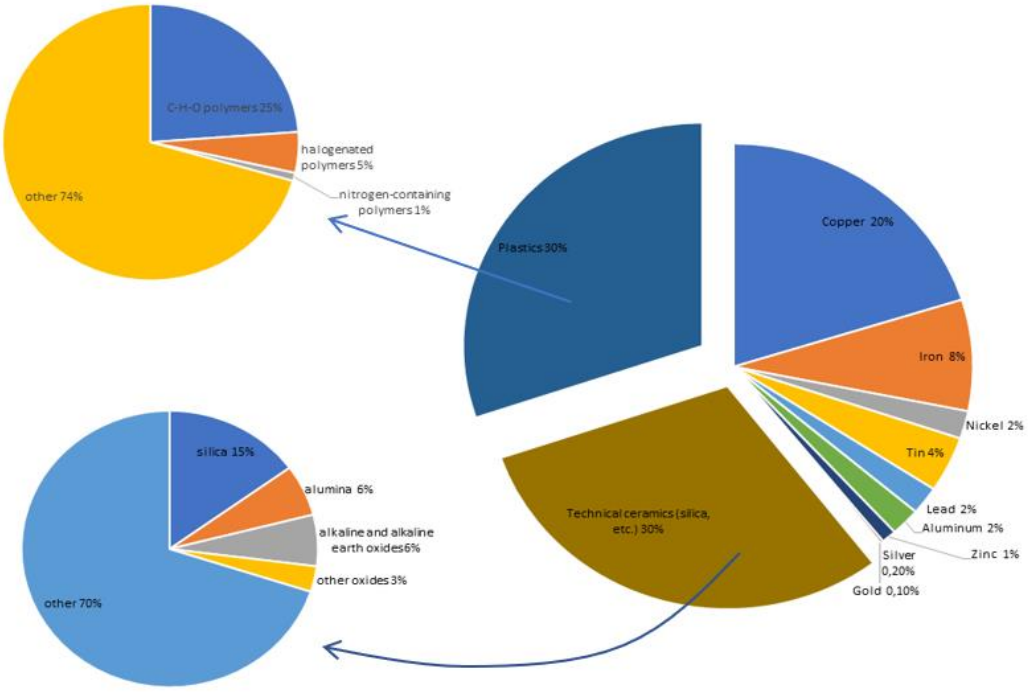

Diagram 1.2. *Another composition diagram, based on a 1991 publication by Elaine Y.L. Sum.* (42) *Palladium, not included on the diagram, makes up less than 0.005% of the weight.* (43) *Older WEEE tends to have higher levels of precious metals.*

Material composition of an old PC

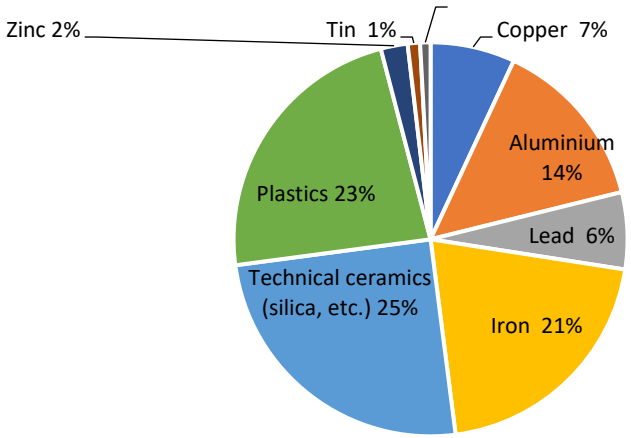

Diagram 1.3. *Based on the Microelectronics and Computer Technology Corporation (MCC) 1996 publication* Electronics Industry Environmental Roadmap. *Note again that the weight of various substances is negligible when compared to total weight and hence not shown in the diagram: less than 0.01% for gold, mercury, arsenic and cadmium.*

Diagram 1.3 above shows the material composition of an old PC, with a CRT (Cathode Ray Tube) monitor. Newer computers obviously use different materials, but old computers still make up a large part of the global e-waste stream. Older WEEE tends to have a higher content of precious metals but also of hazardous substances when compared to newer equipment. (15) The replacement of CRT monitors with LCD displays will alter the composition of the stream gradually, as more and more of the newer computers become obsolete and are added to the e-waste stream. The concentration of lead will decrease but mercury, tin, zinc and indium will likely increase since LCD displays contain these elements. Copper content is also likely to decrease as copper wires are replaced with fibre optics, which will tend to increase the amount of iron, palladium, yttrium and zirconium since fibre optics contain those substances. Nickel-cadmium based batteries have also been decreasing in favour of the use of nickel hydrides, and lately lithium batteries. (16)

E-waste is commonly richer in metals than corresponding ores. One metric ton of e-waste can contain as much as 200 kg of copper and one ton of printed-circuit boards (PCBs) as much as 500 g of gold; compared to 0.2%-1.65% and 0.85–1.65% from ore, respectively. (17) (18) Man et al. also claim that copper concentration can be ten, or even a hundred, times higher in a heap of WEEE than in mined ore. (19) The NGO *Electronics TakeBack Coalition* reports that the recycling of 1 million mobile phones can, in theory, lead to the recovery of circa 24 kg of gold, 250 kg of silver, 9 kg of palladium, and over 9,000 kg of copper. (20)

Another report states that heaps of discarded mobile phones can be up to 70 times richer in gold than gold ore; assuming that a lower grade, but still commercially viable, gold mine would contain around 5 grams of gold per ton of ore. (21)(22) Electronic waste in general can yield between 300–400g of gold per ton, making so called ‘urban mining’ deposits between 40-50 times richer than the lowest quality mined ores. (23)(24) Thus, the total gold theoretically available per year from e-waste is, using the UNU 44.7-million-ton estimate, 13,410 – 17,880 tons.

However, these numbers ought not to be uncritically accepted. Global gold mining output in 2016 was 3,226 tons, and the UN University data also states that “[n]ew PCs, cell phones, tablets, other e–products now use 320 tons of gold [...] per year, and rising”. (25)(26) If the ‘300-400g/ton' number is correct, that would give 9,233,333 tons of e-waste at most even if we assume that the entire gold output from mines in 2016 wound up in e-waste. This seems unlikely based on what we know of global e-waste generation, as the number is far too low even given the extravagant and unrealistic assumption. On the other hand, if the '320 tons of gold in e-waste' number is correct, at most 7.16 grams per ton on average would exist in the world’s e-waste, assuming again the UNU

44.7 Mt global generation for 2016; this seems far more reasonable. My suspicion is that the 300-400g number is overestimated or misinterpreted, and most likely applies to cell-phones alone. This is corroborated by later reports, where '300-400g per ton' is given explicitly for mobile phones. (27)(28) This would nonetheless make the abstract category of 'e-waste' richer in gold than the lower end of commercially mined ore.

The UN University estimate also points to WEEE containing 7,500 tons of silver, i.e. 167.8 g of silver per ton. (29) At the time of writing, the price for gold is approx. 41 337 USD per kg and approx. 470.5USD per kg of silver, which would put the total value of the gold and silver in all the e-waste generated in 2016 at 13,227.84 million USD in gold and 3,528.75 million USD in silver, for a total of 16,756.59 million USD. (30) Consider that only around 10-15% of the gold and silver in e-waste can be recovered in the informal process employed in e.g. Agbogbloshie; about half the gold present in WEEE is lost due to the crudeness of the dismantling process used, and merely a quarter of what remains is recovered in the recycling process itself. In contrast, around 71.25% of total gold content can be recovered in modern recycling methods used in developed countries. (31)

It is not the intent of this thesis to concern itself with the purely economic loss of resources due to informal recycling, though it is nonetheless interesting to note the hidden costs present. It would also be worth noting that the recovery rates for rarer minerals – such as platinum, palladium or REEs – is in practice non-existent in informal recycling as their content is simply too low. Informal recycling instead recovers mostly copper and lead, and at times gold and silver depending on which methods are used. Considering the rarity and critical importance to the modern economy of some of the non-recoverable minerals and their importance to much modern technology, the economic impact of their loss is more complicated than simply their price multiplied by the weight lost. The economic, industrial, technological and even political impacts of the unrecoverable dissipation of rare elements is in my view an issue worth further investigation, though it will not be the topic of this thesis.

3. Approaches to studying e-waste – a brief overview

3.1 Metabolic studies

Being interdisciplinary in nature, this thesis attempts to connect concepts and ideas from several different fields and subjects for the purpose of examining e-waste. This approach is suitable because it fits the subject matter, e-waste now having been shown to be a complex phenomenon

that occupies many overlapping conceptual spheres: it functions both as a source of mineral wealth in the role of an ‘urban mine’ and as a source of second-hand market goods, but also as waste; it has economic benefits both by enabling local refurbishing and recycling industries and by feeding manufacturing industries with resources, but also negatively impacts other industries such as fishing and farming; it gives rise to the exploitation of labour and environment in developing countries but also genuinely helps people in these countries get access to affordable electric and electronic equipment they otherwise could not have afforded. For this reason, it is necessary to approach e-waste from several angles if the subject is to be done justice.

As mentioned in the Preface, one objective of my research is the combination of the perspectives of ecological economics and political ecology, placing economic activity and the associated matter-energy flows in both a natural and a political-institutional context. That is, the study of the *social metabolism* of electronic waste, for which tools from industrial ecology are suitable, particularly those pertaining to industrial metabolism. Renowned social ecologist and metabolic researcher Marina Fischer-Kowalski defines industrial metabolism as that aspect of industrial ecology that “focuses on the flow of materials and energy in modern industrial society through the chain of extraction, production, consumption, and disposal.” (32)

Emerging originally from biology and biochemistry, the concept of ‘metabolism’ has developed along its own lines within the social sciences into a separate idea, one which refers to the flow and transformation of matter and energy in systems – something which would not be considered ‘metabolism’ in biology (33). This separate line of conceptual evolution can be traced to the work of Marx and Engels, who applied it to the labour process and their analysis of the rift between town and country, inspired by their foray into the natural sciences, in particular the works of Justus von Liebig and Jacob Moleschott. (34)(35) Ecomarxists have since developed this use further and made the case that the metabolic concept is more crucial to Marx’s whole theory than what has previously been assumed. (36) The Ecomarxist perspective builds upon a metabolic reading of value theory rooted in Marx’s original conception of labour as a metabolic process; “an eternal natural necessity which mediates the metabolism between man and nature, and therefore human life itself.” (37) The role of value creation and the driving force of the industrial-metabolic process taking place under capitalism is here emphasised. The distinction between exchange value creation and use value-creation then takes the form of a class conflict over the function and role of the natural world, as the foundation of life vs. the material basis of capital accumulation. This in particular is a key concept for the purpose of this thesis.

The metabolic has also played an important role in ecological economics, particularly in the work of pioneers such as Boulding, Kneese and Ayres whom introduced formal material flow analysis. (38). Healy et al. in fact define the field of ecological economics as one that "studies social metabolism, i.e. the flows of energy and materials in the economy". (39) The metabolic approach has also found uses within geography and sociology, through for instance the work of Burgess and his work on urban ecology. (40) Metabolic research hence represents an overlap between ecological economics and Ecomarxism, and arguably a suitable entry-point for my intent to combine the two in some form, as per the work of Marxist ecological economist Paul Burkett (41).

So far, research of this kind is somewhat lacking. A bibliometric analysis by Newell and Cousins identified a gap in the research wherein specifically Marxist approaches to industrial ecology are lacking, the Marxian metabolic tradition instead being isolated from industrial ecology and forming separate academic clusters between which there is little cross-fertilization. They propose a *political*-industrial ecology as a solution, where the material flows studied by industrial ecology are not only socially embedded, but this embedding is analysed though explicitly Marxist political economy. (42) Such a Marxist approach is partially presented by Foster and Holleman, who argue in favour of a combination of the unequal ecological exchange and metabolic rift perspectives, based on the work of ecologist Howard T. Odum, ostensibly the founder of the field of systems ecology. (43) However, their work is criticised for its focus on energy and lack of material flows analysis by Hornborg, who calls it a "major omission" on their part. (44) This is precisely the gap in the research that this thesis aims to fill. Therefore, material flow analysis, which is related to and ultimately based on systems theory, will be relied on as major tools in my thesis.

MFA approaches are common to waste management in general, and have often been employed to analyse e-waste specifically, with a lot of the research being published in the journals *Waste Management* and *Waste Management and Research*. Much like metabolic research in general, however, here too is a lack of social embedding and the approach is chiefly a technical rather than social scientific one. (45) This is confirmed by a 2018 review of MFA approaches to e-waste research by Huda and Islam, which shows that the focus of this kind of research has hitherto been on estimating generation, measuring efficiency of recovery and recycling, and analysing material and chemical content. (46) While my own approach will consider technical aspects to the degree that they have relevance to social and environmental conditions, it will not produce any original data on these topics but focus entirely on the socio-political aspect.

3.2 World systems theory and unequal exchange

Looking at e-waste trade as part of a global chain lets us place informal e-waste recycling in a *world-system* context, allowing for the analysis of economic roles of geographical regions in the global network and the *unequal ecological exchange* that takes place. The concept of ecological unequal exchange builds on economic unequal exchange: David Smith summarizes the core concept, referring to Emmanuel and Amin who "argued that the essence of core exploitation of the poor, underdeveloped regions of the periphery is transmitted through the unequal trade of low-value and less-processed goods from the periphery in exchange for expensive finished products from the core". (47) Bunker expanded this, arguing that it was the "unbalanced flows of energy and matter" from periphery to core that illustrated unequal exchange better than did price or labour time. (48) Jorgenson and Rice are among those scholars who recognize the basis of ecological economics as compatible with, and in fact quite beneficial to, world-systems theory, since capital accumulation is the driving force in the dynamic of the world-system, but accumulation itself is founded upon the eco-system of which the economy is a sub-system. (49) Once that basic premise of ecological economics has been accepted, the argument could well be made that neither the concept of unequal ecological exchange nor that or world-systems are complete or meaningful without each-other. Every instance of production equates also some kind of 'addition' to, or 'withdrawal' from the natural world, and every instance of production also has a place within the world-system. As Hornborg explains, "[t]he unequal exchange underlying machine technology can only be revealed by exposing, beyond the monetary price tags reified by conventional market ideology, material asymmetries in the net flows of biophysical resources gauged in terms of alternative metrics such as energy, matter, embodied land (ecological footprints), or embodied labor." Or in other words, "wastefulness and unsustainability of industrial resource management is made possible by displacing environmental impacts to other areas, populations, or social categories". (50) In order to grasp the one, we must grasp the other.

Consideration of exchange of biophysical resources is, as previously discussed, the essence of metabolic research. As Frey shows, understanding the world-system in metabolic terms as the "entry of energy and materials and exit of dissipated energy and material waste" is a well-established practice, and Frey cites Martinez-Alier, Rice and Hornborg as examples of world-systems scholars who employ such an approach. (51) Thus, it is possible to conceptualise world-systems theory as a particular approach to metabolic research, and MFA as the particular tool I will employ, with unequal ecological exchange being the phenomenon to be studied. Given the apparently seamless way in which all these so far mentioned approaches fit together, and the

intellectual history they to a degree share, it is somewhat strange that so little overlap exists between them in practice, and that so little explicitly Marxist research on industrial metabolism using MFA has hitherto been done.

Considerations of e-waste within the world-systems framework are also frequent. Hermele mentions it as an example of what he calls the “appropriation of ecological space” and it is cited as an example by Kick and McKinney in their analysis of entropy in the world system as well as by Frey in his analysis of hazardous products and waste. (52)(53)(54) Yet the focus is seldom on e-waste directly, it rather being used as an example or only briefly mentioned, rather than scrutinized in detail. The exception is an analysis by Frey of Guiyu which looks at the creation of anti-wealth from an environmental justice point of view, conceptualising e-waste as “a byproduct of the information and communication technology-infrastructure underlying the world system's social metabolism”. (55) As such, Frey’s article represents the approach I wish to build upon in greater detail and apply to both a local and a global context.

3.3 Discard studies

Discard studies is a small, emerging interdisciplinary sub-field represented chiefly by anthropologist Robin Nagle, geographer Josh Lepawsky, and environmental scientists Alex Zahara and Max Liboiron though their website *discardstudies.com*. They define their sub-field as one that “looks at wider systems that make waste and wasting they ways they are”, and “analyses the wider role of society and culture, including social norms, economic systems, forms of labor, ideology, infrastructure, and power in definitions of, attitudes toward, behaviors around, and materialities of waste”. Their view is of waste as social, and not individual, product with both material and social/relational components, the latter having meanings dependant on socioeconomic and cultural context. (56). This is what characterizes the method and approach of discard studies, rather than the employment of any particular tool. It is an approach that is broadly compatible with a Marxist and dialectical outlook given its way of looking at relations, socioeconomic context, and material conditions, and hence one I hope to contribute to by way of placing it on an explicitly Marxist basis.

Josh Lepawsky in particular has taken a keen interest in e-waste and has published numerous articles as well as the book *Reassembling Rubbish: Worlding Electronic Waste* on the topic. His approach is characterized by a focus on the '3Rs' -- reduction, reuse and recycling, and notably also by questioning what he calls the 'mainstream narrative' surrounding e-waste. He is especially

critical of what he considers oversimplified media portrayals of the issue, and the picture presented by Jim Puckett and the Basel Action Network. Lepawsky's view of global e-waste flows runs contrary to theirs and calls many of their statements into question. (57)(58) His work, and theories on global flows above all, has a significant potential impact on my thesis and is crucial to consider in connotation with the case-studies of Ghana and China. Lepawsky and other authors in the same school of thought will be discussed in greater detail in Chapter 3.

To conclude, this thesis is a Marxist ecological economics analysis of e-waste, combining a material flows analysis approach, world systems theory and analysis of situated labour processes, which will focus on a case-study of Agbogbloshie in Ghana but include with supportive and comparative reference to e-waste recycling Guiyu in China and Katrineholm in Sweden. To this end, I will adopt a micro-ethnographical approach where I focus in particular on practices related to e-waste recycling, especially as concerns ordinary workers. Having thus established the aim of the research, the object of study and relevant background, and different approaches to studying it, I will instead turn to the particulars of my methodological choices.

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Chapter 2

Theory and Practice

1. Theory: The Materialist Dialectic as a Method of Scientific Inquiry in Studies of Social Metabolism and Socio-Natural Interaction

1.1. Introduction

The reason for beginning with an in-depth discussion on my philosophical underpinnings are two-fold; first, one's ontological considerations, or 'pre-analytic vision', is of great importance to ecological economics and is commonly stressed, implicitly or explicitly, as the cause of the very different analyses of ecological and neoclassical economics. (1)(2) This goes beyond the practicalities of specific methodology, though it relates to method as well, but concerns the fundamental assumptions and perspectives employed in the study; the larger picture it fits into. A clear exposition of the theoretical foundation of my method is hence a requirement of ecological economics as such but is also needed to clarify how and why I arrived at the practical method I used in my research. Second, I want to define my particular use of the materialist dialectic in order to minimise misunderstandings. It is not my intention to deny or gloss over the ethical and scientific problems of the terms 'dialectics' or 'dialectical materialism' – nor to discard other possible and legitimate approaches to scientific inquiry. Rather, my aim is to defend *an* approach to materialist dialectics, which I argue is both scientifically valid and helpful for my particular investigation.[3] As I move from an abstract discussion on the materialist dialectic towards concrete examples, whether pertaining to my subject or not, and back again, these advantages and the necessity of my choice

[3] Note that I will not engage in the debate around Marx's 'Prometheanism'. While a view popular among 'first-stage ecosocialists' especially in the late 1980s and 1990s, the view within academia has shifted since. Due largely to the work of the 'second-stage ecosocialists' since the early 2000s, Marx has been seen to take environmental questions and ecological issues seriously. Kohei Saito even argues that "[i]t is actually no exaggeration to say that those who call Marx's theory 'anti-ecological' are now a minority among serious Marxist scholars and activists" (3) For my own argument regarding 'Promethean' misunderstandings of Marx, see Chapter 2.1. of Mujezinovic D 2013, 'Socialism, Capitalism and Dalyian Steady-State Economy' (University of Manchester MA thesis).

become apparent.[4] The following words by J B Foster et al. summarise my reasoning in this matter quite well:

> "Dialectical thinking in ecology was more a question of necessity than choice. Neither mechanism nor vitalism, neither determinism nor teleology were adequate in the ecological realm – a realm that demanded an understanding that was at once genetic and relational. The inability to conceive of an ecology that left humans out meant that ecology was from the first at once natural and social." (4)

This holds for my subject matter too. The phenomenon of e-waste is complex, touching upon matters of economics, geography, sociology, law, ecology, chemistry and health/medicine. It intertwines with both the social and natural sciences, dealing as it does with the interaction between human society and the natural world, giving rise to the need for an approach that can be both natural and social. The very existence of the e-waste phenomenon is also, as I hope to demonstrate, tightly related to its occurrence in a capitalist society, demanding hence a method that can draw out and critique those aspects of capitalism that generate it. This will become more apparent in Part III of the thesis, which attempts to draw out a critique of capitalism from the e-waste issue.

Combining a dialectical approach with ecological economics is not unprecedented. An example is the work of John Bellamy Foster, quoted above, and also of Marxist ecological economist Paul Burkett. Burkett has also clearly shown that an interdisciplinary approach, methodological pluralism and historical openness to "new visions and possibilities" are central to ecological economics, according to its most central figures.[5] (5) Additionally, Nicholas Georgescu-Roegen, the ostensible founder of this field, has argued in favour of a dialectics being used in what he called 'bioeconomics', which gave rise to the 'ecological economics' of today, though he was not a Marxist and did not refer to Marxian dialectics specifically. (6)

One clear advantage of the materialist dialectic is that the e-waste phenomenon possesses many dualities. First, it is both waste and a resource, depending on where in the production-recycling chain one is. Second, it is a source of toxic substances that contaminate the environment and endanger public health, but also forms a vital basis for the local economy on which the e-waste workers are dependent – a case of *quod me nutrit me destruit*, to use Kit Marlowe's words. Third, the e-waste phenomenon represents a clear case of the exploitation of a developing country, but

[4] Friedrich Engels's *Dialectics of Nature* is not discussed directly, because it is both unfinished and predates several major scientific breakthroughs. It remains indirectly influential, however, as it has been a major influence on authors on whom I rely, such as Ollman.
[5] Burkett lists many examples of scholars who agree with this, including Boulding, Costanza, Norgaard and Folke.

often involves a genuine attempt at aid through the legitimate donation of second-hand electronics. E- waste is not one-sidedly one of any of the above pairs but all of them simultaneously. There is an *interpenetration of opposites,* a *contradiction* between both aspects. Even as a resource it functions in three ways: first, as what can be repaired and used; second as a conceptual metamorphosis of something considered 'waste' into something that is a source of revenue for the people working it; and third, the physical transformation, through labour, of high-entropy waste into useful low-entropy material.

A dialectical outlook politicises the process of waste management. As Georgescu-Roegen clarifies, the laws of thermodynamics mean that waste is an inevitable by-product of production. Rather than simply being something that finished products become when their usefulness is through, waste as entropic loss is part of the manufacturing process at each step from extraction to disposal, including recycling.[6] It is, to use dialectical language, an *absolute.* What is interesting is to note what specific form waste takes, both qualitatively and quantitatively, depending on the social and economic context. The way that e-waste is handled at Agbogbloshie is *relative,* as opposed to absolute, and dependent on context. The problem of waste is, in other words, not unique to capitalism, but is exacerbated by it and can be shown to take a particularly destructive form under it.

The question might then rightfully be asked if other, non-dialectical, methods could be applied to my investigation with similar results. Indeed, by combining an application of systems theory, especially further developments of it such as hierarchy theory, with specific readings of non-dialectical approaches that avoid possible pitfalls of reductionism, one might perhaps do without materialist dialectics – to a point at least. It is after all the specific properties of the materialist dialectic that make it a suitable method of inquiry; obviously any other methods possessing the same or similar properties might also be potentiality suitable. Yet one can hardly claim to have 'replaced' materialist dialectics by introducing an approach that emulates its strongest points; a derivative of it even. My aim is to show the advantage of a materialist dialectic approach to an investigation of e-waste, due largely to the lack of attempts at such investigations in the past. This absence is crucial, for in my view the only truly dialectical way is to proceed, as Marx did, via critique – to find the gaps and faults in contemporary research on this topic, demonstrate their flaws and advance a different understanding.

[6] Including Georgescu-Roegen's 'garbo-junk'; loss due to friction, etc. Things, unlike broken glass bottles or discarded newspapers, that cannot be recycled (at least not with today's technology) and are simply lost. See Georgescu-Roegen's discussion on the so-called *Fourth Law of Thermodynamics* for more details.

1.2. Dialectics and the relation between social and natural sciences

In order to proceed towards a model fitting for my thesis, I will begin with the general problem of dialectical modelling as it related to the social and natural sciences. A critical view on such modelling is given by Stephen C. Lonergan, who argues that "[i]ntegrated economic/ecological models can only be developed for a positivist or Aristotelian materialistic perspective [...]. We are not, then, able to relate Marxist perspectives with those of environmental scientists; they are ideologically variant and diametrically opposed." (7) I disagree with this statement; environmental science is not necessarily positivist – on the contrary, as Foster, Levins, Lewontin, and others argue, a dialectal ecological science has many advantages. Nor is dialectal modelling impossible – the models are just not considered universal truths but need to be more flexible. (8)

There is of course a long-standing division, and even antagonism, between the social and natural sciences, which I believe can be overcome via dialectics.[7] While I reject many of the strong claims made by Engels in his *Dialectics and Nature,* I do believe that there is much to gain scientifically by applying a dialectical approach even in areas where it is not customarily applied. This is especially true when one studies the interaction between the natural world and society, as such research represents a case of the two usually (conceptually) separate worlds overlapping. Alf Hornborg eloquently summarises this view: "material aspects of global society are widely ignored in social science, in part because they implicate knowledge and methodologies generally reserved for the natural sciences. Nor can they be fully grasped by the natural scientists themselves, simply because these researchers generally have a poor understanding of society". (9) An approach that can break through the dichotomy between the two fields and offer a unified way of studying the interaction is highly relevant to my topic. Dialectics offers that possibility, by focusing on the relevant levels of abstraction in research, and not on any artificial division between social and natural sciences. One accepts that different approaches may be suitable for different domains of study, but whether experimentation, quantitative methods or whatever else, is used or not does not determine something as a social or natural science. In fact, the "typical" argument on division between the social and natural sciences ignores what Schumpeter called the aforementioned "pre-analytic vision" of disciplines. (10) Schumpeter argued that every analysis is preceded by a cognitive act that determines what is to be analysed; thus, any quantitative analysis necessitates

[7] I will not discuss the classical critique of Lukács et. al. here, as those arguments are best expressed by those authors themselves but will focus instead on my reasons for partially disregarding that critique. I will, however, note that Lukács's critique does not consider studies of the *interaction* between society and nature. Since my research, despite its strong inclusion of the natural world, focuses on the social aspect of the interactions, it is unclear whether or not my particular use of dialectics necessarily contradicts Lukács at all.

qualitative choices. Conversely, qualitative understanding alone cannot explain matters such as the movement of galaxies or planets. The complete separation of the two is impossible, and the claim that one is superior to the other creates a false dichotomy that damages serious scientific progress, especially in fields relating to socio-natural metabolism. What approaches are preferred ought ultimately to depend on what is studied.

I further argue that a dialectical approach to, for example, ecology and biology, opens those fields up to political criticism and reveals the necessity of a social scientific understanding. An example can illustrate what I mean here: the theory that malaria is caused by parasitic protozoa carried by mosquitoes is certainly objectively true. Its “truth”, however, really only works on a certain level of abstraction, which ignores the interaction 'protozoan-mosquito-human' and the forces that shape and influence various aspects of that interaction. To paraphrase Levins and Lewontin, do poor people get malaria because of parasitic protozoa, or are parasitic protozoa one of the ways that poverty kills? (11) After all, mosquito-bites would not be a problem if everyone could afford mosquito nets. Human-caused eutrophication of lakes can lead to plankton blooms, followed by a lack of oxygen that kills, *inter alia,* the dragonfly nymphs which are a main predator of mosquitoes, thereby increasing the number of mosquitoes. (12) Human-caused climate change can also intensify the spread of mosquitoes by expanding their habitation zones. (13)(14) The tension between the absolute and relative is illustrated by a dialectical approach. While the culpability of the parasitic protozoa is absolute, a biological fact, the extent to which this influences humanity is relative and depends largely on conditions that are subject to political influence. Hence the simple claim that malaria is caused by protozoa is, on its own, implicitly a denial of the other factors that influence the spread of the disease; an obfuscation of the social injustice and political decisions that allow the disease to spread. Such a claim would provide implicit support to the existing social order by not holding it responsible for the reality we observe and ignore how social change can alter ecological and biological conditions. The very same claim also implies that the best solution to the malaria problem is to be found in new and better medicine, rather than in changing society.

If the social dimension is ignored by science, it is also marginalized from the debate concerning potential solutions. Many aspects of our reality, rather than being 'neutral' facts, are instead results of political-economic outcomes, and can be altered through political struggle. For instance, lack of public health-care is as much a cause of disease as are bacteria, parasites or viruses. Once again, a dialectical approach places a phenomenon in its socio-political context, and a materialist dialectic approach to ecological economics therefore implies the need for political ecology. Moreover, a dividing line between social and natural sciences really becomes both misleading and impractical

in any case when nature is affected by the actions of human society, or human society is impacted by nature. There is no obvious political aspect to astrophysics, for mankind cannot change the laws of physics. However, ecology does possess such a dimension in that political-economic decisions affect everything from the global climate to the spread of habitats of different species – and that in turn affects human society. Studies of a phenomenon are necessarily intertwined with everything that can influence and change it; especially when the studies themselves can shape matters by influencing policy. For example, the findings of climate science affect people's views on climate change, which may alter climate policy, which again changes the climate and leads to different scientific findings, and so on. Such a relationship between, and mutual influence of, *theory* and *practice* is a crucial dialectical concept, and is argued by Ollman to be one of the defining aspects of Marx's work. (15)

My commitment to a materialist dialectic approach must therefore not be taken as any kind of materialist reductionism that rejects the world of ideas; on the contrary, this is why I have stressed the importance of dialectics to my research. I propose that, as in the example above, ideas and reality are dialectically connected and that both develop through contradiction and interaction. Reality can clearly be influenced by values, goals and policy decisions; the error of idealist approaches is to assume that ideas and beliefs are the cause, and the failure to realise that ideas do not form in a social vacuum. They are instead outcomes of specific processes with specific goals, and cannot be separated from the historical, political, economic, cultural, etc. processes that they are a part of or the institutions through which they are carried out.

In sum, maintaining an artificial boundary between social and natural science is not just an ethical problem, but is unscientific because it ignores a vital aspect of an object of study. Additionally, to ignore the social and political-economic dimension of a problem can itself be seen as a kind of political action that masquerades behind a veil of objectivity; political factors are not just made explicit. (16) As Brad Werner argues, it may be necessary to include socio-political dimensions even in purely scientific models, precisely so that they maintain objectivity and actually describe the reality we live in.[8] (17) This is especially true when the thing being studied is the relation (metabolism) between society and the natural world, as is the case with my research. Even though my research emphasises the social relations involved and is far more 'social science' than 'natural science', I must take ecology, chemistry and medicine into account. After all, if it were not for the specific chemical properties of e-waste making them harmful to health and environment in specific

[8] Werner's case concerns the inclusion of political resistance in systems ecology models, since such resistance against emissions and environmental degradation is a factor that affects the level of actual emissions and degradation.

ways when handled a certain way, there would be no problem (or at least a very different one). The cause of the e-waste problems is not to be found either in the physical properties of the technology involved or the properties and limitations of the local environment ('natural science'), the recycling techniques employed ('technology'), the laws and policies regulating the former ('politics/law'), nor in the social relations in which all of this is embedded ('social science'). It is rather the outcome of a particular interaction between all of the above, and of the context in which they exist, specifically the mode of production that shapes them.

1.3. Totality and analytical separation in dialectical models

A further challenge for dialectical modelling is the occasional necessity of analytically separating interconnected concepts that form a unified whole in order to examine them more closely. In the dialectical view, a 'thing' consists in part of its relations; those relations shape it and are a part of it. Isolating something from its relations by definition changes the object of study. It is, of course, both acceptable and necessary to separate concepts in this manner in the course of a dialectical investigation, as one would do in any non-dialectical research. The difference is that a dialectical approach must keep in mind that connections with other phenomena exist and attempts to join the different parts together in the final analysis. Connections and interdependencies, after all, do not mean that there is no independence at all; parts of a system can still have enough autonomy to be analysed on their own – the understanding is simply not complete until a system is placed within the context of the larger system of which it is a part. Hence, I am able to focus, for instance, on the local e-waste-based economy in Accra in order to understand better that particular part of the total phenomenon. Dialectics is a matter of extending and deepening the inquiry, not of imagining that one can analyse the whole of a phenomenon at once. The problem emerges if we stop there, if our inquiry is cut off and we presume that we have the whole picture without analysing, e.g., the influx of e-waste, the effects of its recycling on the health of the locals, and so on.

An analysis of a sub-system without an accompanying analysis of the greater system of which it is a part is not necessarily incorrect, merely incomplete. After all, even when I have completed my research, no final picture will have emerged, since some aspects are by necessity excluded from my analysis, such as the precise workings of global capitalism (the total economic system of which the subject of my research is a sub-system). That leaves my analysis incomplete, though hopefully still useful, and an understanding of the precise workings of capitalism would be required for a complete understanding of the phenomena of e-waste; which is, in part, what I hope to demonstrate.

To express the matter using dialectical categories, the Agbogbloshie and Guiyu cases are merely the *particular* forms of a *general* tendency of e-waste displacement, which in itself is just a particular form of the general tendency of exploiting developing nations, and of shifting costs and neglecting the natural world due to the constrains of the profit imperative – and those phenomena are in turn themselves particular forms taken by the general laws of capitalism.

The advantage of an analytical separation, such as investigating the local economy on its own, lies not merely in a greater simplicity; it is not an *idealist* abstraction, an artificial separation that we imagine for the sake of the model. The truth is that the local e-waste-based economy really *does* work separately and is even in *contradiction* with other issues, such as those of human and environmental health. As Levins and Lewontin put it, “a society is not a servomechanism; its component classes pursue different, both shared and conflicting goals.” (18) This, I believe, is the essence of Marx's method. He abstracts *materialistically*, proceeding from the workings of the real world – for example, Marx analyses commodities as a thing on their own because in capitalism they *become* separate things due to alienation. Only once that phenomenon is understood, or understood as well as it can be on its own, is there an attempt to join it together with other concerns and to demonstrate interpenetration and mutual determination, and so on. In my case, the natural world appears as something separate from the economy. In a way it is clearly *not* separate because the two demonstrably affect each-other; yet in another way it *is* separate because of the presence of contradicting goals. As in the case of the wealth of capitalism appearing as “an immense accumulation of commodities”, the natural world appears as a ‘free gift’; and just as in the case of commodities, the appearance takes on a real form. (19) It is my task both to analyse the issues separately, but to also bring them together and show that they are, 'behind the veil', a part of the same overarching phenomenon.

1.4. Dialectics and systems science

The principles of system's theory are suitable to the study of the organization and interaction of interrelated and interdependent parts that form a unified system, and arguably lend themselves better to modelling than does dialectics for reasons that I will shortly make apparent. As has been argued by, among others, the pioneering British evolutionary biologist and geneticist John Maynard Smith, there are overlaps between dialectics and systems theory; both focus on wholeness and complexity, the relation between things and the way that something can be both cause and effect. Furthermore, the systems concept of 'feedback' can be said to be similar to the dialectical

‘interchange of cause and effect’, and the 'phase transition' or 'threshold effect' of systems theory bears similarity to the 'transformation of quantity into quality’ of dialectics. In response, Levins has argued that the similarities certainly are positive, and imply that even non-dialectical science is becoming a bit more dialectical, but that one cannot speak of systems theory replacing dialectics. (20) He is, however, sympathetic to a combination of the two, and it is such a combination that I intend to make use of. (21)

The advantage of systems theory to my topic lies in its formalism and its suitability for schematization. It is much easier to use systems theory to show the simple empirical facts and approximately demonstrate the relations that exist in such a complex system; or in a systems language: the *input* of waste, its *process of transformation* through recycling into useful metals and the *output* of the same.

Yet this would merely show the appearance of things, the *simple* empirical facts. On its own such an application of a systems approach would bring nothing new to the table; it would simply re-arrange available data such that relevant facts and connections/dependencies are more easily observed. In contrast, I employ the categories of systems theory to advance a Marxist analysis of the system in question. The underlying forces and movements, *the essence*, that are hard to illustrate in a flow analysis or schematic are addressed though a deepened analysis. The role of systems theory is to simplify, which allows for the creation of models that present *the appearance.* After this, I proceed with the actual analysis of that which is *not* so easily observable, that which lies beyond the veil of appearances. The map is never mistaken for the territory but used to illustrate certain complexities and form the basis for deeper discussion. As in the case of analytical separation, the systems model would be incomplete unless placed in the proper context. This distinction and tension in dialectics between the appearance and essence of a phenomenon, between the *form* of expression and the total *content* of the relations (and potentials) within it, is best illustrated in Marx’s treatment of money as the expression of value.

The roles of systems theory and the materialist dialectic are thereby complementary; the one being more rigid, the other more fluid.[9] So, with the materialist dialectic, unlike with systems theory, one does not conceptualise distinct *things* which are then connected to each other via *relations*, with the two concepts 'thing' and 'relation' held apart. Instead, the process-orientation of dialectics means that the relations which something has and the context within which it exists are thought of as being

[9] Levins argues that the comparative rigidity of systems theory has to do with its roots; it was designed initially for designed and manufactured systems for which its assumptions are very much valid. (22).

part of the thing itself and able to change it. That change is not just quantitative, as systems theory addresses, but qualitative too. Hence money does not merely increase in quantity via accumulation but is *transformed* into capital. Predators do not merely affect the population size of their prey (quantitative) but apply evolutionary pressure that selects for survival against said predator; the prey will *evolve* over long spans of time (qualitative change). This change of quantitative into qualitative, or vice versa, is one of Engel's 'laws' of dialectics in *Dialectics of Nature*. (23)

1.5. Critical Realism

The philosophy of science of my thesis is broadly consistent with that of critical realism, which is itself compatible with a Marxist, and dialectical and historical materialist, outlook. The intricacies of a critical realist perspective, and the advantages it can provide to a study of this kind, are worthwhile to consider for future endeavours, though in this thesis I am satisfied with establishing a broad consistency only. Particularly relevant here is the work of Bhaskar, Sayer and Jessop. (24)

Important to note is that the critical realist perspective does not claim a privileged access to truth, nor does it guarantee that the outcome of its application will be useful knowledge. It also rejects naive objectivism. Sayer argues that the “defining feature of realism is the belief that there is a world existing independently of our knowledge of it”, a belief which is justified by the “fallibility of our knowledge – the experience of getting things wrong”. (25) The world being independent from our beliefs and knowledge of it, make guarantees of truth impossible.

The basis of the critical realist foundation is to distinguish between three strata of phenomena; the real, the actual, and the empirical. The *real* comprises the causal mechanisms that have generated the events, including the underlying mechanisms of capitalism of which the e-waste phenomenon is a particular expression. It is that which exists, irrespective of our knowledge or understanding of it; the “the realm of objects, their structures and powers” as Sayer puts it. (26)

The *actual* refers to the whole of the events that take place, including what lies beyond the experience of actors, the actualization of potentials. This would be the larger phenomenon of export and informal recycling of e-waste, including laws and regulations and the flows themselves. The actual, then, is when reals powers and structures are activated or otherwise come into play. Sayer uses the example of the Marxist differentiation between labour-power and labour; the former referring to a real capacity and the latter to actual work, namely, the carrying out of the capacity. (27)

The *empirical* concerns the production of evidence for the actual.[10] In the case of this thesis, this would be my observations on the lived experiences of e-waste recyclers, and the mapping of e-waste flows. The empirical is the experience of the real and/or actual, again irrespective of our knowledge or understanding of it. It permits, but does not require, observability. Forces and powers can exist which do not come into play, and likewise things may come into play without being observed.[11] (28)

Noteworthy is that Clive Spash, an ecological economist who is apart from the mainstream, has argued in favour of a dialectical approach, and endorsed critical realism as the base philosophy of science for ecological economics as a subject. The view is shared by other researches in the field, such as Armin Puller and Tone Smith. (29)

For the purpose of this thesis, no defence of critical realism *as such* is necessary. Jessop argues that while it is true that "philosophical argument can justify a 'critical realist ontology and epistemology in general'", it also holds true that "there is no such thing as critical realism in general or general critical realism, only particular critical realisms and the sum of critical realist arguments". (30) That is, to defend critical realism as such would be pointless for the purpose of this thesis, even if possible; any particular critical realism can only be validated in respect to the specific research application for which it is applied. Adapting a critical realist framework does not in and of itself provide a relevant framework or approach suitable to a particular research project.

Therefore, while my research is broadly compatible with critical realism, critical realism is insufficient on its own. What critical realism does provide my thesis with, however, is an ontological and epistemological foundation, which itself offers the possibility of explaining things in a multi-sided way, exploring multiple interacting causes, not all of which can be derived from value theory, nor explained by an orthodox Marxist approach. This is what allows for a broadening of Marxist ideas into something that includes insights and tools adapted from other disciplines, like ecological economics and industrial ecology, rather than having to rely on a reductionist reading of Marxism. Marxism, including in particular the Ecomarxism with which I broadly align myself,

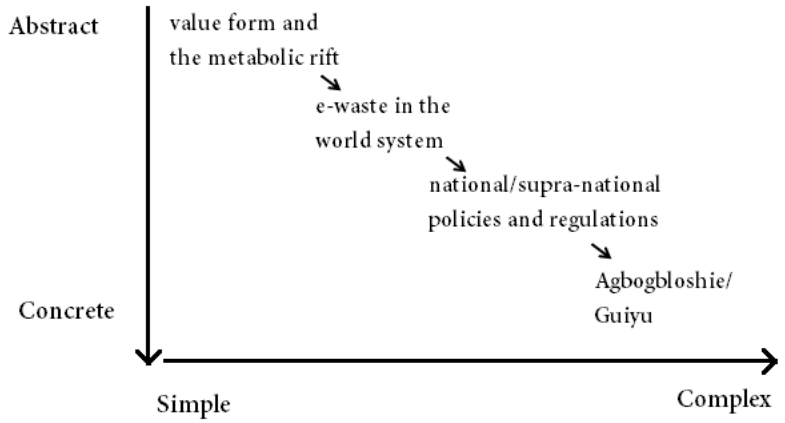
[10] As Jessop clarifies, it is the "observations concerning the actual and/or the real, lived experience, observations, measurements of actual pattern of events" (31)

[11] Sayer argues that "a plausible case for the existence of unobservable entities can be made by reference to observable effects which can only be explained as the products of such entities". Lack of observability does not in and of itself imply the non-existence of something, the implication being that just because something has not happened yet may not mean that it could not happen. (32)

emphasises the real – the underlying causes, tendencies, dilemmas, contradictions and interactions found at different levels in the global flow of e-waste – which explains the empirical and the actual.

Marxism also stresses the importance of *tendencies* as integral parts of the real; for it is possible for mechanisms to exist either latently, without being activated at all, or for them to be counteracted by some other mechanism. While the empirical and actual can serve as a basis for questioning the real, not all that is real is always revealed in the actual or empirical through events or observations – which does not in itself prove the non-existence of the thing at hand. So, as the thesis will demonstrate, the management of e-waste in a country like Sweden is done in a completely different and largely environmentally sound manner. Yet this does not on its own disprove the existence of some kind of underlying tendency towards mismanaged recycling, since it may also be the case that, for instance, the laws and regulations specific to Sweden serve as a strong enough counter-tendency to prevent, or at least supress, the expression of the underlying mechanism.

What I study can be said, in critical realist language, to be the *concreteness* of e-waste. It is not about critical realist philosophy itself, but a case-study of the *concrete-complex* nature of e-waste management from an Ecomarxist perspective.



A simple illustration showing the movement from simple-abstract to complex-concrete in the thesis.

The territory-scale levels are *representations* of how the phenomenon expresses itself. The e-waste stream is the true concrete, and not the regions as such. China and Ghana as countries, as well as Guiyu and Agbogbloshie as specific locations, are merely potent examples; the concrete stream of e-waste, as it is my intention to show, moves to find the proper conditions for its own existence, vis-à-vis local laws, regulations, economic conditions, organisational structures, etc.

In this thesis, I have moved backwards from the *concrete and complex* to the *abstract and simple*; beginning with the observed phenomena and the "world of appearances", and moving up to the more abstract levels to try and reveal the real forces at play, whilst continually trying to tie everything back to the concrete. I believe this to be consistent with that Marx argued in the *Introduction to the Contribution to the Critique of Political Economy*, namely, that the goal of critical social science is to reproduce the real-concrete as a concrete-in-thought. (33) This requires a continual dialectical interplay of empirical phenomena and abstract-simple theorization, aiming to combine the results into a concrete-complex analysis of the real-concrete whole.

In other words, I theorise that the "metabolic rift" is part of what forms value and try to connect the "ecological rift" to "alienation", and alienation as the root of value, arguing in favour of a "socio-metabolic value theory" in Chapter 15. This is an extension of the commonly accepted meaning of "alienation" derived from Marx's *Economic and Philosophic Manuscripts of 1844*, which relies strongly on Saito's philological work on Marx's *Paris Notebooks*, as well as the metabolic rift theories of Foster et. al. In Chapter 14, I try to connect the accumulation of value (which follows from the above) to the world-systems division of labour and to unequal ecological exchange, arguing that unequal ecological exchange is a specific form that the ecological rift takes. E-waste itself is just a particular form of unequal ecological exchange, of "dark value flows".

In chapters 3 and 4, I present the situation on the national level, though I mention the influence of policies and regulations, that constitute part of the actual, throughout the thesis. I argue that China and Ghana are just specific countries that happen to have the correct conditions to receive e-waste, and that the flows can and will shift should the conditions change, as has already been observed regarding China. A similar outcome has also occurred regarding the flows into Nigeria, which have shifted more and more into Ghana as local regulations have become stricter, though this is only briefly mentioned in my thesis. Policies on e-waste are shaped by the (changing) positions in the world-system of regions, which is a thought I present first in chapter 10.

Lastly, mainly in chapters 5-7, I show the concrete, empirical, situation at Agbogbloshie and Guiyu and how the abstract forces play out on the ground.

Things become complicated due to necessary "detours" required to explain what e-waste is, why it is valuable, why it is a problem, how it could be dealt with differently, as well as issues with non-critical perspectives, etc. Chapters 3, 8, 9, 10 and 11 are devoted to this.

Ecological economics comes in firstly as a "meta-paradigm" as Burkett calls it: accepting the economic system as a subsystem of the ecological system. Secondly, it comes in during the world-

system analysis, as a part of the argument on unequal ecological exchange. There are also some wider issues, and I try to discuss these and explain the implications of what my thesis means for ecological economics in chapter 13. Returning to chapter 15, I invoke ecological economics here as well, in order to clarify the exact meaning of the project of establishing a Marxian, i.e. value theory-based, reading of ecological economics and political ecology. That is, reinterpreting the concepts of ecological economics on a Marxian foundation.

2. Theory to Practice: MFA and micro-ethnography

2.1. Socially embedded MFA and the industrial ecology of e-waste

Proceeding from the theoretical discussion on dialectical modelling and the compatibility of the dialectical and systems approach, it is now possible to develop the appropriate method for the subject of this thesis. A major component will be the use of a socially embedded material flow analysis (MFA). Despite the wide-spread use of MFA in industries, the systems and processes in an MFA need not be parts of an industrial production process but can represent both concrete and abstract entities, including social and cultural ones, given that they are well-defined enough to enable an analysis. Wallsten argues that it is in fact necessary to "integrate the flows and stocks' societal dimension into the MFA", especially in recycling and urban mining research, since this is an oft neglected component in industrial ecological research which instead deals with the flows as given without contextualising them. (34) Moore argues that the only proper materialist dialectic approach, and indeed the only proper scientific one, entails looking at the social relations in question as they contain in them the phenomena taking place at higher levels, so that the social context of e-waste flows can lead us to the underlying forces of which the e-waste problem is an expression. (35) A socially embedded MFA can be used to establish that unequal ecological exchange occurs, and in what ways, in the e-waste trade, by showing the inequalities between regions. But while MFA schematics show *that* unequal ecological exchange and metabolic rifts exist, one must also show *why* they exist; which is the role of the social context analysis. The theory of unequal ecological exchange coupled with metabolic rift analysis forms the foundation of this

wider social context into which the MFA is embedded. MFA schematics are hence an illustration and a schematic expression of the 'exchange-rift'.[12]

This thesis will present MFA schematics showing global e-waste flows and their movement to/from countries and regions; the local movement of e-waste within Agbogbloshie; and flows of toxins out into the environment/people and metals out into the industry. For this end a combination of top-down and bottom-up data collection was utilized. Top-down data was collected by combining trade and import statistics from various sources, including electronic equipment sale data and customs data, and estimating the inflows and outflows of WEEE. Bottom-up data-collection relied on a micro-ethnographical study of Accra and the Agbogbloshie e-waste site in order to observe and trace the flows within the area. Two smaller, comparison studies, were also conducted in a similar fashion: one of Guiyu in China and a very brief one of a modern, state-of-the-art electronic waste recycling facility in Katrineholm in Sweden.

The aim of this political-industrial ecological mapping is, then, not to study the people in relation to their sociocultural context, but in relation to the material conditions of the informal e-waste industry. Hence, I do not focus on the subjective experiences as understood by the e-waste workers themselves, though I attempt to allow some this experience to be shared but analyse their conditions in the specific context of both the global e-waste flows and of capitalism itself. This does not mean to imply that a more classical ethnography of Agbogbloshie or Guiyu would not be worthwhile, but simply that it is not the aim of this thesis. More importantly, some restrictions I faced regarding access and time would preclude an ethnography of the lived experiences of e-waste workers but does not preclude the political-industrial ecological analysis which is my aim. The reason being that it is not the perspective or experience of the workers, either as individuals or as a community in their own right, which is central, but the role they occupy in the aforementioned productive nexus. The individual workers are analysed as actors in the structure of the industrial ecologies of Agbogbloshie and Guiyu, which is far easier to establish and not nearly as dependent on lengthy observation and personal interaction. Instead, micro-ethnography is utilized as merely one tool among others, employed in the documentation and examination of the particular expressions of class in the context of e-waste work. The micro-ethnographical component is meant to validate and complement existing data rather than stand on its own, the overall aim being to provide an overview

[12] The concept of entropy also enters into consideration, as I will argue later on. An MFA is meant to demonstrate my assertion that a kind of 'unequal exchange of entropy' or 'entropic quality' occurs when useless high-entropy waste enters dump-sites but useful low-entropy resources leave it.

of specific segments of the global metabolic network at a specific point in time. The observations of others, statistical data, natural scientific and medical data, and interviews with experts can thus all be woven together with my micro-ethnographical observations for the purpose of an aggregated narrative structure that reveals the ways in which the class structure expresses itself in the context of e-waste work.

2.1.1. A brief note on energy and labour

Robert Ayres argues that industrial metabolism is “the whole integrated collection of physical processes that convert raw materials and energy, plus labour, into finished products and wastes...”. (36) As I have made clear, in my thesis I intend to analyse material flows, but what about flows of energy and labour?

Having considered exergy and emergy models, such as those in Odum's and Foster's work, I have found their usefulness limited for my research. Energy is not that important quantitatively speaking in the e-waste case; it is the quality of energy and the context and manner in which it is used that is determinant to the outcome. That is, it is not the amount energy added through setting a computer case on fire to melt the plastic, or the energy in the stove-like device that melts the copper, that matters –– it is the fact that a computer case is being set on fire and that a stove-like device is used for melting copper that matters, as well as the consequences these acts entail. Concerning labour, here also the qualitative nature of it – the risks and hardships it involves – matters far more than any quantified measure of, for example, labour hours. The qualitative aspect of energy usage and labour forms a part of the social context into which my MFA will be embedded and will therefore be a part of my analysis. However, quantitative measures of energy, labour and related concepts such as exergy and emergy, will not be considered in this thesis.

2.2. MFA and dialectics

My dialectical approach to systems theory impacts my use of MFA, since it is itself based on systems theory, which leads to the question: what would a dialectical materialist MFA be like? According to Brunner's and Rechberger's classical and defining work on the subject, an MFA system always consists of the following: (37)

1. The system boundary, which defines the scope of the analysis.

2. One or more processes within that boundary.

3. The material flows between those processes, and also between processes within and outside the system boundary, through which exchange occurs between the system being analysed and its broader environment.

4. The stocks of materials within the relevant processes.

Considering the above four contents of an MFA, a materialist dialectical re-imagining of the same can be described as follows:

1. A dialectical approach means, firstly, that the system is embedded in a social, environmental, economic, and spatial, context. Secondly, boundaries are not absolute, and different levels of abstraction and interconnections are considered. The 'system' is hence a theoretical abstraction, a simplification that highlights certain processes taking place in reality – something that is not necessarily valid outside of that particular model. A different model could always be made with different system boundaries, giving different results.

A system, according to Brunner and Rechberger, is the “actual object of an MFA investigation”. (38) The boundaries of the system are defined in time and space; in this thesis it is the cities of Accra and Guiyu, in the first case looking at flows from around 2008 until the present day, and in the latter case looking at the changes since the 2013 industrial park construction. The system compartments, or sub-systems, are in the Ghanaian case: the 1. Agbogbloshie scrap-yard (and a new, smaller scrapyard right outside it), 2. the surrounding Old Fadama slum, and 3. the various locations in Accra where second-hand electronics are sold, which will be treated as the same compartment due to their similarity and geographic closeness. In Guiyu, the compartments are: 1. the central parts of Guiyu town, 2. the Industrial Park, and 3. Longgang district. On the micro-level, the object of study is the e-waste workers. On the meso-level, it is Agbogbloshie and Guiyu as communities and their surroundings. On the macro-level, it is the national and global context as it pertains to e-waste.

Note also that environmental impact is seldom confined to national borders, especially when it comes to the atmosphere and water systems. In the e-waste case, however, it would appear that the impact is contained to the local environment and does not spread far beyond it in any of the cases studied. I can therefore confine my analysis of environmental problems to Accra and Guiyu and the nearby surrounding area.

2. In ISO 14040, a 'unit process' is defined as the “smallest element considered in the life cycle

inventory analysis for which input and output data are quantified.” (39) Such a process can include *social processes*. The aforementioned work of Levins and Lewontin in applying a materialist dialectic approach to biology shows us that such an approach can also 'define and separate' certain things from others, at least when specific models are concerned. Processes work dialectically but can be illustrated systemically, with certain assumptions made explicit; for example, a 'thing' and an 'effect' could be illustrated as separate but connected, even though they are really not so much 'connected' as part of the same process in which they shape and alter each-other. They can still be analytically separate: consider the human heart, which of course works with, affects and is affected by the entire body –- it is part of that system and is *practically* inseparable since to remove a person's heart is to kill the person –- yet we can still isolate it *conceptually* and study “the heart” as an independent organ. Likewise, for the purpose of a model one can quite easily separate 'e-waste' from 'various stages of recycling the same'.

3. The material flows, in reality, shape and determine the nature of the process in question and are at once determined by the process -– and the same is true of the system as a whole. But we can still separate the two conceptually and illustrate a relation in a simplified matter for better overview. As long as this is accompanied by a contextual analysis, the whole is still valid. It is simply a matter of being explicit about assumptions and simplifications and not relying on a single model but building a picture of the whole using different models working together.

The selected flow in this thesis is second-hand electronic goods with an obvious emphasis on e-waste. While some attention will also be placed the toxic chemicals released and produced through informal recycling, those are not subject to an MFA. The reason for looking at second-hand electronic goods in general, is that distinguishing between legitimate second-hand goods and e-waste is part of the problem and is not always straightforward.

4. This part is the most straight-forward and needs not be altered at all in a dialectical version. One only needs to bear in mind the context and the 'how and why' of the stocks. For example, for the sake of the MFA-model itself it can be simply accepted that a certain quantity of e-waste is stored in various small, privately-owned repair shops around Agbogbloshie. But in the wider analysis, the reasons for that stock having arrived there in the first place and for being stored must be probed.

2.3. Marxism, ethnography, micro-ethnography

As previously mentioned, a micro-ethnographical study of Accra and Agbogbloshie was utilized as a means of gathering data about the on-site conditions. Micro-ethnography was the tool most suitable given both the constraints and the aims, the latter being to study a very particular and limited aspect of the e-waste phenomenon as manifested at a particular place and time. Wolcott defines micro-ethnographies as focusing on a specific set of behaviours in a specific setting, contrasted with the portrayal of an entire cultural system that defines ethnography proper. (40) Garcez likewise suggests the suitability of micro-ethnographies to the study of very specific situations. (41) Lambert et. al. characterize micro-ethnographies as the "application or borrowing of ethnographic techniques… as opposed to 'true' ethnography". (42) This latter is the position that I explicitly take, as my micro-ethnographical research into Agbogbloshie, and to an extent Guiyu, is meant to be a part of a wider, political-industrial ecological examination of e-waste trade.

Nonetheless, my methodological commitments necessitate a *Marxian* micro-ethnographical approach, distinguishing it further from 'classical' ethnography and even other forms of micro-ethnography, particularly in the way the class concept is approached. Crucially, as Beach argues, in the Marxian tradition of ethnography *class* is a matter of ontology rather than epistemology. (43) That is, the category 'class' is not constructed as a tool to study real phenomena but is taken to *be* a real phenomenon. As Beach puts it, "[i]n Marxism class is a historically created relation of individuals to nature and to one another through relations of/to production, which is handed down to each generation from its predecessors", and not a 'social construct' as it may be in non-Marxist research. (44) It is real in itself, and not merely real in terms of measurable social, political or economic ramifications; though such ramifications will likely exist due to class structures, they do not *constitute* class but are expressions and indications of it. This must not be taken as crude economic reductionism in which the economic base determines all else, but simply the acknowledgement of a basic fact of life: that people must "eat, drink, have shelter and clothing" before all else, hence the means of acquiring the substances and necessities of life is the entry point of class analysis. (45) The economic base of a society, in the sense of how the means of substance are acquired and produced, is the fundamental condition of human history, not its sole determinant. (46)

The practical implication is one of materialist, as opposed to idealist, abstractions. Firstly, this relates to the discussion in section 1.3. on analytical separation and boundaries. Secondly, this means that any analysis of the particular class structure of Agbogbloshie and Accra must consider

observations of what positions people occupy in the hierarchy of the extraction-recycling-(re)production nexus – and not merely rely on abstract, theoretical notions of class. These hierarchical positions do not constitute class but are the expressions of class. Taken together, the specific connections and relations between people between which there is some degree of opposition and contradiction of interests, rooted in the overall process of extraction-recycling-(re)production, reveal the underlying class structure. Whatever else may be true, the distinction between those who have nothing but their labour to sell and those who own and control the means of production is central. This does not preclude the existence of other classes besides *worker* and *capitalist*; be they peasants, small business owners or academics or something else entirely. Nor does it preclude a diversity in the way that classes are expressed or the existence of other hierarchical structures that affect the class structure. As we shall see, the traditional chiefdoms and tribal structures still present in Ghana have a substantial impact on class formations, as does the existence of pseudo-petit bourgeois microenterprises of refurbishers and tinkerers. The historical process of class formation in the Ghanaian e-waste industry is nevertheless a particular expression of the general laws that govern capitalist society, and thus we will find that though it is not identical to Marx's case-studies in Vol. 1 of Capital, particularly those of so-called domestic industries, it is subject to the same general tendencies. The Marxian concept class remains the primary analytical category.

Note that the materialist approach to abstraction here described contrasts with the previous description of MFA modelling in section 2.2., in which the model was theoretical and abstract and not at all assumed to be valid beyond the particular instance the schematic described. In other words, it was epistemological and not ontological. This is due to the reductionist nature of MFA schematics, which cannot illustrate the complexity of class relations, and hence cannot be based directly on a 'materialist abstraction'. Instead, MFA modelling makes the necessary assumptions and simplifications needed to illustrate the point it is being used to support; hence the necessity of following this up with social embedding and class analysis in order to present a valid whole. A stand-alone MFA schematic of e-waste flows would be too arbitrary, its results too dependent on particular system boundaries chosen. As will be shown in the thesis, the validity of any material flow analysis in fact depends on the validity of the accompanying social context analysis; it is the role of the social context analysis to show that the system boundaries and other assumptions of the MFA are not arbitrary but reflect actual conditions. In this way, my MFA schematics are *indirectly* 'materialist abstractions'.

3. Practice: approaches, issues and documentation

3.1. Qualitative data

Qualitative data is presented in the case-studies in Part II of the thesis and was gathered by me via visits to Agbogbloshie and Guiyu. The data combines different kinds of interviews, both with experts and e-waste workers, and observation of e-waste related work and the context in which it occurs. The interviews were all *unstructured interviews* relying on some closed but mostly open questions, leaning somewhat towards s*emi-structured interviews* in the cases when experts were interviewed. This allowed for a greater room for improvisation and allowed me to develop questions during the course of the interview and respond to the interviewees' statements. The below list of four question categories was used as a prompt.

- Overall personal impression
- Income and living conditions
- Labour conditions
- Power relations

The more casual nature of these interview tended to make interviewees feel somewhat more at ease and allowed them to share their perspective more freely. Some interviewees felt uncomfortable to engage in a longer discussion or continue an interview for very long, likely due to a fear of an impact on their livelihood. Note that this applies only for e-waste workers, and not the experts. Though many subjects were careful and reserved, it was not uncommon for them eventually to relax and speak casually and widely about both relevant and less relevant subjects and even laugh and jest. The subjects were generally able to tell *their* story in their own way, allowing me to gain access to their world-view.

Interviews were combined with *participant observation*, which in practice meant that I followed the workers around and observed their actions and behaviour, paying particular attention to the happenings and conversations taking place around me as far as language allowed, while continuously asking questions. Note that no *nonintrusive* observation could take place since I, as a man of Slavic/European descent, stood out clearly at both Guiyu and Agbogbloshie and thus could not observe while myself remaining unobserved. Rather, my presence gathered attention and I would often be approached and asked about my reason for being there, to which I always gave an honest answer.

By confirming observations with interview questions and vice versa, and also double-checking with reports from other researchers, a kind of triangulation is achieved which results in a greater degree of confidence in the findings, a not uncommon approach in ethnographical studies. (47)

I made use of *jotted field-notes* for most documentation, using audio recordings when possible and permitted, and some photography also when possible and permitted. This approach is typical of micro-ethnographical research, as Garcez argues: "[m]icroethnographers typically work with audiovisual machine recordings of naturally occurring social encounters to investigate in minute detail what interactants do in real time as they co-construct talk-in-interaction in everyday life." (48) During interviews it was imperative that I not make subjects feel self-conscious or worried about possible consequences; being seen taking notes could cause that to occur, as well as other types of problems, especially when it comes to the illegal side of e-waste trade, but also the possibly technically legal yet unsavoury aspects such as child labour.[13] Hence a substantial part of documenting observations came down to *mental notes* of what I had seen and heard. At the end of each day I used all the aforementioned documents to compose *full field notes* which then served as my source of data.

Finally, in order to clarify the health impacts and potential hazards of e-waste work, Chapter 8 will go over and summarize the findings from various different sources, relying chiefly on natural-scientific and medical second-hand data. Given that this is a work of social science, this data will not be analysed in-depth but merely be contextualised within the grander scope of the e-waste problem, its function being mainly to prove the negative health impacts of e-waste work. Consider the example of malaria discussed in the beginnings of this chapter, and the manner in which social contextualization can politicize a medical problem. The idea here being that in order to politicise properly the medical problems, they must first be well understood and concretely connected to e-waste. One must understand, for example, the led contamination not simply as 'negative' in a vague sense, but clearly see both the source or the led in terms of physical and social cause, and the health effects of it entering human bodies. Contamination can only be politicised when the whole of the complex chain is understood: from the socio-political and economic conditions that give rise to informal e-waste recycling, to the practical matter of the way in which it is recycled and why, to

13 In Ghana, children are legally allowed to do "light work" from the age of 13, and ordinary work from the age of 15, but with some legal restrictions for those under 18 regarding safety and work time. Whether or not e-waste work is legal or not is thus very much a matter of opinion. Child labour is overall considered a big problem in the country, with the Ghanaian government exerting itself to reduce it.

the chemicals released and created because of this, to the specific health effects of those chemicals on human bodies.

It is worth noting that in their work of MFA, Brunner and Rechberger (49) differentiate between Substance Flow Analysis as a subset of Material Flow Analysis which deals only with chemical substances, whereas MFA is more broadly defined and can refer both to chemical substances specifically and to goods. An SFA could be relevant to more carefully investigating the flow of chemical and toxic substances in the informal recycling process but is not something this thesis will engage with.

3.2. Quantitative data and secondary data analysis

The estimation of the volumes of e-waste flows will rely on secondary quantitative data, presented in Chapter 3 and Chapter 4 through a secondary data analysis. This has several reasons, not the least of which is that the time and resources required to obtain reliable first-hand data on these matters is beyond those at my disposal as a solitary researcher. As will be shown, even government agencies and influential NGOs struggle with producing reliable first-hand data on flows. Even less reliable data, such as in some cases simply counting the number of cargo containers laden with e-waste entering a port and estimating volume based on container capacity, is difficult to obtain due to difficulties of access, namely, obtaining permission to inspect containers in restricted areas of ports from the proper authorities.

Reliance on second-hand data is also an unobtrusive method of getting relevant data which avoids both reactivity and any potential ethical problems of trying to obtain data covertly, such as by entering restricted areas without permission or documenting things with camera despite it being prohibited. As such it provides a complement to the first-hand data, which was gathered through interviews and observations in which all participants were informed that they were being studied and for what purpose. This exemplifies what Webb et al. called *triangulation* in social research, that is, the use of both reactive and unobtrusive approaches in conjunction, with the aim of producing more reliable results. (50) As Deacon et al. as well as Jick show, triangulating quantitative and qualitative data in combination in this way is not typical in social scientific research, but certainly offers benefits. (51)

Second-hand data, however, offers other advantages than simply being easier to obtain and complementing the first-hand data. Due to controversies and contradictions in claims about volume

flows, which will be discussed in greater detail in the coming chapters, it is better to rely on several and official sources of data from both governments and NGOs. Several different sources allow for a more accurate analysis and allow for a better estimate of the real flows, while the official source signify better quality data. As will be shown, data on e-waste is very lacking overall. Official statistics are difficult when it comes to legal grey-areas such as e-waste; if it is e-waste it is almost per definition not part of the official statistics. Much of the data from government agencies therefore relies on looking at gaps in their own numbers, for instance comparing collected volumes with volumes placed on market and making estimates based on that. Many governments, most commonly those of developing countries, do not keep statistics at all and even the official data we have are merely rough estimates. Yet, official reports represent the best and most reliable data we have, particularly data from NGOs specifically devoted to the e-waste issue.

The lack of reliability coupled with the contradictive conclusions, however, necessitate a reanalysis of the data. Far from merely presenting different official statistics, my approach is to examine more carefully the reliability by way of looking at data collection methods, sources, assumptions made, and congruency with other similar data. As will be shown, one difficulty is that what first appears as a plethora of official data supporting the same or similar volumes soon turns out to be citations of other sources, or even citations of citations, which ultimately are derived from the same handful of sources. And whilst the original sources may be completely forthright about lack of precision, data collection issues, and the necessity of rough estimates and approximations, later citations often neglect to mention these details. This can give the impression of certainty where none exists. Thus, it turns out that what appeared at first to be exact data on flows corroborated by half a dozen different official government or NGO reports, turns out in the end to be a rough estimate or educated guess made by one person a decade ago.

In the end it must simply be admitted that there is, at the moment, a lack of verifiable and accurate data on e-waste flow volumes especially for developing countries; for reasons that this thesis intends to make clear. Given the often illegal, or at best legally questionable, nature of e-waste shipping this is understandable as there are often explicit efforts to hide or otherwise mask e-waste shipping. The best that can be done is to scrutinize the different estimates available and attempt to arrive at a rough estimate that is reasonable given what is known.

3.3. On-Site Situations and Access Issues

3.3.1 Agbogbloshie

I learned of the organizational structure at Agbogbloshie through my experiences and also though discussions with Accra and Agbogbloshie locals, including Bennet Akuffo and Issah Abdullai of Green Advocacy Ghana, Larry Kotoe of the Ghanaian EPA and Dr Francis Agyenim Boateng of the Ghanaian *Council for Scientific and Industrial Research,* as well as various workers in and around Agbogbloshie. (52) It is a complex system, to which outsiders are not commonly privy, and and one of which I only possess the most rudimentary understanding. From what I gather, it is rooted largely in the traditional structures of the local tribes, as the people in the area are very respectful of old, pre-colonial customs. The Greater Accra Scrap-Dealers Association is organized along informal lines, consisting of smaller groups federalized into larger ones. This tends to create occasional problems since there are several groups and tribes represented at Agbogbloshie, and so problems and conflicts from the Northern Region, from which most of them have migrated, tend to trickle down to Agbogbloshie, and lead to issues with cooperation, though usually not violence.

‘Local representatives’, or ‘opinion leaders’ are people who do not occupy any official position but are just respected in the community. This includes traditional chiefs, who, as will be shown, play an important role in the e-waste business. It is worth noting that while ‘informal’ in the sense of not being a part of official, government structures, these traditional offices are constitutionally protected in Ghana, and are hence considered legitimate offices of power. It is the opinion of such informal leaders that carries weight at Agbogbloshie, and they care not much for titles or positions in government or NGO institutions, nor various university scholars or journalists. The presence of the latter, unannounced and unapproved, tends to upset and anger the locals. Such things have simply happened too many times over the years with negative representations of their work usually following, making them cautious. An outsider needs a local representative to assist them, and could otherwise not gain access, and this goes twice for any outsider who clearly stands out due to things such as different skin-colour.

As Dr Francis Agyenim Boateng put it, a white man at Agbogbloshie stands out like a sore thumb; I saw no other European anywhere nearby and was continually gawked at by locals. I was also informed that the local chieftain had been informed of my presence but had no real interest in it as long as I remained under the guidance of Bennet Akuffo or Issah Abdullai –- who had already obtained permission as part of their work with Green Advocacy Ghana and were a well-known presence at Agbogbloshie. Independent exploration was discouraged and would have been

practically difficult due in no small part to language constraints. Additionally, locals appeared weary of outsiders and rarely expressed any interest in answering questions unless encouraged by my guides. Simply put, to explore alone, let alone snoop around unnoticed, would have been impossible.

Overall, my experience while there was that people were quite cautious and concerned about their privacy, though still openly curious about who I was and what I was doing there, often approaching me before I could approach them and wanting me to explain my presence. They were never hostile, though sometimes annoyed, and taking pictures seems to have made them particularly upset, and I was usually not permitted to do this even on the promise that I would censor faces. The pictures I did take required either some persuasion or were taken stealthily. Given the international attention, there is also a widespread belief among locals that outsider involvement can get them money; they would often ask for payment to speak with me or allow pictures. I did not provide this, due to both ethical concerns and worry about getting reliable information if I offered payment. I relied on persuasion instead, with which I was kindly assisted by Issah Abdullai who knew many of the workers personally. Once my status as an academic, rather than a journalist, was made clear, people tended to become far more cooperative.

In the end, I was only able to secure a handful of visits to the Agbogbloshie scrapyard itself, which in a semi-enclosed area, and only three full days. These full days included guidance and help with translation and a ‘tour’ of all of Agbogbloshie as well as the nearby residential district and the markets. Notably the area around the local chief’s residence was off limits to me, though it was pointed out to me. Apart from this there was also a guided, longer visit to a scrap-yard just outside of Agbogbloshie, part of a recent expansion under separate management. I was also able to do some observations of the living area and markets outside of the scrapyard by walking around on my own, as well as look at the work area from a distance, though my presence drew negative attention so that I could not continue this for long.

Access to the informal second-hand markets within Accra itself, which commonly dealt with used electronic goods and were connected to Agbogbloshie, was never an issue and I could stroll around them and observe and speak to people at will with no need of guidance or even much translation. The people working here were commonly from Accra itself and not the Northern Region and could hence speak English. Observations in these places were therefore sporadically made through-out my month-long stay in Accra.

Ultimately, the restriction of access was an issue I could not plan ahead for, due in large part to its

informal nature. This necessitated improvisation and on-site resolution to the best of my ability. There were also ethical issues involved with potentially gaining access to restricted places without permission. A covert role may be necessary to map fully the Agbogbloshie situation but was not used in this study due to ethical concerns and the aforementioned practical restrictions. I believe that the inability to get it, and my long process of repeatedly attempting to obtain it over a month's time, are simply part of the situation at Agbogbloshie. In a way, the fact that a site is off-limits to outsiders says something in itself.

3.3.2 Guiyu

Similar issues of access cropped up in China. (53) I began trying to arrange for my trip to Guiyu long before coming to Guangzhou and was assured, though in vague language, that I would get the assistance I needed. No commitment or specific plan was possible to arrive at, and I was told this would be easier to do on site. Once I arrived in Guangzhou and settled in at the South China Agricultural University, I immediately began trying to arrange for the trip but got little to no help. Most people seemed either noncommittal and made vague promises, or flatly stated they had no idea how to assist me. The SCAU seemed to have little interest in me besides taking pictures of me in front of advanced equipment wholly unrelated to my research and otherwise parading me around as a *white monkey;* a Westerner shown off simply for the supposed credibility of associating with Westerners.

Both the language barrier and the distance were commonly cited as a hurdle; Guiyu is culturally, linguistically and to a degree geographically isolated from the rest of China. *Chaoshan* dialect (also called *Teochew* dialect), spoken in Guiyu, is not intelligible to other Chinese people, even Guangdong natives. Notably, high speed train-tickets to the station nearest to Guiyu did not appear available for purchase online, nor was there any information indicating that anything other than ordinary train-tickets were available to that location – a trip that would take about 8 hours from Guangzhou. Only at the counter at the train station were the tickets available, after I inquired specifically about them.

Due to these issues I was only able to arrange for a single visit over two full days at the Guiyu Industrial Park, where almost all recycling takes place nowadays. Repeated visits could not be arranged despite numerous attempts over a period of two months. It was furthermore an unofficial visit, that local authorities and park personnel were not aware of in advance nor had given any special permission for, further limiting my access to the area since I was not permitted to walk

around as I pleased and was restricted from entering some buildings, most notably those I was told were the offices of higher ups at the park.

Later conversations with a few knowledgeable people, who shall remain anonymous by request, indicated to me that the people at SCAU either knew very well the process needed to contact officials connected to the industrial park at Guiyu, or could easily have found out what the process was. I was told that it was likely not a case of intentional censorship, but that they simply did not wish to get involved in the arduous process of doing everything required, which apparently involves several steps of contacts and bureaucratic hurdles at every point, and could even cause issues for them or at the very least inconvenience them with extra work and the burdens of reciprocal expectations.

Entry to the industrial park itself is supposedly restricted, but this is seemingly not strictly enforced as I did not have any trouble getting in and was not even stopped or asked anything at the entrance; the guard at the gate simply noted my presence and went about his day. Nor did Dr Dennis Zuev, a sociologist formerly at Lancaster University who has done e-waste related research, have any issues with gaining entry during his visit a few years before me. Inside the Park, Dr Zuev was told not to take pictures ‘for his own safety’, and Jim Puckett of Greenpeace also recalls similar difficulties with documentation. Puckett goes so far as to call the attitude of the locals before the park was built, during his early visits, “definitely hostile”, with people in place to prevent filming, photographing and other forms of documentation. (54) Yet at the time of my visit, when the park stood ready, I encountered no such issues and was allowed to take a few pictures when I asked. Taking pictures of the waste itself seemed acceptable to most, but they did not want me taking pictures of workers. This was allowed a few times when I assured people their faces would not be shown in any of the pictures. I also sneaked in plenty of pictures and took several without permission which provoked people, and I was then told not to take any more. After I left the industrial park, a man on a motorcycle rode up to me and stopped me, informing me that the guard in the park had sent him, and that I was forbidden from taking any more pictures at all when I returned again. Noteworthy is that he outright stated that I *was* permitted to return, despite my somewhat flagrant disregard of the rules, as long as I refrained from taking pictures. Hence, all picture documentation of the Industrial Park was done on just one day.

Additionally, while my assistant and translator, Jiambin Deng of SCAU, was very helpful and I certainly could not have done the research without him, I did suspect he was being coached or otherwise restricted in the help he offered me. Occasionally, he would feel uncomfortable with

certain questions and refused to translate them, or did not wish to approach certain people, or refrained from translating some comments into English for me and vice versa. He was reluctant to go certain places in the park though eager to show me other parts, but usually relented and allowed me to go where I wanted. Upon arrival to the park, his attitude changed from an initially very curious one, being an environmental scientist himself, to a far more cautious and restrained one once he had spoken to an, to me unknown, authority figure during the planning stage of the trip. Additionally, his views changed as well. He went from being continuously very critical of the overall situation in Guiyu during our whole visit, to suddenly changing his mind completely during the last leg of our journey. In fact, he stopped in the middle of making a critical observation to receive a phone call from a source unknown to me, a man he just described as his "boss". After a few minutes of conversation, he hung up and immediately changed his tune as regards Guiyu and launched into a brief monologue about how great the initiative was and how good the government was doing. I can of course prove nothing, but my personal impression was that my guide was being coached about what to say and how to present Guiyu, at least to some degree.

Lastly, many workers both inside the park and the handful of recycling shops outside it were unwilling to speak to me, excusing themselves with utterances of "I'm just a simple worker, I don't know anything" or simply telling me they did not want any trouble. Those who spoke with me would only engage in brief conversations, especially if there was a manager nearby, and people were particularly reluctant to let me speak to managers. Observation therefore made up a larger part of the data here than in Agbogbloshie, though I was nonetheless still able to interview some people. My interviews, however, for the most part consisted of dozens of brief conversations and many more snippets of conversation or short comments that I managed to wrestle out of the most reluctant workers. Only a handful of people were willing to have longer conversations with me, and none within the park itself. Seemingly there was no fear of any specific consequence, just a general feeling of unease from their side at speaking to outsiders about their work. They gave the impression of just wanting to keep their heads down, do their job and go home and not be bothered with issues they could do nothing about – but that they are nonetheless aware of those issues, especially those of the past. "What can I do?" asks one worker rhetorically. "There is no other work." People living in Guiyu who are not dependent on e-waste for their livelihoods are more critical, however. They think the government could do more – one man I spoke with going so far as to rant for quite a while about the laziness and incompetence of local government, though we were well out of earshot of anyone else at the time. Openness among all the people I spoke with was far more common when they were alone with me and my translator, and sure that nobody else

could hear our conversation, something that was almost never possible to arrange with the workers.

Once again, access restriction could not be planned for and necessitated improvisation on my part. Here also a covert role may be necessary to fully map the situation. Ideally, ability to blend in would be an asset, as I once again found myself being the only white man for miles around; in fact, I do not recall seeing a single other white person in all of Guiyu. Yet the difficulty of gaining access is part of situation just like at Agbogbloshie and tells us something in itself about the nature of these places. These restrictions ought to be born in mind as one reads the case-studies in this thesis.

4. List of people interviewed

Accra:

- Bennet Akuffo, Green Advocacy Ghana
- Issah Abdullai, Green Advocacy Ghana
- Larry Kotoe, Ghanaian EPA
- Dr Francis Agyenim Boateng, Ghanaian Council for Scientific and Industrial Research
- Mike Anane, environmental journalist
- Emmanuel K. Dogbevi, environmental journalist
- Henry Okine, Program Coordinator at Ports Environmental Network-Africa (PENAf)
- Dr Yvonne Idun, formerly at University of Accra and Environmental Policy Analyst at the UN University
- Two anonymous Green Advocacy staff members
- Anonymous scrap-worker at Agbogbloshie:
    - one buyer
    - six burners
    - seven refurbishers/repairers
    - five collectors
    - twelve recyclers
    - two female food-sellers
    - three residents of Agbogbloshie
    - four residents of Old Fadama
    - five market workers (three manufacturers of goods, two yam/onion sellers)

Additionally, I spoke with three second-hand sellers outside Agbogbloshie. All ordinary workers were insured of complete anonymity, which includes in most cases not even referring to them by their specific position as this might compromise anonymity. For example, there are only a handful of people manufacturing household goods out of e-waste and given that my presence was noted it is not impossible that them speaking to me could have been noticed, so that deducing the exact identity of interviewees could be possible. On the other hand, in the case of burning, for example, there are so many different people doing it that I can freely refer to burners.

Guangdong/Guiyu:

- six residents of Guiyu
- four repair-shop operators (outside the Industrial Park)
- twenty e-waste workers within the Industrial Park; twelve in simple mechanical disassembly, two in machine-tool disassembly, four in chemical treatment, two transporters
- one buyer (in the Park)
- eight workers in Longgang
- three Longgang residents
- two anonymous staff-members at SCAU

Everyone interviewed was insured of complete anonymity, thus I do not refer to them other than by location and not specific position for the same reasons as outlined for Agbogbloshie.

Sweden:

- Torsten Kjellgren, CEO IT For Children
- Mårten Sundin, Head of Marketing at El-Kretsen
- Britta Moutakis, Advisor for recycling and recycling centres at Avfall Sverige
- Sargon Chanko, Sales Manager at Sims Recycling Solutions

Others:

- Dr Dennis Zuev, formerly at Lancaster University
- Jim Puckett, Executive Director and Founder of Basel Action Network; formerly Greenpeace International's Toxics Director
- Kevin Stairs, Greenpeace

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Chapter 3

The Global Flow of E-waste

This chapter will begin with an overview of the most widely spread and accepted narrative concerning global flows of e-waste, before introducing counter-narratives and then moving on to discussing in-depth the problems involved with data gathering and estimations that all narratives share. The issue of illegal shipments, a major cause for the difficulty in establishing flow size, will be dealt with at the close of the chapter. This chapter is meant to set up a general overview and enable a closer look at the flows entering Ghana and China specifically.

1. Global e-waste generation and flows

According to a 2006 United Nations Environment Programme report, an estimated 20 to 50 million tons of WEEE is annually generated world–wide, 75–80% of which is shipped to Asia or Africa for either recycling and final disposal. (1)(2)(3) A more recent report from the UN University, the 2017 *Global E-waste Monitor*, estimates an annual generation of 44.7 million tons of WEEE for 2016, expected to rise to 52.2 million tons by 2021. Of this, only 20% was accounted for and appropriately recycled, while 4% was improperly handled together with residual waste, and the remaining 76% is described as simply having an unknown fate, but was “likely dumped, traded, or recycled under inferior conditions”. It ought to be pointed out that even if e-waste does not wind up in the informal stream, it can still be improperly managed; for instance, winding up in the general waste stream and either landfilled or recycled together with other waste. Neither of those ends can be considered proper as regards addressing the specific pollutants and hazardous materials present in e-waste, even though they may be formal and considered proper for other kinds of waste. Only 67 countries have e-waste related legislation that regulates proper management, which partially explains the large amount of unaccounted for e-waste. (4)

This data is congruent with, though not identical to, data from Greenpeace, which states that of the approximately 8.7 million tons of e-waste generated in the EU in 2008, 75% has an unknown fate while the same number was at least 80% for the USA. (5) It is also congruent with the UN StEP

initiative's 2012 data, suggesting a total world-wide generation of 49 million tons. [14](6)(7)

Region	Generation (total, Mt)	Generation (kg/inhabitant)	Collection Rate (percent of generated)
Oceania	0.7	17.3	6%
Europe	12.3[1]	16.6	35%
Americas	11.3[2]	11.6	17%
Asia	18.2[3]	4.2	15%
Africa	2.2	1.9	<1%

Table 3.1. *Global generation and collection rates, per* the Global E-waste Monitor. *Alternative numbers for 2012 from the* UN StEPinitiative*: 1) 9.9 2) 12.8 3) 12.69 (for only China, India and Japan)*

On the other hand, Robinson places the annual generation on the lower end. (8) Robinson estimates the global output of WEEE in 2009 by taking the UNEP data available for 2005 and adjusting it using increase in world Gross Domestic Product. He then increases it further to account for the lacking information on Latin America, Africa, Canada or Russia, and for the fact that "computers form the bulk of E-waste and that most E-waste is produced in rich countries". (9) Robinson justifies this approach by demonstrating a strong correlation between the GDP of a nation and the total amount of EEE. He argues that this is due to the essential role played by EEE, especially computers, "for the functioning of all but the most primitive economies". (10) Hence GDP-adjustment is an acceptable method of estimating the increase of global WEEE output. Since world GDP grew an additional 30.43% between 2009-2016, following Robinson's GDP-method would allow us to estimate 2016 levels of e-waste generation as approximately 26-32.6 million tons, representing the lower end of the 2006 UNEP estimate and being significantly lower than both the admittedly more recent and thorough UN University data from 2017 and the StEP estimate from 2012.15 This discrepancy should be taken as an indication as to how different results can be depending on method or approach, even if each approach is, in itself, methodologically sound and reasonable in its assumptions.

The Greenpeace report *Toxic Tech*: *Not in Our Backyard* predicted that computers, mobile telephones and television sets would contribute 9.8 million tons to the global stream of WEEE in 2015, constituting up to 8% by volume of the municipal waste in developed countries. This is an increase from 5.5 million tons in 2010. (11) Computers have an average lifespan of three years,

[14] Solving the E-waste Problem
[15] International Monetary Fund data on global Real GDP growth, www.imf.org

compared to more long-lasting equipment such as refrigerators and ovens, which have lifespans of up to 10 to 12 years. (12) The continued increase of less long-lasting equipment in the WEEE stream may further increase future WEEE volumes, as can for example the quicker product overturn in the case of equipment such as mobile phones. This may explain why Robinson's prediction arrives at a lower global generation than more recent data shows, as Robinson did not take the aforementioned factors into account and hence may have underestimated the growth in e-waste generation.

Yet it must be underlined, as the UNU Global E-waste Monitor report indeed does, that statistics on the subject are woefully inadequate, with only 41 countries having official statistics on e-waste, not all of which are complete. The problem is especially pronounced for the e-waste and second-hand electronics that are exported from developed to developing regions. No official statistics tracks e-waste export and import specifically, nor do systems such as the global Harmonized Trade System distinguish between new and used products. (13) Data are usually even scarcer for developing countries, and illegal exports are particularly hard to gauge. Ultimately, all data on the magnitude and flow of e-waste are by necessity estimates.

The European Environment Agency believes that "a substantial portion of Europe's e-waste is exported to areas such as West Africa and Asia, disguised as used goods", though they too acknowledge the inadequacy of the data. Most e-waste from Europe seemingly goes to Africa. (14) INTERPOL concludes that around 1.3 million tons of used and broken electronics leave the EU annually, reiterating the difficulty of separating out functional used good, broken but repairable used good, and completely broken goods, though they estimate that around 70% is functional. Only 2000 tons of illegal shipments are actually seized. (15) Europol also confirms the existence of illegal trade and its general direction but cannot provide exact data on volumes. (16) The environmental NGO *Basel Action Network* has attempted to track flows using GPS trackers, and their results are used in the aforementioned UN University report and considered the most accurate to date. They indicate that around a third of US generated e-waste is exported, the majority of which goes to Asia, chiefly China and Hong Kong. (17)(18)

In recent years, however, a counter-narrative to this story has been emerging through the work of by some scholars, who claim empirical proof that most e-waste is traded between developed countries and that much of it goes *from* developing *to* developed countries.[16] (19)

[16] These authors also emphasize the role of 'the 3Rs'; reuse, repair, and refurbishment.

2. The counter-narrative on flows

2.1. Lepawsky's foundational work

The dominant view on the flows of e-waste is contested by a small but notable school of researchers, that I will refer to as the "denialist" faction for the sake of simplicity, and which I will contrast with the "importists" who claim that import occurs in significant amounts and that e-waste is a problem rooted in export from developed countries. The denialist claims are ultimately rooted in the research done by geographer Josh Lepawsky, whose examination of e-waste flows has reached a wildly different conclusion from those discussed previously. Several other researchers could be said to represent this 'school', among them Peter C. Little, Chris McNabb, and Grace Akese. (20)(21)(22)(23)(34)(25) While they have also written extensively on e-waste, and reference to various degrees the matter of e-waste flows, all their statements on flows are ultimately derived from a new method of studying e-waste flows that was first used by Josh Lepawsky and Chris McNabb in a 2010 article. (26) Moreover, the position I refer to as 'denialist' was first clearly stated by Lepawsky in a 2015 article, based on the method utilized in the 2010 article. (27) The denialist claims regarding flows are significant and not only challenge presently existing e-waste policy but represent the empirical underpinnings of the chief challenge to the claims of this thesis as well as claims made by ENGOs, governmental and supranational bodies, and numerous media reports.

Note that while the claims on the magnitude and direction of e-waste flows are being contested, much of the work done denialist scholars does not deal with flows at all but with informal recycling and the practices of reuse and refurbishment. Here they present a picture that does not necessarily collide with the commonly accepted one, nor what I present in this thesis.

2.2. Analysis of Lepawsky's empirical work

Lepawsky presents his own position, frankly and openly, as contradicting that of the Basel Action Network. It is based around three main claims:

1. "...the bulk of e-waste imports are not waste but are instead working or repairable equipment"

2. "...domestic sources rather than only foreign dumping contribute significant volumes of electronic discards in 'developing' countries"

3. “...trade from rich ‘developed’ nations to poor ‘developing’ nations represents a modest portion of e-waste flows relative to flows within these regions” (28)

Lepawsky makes it clear what he means by ‘modest’ in the third claim: his claim is that trade of electronic waste from what the Basel Convention designates as “Annex VII” territories (i.e., OECD countries, the European Community [EC], and Lichtenstein) to non-Annex VII countries “accounted for less than 1% of total trade” in 2012. Instead Annex VII territories trade with other Annex VII territories, while non-Annex VII territories trade with other non-Annex VII territories to a degree but export most (three quarters) of the goods in question to Annex VII territories. That is, a *reverse* of the flow we would expect, one coming *from* developing countries and going *to* developed ones. We might consider this the fourth of Lepawsky's main claims, given its weight. Lepawsky thus contests what he calls the ‘commonly accepted’ belief in a movement of e-waste from the global centre to the global periphery. (29)

It is noteworthy that Lepawsky himself openly admits that it is “extremely challenging” to measure e-waste flows. In fact, he identifies three major hurdles;: firstly a “lack of a universal definition of e-waste”; secondly an “absence of international trade data that distinguishes between new and used electronic commodities”; and lastly the fact that “illicit trade” occurs and is not measured by official statistics. All three present issues that Lepawsky believes he is able to overcome, but which I believe he ultimately fails to surmount. (30)

I will begin with the last issue. Lepawsky relies entirely on UN COMTRADE data, which is data gathered from ports around the world and based on official declarations. (31)(32) As Lepawsky himself points out, COMTRADE data does not distinguish between new and used EEE. Nor does it contain any information on illicit trade; therefore, if we look at raw COMTRADE data without any sort of interpretation we would indeed expect to find little to no trade occurring between Annex VII and non-Annex VII territories, though we might indeed find trade between Annex VII territories, and going from non-Annex VII to Annex VII.[17] Furthermore, Lepawsky specifies that the particular COMTRADE category he employed was “Harmonised System (HS) 2002 code 854810 (waste and scrap of primary batteries and electrical accumulators)” and explains that he used that code “because it is the only one available in the COMTRADE dataset related to electronic discards”. (33) Lepawsky thus uses data concerning a far narrower set of goods as a proxy, assuming that it can indicate the fate of total e-waste trade.

[17]Consider that the USA, an Annex VII territory, has not ratified the amendment in question.

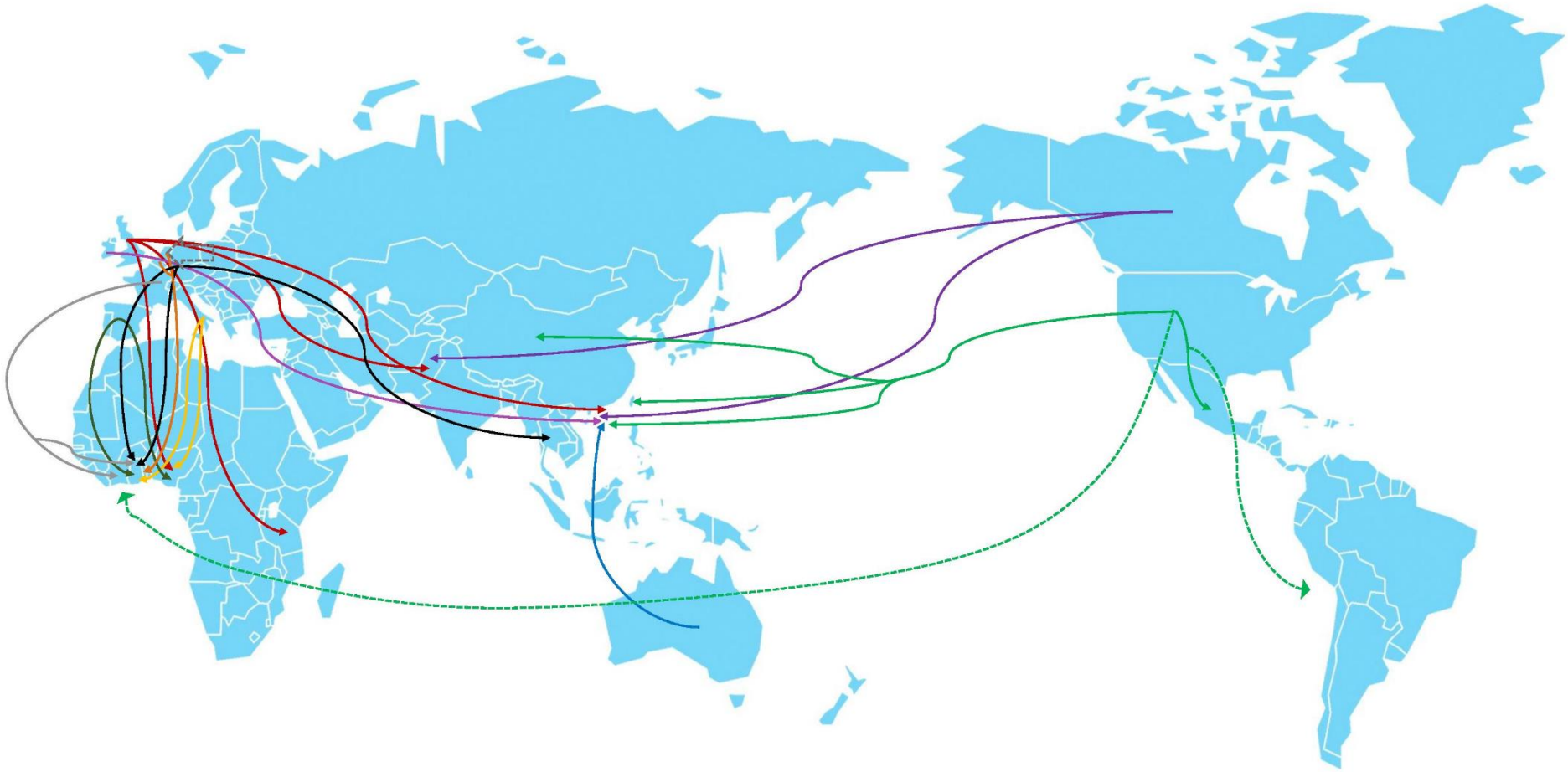

Figure 3.1. *E-waste flows in the world system: taking all the importist data and reports together, this is the picture that emerges for e-waste trade from the EU and North America as they are most likely to be at the time of writing. Note that shipments within the EU, even to developing countries, has been discarded. The dotted arrow represents movements from within the EU, mainly Germany, to the ports in Belgium and the Netherlands, from where they are then exported to developing countries. The dotted lines represent general flows to region, in this case from the USA towards Latin America and West Africa. Arrows show direction only, and not the volume of any particular flow*

Lepawsky is not unaware of the problem with this, stating in the same article that “while the data analysed here cannot directly measure the crucially important aspects of trade related to reuse, repair and refurbishment, it is also true that no existing HS tariff code can do so because no such trade code exists”. He therefore acknowledges that the extent to which code 85481 data can be used in lieu of total e-waste data depends on how well the former correlates with the latter. The problem is that Lepawsky does not establish that there is any correlation at all; in fact, he establishes no connection between the code 85481 data and e-waste other than making the trivial observation that goods designated as code 85481 are technically a kind of e-waste. But ‘e-waste’ is a broad category of very diverse goods, and there is no reason to presume that data for the very specific and narrow category that is batteries will serve as any kind of predictor or indicator for trade with laptops, toasters, refrigerators or any of the many other forms of electronic waste. Yet Lepawsky maintains that COMTRADE data “can tell us (...) where e-waste is traded from and where it goes”, despite the definition of e-waste as *illegal* to ship between Annex VII and non-Annex VII countries and thus, to reiterate, *not* included in official COMTRADE data. (34)

Kahhat and Williams point out flaws with Lepawsky’s approach, with Lepawsky acknowledging their concerns as correct but claiming that they “do not necessarily refute the validity” of his approach. (35)(36) His reason is Kahhat and Williams's own 2012 paper, as well as another paper by the same authors from 2009, which he claims are in fact consonant with his results using HS 2002 854810. (37)(38) Kahhat and Williams, however, make it abundantly clear that they refer only to “*official* trade” (their own emphasis) of end-of-life computers, and show that Peru imports large amounts of second-hand ICT equipment from the USA. In no way does their paper contradict the idea that both second-hand electronics (both legitimate and some that is actually disguised e-waste) and illicit waste mainly flow from developed to developing countries. In fact, it corroborates this idea, merely shifting the focus from the illicit trade of e-waste to the perfectly legal trade in second-hand electronics.

Kahhat and Williams in fact openly criticise Lepawsky's method, referring in this case to the earlier 2010 article cowritten with McNabb, where the method was introduced. (39) Their criticism observes that Lepawsky’s choice of code does not necessarily map to, or serve as a proxy for, other end-of-life electronics. They also note that the particular category Lepawsky has chosen, i.e. batteries, is not reusable in the same way as the computers they investigated, and that the trade is thus likely “driven by materials recycling and not reuse”. (40)

Lepawsky also refers to several other studies as being consonant with his results. Among these is one by Shinkuma and Huong, which focuses on inter-regional trade in Asia. However, their results show a flow from developed regions, in this case Japan, to developing regions in Southeast Asia (for home appliances) and China (for computers and PCBs); mainly Guangdong Province, where Guiyu is located, in the latter case. (41) This is in line with what we would expect following the importist narrative, and not what Lepawsky asserts. The only 'reverse' flow their study shows is the case of Cambodian PCBs going mainly to China. A similar result is found in Kahhat and Williams's paper, which concludes that Peru is a net exporter of printed circuit boards to Germany and China, and also exports a lot of microprocessors. (42)(43) This is used by Lepawsky as an example of "e-waste flowing in the opposite direction that the dominant storyline emphasises" in the case of Germany and of "trade between developing countries" in the case of China. (44) In my view this conclusion ignores the particular conditions. PCBs are technically 'e-waste' but in practice they are the final product of certain kinds of informal recycling where the capacity to further process the boards is lacking. They are therefore exported for the purpose of such processing, which technically constitutes export of e-waste. Peru and Cambodia both lacked the capacity to process PCBs and microprocessors consistently in an economically viable way, and since the recovery rate of precious metals was usually higher abroad, both goods were commonly exported for further processing. Export of PCBs and microprocessors is exactly what one would expect given these conditions.

Lepawsky then goes on to list and quote several other works: Kiaka and Kamanda; the BAN-supervised *E-waste Africa Project;* and several Basel Convention supported reports by Amoyaw-Osei et al., Manhart et al., Ogungbuyi et al. and Strother et al. (45)(46)(47)(48)(49)(50) All these reports indeed confirm that reuse and repair are important aspects of the e-waste issue, and that most of the shipments examined contain functioning second-hand goods, as the importist studies showed as well.

Crucially, Lepawsky is actually making two separate claims: 1) those related to flows of e-waste and 2) those related to the importance of reuse and repair as part of the flows. He quotes articles, however, that support 2), a widely acknowledged phenomenon, as 'corroborating his findings', even though none of these articles support claim 1) but only claim 2). Lepawsky has not in any way been dishonest about the studies in question; the very quotes he has chosen to include in his article indicate non-negligible amounts of e-waste entering several developing countries. Conclusively, none of the works cited in favour of Lepawsky's results are actually consonant with his results on the matter of flows.

The 2010 Lepawsky and McNabb article is devoid of the bold claims of Lepawsky's 2015 article, despite no new data or new method of analysis being introduced in the latter. Nor do I find any justification, or testing, of the viability of the code used in this article, simply a statement that it is "... the only trade data category available that would bear a relationship to the legal trade in the broader category of e-waste." (51)(52) To their credit, Lepawsky and McNabb are very honest about problems, limitations and exclusions pertaining to their research in the 2010 paper: "[n]ot only is there a lack of formal trade data categories that cover the range of materials that constitute e-waste, the data available from COMTRADE focuses only on licit trade and thus cannot measure the extent and geographical reach of illicit traffic in e-waste." They admit, furthermore, that their data "significantly underestimate(s) the volume of e-waste flows". (53)

The 2010 Lepawsky and McNabb paper offers interesting conclusions when contrasted with Lepawsky's 2015 paper. While still claiming that most e-waste trade is intra-regional, they also found "that e-waste trade transactions tend to occur between trade partners where the importer has a lower GDP per capita than the exporter". They acknowledge fully that "e-waste is traded inter-regionally, moving from developed to developing countries" but add that there is also "substantial trade in e-waste between developing countries". Lastly, they assert that their results "complicate – but do not contradict – the dominant storyline of e-waste as presented by ENGOs and, increasingly, the media where the story is framed largely as a problem of the rich countries of North America and Europe dumping waste in the poor countries of Africa and Asia." Continually they stress that we must recall the above-mentioned caveats when considering these conclusions, though they do not address the fact that these caveats are potentially so significant that they cast serious doubt on the research results. (54) Despite the far milder – even contradictory – conclusions as compared to the 2015 Lepawsky article, and the employment of the same method with the same exact weaknesses and limitations, this 2010 article is invoked in support of the conclusions in 2015 without any new data or analysis.

2.3. Towards a world-systems view

Though Lepawsky's main claims are questionable, I believe that a more favourable reading of him is possible, if one directs his critique towards the definitions and distinctions made in the Basel Convention rather than against a world-systems understanding of core-periphery relations, or an economic understanding of developed and developing regions. For China, this

is particularly crucial, as many of the economically powerful regions of China are hardly 'developing' anymore.[18] Yet counting China (and Hong Kong) as a developing country is a major and repeated component of Lepawsky's argument on the reverse direction of flows. (55) Given that China and Hong Kong are, by Basel Convention definitions, non-Annex VII regions he certainly has a point in doing so. The BAN publications referred to in the importist sections also count China and Hong Kong as developing. Thus, Lepawsky's analysis is better read as a critique of the too simplistic model the Basel Convention relies on, but does not disprove a more sophisticated, region-based world-systems approach. There certainly are problems with the definitions and divisions the Basel Convention uses; consider for instance that Mexico, sometimes considered a 'developing country' and at other times not, is still an Annex VII territory by Basel Convention rules, and thus counted as 'developed' in BAN documents. [19](57)

The BAN *e-Trash Transparency Project* was initiated in part because the BAN noted what they refer to as a "disturbing recent trend of export denial in the recycling industry", which "has been exacerbated by US and Canadian government funded studies that purported conclusive results but failed to use actual e-waste movement data". Instead these studies relied either on surveys, where companies essentially self-report, or statistics on 'surrogate' products. (58) Though Lepawsky's study is not mentioned specifically, it could be argued to fall under the category of a 'surrogate-based' study. The BAN launched their GPS-based study specifically to disprove these claims and establish with empirical evidence that illegal e-waste trade does occur, and that it moves from developed to developing nations. Yet their success in this regard depends on the choice of definitions of 'developed' contra 'developing' nations. For their results showed that most US exports go to China, specifically Hong Kong. If we go by Lepawsky's definitions, with China as a developing nation, the BAN study disproves empirically his claims as it establishes a movement from a developed (USA) to a developing (China/Hong Kong) country. However, these definitions are worth closer examination.

As was stated when discussing MFA system boundaries in Chapter 2, the results of any MFA are dependent on particular system boundaries chosen, which this conundrum illustrates very clearly. The choice of the Annex VII/non-Annex VII approach is a choice of a particular set of system boundaries and definitions and, as has been shown, one can get completely different

[18]Note that China (and Hong Kong) are listed under "Advanced Economies" in the IMF's World Economic Outlook of 2018. The World Bank, in contrast, argues that "China remains a developing country" on its website. (56)

[19]Mexico is listed under "Emerging and Developing Economies" in the IMF's *World Economic Outlook* of 2018, even though it is an OECD country. See: www.imf.org/external/pubs/ft/weo/2018/02/weodata/groups.htm (accessed 2019-01-02)

results if one defines the boundaries differently. However, the validity of such choices depends on the validity of the accompanying social context analysis – and though the particular choice of Annex VII/non-Annex VII is understandable, as is the difficulty in defining certain countries as developing or developed, I contend that this division does not properly take the reality of social context into account. Let us consider the classifications in a hypothetical scenario where the flow of e-waste goes from the US to Mexico and from China to Ghana. It would be considered as different Annex VII countries trading with each-other and different non-Annex VII countries with each-other, respectively. Flows from China to Mexico would be considered to flow 'in reverse' of the expected, i.e. from developing to developed. Yet in all cases we could still potentially be dealing with flows going from developed to developing regions, depending on whose definition we adopt. The Basel Convention rules clearly do not capture the whole complexity of either e-waste trade or global economic development. Its rules reflect not the reality of economic development but the reality of how trade is organised and legally controlled. The rules are adapted for ease of definition and enforcement and not to the actual economic conditions found in different geographic regions. That this necessitates a closer look at the Basel Convention's approach to geography is something that I could certainly agree with Lepawsky on, but I do not believe it turns academic research on the topic on its head or disproves that e-waste flows strongly tend to go from developed to developing regions.[20] Even Hong Kong itself, an economically developed region, has areas that are underdeveloped, like the rural areas of the New Territories, to which coincidentally the BAN found all Hong Kong-bound e-waste to be going.

2.4. Conclusions on Lepawsky

Lepawsky is certainly right in criticising both the overtly simplistic Basel Convention categories and certain media portrayals of the e-waste issue that can give the impression of massive amounts of unusable and broken goods being dumped in 'poor' countries from 'rich' ones with impunity. This is a portrayal that lacks nuance, though it is not necessarily wholly wrong, and is much too one-sided since it ignores the positive impact the trade can have as well as local dependence on it. Issues such as the livelihoods of recyclers and refurbishers, not to mention the role cheaply available ICT equipment can play in developing countries, should not

[20] The issue is not something for which the BAN can be blamed, for it is after all an ENGO devoted to encouraging the enforcement of the Basel Convention, and the Basel Convention uses the 'Annex VII/non-Annex VII territory' distinction, and the BAN must therefore follow that.

be ignored. Lepawsky and other denialists are right to challenge the media narrative regarding them.

Additionally, Lepawsky and Little both acknowledge the health and environmental impacts informal recycling of e-waste can have, while stressing the positive contribution to livelihood and development, which are points I wholeheartedly agree with. Both are also certainly right in that we need to consider reuse, repair, and refurbishment – the 3Rs – more. Both also acknowledge how difficult this is given the lack of data, since trade codes do not presently make any distinction between new and used electronic goods. (59)(60)(61) Though I have concerns over this approach being misused to obscure the actual problems, which in the end are the same regardless of how much usefulness can be squeezed out of old electronics by the application of local labour and ingenuity, intellectual integrity demands that the 3Rs be considered seriously.

Nonetheless, Lepawsky's data on flows is, ultimately, so flawed that it necessitates discarding for the purpose of my thesis. At the very least, the degree of uncertainty in Lepawsky's method is great enough that it warrants a more careful study of his method by way of testing it against scenarios where the materials flow is already known with a reliable degree of confidence. As regards the three (or four) points outlined at the beginning of this section, the first is trivially true and openly admitted by most research on the topic: the bulk of *legal* trade in working second-hand electronics is, indeed, precisely that; working second-hand electronics. This neither addresses the point that a non-negligible part of that, likely between 10-15%, is unrepairable waste (while up to 30% is broken/non-functioning upon arrival), nor the problem of illegal shipments and smuggling. The second (and fourth) points become rather moot once we realise that we are dealing with either recovered PCBs and microprocessors, or simply the limited Basel Convention definitions of 'developed' vs. 'developing', that account for the observed 'domestic production' of e-waste and 'reverse flow' of it. Consider also that imported second-hand electronics that break down are also considered 'domestically produced' e-waste, regardless of how long they were functional. The third point remains unproven, with only Lepawsky's data supporting that conclusion. In any case, it would not detract from the volumes of actual waste nor their impact, even if their *relative* size compared to total trade were small.

Lastly, I also fear the denialist narrative can be misused by corporate powers with a vested interest, as it implicitly shifts culpability away from industries and recycling firms in developed nations, however far from the intention of the denialist theorists that outcome may be. Given the attention in both media and academia to the e-waste problem, and how it has been presented,

private interests that have a financial stake in the matter are moved into action to protect their businesses and livelihoods from what they perceive to be unfair restriction and regulations that might make their ventures less profitable or even impossible. I do not believe this to be intentional on the part of the denialist school, but a case of scholarly work that risks being appropriated to serve the interest of business. The denialist narrative on e-waste flows, if simplified enough, simply fits with the image that the private firms wish to project – an image that keeps their ventures safe from what they perceive as undue restrictions. Simply put, capital scrambles to protect a particular accumulation scheme from regulatory interference which threatens profitability, by way of providing a counter-narrative and shifting focus away from the central problem. Lepawsky et al. are themselves hardly capitalists nor directly employed by capitalists for the purpose of propaganda dissemination; their narrative is simply one that capital can easily seize upon and support out of self-interest. Though not the topic of this thesis, how the discourse surrounding e-waste is shaped and determined by public and private interests and the struggle between them is a matter worth considering. Echoing the theories of John Bellamy Foster and Paul Burkett, I would suggest that not only the natural world, but the narrative we tell about it and our engagement with it, is a site of class struggle. (62)(63)(64)

3. Hidden flows: illegal shipments

3.1. Illegal shipments from Europe

Part of the issue with e-waste is that the flows of it are embedded into a very particular social condition characterized by uncertainty, as discussed previously, but also by the legally grey or outright illegal nature of exports and imports. This further increases uncertainty regarding flow volumes; to put it plainly, nobody knows exactly how much waste is exported illegally, and we have only estimates and educated guesses to work on. For example, in 2008 Greenpeace estimated that the EU annually produced 8.7 million tonnes of e-waste, of which only 25% was collected for recycling or destruction – with no data on what exactly happens to the remaining 75%, though Greenpeace concludes it likely that it is either stored, incorrectly disposed of or exported for reuse, destruction or recycling in non-EU countries. (65) Different numbers pointing to the same issue are found in a 2012 European Environment Agency report, *Movements of waste across the EU's internal and external borders.* It claims that in 2008, 3.4 million tonnes of WEEE were collected and formally reported in the EU, whereas 10.2 million

tonnes of new electric and electronic equipment were put on the market. Similar numbers are found in an EU-funded INTERPOL project, *Countering WEEE Illegal Trade* (CWIT), presented its findings in a 2015 report where it stated that 3.3 million tonnes of the e-waste discarded in 2012 in the EU, only 35% of the total generated, was reported as legitimately collected. A UN University report from 2007 concludes, similarly, that "only 25% to 40% of WEEE is collected and treated" in the EU on average, with different regions and WEEE categories differing somewhat. (66)(67)(68)

But how much is illegally exported to developing countries? The CWIT report estimated that 1.5 million tonnes of UEEE left the EU-28 (plus Norway and Switzerland) annually, 200 000 tonnes of which is documented as presumably legal second-hand exports. Most of the legal exports are ICT items, and they are typically exported for reuse by charities or professional refurbishers. 1.3 million tonnes were undocumented, and likely illegal, exports. While the majority of this undocumented equipment is working or repairable, and intended for repair and reuse, it is estimated that around 30% is e-waste, which corroborates the previous estimates for Ghana. Since there is a mix of working and non-working equipment that is undocumented, "[t]he entire amount is a grey area subject to different legal interpretations and susceptible to export ban violations" despite the bulk of it being technically functional. (69)

The previously mentioned BAN *e-Trash Transparency Project* has also used their GPS method to track exports leaving the EU-28. In 2018 they tracked 314 units, 6% of which were exported out of their origin countries, with 61% of exports going to developing countries. The UK had the most exports to developing nations, followed by Denmark and Ireland. 64% of shipments going to developing countries went to Africa, mainly to Nigeria but also to Ghana and Tanzania. Other destination countries include Pakistan, Thailand and China/Hong Kong, but others were less developed countries within Europe, namely the Ukraine and Romania.[21] The project estimates, based on these findings, that 352,474 tonnes of UEEE are exported annually from the EU-28, significantly less than the CWIT estimate. Given that the BAN project relies on GPS trackers, it is more likely to have accurate data for the e-waste it tracked. However, the project also focused on tracking only some e-waste categories (LCDs, CRTs, printers), and also extrapolated based on a relatively low sample size; issues that they themselves readily admit to.[22] The study also focuses on e-waste proper, i.e. non-working EEE, and not merely

[21]The Ukraine and Romania are both listed under 'Emerging and Developing' economies in the 2018 IMF *World Economic Outlook* report.
[22] LCD = Liquid-crystal display monitors, CRTs = cathode-ray tube monitors

undocumented exports in a legal grey area. (70) The disparity between the two findings, both representing major and scientifically rigorous attempts to calculate flows based on the best available data, should be taken as an indicator as to just how difficult it is to quantify flows and how much uncertainty there is, and how much results can differ depending on what method is employed and what definitions are used.

The EU's Network for the Implementation and Enforcement of Environmental Law (IMPEL) carried out two enforcement projects to try to map illegal waste exports. The first such project, *IMPEL-TFS Seaport I,* surveyed Europe's six largest ports between 2003-2004 and found that about 20% of all waste transports could be classified as illegal. The second project, *IMPEL-TFS Seaport II,* carried out in 2006 found that as many as 51% of inspected transports were classified as illegal. The project focused on exports to non-OECD countries and on electronic waste and second-hand goods (which included electronic goods and vehicles), but it did not deal with this exclusively and does not state how many of the illegal shipments were e-waste specifically. It did however state that the most common method of smuggling second-hand electronics was by way of hiding them inside second-hand vehicles, and uncovered many such cases coming from the port of Amsterdam, with many of the shipments headed to Africa: “used electronic equipment was loaded in second hand vehicles. The equipment is mostly declared as second-hand goods and is – according to the explanation of exporters – still working. For example, a used truck was declared, loaded with personal goods and destined for Africa. Inspection inside this truck showed that it was loaded with televisions and Hi-Fi equipment.” Much of it was, however, badly stored and somewhat damaged, and the report states that “[t]he inspectors tested the televisions: more than 50% were not working anymore and were considered as hazardous waste”. Western Africa and China, including Hong Kong, were the most common destinations; a conclusion that fits well with the previously discussed importist claims, though there is no exact data on the volumes of flows but merely a confirmation that these flows do exist. (71)

Likewise, a report from the Swedish EPA acknowledges that export of illegal waste is, by virtue of being illegal and therefore intentionally obscured, difficult to map. The report estimates the volumes by looking at export declarations and comparing the type of exported items and how much of them are being exported with the value specified on the declaration. 15,000 tonnes of TVs were exported from the EU to Ghana, Nigeria and Egypt in 2005; these where ostensibly legal shipments of working TVs. However, on average the declared value of these TVs was only 8.2% of the average value that exported televisions commonly have. The report concludes

that the low declared value indicates that it is likely that most of the exported TVs where in fact not new but used. The EPA report, as well as reports from the European Environment Agency and the European Topic Centre on Sustainable Consumption and Production that also discuss this finding, and all conclude that there is a high likelihood that much of it is actually waste, or will soon wind up as waste, but there are no exact numbers on this. The official data does not even distinguish between new and old products, necessitating a reliance on estimations even there, and making exact numbers on actual e-waste even more elusive. (72)(73)(74)

A 2012 European Environment Agency report, *Movements of waste across the EU's internal and external borders,* acknowledges that "[t]here is little information and data about cross-border movements of WEEE". Nonetheless it concludes that "there are many indications that a substantial portion of Europe's e-waste is exported to areas such as West Africa and Asia, disguised as used goods", in clear violation of the EU's WEEE Directive and the EU's Waste Shipments Regulation, which prohibits WEEE export to non-OECD countries. (75) The report also claims the involvement of organised crime, stating that "Europol has identified an increase in the volume of illegal waste movements across borders, which has become one of the fastest growing areas of organised crime". It concludes that smuggling of waste is "often facilitated through cooperation with established sectors such as import and export firms, metal recycling and financial service". (76) This assessment is based on a 2011 Europol report which discusses the smuggling of e-waste from the EU to West Africa and Asia. Europol claims "evidence of corruption in the public and private sectors", including issuing of false certificates, and widespread usage of intermediate storage sites to "disguise the ultimate destinations of waste and to frustrate law enforcement efforts to identify source companies". (77)

While, as mentioned before, there exist official reports that rely on the previously cited importist data to support claims of illegal exports to Africa and Asia, I have purposefully avoided using them as they can hardly be said to corroborate importist data given that they either merely repeat it or partially rely on it for their own conclusions. Instead all the reports I have cited here make ostensibly independent claims, both with respect to the importists and to each other, and can therefore be taken to corroborate the gist of importist claims, as least as far as the existence and direction of flows is concerned.

Note, however, that the above EEA report also makes it clear that "hazardous waste exports overwhelmingly stay within the EU". This movement is perfectly legal and is likely due to lack of internal capacity to handle waste properly. Sometimes it is simply cheaper, or even just

geographically closer, to ship waste to another EU country for processing. Yet the implications of this are uncertain, as the report does not clarify how much of said 'hazardous waste' consists of e-waste. E-waste does seem to be an exception, however: while the "EU reporting system does not deliver clear data on transboundary movements of e-waste", there is plenty of national data which "suggest that the amount of legally shipped e-waste is small compared to the amounts collected" and that there are "plenty of indications […] that a significant amount of this waste is not collected and treated according to EU standards" but is instead "exported to countries outside the EU, disguised as used goods". (78)

Nevertheless, given already existing laws and regulations and enforcement thereof, not to mention negative public relations impact for firms involved in illegal shipping, one would still expect the bulk of recycling to be nominally legal, that is, either properly treated or disguised in order to avoid detection. Since we are dealing with colossal total volumes of WEEE being generated annually, it is crucial not to underestimate the volume of e-waste being exported to developing regions, even if the majority were to be properly handled.

3.2. Illegal shipments from the USA

As the USA has not ratified the Basel Convention, exporting broken down electronics from the US is technically not illegal, though the import of those goods into the intended destination countries might still be. Regardless, it is a practice most firms would rather not be associated with, as a report from the US International Trade Commission acknowledges. (79) A 2009 INTERPOL report concludes that organized crime is involved in both EU and US e-waste trade, based on interviews with key figures in recycling companies, government agencies and customs authorities and thirty-five case studies of illegal import/export gathered from the UK, the United States, Canada, Sweden and the Netherlands. [23] It confirms the hitherto discussed reports in stating that the "two most common methods of illegal export are mislabelling containers to conceal e-waste and mixing waste with a legitimate consignment, such as end-of-life vehicles". (80)

However, the authors also admit that there is "limited information available about the trade in e-waste", especially concerning the total volumes being generated and the volume being

[23]Research conducted by Bureau Veritas and Michigan State University on behalf of the INTERPOL Pollution Crime Working Group (PCWG).

disposed via primitive methods. They also consider it “difficult to identify the criminals involved in illegal e-waste disposal” and admit that “the extent of organized crime involvement in hazardous waste disposal is unknown”, citing loose and temporary criminal structures as part of the reason for the difficulty. Additionally, “[m]uch of the evidence regarding export mechanisms and how the sector operates is anecdotal”, and a lot of the information is derived from rumours and beliefs conveyed by knowledgeable people in various agencies. (81) Worth noting is that an EU report on organized crime and e-waste, published by the European Union Action to Fight Environmental Crime, also agrees that e-waste related crime is less centralised than other crimes of a similar nature and scale, though insists that organised crime is nonetheless undeniably involved. (82)

The exact methods employed by criminal networks are also unknown, though there is reason to suspect that they often pose as tourists in order to avoid detection by minimizing any link to customs. Many also “exploit the need of local authorities to meet recycling targets by buying e-waste directly from municipal sites for recycling”. Links to the US organized crime families were suspected, with evidence suggesting that they make use of the waste-related organizational infrastructure they already possess since their infamous dealings with the solid waste industry in New York and New Jersey in the 1970s. Conclusively, though, the authors admit that more investigation and research is needed to fully map illegal e-waste shipments. (83)

Finally, the previously mentioned CWIT report also concludes, based on INTERPOL national surveys, that only on average 2,000 tonnes per year of the 1.3 million tonnes illegally exported from the EU are actually “reported as seized illegal shipments, leading to some form of sentencing and/or administrative fines or civil penalties”. The report argues that it is not “a lack of inspections” that is the cause of the few seizures “but rather the difficulty and lack of intelligence and evidence gathering prior to prosecution that hampers solid court cases and thus proper sentencing”. (84)

3.3. Illegal shipments from Sweden

Given that I will focus somewhat on Sweden later as an example of modern e-waste management and a contrast to informal recycling, it is interesting to explore the flows of illegal shipments from Sweden specifically. It is worth noting that there is a general awareness in Sweden of the e-waste problem and Agbogbloshie specifically since it is a phenomenon that Swedish media has reported on repeatedly, and with which every Swedish expert to whom I

spoke was familiar. (85) The Swedish case is illuminating because it is a small country with a very well-organized system for handling e-waste, with clear demarcations of responsibility, giving me the opportunity to discuss the issue of illegal flows and their causes directly with the experts and decision-makers in the relevant institutions.

As with the USA and the rest of the EU, there are no precise statistics on the volumes of illegal e-waste export from Sweden, nor any concrete evidence on who is involved and what the source is. The Swedish EPA acknowledges this, and argues that evidence for illegal waste streams is to be found in individual cases, citing for instance a case of Swedish scrap cars, all welded shut and filled with e-waste, headed for Ghana but caught by the German Federal Customs Service (*Bundeszollverwaltung*) in 2008. (86) Other similar evidence exists; 2015 statistics from the Swedish EPA show that there were 11 cases of seizures of electronic waste at Swedish ports, and 5 cases of seizures of LED batteries, but there are no numbers on volumes. Most of what was seized was heading to western Africa, chiefly Nigeria. (87) Regarding shipments of waste leaving Sweden, the county administrative boards (Länsstyrelser) are the regulating bodies and supervising authorities, that the Swedish Customs Service (Tullverket) works together with on monitoring and investigation of exports, while the Swedish EPA is responsible for granting permissions for waste exports.

The Swedish Customs Service admits that defining waste as a commodity is complicated given the current legislation. The Swedish waste regulation legislation, Avfallsförordningen (2011:927) and environmental legislation, Miljöbalk (1998:808), use a broad definition of waste based on intended use, i.e. something is waste if one intends to throw it away. In contrast, the tariff rules of the Customs Service use a narrow definition, wherein goods retain their specific status as a given good as long as they retain the general characteristics of that good; i.e. a laptop remains classed as a “laptop” as long as it retains the form and properties usually associated with a laptop, and it cannot be re-classified as another good, including the good “waste”, as long as those properties remain. Additionally, legislation regarding penalties is also complicated which, according to Customs Service personnel I contacted, in practice leads to few shipments being seized. (88)(89)(90)

Swedish and Norwegian media reports have employed a combination of investigative journalism and GPS trackers to demonstrate conclusively that used cars filled with e-waste are illegally shipped from Scandinavia to Nigeria, commonly via Hamburg in Germany. The same reports also confirm that theft of e-waste from recycling facilities and disposal centres in

Scandinavia occurs, with incidents of employees being threatened with violence by thieves. The investigators found indications for organised criminal structures involved in global e-waste export, which the Norwegian Environment Agency confirms may be possible though they have no conclusive evidence at the time. (91)

Likewise, a 2009 report from Sveriges Radio corroborates both the above numbers and the few seizures. It claims that neither the EPA, the Swedish Police or the Swedish Customs Service knows how much e-waste leaves Sweden illegally, and, after speaking with Swedish Customs officials, they conclude that the issue is not at all a priority and that it's likely that "quite a lot" of illegal e-waste leaves the country successfully.[24](92) Additionally, a 2011 report by municipal environmental management authorities in the city of Stockholm (*Stockholms Stad Miljöförvaltningen*) claims illegal exports are a known problem to electronics retailers, many of whom are solicited by private individuals seeking to relieve them of, or buy, their electronic waste (in violation of Swedish law). While this corroborates the existence of at least some illegal exports, at least in 2011, the report has no numbers on volume nor any evidence apart from the testimonies of the retailers. (93) According to an analysis of export statistics from Statistics Sweden's Statistikdatabasen by environmentalist NGO SwedWatch, "2095 tonnes of mobile phones and 1063 tonnes of stationary computers" were exported in 2007, though these are official and perfectly legal exports.[25] However, SwedWatch suspected inaccuracy due to average weight and price reported not matching the products, claiming that higher volumes are likely and that the shipments may contain used products or even waste. Their inquiry about this with the Swedish Customs was, however, denied. (94)

A 2017 Swedish study shows that around three quarters of Swedish municipalities actively work on preventing illegal exports of e-waste. That is, they take various measures beyond merely complying to the Swedish laws and standards. For the most part, this was a matter of increased supervision and oversight of the process chain and the firms and organizations that comprise it, such as through audits and careful scrutiny of all documentation. The same study reports that the cause of illegal exports was believed to be deviations from the legitimate flow, deviations that arise mostly when the e-waste is handed over to illegitimate transporters or handled by unauthorized recipients. Outright theft from recycling centres was also suspected to be a cause by municipal officials. (95) EPA interviews with several municipal authorizes in Sweden in 2009 revealed that they all experience that e-waste disappears from their collection

[24] "Swedish Radio", Sweden's national and publicly funded radio broadcaster.
[25] "Statistic database", a database with a great variety of official Swedish statics.

sites due to theft, though with varying frequencies and never in any greater quantities at once. Nobody knew where the stolen e-waste went. (96)

The above reports' conclusion on active preventive work stands in stark contrast to a 2010 report from the Swedish EPA, which concludes that the cities of Stockholm and Gothenburg were the only ones where supervisory authorities actively monitored transboundary movement of waste. Some of the authorities interviewed by the EPA did not even know that they were responsible for the supervision or why it had to be carried out. The report states that "the practical experience of supervision of transboundary shipments of waste is limited in Sweden".[26] It is, or was at the time, an issue of low priority that the official operational planning did not even mention, and that no-one outside of Stockholm and Gothenburg had any practical experience of. Almost all of the officials interviewed in the study admitted it likely that waste within their municipality could wind up in the illegal stream. While none of them could say for sure what the source was, which is understandable given their admitted lack of knowledge and experience, many speculated that scrap dealers, waste facilities as well intermediate storages for electrical waste could all be sources. (97) It is unclear whether this difference is due to more diligence and increased knowledge of the problem in 2017 than in 2010, something that the EPA has been working towards and that is reflected in legislative changes such as SFS 2014:1075, or simply different approaches and methodologies in the different reports.

Lastly, statistics from the Swedish EPA that compare how much equipment is put on the market with how much is actually collected show a discrepancy across all products, and across different ways of measuring such as in numbers of individual products or by weight. (98) In a similar vein, European Environment Agency statistics indicate a discrepancy between how much e-waste is produced and how much is recycled all across the whole EU. Specific examinations in Germany (by the German Federal Environment Agency) and Denmark (by the Danish Environmental Protection Agency) show the same kind of discrepancy. (99)(100)(101)(102)(103) Both those reports affirm that the gap is far too great to be explained simply by, for example, e-waste equipment being kept in storage or mistakenly winding up in the municipal waste stream, concluding that illegal shipments account for at least some of the difference. The same view is shared by two experts I spoke to, Mr Sargon Chanko, Managing Director of the Swedish division of international e-waste recycling firm Sims Recycling, and Mrs Britta Moutakis, recycling advisor at Avfall Sverige. (104)

[26] Author's translation from the original Swedish.

3.3.1. Possible causes

Mr Chanko believes that the export of e-waste that occurs in Sweden is mostly done by small, local recycling actors who can slip through the cracks of the system, and that the e-waste too originates in smaller companies. These smaller and local actors tend to have smaller capacities for recycling, and Mr Chanko believes that neither the government nor the other regulating institutions seem as keen on controlling their activities as thoroughly as with larger companies. He explains that both the large recycling actors and the large firms that need their e-waste recycled, are too tightly regulated for illicit activities to be possible, and furthermore lack a strong enough incentive for illegitimate exports. The current market prices of recovered materials are so high that both recyclers and the companies that use their services can currently turn a profit through legitimate recycling. This has been true for many years and reflects improved recycling targets and the subsequent increase of availability. Firms making use of SRS's services rarely pay for them; the materials they want recycled are usually so valuable that SRS instead winds up paying *them*. But smaller recycling actors, Mr Chanko argues, do not have the same capacity and thus cannot extract as much valuable materials, and hence they can sometimes make more money doing things illicitly, i.e., by selling the e-waste to someone who will export it to locations like Agbogbloshie. Smaller actors can also often pay firms more for their e-waste, since a facility like SRS is expensive to build and maintain, which leaves them with smaller margins for buying in e-waste; a smaller actor might pay 1 SEK per kg of material while SRS might only be able to offer 0.60 SEK per kg. For most bigger firms as well as municipal organizations, however, the potential PR damage of being discovered as participating in the illegal export of e-waste far outweighs the financial benefits, and so they opt for legitimate recycling anyway. Smaller firms are more likely to employ the services of smaller recyclers. (105)

Investigations by the Swedish EPA, which included interviews with those involved in the e-waste recycling business, conclude that Mr Chanko's beliefs are not uncommon among e-waste experts. The EPA reports that, despite of the lack of concrete evidence, knowledgeable people in the business commonly speculated that poor controls and lax standard among firms and organizations, especially those who provide the e-waste, is to blame for e-waste mismanagement. (106)

Mrs Moutakis, recycling advisor at Avfall Sverige, also acknowledges that, unfortunately, parts of the generated e-waste in Sweden still ends up in illegal waste streams, outside of the

approved collection system. She is very aware that what she considers ‘irresponsible and illegitimate organizations’ exploit the fact that e-waste management can be cheaper and easier when done by illegal means since that kind of handling “often fails to protect the environment and those who work there”. Yet she emphasizes that one cannot place the blame for this on the advanced yet comparatively costly Swedish system: “the technologically and legally advanced systems we have in Sweden and other [developed] countries exist to protect people and the environment”, she argues, which is a desirable and important goal. The essential question, Mrs Moutakis claims, is ”what kind of society we want and how we can work to reach our goal?… if we want a society where there is no risk of hazardous waste polluting the environment or exposing people to health hazards, then the legal demands must be made accordingly”. She argues that allocating more resources to Swedish Customs together with increased cross-border cooperation is needed to address illegal flows, for example through the *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal*. (107)

Based on all these reports we can conclude that illegal exports at least *did* occur at one point, though we can say little about them today. All we have to go on are three things; firstly, the above-mentioned discrepancies between what is put on market and what is collected. Secondly, the fact that regulations on larger companies are very thorough, including their internal controls such as ensuring a rough balance between what comes in and what is exported, and the damning consequences of illicit activities for their reputation and profits. (108)(109) Thirdly, despite the seeming increase in knowledge and dedication to tackling the problem, there are still plenty of Swedish municipalities that do not address it, nor is it a high priority of port authorities or the police. Based on the above, and the very clear monetary incentives involved, we can conclude that it is very likely that a) some illegal export still occurs and b) the export that does occur probably comes from the actors that are the least regulated and have the greatest financial incentive. A 2009 Swedish EPA report on the matter supports my conclusion, stating that what they call 'leakage of e-waste' very likely occurs, but that little can be said about the scope of it other than that it is potentially large. (110)

4. Conclusions on flows

The outcome of the complexity covered is ultimately uncertainty. In spite on many reports from many sources, the agreement is, in the end, only on the lack of precise data. Nor can this be

lamented while simply wishing for greater accuracy in the future; the lack of data has causes which are entwined with and part of the e-waste phenomenon as a whole.

What can be concluded with some certainty is that the denialist narrative is wrong and founded on an incorrect methodology as well as a misunderstanding of the intricacies of both the e-waste industry and the world-system. The usefulness that this theory provides as a counter-narrative benefiting profit-motivated and self-interested firms involved in the e-waste trade, though not part of this thesis, cannot be understated and forms a part of the class-struggle over e-waste. The main contribution of the denialist theory is, if one is to focus on its strengths, in illustrating the problems with an oversimplified view of developed vs. developing countries and highlighting the necessity of a more advanced approach. Here I will offer a world-systems understanding in which networks, and geographically and developmentally delimited places and regions, become more important than national borders.

It can also be concluded that the importist side, suggesting a flow of e-waste from developed to developing countries, is more reliable and correct in its overall claims, in spite of issues with establishing the exact size of flows, and the existence of over-simplified narratives from media reports on the subject. Nor are the hidden, and often illegal, flows of e-waste are to be taken simply as a 'lack of data', for in themselves they say something crucial about the e-waste phenomenon. Indications that it involves criminal elements ultimately make e-waste smuggling reminiscent of other criminal ways in which capital is supplied with the raw materials it needs for production, for example, the illegal mining of rare earths used in electronic and electric equipment.

The lack of data is also rooted in the position of e-waste as a non-prioritised illegal good. While not the subject of this thesis, it is important to consider the global trade in illicit and harmful goods in total: the smuggling of weapons, drugs, people, etc. will always take precedence in terms of legislation and resources devoted to the problem over e-waste. This is particularly pronounced given the difficulty in distinguishing e-waste from legitimate second-hand goods that have happened to break. The fact the we nonetheless have some data on port seizures, and reports from Europol and INTERPOL on the subject, show that the problem is taken at least somewhat seriously despite not being prioritized.

At the same time, the e-waste industry serves several needs in the capitalist economy, providing services: cheap recycling; cheap resources; work for the impoverished; and cheap electronics for the developing world. Despite its unsavoury aspects, the beneficial side of it cannot be

denied, nor can any action taken against e-waste smuggling be separated from the beneficial aspects. It represents, on some level, both an attack on the interests of global capital but also, at least in the very short term, on the livelihoods of people in developing nations. As such, it cannot go unanswered, and counter-narratives are to be expected: they are part of the narrative.

It is now necessary to look closer at the e-waste flows into Ghana and China specifically, which is the task of the following chapter. The error of Lepawsky's counter-narrative will be further shown by way of establishing the existence of such flows. However, as we shall see, the problems of lack of data and difficulties in estimation are much the same for specific countries as they are for global flows – as are the causes of it, as well as the understanding we can gather from the veiled nature of the e-waste flows themselves.

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Chapter 4

E-waste in Ghana and China

1. The flows of e-waste and issues with estimations

Much like the case was for global flows, the exact figures on e-waste flows into both Ghana and China are contested and controversial. Numerous claims have been made that the flow of e-waste has in fact significantly decreased and even that it may no longer pose a major problem. The narratives and claims differ greatly, from the Ghanaian EPA speaking of a small decrease in flows that nonetheless continue to create significant problems, to reuse advocate group WR3A claiming no dumping of e-waste occurs at all and calling the Agbogbloshie reports “a hoax”. (1)(2) Contested narratives such as these are expected given the scope of the problem and the uncertainty involved, not to mention possible financial incentives. I have chosen to avoid looking into or questioning the motives of anyone, on either side, preferring to stick to what can be proven or logically inferred from academic publications or official reports. Since the aforementioned WR3A claim was public statement from its founder Robin Ingenthron, and neither an official report or academic publication, and since ‘denialist’ claims deal with global flows and not flows into any particular country, there are in effect no official reports that outright deny import of e-waste into Ghana, and we are left with different data all supporting an overall ‘importist’ narrative. Whilst the denialist side certainly rejects the idea of major e-waste import into Ghana specifically, these claims are rooted in Lepawsky's aforementioned global flow data, which has already been thoroughly addressed, though the establishment of approximate flows into Ghana and China can be seen as a further refutation.

1.1. Overview of imports into Ghana

No duty is paid on used computers and computer accessories imported into Ghana, only the VAT, which is itself dispensed with if the imports are intended as donations. This is very much intentional, and part of the Ghanaian government's ICT policy, meant to 'bridge the digital divide' and facilitate the development of information and communications technology in Ghana. The policy was implemented in 2004, and it is worth noting that it makes no mention of the

negative effects of the import of second-hand EEE. (3)(4) Legal loopholes of this kind have also been exploited in China and India.

There is a notable lack of laws regulating recycling practices in Ghana meaning that any positive effects of the import are presently diminished by the negative impact on people and environment. (5) It is also worth noting that Ghana faces heavy budgetary constraints when it comes to the issue of e-waste; 90% of the country's health budget is devoted to fighting malaria, leaving little funds left to address other issues. (6)

Simply banning e-waste recycling would, however, itself be problematic since it has become an industry in its own right in Accra and plays a major part in the city's economy. Approximately 3000 workers are registered with the scrap dealer's association of Greater Accra, and about 30,000 are estimated to be involved in the broader chain. Additionally, some people who are otherwise employed in some part of the formal sector nonetheless take part in the informal recycling sector as a means to gain extra revenue, or are otherwise partially engaged with it – there are, for instance, many women and young girls selling food and beverages to the men working at the scrap-site. Most workers live in the Agbogbloshie slum, and around 40% of them are young boys, some as young as 5. (7)(8)

Despite the potential problems involved with a ban, the Ghanaian government brought a ban into action in 2013 on the export of ferrous scrap metals, in the hopes of making more raw-material available to sustain the domestic steel industry. This was following complaints from the steel manufacturers and their organisation, the Steel Manufacturers Association of Ghana, that a lack of materials had led to factory operations constantly being well below capacity. The legislation, known as *Ferrous Scrap Metals (Prohibition of Export) Regulations, 2013 (L.I.2201),* came into force on 26 March of 2013. The steel industries in Ghana were, before the ban, sometimes working on as low as 30% capacity due to a lack of raw materials. (9)(10)

Various reports from Ghanaian business news sources indicate that there is a strong belief that the generation of iron scrap in Ghana is great enough to meet total industry demand. The Forum for National Equity has even stated that more scrap iron is produced than the domestic industries can absorb. On the basis of this they have in fact argued against the ban, claiming that it results in a net loss for the Ghanaian economy, suggesting that the ban cripples the scrap industry without leading to a sufficiently great increase in steel output to offset that loss. They have been joined in this opposition by the Scrap Dealers Association of Ghana, both organisations also arguing that the ban negatively impacts the great number of people who are in some way

dependant on scrap industry for their livelihoods. The government has stated, however, that they intent to maintain the ban. Illegal exports nonetheless continue in spite of government actions, with government suspecting corruption within its own agencies facilitating it. The Economic and Organized Crimes Office of Ghana is heavily invested in cracking down on corruption. The problem is deep-seated, with both the Ghana Revenue Authority and Ghana's Customs Excise and Preventive Service division being identified as including possible collaborators. (11)(12)

Related to this is a similar plan on banning copper exports, due largely to the theft of copper in phone-lines. The plan has been in the works since 2013, but nothing has come of it as yet nor has the Ghanaian news provided updates. (13)(14) Related are also existing plans to start a national gold refinery for the first time since Ghana began mining for gold. (15) The intended change with perhaps the greatest impact is the plan to build a new, state-of-the art recycling facility at Agbogbloshie. Despite promises, however, building has yet to commence, at the situation at Agbogbloshie remains unchanged. (16)(17)

Note also that whilst Agbogbloshie is by far the largest informal e-recycling site in Ghana – in terms of physical size, workforce quantity and volume of e-waste – there are several other similar sites around Ghana. Two of them, the port city of Tema and the city of Ashaiman, are close to Accra and part of the Greater Accra Region. Tema is located approx. 25 kilometres east of Accra proper. The city's approximately 140m^2 scrap-site is situated along Nana Kena street, and unlike other sites very little open burning takes place here. Tema is also home to the Tema Community One second-hand electronic market, where one can find used sound systems, TVs and fridges, among other things. Ashaiman is situated 4 km north of Tema, and about 30 km from Accra. The dismantling of e-waste occurs at Washing Base, along the Ashaiman-Tema road, and the scrap-yard has been operational for over 15 years. (18) Kumasi is the second largest city in Ghana, and situated in the Ashanti Region, and home to two informal recycling sites; the Suame light industrial area and the Afful Nkwanta dump-site. (19) Korforidua is a smaller operation, and according to a Greenpeace report faces the same issues as Agbogbloshie. The report believed Korforidua to be "typical of these numerous small e-waste recycling operations within Ghana, engaged in similar activities to those at Agbogbloshie but on a far smaller scale". (20) Very little is known about the Takoradi site, and it is only briefly mentioned in one official report prepared for the Ghana Audit Service. (21) Though this thesis focuses exclusively on Agbogbloshie, being both the largest and most well-documented site, it ought to be born in mind that informal e-waste recycling is a phenomenon that occurs in and impacts

many places in Ghana. Particularly when it comes to matters of the volume of e-waste flows should it be remembered that the flows into Agbogbloshie represent only part of the total flows into Ghana.

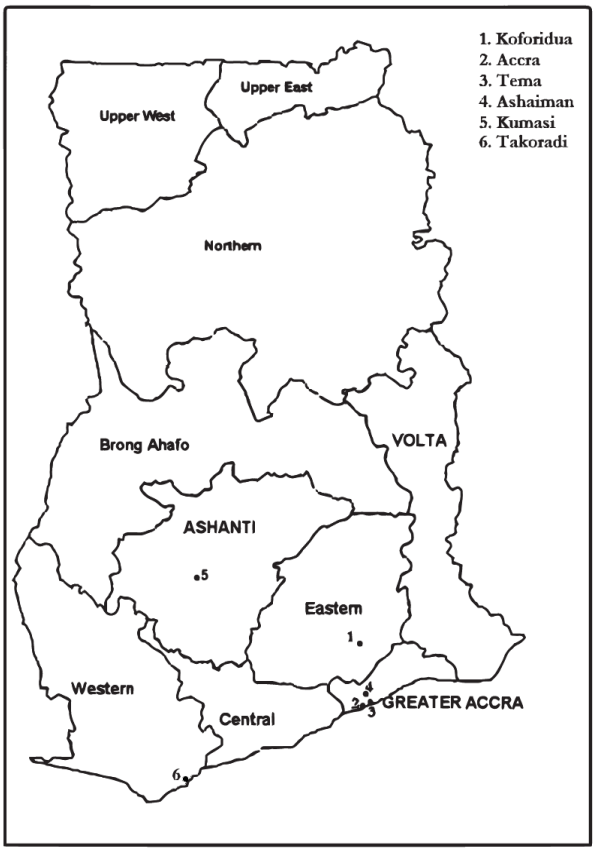

***Figure 4.1**. Map showing the known major informal e-waste dismantling and processing sites. Based on Agyei-Mensah and Oteng-Ababio, 2012, with additions by the author.*

1.2. Flows of e-waste into Ghana

Perhaps unsurprisingly, the numbers regarding flow volumes are far from exact and also quite outdated, with the latest estimates from the Ghanaian EPA done in 2012. This section will investigate more closely both the different claims regarding e-waste flows and the problems and hurdles encountered in flow estimations.

I spoke about the e-waste flows with Mr Larry Kotoe of the EPA in September of 2018. Mr. Kotoe told me that he believes the current figure to be around 500 containers of second-hand electronics arriving into Accra per month. However, he acknowledges that neither the EPA nor any affiliated organization has done any recent, detailed assessments, and that his estimate is based on testimonies of port personnel. There was, however, no available documentation to

confirm the ‘500 containers/month’ number, other than a 2011 Dateline documentary called *E-waste Hell*, that Mr Kotoe referred me to, and which he told me was used “for sensitization across Ghana” by the EPA. (22) The statement on flows in the documentary is made by environmental journalist Mr Mike Anane. When I spoke to Mr Anane in September of 2018, he insisted that his more recent observations confirm that the number was still at least 500 containers per month, and occasionally more. Mr Anane did not provide an exact date for the last investigation but told me that the number was an estimate based on his continuous study of e-waste shipments over many years. (23)

One of the most extensive studies on e-waste flows into Ghana, that Mr Kotoe referred to when we spoke and that has been used by the EPA, is the 2011 publication *Ghana E-waste Country Assessment.* It was produced through a collaboration of the local NGO Green Advocacy Ghana, the Ghanaian EPA and the Swiss Federal Laboratories for Materials Science and Technology (EMPA) – with the support of the Secretariat of the Basel Convention (SBC) as part of the SBC *e–Waste Africa Project.* It determined that total imports of EEE into Ghana in 2009 was approx. 215,000 tonnes. 70% of this, or 150,500 tonnes, was second-hand goods of which 30%, or 45,150 tonnes, is to some degree broken on arrival and thus constitutes e-waste by the legal definition. 15,050 tonnes (10% of the total) consisted of items broken beyond repair while 30,100 tonnes (20% of the total) contained items that could be serviced and restored to functionality for a time. The assessment predicted a linear growth of EEE imports, which would lead to a doubling of imports between 2009 and 2020. However, the report is clear on this being only an assumption based on the market trends at the time of writing, and there is no follow-up report since that time than can confirm or disprove the prediction. (24)

Importantly, the study admits frankly that their data is often incomplete and of dubious accuracy, and continually discusses the resulting problems. By combining UN COMTRADE data, flows from imports by private individuals, reports from the port and customs authorities and household surveys, the authors nonetheless attempt to arrive at an estimate. Their estimated number is 169,000 tonnes for 2008 for all electronic equipment both new and old, based on their own interpretation of the admittedly inaccurate data. The 2009 numbers are themselves an estimate based on projected growth from 2008. Hence 70%, or 118,300 tonnes, was second-hand electronics and 30%, or 35,490 tonnes of which, was technically e-waste. Of this 11,830 tonnes is pure waste and 23,660 tonnes can be repaired and function for about two years before also winding up in the e-waste stream. The percentages are estimates based on the average observed ratio between broken and working items found in EEE shipments checked at the port.

There have not been enough investigations or seizures to produce a viable sample size to determine the exact percentage of working or broken items. The study in fact makes it clear that "(t)he percentage of imported EEE that respond to power could be far less than 70%"; note that it was only possible to ensure that equipment responded to power, but not to control it for full functionality. The EEE arriving at the ports is seemingly more likely to be broken than EEE imported in other ways, with around 60% being in working condition at arrival. (25)

These numbers are consistent with those found in a 2008 Greenpeace report, *Poisoning the poor – Electronic waste in Ghana,* which quotes Mr Kurt van der Herten, an EU Commission official, who estimates that at least 25% but potentially as much as 75% of all second-hand EEE exported to Africa is broken on arrival. (26) A Blacksmith Institute (formerly *Pure Earth)* report from 2014, *Top Ten Countries Turning the Corner on Toxic Pollution,* repeats the '215,000 tonnes of second-hand electronics' number, but states that "[a]bout half of these devices are usable, either instantly or after refurbishment", thus giving a much higher number than the *E-waste Country Assessment* but still consistent with Mr. Kurt van der Herten's estimate and not directly disproving the SBC estimate above[27]. (27)

Recall that the shipments of (W)EEE are often not labelled or are mislabelled as 'personal effects' or 'household goods', and that it is only when one opens a container that one can see if it contains EEE. Even then, how much of this will prove to be waste and how much is usable is uncertain; it is not possible to test the goods properly for functionality on site, and so they are mostly inspected only for obvious external damage, or at most for response to electricity. Goods that pass such a shallow examination may have hidden damages or lack vital components. (28) Hence, as a 2011 report from Danish ENGO DanWatch puts it, it is "impossible to accurately determine the exact amount of the obsolete imported used electronics". (29) Whatever the actual number, the large amounts of non-functional units makes it likely that second-hand EEE intended for export is not being tested before being sent, despite EU guidelines stating that such items "can only be considered second-hand reusable goods if they are tested for use and properly packed and labelled" to avoid damage during transport. (30)

The above mentioned DanWatch report also attempts to estimate e-waste flows by way of interviewing a port authority at Tema: "Tony Mensah, chief collector at the Laboratory of Ghana's Customs, Excise and Preventive service (CEPS)… estimates that almost every day no less than twenty containers full of e-waste are encountered at the Tema port." This would equate

27 The report gives no sources for the numbers or details as to how they were obtained.

to around 600 containers per month at least. This is somewhat close to the claims made by Mr Anane and echoed by Mr Kotoe, i.e. 500 containers per month, though both numbers are rough estimates. As the DanWatch report makes clear, ”as the electronics are not tested at the site DanWatch had as much difficulty as the Ghanaian authorities in determining how many of the imported goods are obsolete.” (31)

Is this information consistent with what the *E-waste Country Assessment* tells us? Calculating this is straight-forward, though hardly an exact science; container weight capacity is limited by both the containers themselves and various regulations like road weight limits for trucking it to and from a port. It can also vary between containers depending for instance on manufacturer, and exact numbers are therefore impossible to obtain. Consider, for instance, Danish shipping company DSV Global Transport Logistics, which puts the maximum capacity of their 20-ft dry containers at 25,000 kg when one visits their English website, but 28,180 kg at their Swedish website (dimensions and descriptions otherwise unchanged). British shipping container company ContainerContainer lists the capacity of the same containers as between 21,840 kg and 28,320 kg depending on manufacturer; the Orient Overseas Container Line lists the max payload weight for their 20’ containers as 21,720 kg. Of course, consider also that a container fully loaded with EEE which has reached its maximum capacity in terms of volume, may not necessarily have reached its maximum weight capacity. Given the wide range of products that are considered e-waste, from a small cellphone to a large refrigerator, an ‘average’ e-waste weight is by necessity an approximation. (32)

Assuming the lowest number of 21,720 kg, 118,300 tonnes of second-hand electronics annually would mean around 453 fully loaded 20-ft containers per month, or 395 containers assuming 25,000 kg capacity. The 2009 estimate of 150,500 tonnes would mean approximately 577 containers with a 21,720 kg capacity or approximately 500 containers with a 25,000 kg capacity. These figures are acceptably close to the ‘500-600 containers/month’ numbers, though one must bear in mind that Mr Anane’s and Mr Mensah’s statements are from about two years later and represent inflow to the port only while the *E-waste Country Assessment* looked at total inflows into the country as a whole. Calculating in the other direction, 600 containers per month as per the DanWatch report would equate approximately 13,032 tonnes per month of UEEE or approx. 156,384 tonnes per year, assuming 21 720 kg capacity – or, alternatively, 15,000 tonnes per month or 180,000 tonnes per year assuming 25,000 kg capacity. Again, this is acceptably

close to and consistent with – without proving – the numbers in the *E-waste Country Assessment*[28].

Furthermore a 2010 report, *Socio-economic assessment and feasibility study on sustainable e-waste management in Ghana*[29], states that "between 10,000 and 13,000 metric tonnes of e-waste are treated annually in Ghana by the informal sector", primarily in Agbogbloshie. (33) This overlaps with the numbers in the *E-waste Country Assessment*, which were 11,830 tonnes for 2008 and 15,050 tonnes for 2009 of unrepairable e-waste bound directly for recycling, though there is obviously some disparity. Total e-waste inflow was given as 35,490 tonnes for 2008 and 45,150 tonnes for 2009 in the *E-waste Country Assessment*, though a large part of this could be repaired and would hence not wind up in the informal recycling sector immediately. The *E-waste Country Assessment* also states that "there were about 295,000 tonnes of obsolete items stored" and that "[t]he stock was growing by 44,000 tonnes in 2009"; i.e. much of the e-waste heads for storage rather than directly to recycling, accounting perhaps for some of the disparity in the numbers. Consider that the *E-waste Country Assessment* concluded that "about 171,000 tonnes of WEEE from consumers, repair shops and communal collection reached the informal recycling sector in 2009" – only 0,2% of the total material flow went to the formal recycling sector. It is not altogether clear how these vastly different numbers square with one another, though the 2010 report states how much was actually *treated* whereas the 2009 states how much *reached* the informal sector (including, one presumes, all that went to storage).

Note that all the reports on flows so far mentioned have referred to flows of *e-waste*, though this is technically incorrect: it is only e-waste legally speaking if it is broken upon arrival, and if this is due to a lack of testing equipment before shipping and not an accident. To speak of e-waste and then discuss whether it works or is broken is a contradiction in terms; if it works, it is second-hand electronics per definition not e-waste. This is a common mistake in reports on the subject, including media reports as well. I would argue that working (and reparable) second-hand goods bring with them problems as well, as will be discussed later, and may also be illegal depending on whether or not the proper export procedure was followed or not, such as testing the items before shipping them. Yet it is important that the difference in terms be stated clearly. What has been presented here are the *total* annual flows of second-hand EEE, which includes

[28] It should be underlined that these various corroborating sources are independent with respect to one another, and that care has been taken to verify that they are not ultimately rooted in the same raw data.

29 The field work, desk studies and analysis of the study was conducted by the Öko-Institut e.V and Green Advocacy Ghana in close co-operation with E-waste Africa Project managed by the Secretariat of the Basel Convention.

around 30%-40% of goods which are technically e-waste upon arrival, while 10-15% is completely unrepairable. The numbers cannot fully consider smuggling or other forms of illegal shipments, since these are hidden flows, but reflect for the most part the non-reparable parts of avowedly legitimate second-hand imports. Actual flows of e-waste may therefore be higher, and the numbers discussed should be taken to represent a minimum.

Almost all publicised numbers that pertain to e-waste volumes derive from one or more of the above discussed sources, with the notable exception of course of the 'denialist' claims. The numbers repeated in many different reports, articles and media publications including the following:

- The 2011 Secretariat of the Basel Convention publication 'Where are WEee in Africa?' has data for Ghana based on the *E-waste Country Assessment.*
- The 2017 United Nations University publication 'The Global E-waste Monitor' in turn has data on illegal import and local e-waste generation in Africa that is derived from the above SBC publication.
- The earlier UN University 2014 publication of the same name relied on the same source.
- The 2009 European Environment Agency report 'Waste without borders in the EU – Transboundary shipments of waste', relies on BAN and Greenpeace data on export to Africa and China[30].

These reports are then themselves often cited in other publications, giving the impression of a far greater number of sources supporting the importist volume claims. It is therefore crucial to not take reports, even from official sources, at face value but follow the evidence and citations to their original source, for only then can we get an accurate picture of how much corroborating evidence there is.

In conclusion, the most likely flow volumes into Ghana can be summarized in the below table.

30 Both sets of data originating in work done by the same person, namely Jim Puckett who has worked for both. Worth mentioning is also that the report echoes the difficulties in data acquisition, acknowledging that it is "very difficult to follow transboundary shipments of e-waste within and out of the EU" and that "waste fractions are assigned ambiguous codes when reported to the Basel Convention and the European Commission. Furthermore, it can be difficult to discern when a used electrical or electronic item is waste or just second-hand".

	Second-hand imports	Total e-waste	Broken beyond repair	Usable or repairable
Ghana E-waste Country Assessment (2009)	150 500 tonnes	45,150 tonnes (30%)	15,050 tonnes (10%)	30,100 tonnes (20%)
Greenpeace (2008)	-	25% -75%	-	-
Blacksmith Institute (2014)	-	-	-	50%
DanWatch (2011):	156,384 - 180,000 tonnes	-	-	-
Mike Anane and Larry Kotoe (2012-present):	130,320 - 150,000 tonnes	-	-	-
Öko-Institut (2010)			10,000 - 13,000 tonnes	

Table 4.1 *Various estimates of flows. 'Total e-waste' refers to how much of second-hand imports, in tonnes and/or percentages, are be non-functioning upon arrival, and therefore classed as 'e-waste'.*

Lastly, let us consider the possible value of the flow. Using the arguably most accurate estimate of 215,000 tons of total imports, of which 45,150 tons is actual e-waste, into Ghana annually and relying on the precious mineral content presented in the previous chapter, it would mean that there is around 323.3 kg of gold in the e-waste, or 1,539.4 kg in the total imports. The total silver content would be 7,576 kg for the e-waste or 36,077 kg for the total imports. At the time of writing, the price for gold is approx. 41.337 USD per kg and approx. 470.5USD per kg of silver, which would put the total value of the gold and silver in all the e-waste imported into Ghana at 13,364,252 USD for the gold and 3,564,508 USD for the silver – or 16,928,760 USD in total. For the total imports this would be 63,634,170 USD for the gold and 16,974,228.5 USD for the silver, or 80,608,400 USD in total. That is a total value of approximately 17 million USD for the e-waste portion and 80.6 million dollars for all imports, using 2009 numbers, for the gold and silver content only.

As mentioned previously, however, in practice only about 10%-15% can be extracted due to problems with the recycling techniques employed. Assuming numbers for silver extraction are similar, there is a total annual loss of over 45,342 million USD dollars due to inadequate silver and gold recovery, considering total imports.

1.3. Imports into China/Hong Kong

Apart from being a major exporter of brand new EEE, China has also been a major destination for used and broken EEE for many years. In 2013, *The Guardian* reported that "China controls a large portion of the recycling market, importing about 70% of the world's 500m tonnes of electronic waste and 12m tonnes of plastic waste each year", though that is of course a media report and not the result of scientific inquiry. (34) A more rigorous report comes from the United Nations Office on Drugs and Crime (UNODC), which estimates that around 8 million tonnes of e-waste are imported into Asia annually, constituting 80% of the global amount, of which China imports 90%. (35) Around 690 000 people in China were involved in the informal recycling industry, either as collectors or recyclers, in 2007. However, the *Home Appliance Old for New Rebate Program*, running from 2009 to 2011, combined with legislation banning e-waste import in 2011 (*Regulations on the Administration of Recycling and Treatment of Waste Electrical and Electronic Equipment*), seemingly stifled the informal sector somewhat and gave rise to a growth of the formal recycling business. Of course, lacking data on exact flows (including collection and treatment) in the informal sector, the exact impact of the policy changes on informal recycling is impossible to know. (36) What is crucial to note, however, is that the e-waste situation in China has changed relatively recently, and that flows are no longer going to the town of Guiyu in Guangdong province, once a hub in Chinese informal recycling, with one estimate claiming that the town processed around one million tonnes of WEEE every year. (37)(38) Guiyu will be discussed in the case-study in Chapter 7.

In fact, according to a 2013 report by the UN University initiative *Solving the E-waste Problem* (StEP), "China totally banned the import of e-waste in 2000, and no exception is allowed to any recycling company or organisation". But they add that "imports of second-hand EEE and e-waste into or through Hong Kong is legal if an import license is obtained in Hong Kong", creating a loophole through which e-waste can still enter the country. (39) This is because once a shipment of ostensibly used but working electronics arrives in Hong Kong, it can be exported for re-use to any other country without a permit, including to mainland China. In other words, as long as the UEEE takes a detour through Hong Kong, it can reach mainland China without any issues. This leaves the same old loophole in place: equipment that is technically e-waste being declared as working UEEE. Hong Kong's proximity to Guangdong province was likely a factor for Guiyu becoming an e-waste hub.

Do we know how much e-waste actually enters China? The estimations are more accurate than for Ghana, but there is really only one source: the Basel Action Network, or BAN, a Seattle-

based ENGO focused on uncovering and resolving e-waste issues. It is headed by Jim Puckett, formerly of Greenpeace, who is credited with being the first Westerner to document the informal e-waste recycling taking place in Guiyu. As part of its *e-Trash Transparency Project*[31], BAN is currently employing a method of tracking e-waste flows that relies on hiding GPS-based geolocation devices inside used or broken electronic equipment. (40) The method, and BAN's findings, are also covered in the 2017 UN University publication *The Global E-waste Monitor*, where it is cited approvingly and presented as one of two new methods that give relatively accurate data on flows, along with Person-in-the-Port studies[32]. (41) Due to the uncertainties involved with all e-waste related data, and the lack of official statistics, the BAN project represents the most accurate measurement of e-waste flows coming from the USA. Tracking "LCD monitors with mercury backlights, CRT monitors, and printers" in the USA between July 1 of 2014 and February 2 of 2016, BAN found that "exportation of electronic waste from the United States to developing countries continues to occur at an alarming rate", despite their efforts to bring attention to the issue and educating the public and relevant industry personnel. Nor did the existing electronics recycling certification programs seem to have any great effect; R2 certified recyclers had a higher rate of export than uncertified ones, and even among those certified with BAN's own *e-Stewards* certification one was guilty of export, thus losing the certificate. (42)

Of the 205 trackers they deployed, 34% were exported. 31% of the total, i.e. 93% of the exports, went to developing countries, mostly in Asia. Most went to Hong Kong, specifically the New Territories, with the rest going to mainland China and Taiwan (*Fig. 1*). The BAN asserts that by their "knowledge of waste trade law", 96% of the exported items "were likely to be illegal shipments, due to the laws of importing countries and their legal obligations as Parties to the Basel Convention". (43)

These numbers are, however, a weighted average of the two kinds of organizations studied; recyclers and charities/retailers. The two did not export at the same rate, with the former exporting 40% of items and the latter only 15%. A quarter of the companies involved in exports make "strong claims on their websites that they will only manage it domestically". Many are also affiliated with reputable environmental organisations and waste takeback programs, like

31 Several different BAN publications deal with the same project, only some of which will be mentioned here. For access to all publications, see www.ban.org/trash-transparency
32 A Person-in-the-Port study was conducted in Nigeria and will be discussed later in this chapter.

Dell Inc.'s *Reconnect* program, the business association Institute for Scrap Recycling Industries or the US EPA 'WasteWise' program. (44)

A United States International Trade Commission publication, *Used Electronic Products: An Examination of U.S. Exports*, confirms that most US shipments go to China, and that less than 1% ends up in Africa, though it should be noted that the report relies largely on the previously discussed *Ghana E-waste Country Assessment* for this conclusion. Better African-European trading relationships and lower export costs to East Asia for US businesses are cited as reasons. (45)

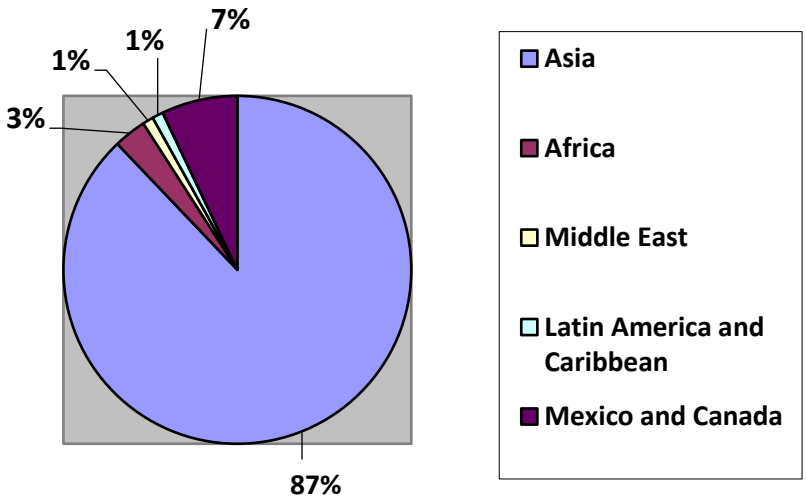

Diagram 4.1. *Division of exports of electronic waste.*

Although the USA has not ratified the Basel Convention, which entails that exporting e-waste from the USA is technically not illegal, the study is confident that the documented exports "were still likely to be illegal under existing US law" because the latter demands pre-notification to the US EPA for CRT export, which none of the companies involved had undertaken. Furthermore, the exports are in any way "almost in every instance [...] likely to be in violation of the laws of importing countries". In other words, while e-waste may not be illegal when it leaves US ports simply by virtue of being e-waste, once it has left it is "illegal traffic" according to the BAN and importing it into a non-OECD country is a criminal act. As mentioned, China, including Hong Kong, where most of the exports went, banned e-waste import as early as 2000. (46)

As pointed out in *The Global E-waste Monitor*, there exists a great difficulty in obtaining official, verifiable statistics on e-waste, since this is rarely something countries keep track of, especially not developing nations. Alternative means, such as GPS tracking, provide a way to estimate more accurately both the magnitude and direction of the flows. However, the BAN itself acknowledges that we are still dealing with *estimates* even in their study; the 205 trackers they used are simply far too few given the amount of electronic waste to constitute a big enough sample size for statistically accurate results. Therefore, it is not accurate to interpret the BAN results as '93% of exports going to developed nations'; rather, 93% of the exports *that the BAN found with its 205 trackers* went to developing nations. The BAN openly discusses their methodological limitations, stating clearly that more studies are needed to obtain conclusive evidence. (47) One problem was their choice of goods, which was assumed that these were the e-waste types most likely to be exported and that violations of the law are easy to establish with CRT monitors due to the need to notify the US EPA[33]. Nonetheless the study acknowledges that their choices "could have been unrepresentative of the entire scope of what is generally considered e-waste". Thus, we once again there is no absolute proof regarding exact flows, though this study demonstrates that illegal e-waste trade does occur and the direction of the flows. The BAN intends to continue sending out trackers and reporting on finds, having already published brief updates in 2017 and 2018, wherein more US-based recycling companies were implicated as participating in some manner in illegal e-waste trade. (48)(49)

The BAN data is nonetheless the most accurate so far. For instance, the UN University *StEP* initiative did an assessment for e-waste flows in China in 2013, published in cooperation with the US EPA. The report concluded that China generated about 3.62 million tonnes of e-waste in 2011 domestically, and, while acknowledging substantial e-waste imports from abroad and loopholes through which they entered the country, they could not quantify the flows with any accuracy. Based on an earlier estimate by the Beijing Zhongse Institute of Secondary Metals and similar works, the report does estimate that around 1.5 million tonnes are imported annually into China, but adds that "[e]xisting estimations in the literature regarding the total volume of e-waste imported into China are very rough and outdated", thus casting doubt over their own estimate. (50) In the light of this, it is not surprising that the later UN University publication,

33 Their age and the relatively weak demand for them on the second-hand market compared to other kinds of screens also makes them less likely to be legitimate second-hand goods.

The Global E-waste Monitor, uses the BAN project as a source rather than its own earlier publication for the data on e-waste flows into China.

The *e-Trash Transparency Project* has also tracked flows from Canada and Australia. In Canada, 43 "non-functional and economically unrepairable" devices of the same types as before were tracked between March and August of 2018. 12% were exported, 80% of which went to what the BAN defines as developing countries; again, mostly the New Territories region of Hong Kong but also to Pakistan. (51) In Australia, 35 non-functioning pieces of the same types as before were tracked between September and October of 2017, but only 2 or possibly 3 were exported, again going to the New Territories in Hong Kong. (52) As for exports originating from the EU, the BAN project found that very few shipments went to China or Hong Kong, instead going to different countries in Africa. (53)

On the other hand, the European Union Action to Fight Environmental Crime (EFFACE) draws different conclusions about EU exports of e-waste to China, based on an extensive review of the relevant literature, which includes the aforementioned UNODC and StEP reports. The report also cites Zoetman's 2006 article that arrives at 1.9 Mt of WEEE[34] exported from the EU annually, of which 0.95 Mt goes to Asia, 0.62 Mt of which went to China. The EFFACE report is, however, careful to point out that "estimates of the amounts of illegally imported WEEE in China are also considered to be very rough, and do not reflect the true nature of the illegal activity". (54)

Given their own admission to uncertainty, and the more recent and more rigorous BAN data, it is plausible that shipments of e-waste from the EU to China are not as prevalent as those going from the USA to China or from the EU to Africa, at least not in recent years. This would be consistent with the previously mentioned report from the US International Trade Commission, which argued that the trading relationships between Europe and Africa are better and that export costs to East Asia are lower in the USA. (55).

34 Note that, like for the Ghana reports, the specific usage of the term "WEEE" is not always straight-forward in most of the reports. Usually, we are dealing with what is technically designated as UEEE but in practice likely contains large amounts of WEEE.

2. Illegal shipments into Nigeria

Though not the focus on this thesis, the e-waste issue in Nigeria is quite prevalent too. Media reports claim the situation to be very similar to that in Ghana; major negative impacts on health and environment and a Lagos that is very similar to Accra in this aspect, with second-hand markets, repairers and dumping sites where primitive recycling is employed. (56)(57)(58)(59) A brief look into Nigerian flows of e-waste and second-hand electronics is warranted, as it may help shed light on the Ghanaian issue, especially given the geographical closeness of the two countries.

What makes Nigeria somewhat different is that a more thorough study of flows has been performed for this country. The UN University and Basel Convention Coordinating Centre for the African Region initiated the *Person in the Port Project* (PiP), which is the most detailed investigation of Nigerian W/UEEE flows to date. The PiP investigated containers arriving into two ports in Lagos in Nigeria: 201 containers and 2,184 roll-on/roll-off (RoRo[35]) vehicles containing UEEE, as well as 3,622 import documents pertaining to UEEE. The total number of containers inspected represents circa 0.7% of what arrived in the two ports in 2015 and 2016; hence "on average, 1 out of 143 imported containers was found to contain UEEE". (60)

The PiP found that "UEEE of virtually all categories" was among the imports, and that it was often "mixed with other goods such as sewing machines, bicycles, kitchenware, sports equipment, and other household items/furnishings". (61) This is similar to what Mr. Mike Anane claims to be true for Ghana. (62) A lot of the UEEE was stuffed inside cars, trucks, and other vehicles brought in on RoRos; in fact, this was found to be the "main UEEE import route" into Nigeria, with around 70%[36] of UEEE coming in via RoRo-imported vehicles and around another 16% coming in inside containers filled with vehicles. This is consistent with the aforementioned *IMPEL-TFS* report, and much like that report states it was common for the goods to be badly stored, with only around 40% being properly packed. The study concluded, based on the container and RoRo inspections and documents reviews, that around 60,000 tonnes of UEEE entered Nigeria in both 2015 and 2016. (63)

Furthermore, "80% of the imported containers carried clean UEEE", i.e. appeared to be undamaged upon arrival. Note however that control was limited to visual inspection only. A

35 RoRo ships are ships designed to carry wheeled cargo, like cars or trucks.

36 The report notes that this number "should be considered a minimum" due to the "suspected under declaration of the weight of imported goods and missing import documents".

more in-depth functionality testing, still limited to only testing basic functionalities, performed on "760 devices of 9 different UEEE types" found that "depending on the UEEE type, a minimum of around 5% (pressing irons, photocopiers) to 55% (LCD-TVs) of the tested devices were nonfunctional. On average, a minimum of around 19% of the 760 devices tested were nonfunctional"[37]. This is consistent with, though not identical to, the numbers in Ghana. It is also consistent with Mr. Kurt van der Herten's broad assessment for all of Africa and illustrates the vast difference in result one can expect depending on what kind of EEE is being tested. The great variation based on type combined with the low sample sizes involved in all hitherto done assessments of this type explains in part the inaccuracy of the results. (64)

If 19% on average is e-waste, it would suggest that 11,400 tonnes enter Nigeria annually. However, adjusting for the inability to test RoRo-vehicle imports and the variation based on EEE type, the report concludes that "at least 15,600" tonnes of e-waste are imported every year. This is less than in Ghana, but still reasonably close. Given the similarity of the conditions and situations in Ghana in Nigeria, and their geographic proximity, one would expect the amount of e-waste imported to be at least somewhat close. However, since the Nigerian government began an effort to better enforce laws against e-waste smuggling around 2010, we might expect less to come into Nigeria. (65)

Most, around 77%, of the total UEEE originates from the EU, with around 7.3% coming from the USA and the same amount coming from China. The vast majority, as much as 98%, of the RoRo-shipments originate from the EU; container shipments are 29% EU, 24% China and 20% USA. This is consistent with the importist claims and the standard narrative of e-waste flowing from developed to developing countries. (66)

The PiP report also goes over the previously done reports that relate to e-waste flows into Nigeria, of which there are only three. Firstly, a 2005 BAN report, *The Digital Dump: Exporting Re-use and Abuse to Africa*, which places the second-hand imports into Nigeria at around 500 containers per month, though the study suffered from the same limitations and lack of exact empirical data as data pertaining to Ghana. (67) Assuming 25 tonne containers, this would mean a total of 150,000 tonnes per year of second-hand electronics. A 2010 SBC report, *E-waste*

37According to the same source, an "absolute best-case scenario" due to testing limitations; "UEEE imported in RoRo-vehicles could not be tested at all". Thus, "the actual volumes of non-functional UEEE imports are probably higher than these estimates suggest", though the report admits that "some of these devices can and will be repaired in Nigeria".

Country Assessment Nigeria, puts the number at 600,000 tonnes of UEEE total, of which approximately 30% was nonfunctional upon arrival and thus technically e-waste. (68) Half could potentially be repaired and restored to functionality. Thus 180,000 tonnes of WEEE per year; far more actual waste then even the total UEEE amounts the BAN study suggests. The data did not distinguish between UEEE and EEE which may explain the disparity. Finally, an ÖKOPOL (Institute for Environmental Strategies) study, *Transboundary shipment of waste electrical and electronic equipment/electronic scrap*, put total imports into Nigeria in 2006 at 2,885,999 tonnes, but this study also did not differentiate between new and used EEE and was plagued with inconsistencies and lack of definitive empirical evidence. (69) Ultimately it was not able to determine exact flows of WEEE into Nigeria.

The PiP report concludes that the information in these reports is "not fully consistent" and "partially based on anecdotal information and reliant on an unclear and complex data situation". (70) Based on these reports, our conclusions would be very similar to the ones we could make for Ghana, i.e. that it is established that illegal imports of WEEE do occur, but that there is a high degree of uncertainty as to how much exactly enters the country. The PiP report is an excellent step in the right direction, and arguably gives us the most accurate data to date for e-waste flows into West Africa. Though still affected by uncertainty and lack of data, the PiP discusses problems like the under-declaration of weight for imported goods and missing shipping manifests, but takes those issues into account and adjust numbers accordingly.

What the Nigerian PiP study can illuminate about Ghana is, chiefly and perhaps most obviously, the great benefit that a similar Person-in-the-Port study in Ghana would have, given that it could resolve the uncertainty and controversy and establish the actual volume of the flow. For want of such a study, however, we can arguably still draw some conclusions regarding Ghana. Firstly, the PiP proves that smuggling e-waste by hiding them inside vehicles, a mere rumour in Ghana, is an established practice in Nigeria, giving cause to be more concerned about the same practice taking place in nearby Ghana. Secondly, given that the goods are roughly of the same kinds in the same approximate mixture in both countries, the PiP corroborates that at least around one fifth of second-hand imports are actually broken and hence e-waste. Thirdly, it establishes with certainty that the flows originate in the developed world; the EU, USA and China[38]. Overall,

38 Whether China can be said to be a developed country as a whole has been discussed already, but we can at the very least conclude that it has developed *regions*.

the Nigerian PiP strongly supports the importist claims and calls into question the denialist claims.

3. A final note on flows and narratives

In 2017, the United Nations University, the International Telecommunication Union, and the International Solid Waste Association together launched the Global Partnership for E-waste Statistics, and released the previously mentioned report entitled *The Global E-waste Monitor*. (71) This publication was a follow-up to the 2014 UN University publication of the same name, and represents a more in-depth study of global e-waste flows with more accurate and up to date data[39]. Though an ambitious endeavor that represents the hitherto most dedicated attempt to map global e-waste flows, the report is still plagued with uncertainty and inaccuracies, which is something the report itself continually discusses and problematizes. For example, it states that "[t]he report … highlights the lack of reliable e-waste data at the country level. Often, merely anecdotal evidence is available on the production, management, and recycling of e-waste", adding that "only Europe has regular and harmonized statistics on e-waste" and that "[c]urrently available statistics are not able to track the amount of e-waste or used electronics shipped from richer to poor sub-regions in the world"[40]. In fact, the only two reliable sources of data that the report endorses are the PiP study in Nigeria and BAN's GPS tracking, which provides the data on China that the report uses.

My argument is nonetheless that this does not preclude a rejection of the denialist narrative, nor an endorsement of the importist one. This is in no small part due to methodological issues and choice of data as well as a lack of corroborating evidence for the denialist claims. The importist claims are more plausible: there are several independent claims that corroborate one another, as well as established cases of illegal shipments, especially in Nigeria and China, along with the data on port seizures covered in the preceding chapter.

The importist data too is marred by inaccuracies and largely based on estimates and assumptions that are necessary to make in light of the lack of accurate information, but do not always reflect

39 For this reason, the 2014 publication will not be considered in this thesis as the 2017 data supplants it.
40 Another quote from the report illustrates the issues: "For the EU, data on the collected and recycled e-waste was extracted from the Eurostat database for 30 countries. For 77 other countries in the world, data was collected from a pilot questionnaire that UNU conducted with UNECE, OECD, and UNSD. From those countries, only 11 countries could provide data, sometimes only partial data. If data was not available, relevant information was searched for in pre-existing literature. Data was collected from 58 countries in total, but the datasets were far from complete and harmonized."

reality. For instance, any calculation of e-waste weight or volume based on counting shipments assumes shipments to be fully loaded with W/UEEE – though, as discussed, empirical findings show that the vast majority of seized shipments have W/UEEE mixed with other goods or stuffed inside cars. The *Ghana E-waste Country Assessment* estimate also makes use of COMTRADE data much like Lepawsky does, and the same problems and criticisms thus apply, though the Assessment does rely on said data only in part, and not the same codes. These issues are all openly admitted and frequently discussed in all publications of this kind.

Nevertheless, a lack of exact numbers for flow volumes does not preclude proof that the flow exists; just like inability to pinpoint with accuracy the exact origin of e-waste does not preclude establishing the general direction of flows in the world system. I feel confident in concluding that non-negligible amounts of illegal e-waste are exported from developed regions into developing ones. Obtaining more accurate data at some point would lend more support to this theory, though I maintain that exact numbers will remain an elusive due to the very nature electronic waste as both illegal and difficult to precisely define.

Much time has been devoted in this, and the previous chapter, on dissecting in detail the issue of the volume of e-waste flows. Why is such a long and intricate overview of global and domestic flows needed, especially when the conclusion is that the numbers are ultimately uncertain anyway? For, as the UN University report makes clear, in the final analysis we simply do not know the exact flows of e-waste into any developing nation or their exact origins.

Firstly, it was critical to establish the uncertainty, for although it is widely acknowledged, it is often only acknowledged in passing, without a detailed explanation of either the problems involved or what different claims exist and to what degree they are congruent. Mine had been a detailed analysis, tracking all available reports on flows back to their roots, covering the origins of all data sources on the subject – therefore it can be said to be a decisive and even conclusive analysis of e-waste flow data, which has not been done before. As such it serves to combat a growing spread of counter-narratives which ultimately either deny the issue entirely, or shift the blame, unwittingly or not. If an analysis of the role of global capital – and ultimately the law of value – in the flow of e-waste is to be possible, the culpability of capital must first be firmly established, and the wholesale shifting of focus away from that culpability prevented. The detailed mapping of flows, to the extent that this is possible, is a necessary foundation.

Secondly, a thorough analysis of flow data reveals three things which are crucial for a further analysis: the importance of regions over nations, the limits of intervention and regulation, and

the *why* of the data absence. For part of what can be gathered from the all the data so far analyzed is, as was also shown in the previous chapter, that flows do not correspond to a simplified "developing-to-developed" pattern, nor indeed to the BAN approach depending on how systems are delimitated and defined. Particularly the data on flows into China and Hong Kong, as well as how flows divide themselves between sites within Ghana, illustrate the need to focus on particular sites and regions rather than national borders.

The limits of regulation show themselves in the lack of capacity to clearly determine the problem on the part of the very agencies expected to revolve it. If the problem cannot be mapped, how can it be properly regulated? Reliable statistics, though not necessarily completely exact, are not only important in order to establish that a problem exists and the exact nature of its source, but also to design proper counter-measures and measure their effectiveness. Counter-measures can include new legislation or new business models, like a change in the legislature and a planned modern recycling facility in Ghana, both of which will be discussed in greater detail in Chapter 6. It is worth noting that, according to *The Global E-waste Monitor* report, "a few modern recycling plants that were established in some east African countries (e.g. Kenya, Uganda, Tanzania) have suffered business failures and closures due, in part, to adoption of inappropriate business models". (72) Ghanaian legal scholar and UN University Environmental Policy Analyst, Dr Yvonne Idun, with whom I discussed new Ghanaian e-waste laws, also fears that a lack of proper enforcement will make the laws ineffective in practice. (73) Yet with the latest official flow statistics used by the Ghanaian EPA itself being a decade old and based on an estimate, how can the impact of either counter-measure be established? As we shall see in Chapter 6, even the exact nature of the conditions at Agbogbloshie itself are contested, though not to the same degree as the flows – and either way, whence the flows originate and in what volumes are important aspects of handling those conditions. Given the lack of data, there is simply no way to deploy counter-measures with a certain effectiveness, adapted to the precise conditions and their causes in the specific scenario that is Ghana. At the very least, without a way to compare the situation before and after any measure, it is difficult to ascertain what impact such measures have. At worst, any hypothetical measure may be entirely wrong, i.e. not suited to the conditions.

If the denialists had been correct in their assertions, a law trying to prevent e-waste import from developed nations would be entirely ineffective at correcting the situation at Agbogbloshie. Likewise, since we can now say with some confidence that the importists are right in e-waste flowing into Ghana largely due to the low cost of recycling, what effect will a costly state-of-

the art recycling facility have on the flows, the informal recycling business and the livelihoods of the e-waste workers? Given the conflict in narratives and how narratives can and do impact policy, it is important to measure the flows of e-waste and second-hand equipment alike as exactly as practically feasible.

Yet, there is a *why* to the absence of data. Every point both I and other scholars have made on the difficulty of data obtainment still stands; there are reasons that we find ourselves lacking data. Completely accurate numbers are a will-o'-the-wisp; even assuming the possibility of accurate measurements, the results would depend far too much of specific definitions of what constitutes e-waste and what legal interpretation one sides with. Accurate measurements are themselves practically impossible due to the already discussed nature of e-waste, with flows being purposefully obscured or hidden, not to mention practical limitations at ports. It would be all too easy to blame a lack of resources and suggest that increasing them would resolve the problem, but that would be to remove e-waste from its real-world context. The smuggling of drugs, weapons and other such serious offenses with immediate and clearly observable consequences will always take priority over shipments of electronics with a dubious but unclear legal status that have far less visible consequences many years down the line. Regardless of the resources available to ports and law enforcement, the e-waste issue will never be taken more seriously than matters like international terrorism and drug trafficking. The lack of data is simply part of the nature of the e-waste phenomenon.

Rather, when I encourage the acquisition of more data, I am referring to more studies similar to the PiP in Nigeria and BAN's use of GPS trackers, but perhaps on a somewhat larger scale and applied to more countries and regions. This would provide acceptably reliable numbers that would suffice for the intended purpose, i.e. to establish the nature of e-waste flows in terms of direction, source and approximate volume. Complete accuracy is not a requirement as long as those numbers can be gauged with acceptable reliability.

Let us remember that both the importist and denialist sides agree about the situation in Agbogbloshie and places like it constituting a problem that needs to be addressed. What separates them is their understanding of the causes and hence possible solutions. What we do to counteract the e-waste problem must be based on a correct interpretation of the situation and context – which in this case requires accurate flow data. Therefore, as Slavoj Žižek remarked, referencing Marx's famous quote on the point of philosophy being changing the world, ”we

maybe tried to change the world too quickly, the time is to interpret it again". (74) That is, we ought to think before we do, and thinking rationally requires evidence.

Following the establishment of flows to the degree that it is possible, it is crucial to continue by examining closely the places where e-waste recycling happens. This is to establish firmly the actual impact that the recycling has, which enables placing both flows and their impacts in a world-system analysis of e-waste. The way in which flows are socially embedded, in both the world-system and in concrete local activities and practices, can of course be studied regardless of the precise volumes involved. Therefore, having established as much as is possible about flow volumes and directions, as well as the chemical properties of WEEE and the health effects of recycling it, let us move on to case studies of the practices of recycling at Agbogbloshie.

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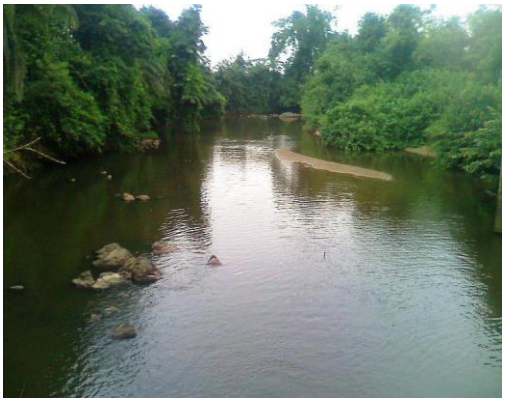
Chapter 5

The Situation in Ghana and Agbogbloshie

In the following chapters, I will present my case-studies, focusing on Agbogbloshie in Ghana but with supportive and comparative reference to Guiyu in China and, to a lesser extent, a modern e-waste recycling facility in Sweden. A situational overview and background of Agbogbloshie is necessary to fully understand the state of affairs, and I will begin there before moving on to the case-study of the informal recycling site in the next chapter.[41]

1. Agbogbloshie's beginnings

Agbogbloshie lies in the South Industrial Area of Accra, on the banks of the Korle Lagoon. The precise history of the area is hard to pin down, but its roots are as a wetland, historically the home and care-taking responsibility of House Korle and named, as the family itself, for a pre-colonial Ga pagan deity. (1) In modern times a ghetto, called Old Fadama, grew there as the city of Accra itself grew and became urbanized, becoming settled with refugees of the Konkomba–Nanumba conflict in the Northern Region during the mid-1990s. (2) Today four of the major tribes are represented at Agbogbloshie; the Ashanti, the Ewe, the Mole-Dagbon, and the Ga. (3) Many of the workers belong to the racially diverse and predominantly Muslim Hausa people, who stem from the Northern Region and speak the Hausa language. (4)



Pictures of the nearby Densu Delta wetland show what the Korle Lagoon once looked like. (Wikimedia Commons)

[41] Note that unless specifically stated otherwise, any information given comes from my own observations or interviews.

Ghanaian environmental journalist Mr Mike Anane, who has written about e-waste and Agbogbloshie for decades, grew up in the area long before the e-waste and even before the Old Fadama ghetto, describing it as a once green, pristine 'garden of Eden' where people lived by fishing and hunting. He recounts the process of transformation as gradual, lamenting that the area became a dumping ground for various forms of waste and rubbish long before the e-waste arrived, and speculating that the explanation is likely the lack of environmental regulations and oversight in the area. (5) When the e-waste began to gradually flow into Ghana, Agbogbloshie was the natural endpoint given both said conditions and history, and the proximity to the port at Tema Harbour.

Grant and Oteng-Ababio argue that the informal recycling sector is a direct consequence of the economic crisis in Ghana during 1980s. The effects of the various liberalisation policies, and the Structural Adjustment Program negotiated with IMF and the World Bank during that period, adversely affected the people of Ghana. The privatisation of state-owned enterprises and removal of government subsidies, combined with the crisis in the global economy and cuts in expenditures of health-care and social services, reduced the resources available to many people and worsened living conditions. It is such conditions of poverty that they believe are responsible for driving people into the informal recycling sector. (6)(7)

Many workers in Agbogbloshie are from the Northern Region of the country, poverty and still on-going tribal conflicts having pressured many to move to Accra. Called *coliba* in their own tongue, they supported themselves initially by collecting and recycling various household waste but branched out into e-waste once that became a possibility. Lack of official structures to handle this kind of waste gave them the opportunity; regular waste-management channels still do not handle e-waste and the coliba thus provide a needed service. Combined with the growing influx of imported second-hand goods that broke down comparatively quickly, much of which was technically waste to begin with as it did not work upon arrival, the end result was the gradual creation of an informal e-waste recycling area over many years. With the adoption of the ICT policy of 2004, second-hand import really took off, and once the capacity to handle e-waste grew enough, the problem was further exacerbated by illegal foreign shipments of e-waste, technically banned the Basel Convention agreement but still occurring to this day. (8)

Today Agbogbloshie's e-waste economy is extensive and has a key role in Accra's urban economy. Approximately 5,000 workers are labouring at 'Agbogbloshie proper', most of whom are registered with the Greater Accra Scrap Dealers Association, and about 30,000 are estimated

to be involved in the broader chain. Additionally, some people who are otherwise employed in some part of the formal sector nonetheless enter the informal recycling sector to gain extra revenue. Note that concerning e-waste recycling, there is presently no formal alternative in Accra. Recycling firm *City Waste Recycling Ltd.* can presently collect, but not process, electronic waste, having therefore only the option of burying it in landfills. I saw no indication of any note-worthy volumes going their way. Practically speaking, all e-waste that comes into Ghana is either placed in storage or goes to Agbogbloshie or a place like it. (9)(10)

As Ghana as a whole has developed, less and less of the waste has come to originate from second-hand waste and more comes from new equipment, though the exact numbers are disputed, as discussed in the preceding chapters. Nonetheless the channels and facilities for handling them are the same informal ones that were established to handle imported waste in the beginning. Nowadays, much of the brand-new equipment comes from China. (11)(12)

At of the time of writing (June 2019), the e-waste recycling activities are also expanding beyond Agbogbloshie. New, smaller bases are emerging; one just across the river at the edge of Agbogbloshie. It focuses on car recycling, but I saw large quantities of ICT equipment being unloaded from trucks as well. Car recycling also occurs in the Kokompe area. (13)(14)(15) Ghana's only two environmental journalists, who have written extensively on e-waste for decades, Mr Emmanuel K. Dogbevi and Mr Mike Anane, have observed several such smaller operations scattered around Accra, still being established and not rooted quite yet. (16)

2. At the ports

Clearance of goods at the Ghanaian ports is done by the Customs Division of the Ghana Revenue Authority together with the Ghana Ports and Harbours Authority, with involvement from the Ghana Standards Authority, the Ghanaian EPA and the Customs, Excise and Preventive Service as well as destination inspection companies and shipping lines. Presently, no particular guidelines exist for the handling of second-hand electronics, and the procedure is therefore the same as for any other good classified as 'high risk'. In theory, this requires physical inspection of the goods by the Customs Examination Officer and other relevant agencies, including the Standards Authority and EPA, at the port's container terminals. In practice, however, such examination rarely occurs, and precise standards for quality testing do not exist, nor does specific equipment fit for the task.

Mr Dogbevi and Mr Anane also inform me that part of the overall problem is a lack of knowledge at the ports as regarding e-waste, with port employees lacking both the education and practical means of testing whether second-hand imports work. A 2011 DanWatch report, *What a Waste*, corroborates this, stating that the examinations at the port in Tema focused purely on physical appearance and did not extend to actually attempting to operate the devices. The second-hand electronics were sorted into two piles, consisting of what is believed to be potentially working and that which is obviously broken. No possibility of actually testing the items existed at the ports at the time. (17) Mr Larry Kotoe of the Ghanaian Environmental Protection Agency informs me that this has changed somewhat recently, which Mr Dogbevi and Mr Anane also acknowledge. The checks on second-hand electronics are now becoming more stringent, to ensure it is not used as a loop-hole to circumvent the ban on e-waste export.

However, Mr Henry Okine, the programmes co-ordinator of the ENGO Ports Environmental Network Africa (PENAf), suggests that despite trying to inspect second-hand electronics, in practice the controls are insufficient in both quality and quantity. Functionality tests are virtually never done in practice, except on those occasions when there is some collaborative effort that involves some international agency such as INTERPOL. Even so, there are simply not enough resources and not enough time to control every container as thoroughly as one ought to, so controls are limited to shallow visual inspections at most. In those cases where examination does occur, Mr Okine observed that a lot of what is imported is broken and technically junk but is allowed in nonetheless since there is a known market for it. Additionally, some of the goods can become damaged during shipping and handling processes at the ports, as well as the inspections themselves. For example, since there is no designated area for inspections of used electronics, such goods are simply removed from the containers and placed on the ground out in the open air, even on rainy days. (18)

Due in part to these difficulties, the EPA is trying to ensure that responsibility for testing second-hand equipment falls on the exporting country, and that all imported used electronic goods carry a certificate that they have been tested. At the time of writing, some goods do carry certificates that they ‘respond to electricity’, which vastly improves the chances of the goods working but does not guarantee it. In a similar vein, in 2012 the Ghanaian Energy Commission banned the import of second-hand air-conditioners, refrigerators, and other white goods which contain ozone-depleting chlorofluorocarbons (CFCs). These are now seized at the port even if they work, though second-hand white goods not containing CFCs were observed for sale throughout Accra. (19)

Mr Kotoe further informed me that official import of actual e-waste, i.e. officially declared as such, no longer occurs – not even from the USA, which has not ratified the Basel Convention. This is due to a change in Ghanaian policy, whereby Ghana simply does not accept such shipments into the country. However, illegal shipments still occur, “a lot” according to Mr Kotoe, and there is active work in the ports, trying to crack down on it. (20) Regarding such illegal shipments, Mr Anane informs me, based on his own continual personal investigations at the port, that e-waste is often disguised as other things on the shipment declarations, or hidden together with other items such as shipments of shoes, household items or tires. This approach has increased in response to government crack-downs on illegal shipments and increased testing of second-hand goods.

As discussed in Chapter 4, the EPA and the port authorities only have estimates on the inflow of e-waste, and not any recent or exact statistics, at least not officially. Lack of resources prevents any kind of large-scale investigation. Their focus is on preventing as many illegal shipments as possible, which is itself difficult and faces resource constraints. Calculating the exact volumes of e-waste is not a concern. (21)

3. Legal and technical framework

In 2016, the Parliament of Ghana passed *the Hazardous and Electronic Waste Control and Management Act*, known also as Act 917. The act is meant to provide “control, management and disposal of hazardous waste, electrical and electronic waste in the country”. (22) The aim is to protect the environment and flora and fauna by preventing the dissipation of harmful substances, and the passing of the act also fulfils Ghana's obligation to the Basel Convention on the Control of Transboundary Movement of Hazardous Waste. (23)

The Ghanaian government is well aware of the ‘loop-hole’ that second-hand electronic goods present, and the new law therefore focuses more on establishing proper handling than on preventing entry. With the passing of this law, the only way to legally recycle electronics in Ghana is to apply for a certificate with the Ghanaian EPA, who will only grant it to those who can show that they have the capacity for proper, environmentally sound recycling. (24)(25) Certification also includes payment of an e-waste levy, which is meant to pay for proper treatment. Handling e-waste without a certificate is considered a criminal offence, the offending party being liable “to a fine or to a term of imprisonment of not less than one year and not more

than ten years or both", as well as being liable for the "cost of cleaning up any contamination caused by the hazardous waste". (26)(27) The new law includes a tax on the import of electronics that goes to *The Electrical and Electronic Waste Management Fund*, meant to pay for the "construction and maintenance of electrical and electronic waste recycling or treatment plants, support research into methods of electrical and electronic waste preservation, prevention and control for research into electrical and electronic waste treatment and recycling, publication of reports, education of the public on the safe disposal of electrical and electronic waste and the negative effects of electronic waste". (28)(29)

The law also places responsibilities on retailers, distributors or wholesalers dealing with electronic equipment, requiring registration with the EPA and careful book-keeping of their activities. Crucially, producer responsibility is introduced via a demand that "manufacturers, distributors or wholesalers of electrical or electronic equipment" take back their products for recycling, and ensure recycling is done in an environmentally sound way. The act is, however, very brief on this matter and does not go into greater detail regarding producer responsibility. (30)

The role that the legal framework plays is a matter I discussed with legal scholar, Dr Yvonne Idun, Environmental Policy Analyst of the UN University's *International Centre for Environmental Governance and Development.* In her view, Agbogbloshie presents a complex problem that requires a multi-faceted solution, including, of course, government policy and strict enforcement thereof. She sees nothing wrong with the 2016 law *per se* but argues for a 'carrot and stick' approach, i.e. for more stringent penalties, including prison, for rule-breakers. (31) This goes against the EPA policy in practice, which seeks to guide people towards the right course of action without punishing wrongdoings. Mr Larry Kotoe informed me that his institution, largely responsible for the practical implementation of the law, seek to do so carefully in order to avoid doing harm to scrap-workers. The EPA is aware that the workers are quite poor, and usually lack any alternative means of supporting themselves, making e-waste work a 'livelihood issue'. Hence, although the legal basis exists for fining and imprisoning offenders, the EPA has chosen not to implement it. Rather they try to educate and provide support, hoping that the scrap-dealers will see the benefits of following their standards, such as greater worker safety and more useful materials extracted, and leave the old way of doing things behind. In collaboration with a *Sustainable Recycling Industries* project, scrap-workers have also been provided better tools in order to more easily comply with EPA standards. The SRI is an organization funded by the Swiss State Secretariat of Economic Affairs (SECO), that works

with informal recycling in developing countries. (32) It is noteworthy that no other aspects of the 2016 law are currently being enforced, due to worries about destabilizing effects on the informal recycling industry. (33)

Mr Kotoe regards the process of ensuring compliance as gradual and long-term, referring to it as “formalizing the informal”; it is about getting the various informal actors in this sector to implement proper ways of recycling so that they fulfil EPA demands and get to register for a permit to do recycling business. Since actors are already organized in associations and informal structures for collection, recycling, and selling of valuable metals already exist, Mr Kotoe sees the EPA’s role as a relatively straight-forward one of just convincing the already existing organizations to adapt to the new law.

Dr Idun however argues that enforcement against corporations and large organizations is not the same as enforcement against private and often marginalized individuals, and that the ‘livelihood issue’ does not really apply to companies or better-off individuals at the top of the informal hierarchies in the way it does to the poorest workers. Nor can the law have any effect it is not implemented at all in practice, though she is quick to point out that it is not about punishing the poor for doing what the desperation of poverty pushes them to, but about a need for alternatives and a more holistic approach to finding solutions. Dr Idun also calls this to ‘facilitate compliance’, i.e. to make it practically feasible for people to actually obey the law without risking their livelihoods. Such a facilitation includes giving e-waste workers better tools, protective gear, and more official and acknowledged, and respected, roles. Possible additional actions are education of the population to inform and change attitudes, a change in incentive structures, a push for more corporate responsibility, and the development of the right mechanisms and facilities. (34) There is also currently no practically feasible alternative for people to get rid of their old electronics, since municipal waste management still does not deal with e-waste.

Mr Kotoe recognises the same problem and acknowledges that scrap-workers lack resources to meet the EPA standards required to obtain a certificate for dismantling. Thus, most are restricted from dismantling and can legally only do collecting, something that requires a smaller capacity and is therefore easier to get a certificate for. The crude ways currently employed for dismantling in the informal sector are simply cheaper, and anyone can do it. Setting up a proper dismantling facility is costly and, so far, the EPA has received only one application for a

certification of a proper e-waste recycling facility at Agbogbloshie, from the local Green Advocacy project, while the rest are applications for collection only.

The hurdle seems to be a lack of resources to provide the scrap-workers with assistance and enhance their capacity. Without proper alternatives, enforcement of the law cannot avoid destroying livelihoods, as both Dr Idun and Mr Kotoe agree. Yet as Dr Idun notes, without any enforcement at all the law might as well not exists since breaking it has no consequences. Though the political will to resolve the issue seems to exist even at the highest level of government, the needed resources are lacking. Nonetheless Mr Kotoe believes that things are moving in the right direction. He has observed changes already, with burning waste being reduced drastically and conditions at Agbogbloshie improving somewhat in his view. Even though he admits there is much left to do, he is hopeful and considers the results so far encouraging.

One recent initiative that seeks to improve the situation was the official adaptation of the *Technical Guidelines on Environmentally Sound E-Waste Management;* are official guidelines for environmentally sound e-waste management in Ghana, which is the first country in Africa to adopt such a framework. (35) It was created through a joint venture between the Ghanaian Ministry of Environment, Science, Technology and Innovation (MESTI) and its implementing agency, the EPA, as well as the foreign organizations *the Öko Institute, the World Resources Forum,* the aforementioned *SRI* and *Empa*. The Swiss research institute Empa (Federal Laboratories for Materials Science and Technology, shortened to *Empa* in German) assisted them together with the German Öko-Institut, or Institute for Applied Ecology. The latter is a private, non-profit environmental research institute that has helped research e-waste work at Agbogbloshie. Finally, the World Resources Forum is another non-profit environmental NGO with a particular interest in e-waste. (36)

The guidelines are “mandatory in compliance with Act 917” and meant to be the practical and technical specification of what the law only generally demands. They apply to anyone in the e-waste recycling business and establish the demands on capacity required for each kind of certificate tier and the restrictions on activities that apply to each tier as well as the exact demand on how to handle the e-waste. The EPA is meant to assure compliance through annual audits but, as has been covered, these guidelines are as yet mostly hypothetical since only the one Green Advocacy facility has been certified so far. (37)

4. The new facility

By far the most important initiative, and the one to likely have the most practical impact, is the construction of a new e-waste recycling facility. The president of Ghana, Nana Addo Dankwa Akufo-Addo, announced in late August 2018 that the construction of a modern, state-of-the-art e-waste recycling facility would commence at Agbogbloshie in October 2018, expected to be ready two years later. The project had been on the table and discussed for years and was even promised by the previous government. The president considers the new facility to be one part of a two-part solution to e-waste, the other being “the designation of the external service provider, i.e. SGS, to verify, assess and collect the Advance Recycle Eco Fee [AREF] on all electrical and electronic equipment, under the Fifth Schedule of Act 917, imported from all exporting countries”. (38) The fees from the AREF are to go to the already mentioned *Electrical and Electronic Waste Management Fund.* The plan also includes establishing “a network of collection centres” and the fund is meant to finance both the collection and various forms of support of it, such as education. The president seemed to take the issue very seriously and hopes that the new facility together with the 2016 law will see the end of the e-waste problem, promising to also create around 22,000 new jobs in Accra through these initiatives. (39) The plan also includes the construction of a health station in Agbogbloshie, meant to both monitor the condition of workers and residents and help with their problems.

Model of the planned facility. Official image from the website of the Presidency of the Republic of Ghana.

The project is supported by two German institutions that have signed agreements with the Ghanaian government, through its Ministry of Environment, Science, Technology and Innovation (MESTI). These are the development bank, KfW Germany, which provides funds of 20 million euros, primarily in order to fund the building and bear the difference between the market price of scrap and the artificially raised purchase price that the project will use in order to attract sellers. KfW is supporting this initiative "[o]n behalf of the German Federal Government", specifically the Federal Ministry for Economic Cooperation and Development (BMZ), with the aim of finding a "new approach for environmentally-friendly recycling that simultaneously ensures that the income of the collectors is not jeopardised", according to their official statement on the matter. (40)(41) The other institution is the development agency GIZ (German Corporation for International Cooperation, GIZ in German), meant to help MESTI in "improving the framework for sustainable e-waste management", such as policy implementation, education and the establishment of a recycling fund. It provides an additional 5 million euros for this purpose.

The project was commissioned by the *German Federal Ministry for Economic Cooperation and Development* (BMZ) in cooperation with the Ghanaian government and was first officially announced in March of 2017 with the German Ambassador to Ghana, Mr Christoph Retzlaff, present. (42)(43)(44)

This facility aims ultimately to absorb all e-waste that cannot be properly recycled at Agbogbloshie, i.e. following proper environmental standards, which would mean almost all of it in practice. Such a facility would ideally change the situation in Agbogbloshie almost entirely, especially together with the 2016 law on e-waste which could then be enforced completely differently. The people currently working at Agbogbloshie would shift to collection only; part of the project is meant to ensure that people can keep making as much as before while doing collection alone. (45)(46) I discussed the plans for the new facility with several experts, among them Mr Dogbevi and Mr Anane. While hopeful that the new recycling plant would resolve Ghana's e-waste problem once and for all, both pointed out that the promise of a recycling plant is an old one but had been delayed for various reasons that where never made clear. The idea of an imminent and complete solution worries them, since little or nothing has happened in practice and such an idea might simply prevent smaller but more practical initiatives from being launched. Mr Anane especially argued that a facility does not solve the problem of illegal e-waste shipments, merely alleviating its consequences. Ideally, a Ghanaian recycling plants is for *Ghanaian* e-waste, and should not risk becoming a justification for importing foreign e-

waste. A far more hopeful impression was given by representatives of the aforementioned local NGO Green Advocacy Ghana, which plays a key role in the promised project.[42] (47)

It bears mentioning that the difficulties in establishing exact flows, and their origins, as discussed in Chapters 3 and 4, play a role here. As mentioned before, counter-measures to address the e-waste issue are always based on some assumption – explicit or implicit – about the problem and its origin. Whether a new recycling facility or a new law, a measure can only be effective if it targets the actual issue; a law forbidding import from developed countries, for example, would have been almost entirely pointless had the denialists been correct in their assertion that the bulk of e-waste in Ghana is domestic. Likewise, the importists claim about e-waste flowing into Ghana due to low costs and a lack of regulations, means that a modern recycling facility risks undermining the very competitive edge that the informal recycling business in Ghana offers on the global market, unless great care is taken to avoid that when setting up the business model. Without understanding the exact nature of the e-waste problem – and its origin – any measure meant to tackle it might prove ineffective at best and directly harmful at worse. Without knowing the volume of flows, measuring the effect of any policy must also be limit only to how it affects conditions at Agbogbloshie, since it cannot be evaluated with respect to its effect on flows.

4.1 Green Advocacy Ghana: a way to sustainable recycling?

As of June 2019, a small pilot project has been imitated in cooperation with the local NGO Green Advocacy Ghana. The organisation began their work at Agbogbloshie in 2009, forming a stakeholder group together with the Ghana Standards Authority, EPA, University of Ghana, Ghana Atomic Energy Commission, and others. Through this, special hand-operated machines for mechanical stripping of wires were eventually introduced to Agbogbloshie. Green Advocacy also began testing alternative methods, such as using knives and clippers, trying to find a way of recycling that was both environmentally sound and safe for workers, and could also compete with the conventional process of burning in terms of the time it takes to dismantle and the amount of valuables extracted. (48)(49)(50)

[42] Note that as of the time of the writing of this thesis, building has not yet commenced, nor have there been relevant reports in Ghanaian media nor have I received any communications on the matter from any of my contacts in Ghana. A small training workshop, Agbogbloshie Technical Training Centre, has been set up and was inaugurated in March of 2019, but conditions are reportedly already deteriorating.

Together with the Blacksmith Institute/Pure Earth and Hunter College CUNY, the first recycling pilot project began in 2012. A facility was constructed at Agbogbloshie that provided the tools and means for stripping cables using specialized machines, in a safe and environmentally sound way, mechanically instead of relying on burning. The facility operates by buying cables from workers and recycling them. Scrap-collectors bring in the cables, they are weighed, and they receive payment immediately though a mobile service. In the first year, about one ton of cables were processed, with the volume increasing after that. Green Advocacy has now been provided with 50,000 euros in funds to buy cables for a trial run of seven months. The results of this project are meant to feed into the larger project, that of constructing a completely new facility, with information about the potential impact on local workers' livelihoods being of particular interest. The project wishes to avoid negative impacts on workers, hoping to absorb them into the project, for example as workers at the new facility. (51) (52)

One of Green Advocacy's chief aims is to prevent burning of plastics, which is seen as the most pressing issue. While burning was technically made illegal in 2016, it still continues in practice due to the aforementioned EPA decision not to enforce the law. As part of this they try to educate Agbogbloshie workers about the negative health and environmental impact of their work. This is done through holding seminars and information events, and through anti-burning messages being placed on posters and T-shirts and shouted out through megaphones, and simply by having Green Advocacy personnel walk around the Agbogbloshie area and speak to workers.

Green Advocacy facility, cable stripping machine.

Another cable stripping machine.

This seems to have had some success, since some of the workers at the new facility are former Agbogbloshie scrap collectors, who transferred over mainly due to concern for their own health, among them my guide at Agbogbloshie, Mr Issah Abdullai. (53)

However, it is worth noting that just the establishment of this small cable-stripping operation has taken many years, and there were many hurdles and difficulties with it being accepted. This according to Mr Bennett Akuffo, environmental scientist and activist at Green Advocacy, who is one of the people spear-heading the new project. In general, he believed that the foreign investment banks did not understanding local conditions or the attitude of the locals, and were not always willing or able to adapt to them.

One problem was establishing a fair and feasible price that the new facility would pay for cables, for it could neither be set too high or low. Too low and nobody would want to sell, since they could make more though traditional means of recycling. Too high and it would threaten other business at Agbogbloshie, since *too many* would want to sell to the facility. Setting prices too high for a period created problems for Agbogbloshie businessmen, who complained that their livelihoods were jeopardized. A fair price had to be arrived at, which took several months and delayed the start of the seven-month project proper. (54) According to KfW's official statement, they expected a price to be set that was above the market price, but 10 cedis per pound of cables was deemed too high. At the end of the trial period, 5 cedis per pound is considered fair based on extensive surveys and trials and is meant to reflect how much the workers would ordinarily make. (55) Collectors pay around 8-10 cedis per pound of copper to scrap-workers; aluminium fetches just shy of 2 cedi per pound, but is more plentiful and usually easier to obtain than copper. It is possible that collectors are pushing Green Advocacy to pay less than they are in order to ensure a competitive advantage, but also worth considering is that selling to a collector requires actually extracting the copper, while Green Advocacy will simply buy the cables with the plastic still there. (56)(57)

Another issue is that their facility cannot handle anything other than cables, and cannot process very small cables, which are the most common ones. Therefore, the facility lacks the capacity to provide a viable alternative to burning, which Green Advocacy recognises clearly. A new machine was installed recently that can, in theory, handle the smaller cables. But in practice, these are often so entangled that they cannot be fed into the machine without much time-consuming untangling being done first. Here they were assisted by the GIZ, which resolved to buy the cables that Green Advocacy's facility cannot process. The limited capacity to buy

cables coupled with limits on their size only mean that burning, unfortunately, remains the quickest and easiest way to recycle for workers. Given these issues for even this small facility, it is unsurprising that experienced observers such as Mr Anane and Mr Dogbevi express some doubts about the grander project. (58)(59)

5. Conclusions

There are four main constraints on the conditions in Ghana, and Agbogbloshie in particular, that have shaped the development of the informal e-waste recycling industry there and will continue to shape it in the near future.

Firstly, there are the port proceedings and the practical limitations in place there. As has been covered, there are practical constraints on the capacity to examine the in-flow of electronic goods, as well as a lack of enforcement of existing procedures and rules. This is, in part, of course due to a lack of resources: personnel, time and tools enough to control the incoming goods. But noteworthy is also the apparent intentional allowance; port authorities know there is a ready market for e-waste and have no real incentive to prevent what is perceived as a resource to enter their country, merely due to rules that they have not to resources to properly enforce anyway.

This unwillingness of implementation of existing rules ties in to the second restraint; the question of laws and regulations, and their enforcement. There is a contradiction between the law as written and the way in which it is enforced, i.e. sparsely or not at all. The contradiction is rooted in the conflict between, on the one hand, not wishing the punish the poor for their poverty, and on the other hand the awareness that a law which is intentionally not enforced is, practically speaking, not a law at all. One hardly imprison or fine people for employing themselves in a major local industry and providing a vital service that the city otherwise lacks, because they lack the tools and capacity to actually follow the law. Especially not when the local chieftains who control the recycling industry have political clout and would be able to resist any such enforcement. Dr Idun is correct in her assessment that an alternative is needed before the law can be enforced, and the EPA’s decision to guide and teach rather than punish and enforce is understandable. However, the outcome is one where the legal and regulatory framework is, practically speaking, rendered moot. The economic conditions to enforce the rules in a way that makes sense are simply not present; Ghana’s new laws on the matter are

ultimately not adapted to the actual conditions in Ghana as they are, but based on a vision of what ought to be, and ignores the limited capacity of people to really follow the law. Therefore, the legal and regulatory framework does not support any development away from the current conditions but is rather reliant on such development taking place first in order to come into effect.

It relies, in other words, on the third constraint, technical solutions, coming into play first; on the capacity to follow the law to develop by way of an alternative way to recycle. Yet, as has been shown, the implementation of new technology has been very limited in practice, the construction of a modern recycling facility seeming unrealistic in light of the many troubles and conflicts involved in establishing merely the small cable recycling facility. At the time of writing no visible or notable outcome can be observed from any of the long negotiations or plans. The complexities of the underlying economic conditions and the political structure, especially the informal chieftains and their interests, paralyzes the development of Agbogbloshie, placing it in a perpetual state of stagnation which nonetheless appears ripe for development. The political will and investment interests seem there, as does the business opportunity, yet conditions remain unchanged even as major changes are promised to be occurring at any time. The threat on livelihoods and uncertainties that such a major project brings in do not mesh well with the established, informal structure already in place and which has been stable for decades. Ultimately, the idea of major solution just over the horizon may do more harm than good, as smaller but practically more attainable improvements are overlooked in favour of holding on to the promised big leap.

At some level one must also question the avowed commitment, and capacity, of the government and its institutions. Certainly, my impression is one of a strong political will existing both at the presidential level and at the EPA, yet the lack of development speaks volumes – Ghana having a somewhat weaker state than e.g. China, and one notoriously rife with corruption. (60)(61) This represents the fourth and final constraint, for the state of course has a pivotal role in setting up the other three restraints: port policy, laws and regulations, and investments in new technology.[43] Taken together, these constraints point towards a more complicated picture than what appears at first glance, one that precludes the typical eco-modernisation view of a solution that is found in regulation and technological innovation, which emerge as the outcome of

[43] The importance of the state as a driver of development will be seen more clearly when contrasted with the stronger Chinese state, and the changes that have occurred at Guiyu, in Chapter 7.

economic growth and development. Local conditions and particularities do not mesh well with the proposed solution.

Having now briefly established the historical, legal and economic framework within which the informal recycling occurs, it is finally possible to examine the Agbogbloshie site itself, as well as its surroundings, in greater detail, which is done in the following chapter.

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Chapter 6

Conditions of the Working Class in Agbogbloshie

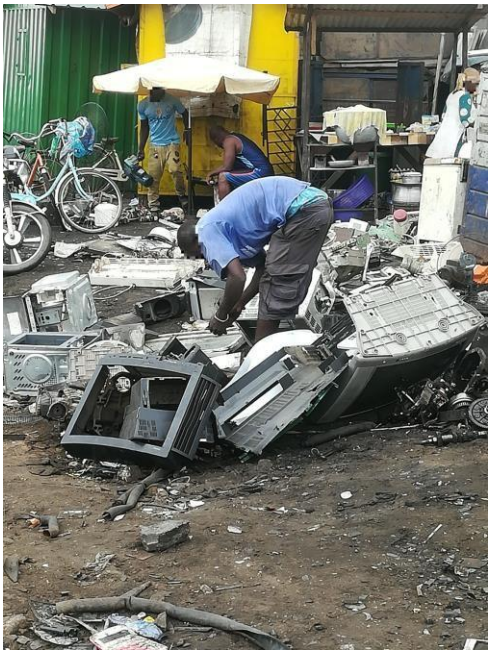
The following is a micro-ethnographical account of the lived conditions of the workers and inhabitants of the Agbogbloshie scrapyard and the nearby slum, gathered via a combination of on-site participant observation and unstructured and semi-structured interviews with both inhabitants and local experts during my visit there in the autumn of 2018, and also via a series of briefer contacts and interviews with key persons during 2019. It aims to paint a picture of the lived experiences, views and attitudes of workers and locals as it was relied to me by them, via a local guide and interpreter. As was made clear in Chapter 2, access was at times problematic even though the area itself is open to visitors, and I was only able to communicate unhindered with locals due to assistance from the aforementioned local ENGO Green Advocacy.

1. Living and working in Agbogbloshie

The Agbogbloshie area is located between the South Industrial Area and the fishing communities of Usshertown, and is easily accessible via bus or cab. At the centre of Agbogbloshie stands the scrapyard itself, a labyrinth of hundreds upon hundreds of tiny and simply made huts constructed from scrap metal, planks and tarp. They house scrap-workers, all of them working with many different kinds of scraps and old machinery, ranging from cars and bicycles to old generators and, of course, all manner of e-waste. Waste picking is a stigmatized occupation and the terms *kaya bola* or *Kaya Bola Boys*, meaning 'waste-men', are used to describe those who engage in it, and also refer to a role in society and not only an occupation. (1)(2)(3)

Strict compartmentalization does not occur in the sense that one kind of waste will be worked on only in one area; rather, people work with what they can get their hands on. Some workers do not have huts, but just work out in the open, surrounded by their raw materials. Some work alone, some in groups; some are serous-minded and focused, others are chatting with one another, laughing and smoking cannabis. The tools used on site are primitive, mostly just hammers and chisels with the occasional screwdriver. A few of the huts housed larger shops that used blowtorches, but that was rare. The work that takes place first is mechanical, and basically consists of just hitting whatever you are dismantling with a hammer until it breaks

down into its constituent parts. The same basic principle, with little variation, is applied to computers, TVs, refrigerators and cars. Rubbish and left-over e-waste are piled up everywhere. (4)(5)

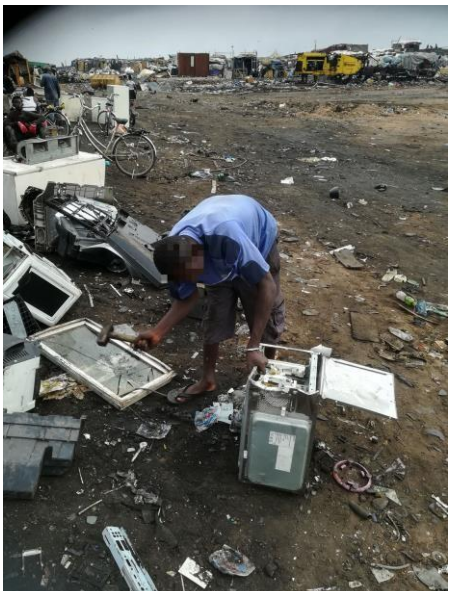


Man working on disassembling ICT waste.

Since Agbogbloshie lacks the infrastructure and equipment to handle e-waste properly, the workers are continually exposed to the toxic and hazardous content of the waste. (6)(7) Yet most of the workers on site use no forms of safety equipment or protection, and those who do use only the most rudimentary ones such as gloves and goggles. The majority seem largely unaware of the possible consequences of doing so or the risks they expose themselves to, and those who do possess such knowledge are ignorant of the details, knowing only about some of the symptoms from either first-hand experience or second-hand accounts. Such symptoms include bodily pains, headaches, chest and breathing problem, nausea, fungal rashes, skin abnormalities and insomnia. There exist also widespread yet medically incorrect beliefs about how to avoid adverse effects from e-waste work, for example that smoking cigarettes protects against the poisonous fumes. (8)(9)(10)(11) The frequency of cannabis use can be explained in part by the belief in protective properties, and also by people needing it to sleep; several workers told me that cannabis is the only thing that helps them sleep after a day of waste work. Yet ultimately workers themselves seemingly cannot afford to concern themselves with worries about health, especially not the long-term risks. Their main concern health-wise is avoiding malaria, and they are otherwise too dependent on the work to worry about it. (12)

What cannot be extracted through mechanical means is burned. Workers mainly use styrofoam, found in fridges, as well as old tires to fuel the fires. Things such as cables are burned in order to quickly remove all the plastic, which is what the Green Advocacy project is trying to discourage.

Other things being burned are not so easy to find solutions for. For example, in the motors in refrigerators there is a large coil made of pure copper, which is very valuable at Agbogbloshie, but the bonding agent holding it is too strong to get the copper loose by mechanical means. It is therefore burned, since the heat loosens the copper and allows the workers access to it. No means of doing this without burning exist at Agbogbloshie currently, nor is it possible to convince the workers to forgo the valuable coils regardless of the dangers burning may pose for them. (13) (14)



Disassembling a computer with a hammer.

People work from around 6 in morning to late in the evening, labouring for about 10-12 hours daily. Income varies between workers and depends on their experience, capabilities and access to tools. Payment is in piece-work fashion, i.e. workers are payed based on how much they collect and do not receive a wage. Some workers make so little that they cannot even afford their own tools, but must borrow from more well-off colleges. Sometimes they even work at night, and in fact that is when most of the burning occurs since the fumes are less likely to disturb people working nearby. The money made depends largely on luck in obtaining e-waste; what kind one gets and in what conditions. The time it takes to dismantle something varies depending on item, worker skill and available tools. Additionally, social and family ties, especially to authority figures like local chiefs, play a role. (15)(16) Some people work as collectors for the higher-ups, the buyers, and help gather and transport the metal they buy, for which they are paid a salary of ca 500 cedis per month; somewhat less than what recyclers make but a steady, guaranteed income with no need for personal investment or risk. Another advantage would be not having to stand right next to the burning plastics. (17)(18)

E-waste delivery, emptied trike.

Much of the collecting is done by people pushing large carts around, who buy it from all over the city. E-waste is also brought there by larger dealers, sometimes in large trucks but more commonly in smaller motorized cargo trikes. (19) Recyclers either collect themselves or buy e-waste from those dealers; either way it is an investment and necessitates a small risk with every transaction. Learning the trade is based on informal apprenticeships, and a newcomer is usually attached to a more experienced family member who teaches them the various aspects of the job step by step, usually beginning with just collecting. The jobs that people do vary, depending on what skills and tools they have managed to acquire and what kinds of e-waste they can afford to invest in. Some people do everything from collecting to dismantling to burning themselves, while others specialize on one task. Different approaches and techniques of recycling also exist, depending on from whom one learned them. (20)(21)

Estimated monthly income of e-waste workers, USD	
Children	≈$45
Collectors	$70-140
Refurbishers	$190-250
Recyclers	$175-285

Table 6.1. *Income of scrap-workers* (22)(23)

Men burning plastic at Agbogbloshie.

More burning of plastic, right by the river.

The informal apprenticeship system has led to labour roles on the dump site generally following an age-based hierarchy. Adult men dismantle electronics, younger men and older boys (around 16-18 years old) set the fires in which scrap is burned and melted, while young boys drag around carts filled with waste materials to bring to the fires, and also scavenge for small pieces of metal. Around 40% of the scrap workers are boys, some as young as five. Neither women nor girls are ever directly involved in the e-waste business, and only a few are even indirectly involved, usually through the selling of food and water to the male workers. They walk around the whole Agbogbloshie area carrying their goods, and are often very young. (24)(25)(26)

Recruitment of workers is also informal, and people in the Northern Region usually hear about Agbogbloshie and the possibility of making money by word of mouth, through friends, neighbours or relatives who have worked there or know someone who has. Some of the workers

are seasonal, returning north occasionally to do farm-work, depending on their financial capabilities and the need for agricultural work, which is seasonal. Others send money back home to support their families, and others again are simply stuck at Agbogbloshie as they do not make enough money to return home. It is common for people who do comparatively well at Agbog-bloshie and can branch out or otherwise grow their business to call on family from up north to come and assist them. (27)(28) Such family bonds add both to the feeling of separation and isolation of the Agbogbloshie community, and the strength of the informal structures and relations which are in place there. The workers are uneducated and often speak little or no English, having their own tribal languages or relying on pidgin, adding further to this isolation. Their lack of education also keeps them isolated, stuck in the work at Agbogbloshie and unable to get any other kind of job – this is made worse by the fact that many of the young boys working there should be in school but elect to make money at Agbogbloshie instead. In my discussions with Mr Anane, he claimed that truancy is a serious problem that perpetuates the cycle of poverty in which Agbogbloshie residents find themselves. He also fears it will affect the self-image of the workers, so that they become stuck not only in poverty but also in a way of thinking about the world and themselves. (29)

Young man collecting e-waste with a cart.

The aim for most workers is to make enough money to work their way up the hierarchy, investing in their business and expanding their capacity. This can mean something as simple as purchasing finer tools or expanding one's little work-shed to be able to process more e-waste, and extract more valuable materials from it. Of course, some lucky ones do not need to start at the bottom, but have enough resources or contacts to enter the business at a higher level. (30)(31)

Burning cables to access copper.

Burning cables, river visible in the background.

Men working at Agbogbloshie.

Perhaps unsurprisingly, most of the money is made higher up. Unlike the smaller, individual scrap-workers, the higher-ups who act as middle-men for the extracted metals can make a comfortable living and afford a middle-class lifestyle. But only those at the very top, who export to other countries or sell directly to industries, make any significant profit. Workers at Agbogbloshie seemed very aware of this, discussing the hierarchy of profit openly, and it is also confirmed by Mr Anane, Mr Dogbevi and Mr Akufo. Many of those at the top are not native Ghanaians, but come from other countries associated with the global e-waste trade: primarily China, India or Nigeria, with some Russians present also. (32) The higher-ups are the final link between the extraction occurring at Agbogbloshie at the various industries into which the extracted materials are fed. Some is exported abroad in finished form, if that capacity exists; some is exported abroad in unfinished form because capacity for proper extraction is lacking; some again cannot legally leave the country, but feeds domestic industries instead. Reclaimed aluminium, brass, iron and steel belong to the first category and are sold to Ghanaian companies that act as middle-men, and sell it on to companies outside of Ghana, primarily in China and Europe (chiefly Germany). Copper, on the other hand, belongs to the second category and cannot be processed domestically at all due to lack of proper smelters; the same is true for brass and gold, as well as printed circuit boards. Iron is what feeds domestic industries the most, and, given the 2013 export ban on iron scrap discussed in the previous chapter, only leaves the country illegally. (33)

Man working on various e-waste, while his comrades enjoy a brief break.

1.1. Living conditions

Child playing with a CD in the soccer field.

It is crucial to note that Agbogbloshie is not just a dump, but a whole community that includes the Old Fadama slum; a village where many thousands live and where many other activities take place. The total area of the slum and scrapyards put together covers 146.21 hectares and is home to around 80,000 people. (34)(35) Its recent history is marred by terrible flood that hit the area on 3 June 2015, and claimed 159 lives, and destroyed many of the makeshift structures. This in turn triggered organized evictions, including the demolishing of thousands of structures, by the Accra Metropolitan Assembly, seemingly hoping to clear up the area and prevent similar disasters in the future. No relocation effort was made, and many where thus left homeless and the area less populated, a move which sparked massive protests from residents. Furthermore, two years before this tragedy, a massive fire had spread throughout the area as well, destroying the homes and belongings of many residents. Nonetheless, recent media reports by the *Daily Graphic* indicate that people are returning and that the population is steadily increasing. (36)(37)(38)

Outside the e-waste area is a rubbish field that functions as a dumping-site for all the refuse produced in Agbogbloshie. Here are found remains of e-waste that cannot be recycled or used in any other way, but it consists mainly of various household refuse, including food remains. Cows, goats and the odd chicken forage here, looking for whatever remains of food can be found. So, in a sense, do people; I saw young girls sifting through the garbage in search of relatively whole and undamaged produce they hoped to be able to clean up and sell at the nearby market. (39) Some people even live here on the outskirts, in tiny huts made of wood and larger e-waste items such as fridges or washing machines, stacked on each other. The huts are very basic, proving only shelter from the elements and places to sleep. Many hundreds of people live like this, but it is difficult to know exactly how many since people come and go, and it is common to share accommodation.

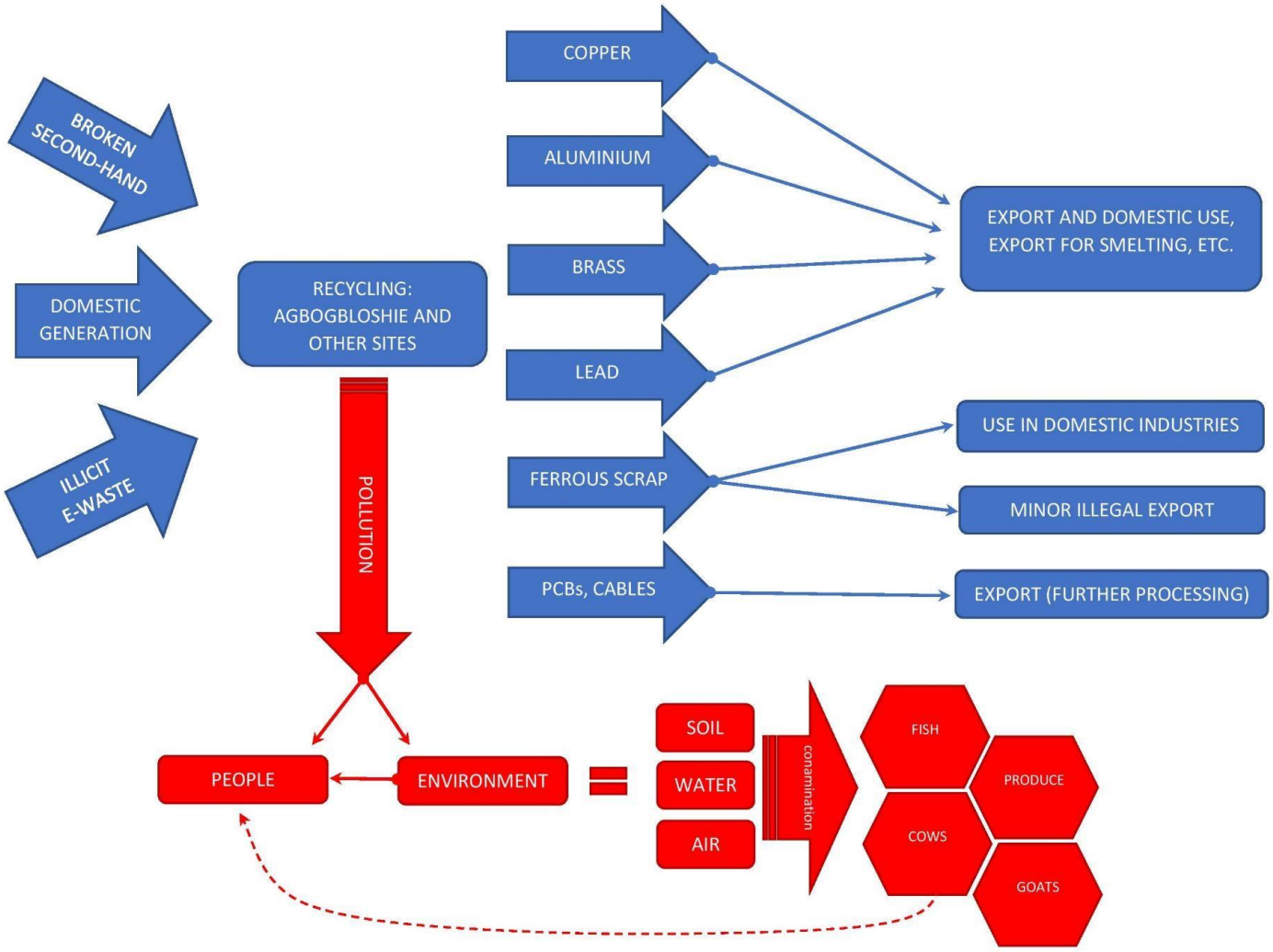


Figure 6.1. *Simplified schematic of outflows from Agbogbloshie (and similar) recycling operations in Accra.*

Both here and near the e-waste area I saw makeshift ‘mosques’; in reality little more than simple places for prayer, where the floor was covered with prayer mats that were kept from the soil and dirt. People could be observed washing up before prayer but not many would participate, seemingly only the most devout taking a break from work to perform the daily prayers. (40)(41)

Near the housing area is what might loosely be called a ‘commercial’ district. Here are larger shops that sell either used motor oil and spare parts of different kinds, mostly for cars and bikes, or various items made from e-waste. Some engage in recycling of old oil, for making tar. Most common among the latter was the making of cooking pots, grills and shelves from recycled metals, mainly aluminium, though I also saw a smith using smelted iron, obtained chiefly from cars, to forge tools. The end products are of excellent quality and display a great deal of skill and ingenuity on the part of the workers. When I asked them whether some formal education or apprenticeship lay behind their skills, they found the idea amusing, assuring me that they had learned all their skills on their own through experience and experimentation. Making cooking pots can earn a man around 100 cedis per day. Some of those involved in that kind of work sell them in bulk to middle-men, who then sell them to consumers, while others operate small stands of their own at the market just outside the scrapyard, often with the assistance of family members. (42)(43) The market is where most people not involved in the e-waste work directly are employed. Those just outside the scrapyard entrance sell produce, mostly onions, tomatoes and yams, while those a bit further down sell various goods, including those made from e-waste. Predominantly women work at the food market, but quite a few men are present too. Smoke and fumes from the recycling regularly reach the market place given that it is very close by; in addition, the vegetables being sold there have been grown using water from the nearby Odaw River, which is contaminated due to the recycling activity, causing the hazardous waste from Agbogbloshie to spread to even more people. (44)(45)(46)

In this district there is also a completely different source of pollution, parallel to the e-waste activity; the burning of goats and cows. As mentioned, in Agbogbloshie, goats and cows are herded, and in Ghana it is common to burn the animals whole in order to get rid of the fur. This is a part of the process of making *wele* or *coat*, a local delicacy that is made from the fur-less hide of cows and goats.

Goats in the rubbish field.

The burning would perhaps not be such an issue were it not for the fuel used: old tires. The operation is large and continuously ongoing. (47)(48) Entry into the burning area, surrounded by a make-shift wall, was not permitted save for a brief glimpse of the activity. Yet the smoke from it, a large black plume, could be seen almost all the time from anywhere in Agbogbloshie. No NGO or other institution has any official contact with this operation, even though the constant and large-scale burning of tires surely has an additional impact on local health and environment. Being that the operation exists for the benefit of e-waste workers and uses a resource, i.e. tires, that is connected to the e-waste flow, it should not be ignored despite its comparatively small size and ostensible independence, though I myself was not successful in learning much about it.

View of the living quarters.

Another view of the living quarters. Note the various pieces of refuse strewn about.

Various pictures of ICT waste.

2. The Old Fadama slum

Streets of "Sodom and Gomorrah".

The main bulk of the population of Agbogbloshie lives right next to the scrapyard itself, in the Old Fadama area that is colloquially referred to as *Sodom and Gomorrah*; though the degree to which that name sees use locally is uncertain. (49) Covering 31.3 hectares, Old Fadama is a slum and technically an illegal squat; crime-rate is high and social problems such as drug use and prostitution are common. (50)(51)(52) The Ghanaian Times has repeatedly reported serious violent clashes occurring in the area, including machete fighting and gunshots, sometimes with fatal outcomes like in a 2017 incident in which two were killed. It is not uncommon for tribal issues either to cause, or to aggravate, disputes. (53) The architecture of the shantytown consists of hundreds upon hundreds of small huts and kiosks built from wood, aluminium and tarpaulin, forming a narrowly winding labyrinth that occasionally gives way to broader streets. Both structures for living and small repair shops can be found here. The dwellings are small, a few square meters at most, but have some basic comforts – more at least than the structures made from e-waste nearer to the scrapyard, and are fairly sturdy, some even incorporating concrete or bricks. The local chiefs live in larger structures, dubbed 'palaces' but in practice just larger houses built in a similar style as the rest. Though bigger and sturdier than the other huts, and somewhat crudely decorated with the pre-Christian Akan symbols often found on local palaces – like the *Adinkra* of Nyame – they are far removed from the luxury of chieftain's palaces in wealthier parts of Accra.

Aphorismic symbols are used particularly by the Ashanti subgroup of the Akan people. This one represents Nyame, their chief god; though nowa-days it is commonly used by Christians and Muslims alike as a general symbol of God or the divine.

The DanWatch report *What a Waste* describes the appalling living conditions in the slum thus: "Crammed into makeshift shacks, people live in an area characterized by narrow and twisted roads, poor sanitation and insufficient basic facilities such as drainage. The area has public baths and toilets, but the

fringes of the Korle Lagoon and the Odaw river are used by both adults and children as a place of convenience where people openly defecate." (54)

The people living here do not make enough to afford an apartment in Accra or any other kind of accommodation, and have no other local options. Some have other accommodations elsewhere in Ghana, like family homes up north, but elect to spend their nights at Agbogbloshie when they work since home is too far away for a daily commute. Others again have no other place to sleep at all. The shops are numerous in the slum. In fact, it is here that much of the mobile phone and computer repair occurs, as well as the recycling of those goods, if and when they cannot be repaired. Most computer and laptop repairers are quite young, around 15 or 16, and quite good with computers. Repairing the computers did not seem to be any great challenge for them, both due to their skill and experience, and the fact that only the relatively unscathed and whole-looking computers even made it this far into the selection process. They happily boasted to me that they could get most laptops brought to them to work again, though they were uncertain as to how long they would keep working. (55)(56)

Some shops, just like those nearer the scrapyard, make new goods out of scrap metal and sell them on the market. Despite relatively recent reports, such as one by Asare Adjei in *The Guardian*, of people cooking motherboards to extract gold, I did not see that occurring at all. (57) In fact, it was denied by both scrap-workers, including those specifically working with mobile phones and laptops, and Green Advocacy employees, as well as Mr Kotoe from the EPA. (58)(59) Unanimously they claim that motherboards are shipped for further processing, and that the gold content does not remain in Ghana. This is confirmed by the above quoted DanWatch report *What a Waste*, which states that motherboards are mainly exported to Germany, with the local firm City Waste Recycling commonly acting as middle-man. Additionally, the very first gold refinery in Ghana, Sahara Royal Gold, was not opened until late 2015, with Ghana lacking refining capacity for gold before then. (60) I must conclude that the media reports of gold extraction at Agbogbloshie are inaccurate.

Mr Isaah Abdullai showing me his dwelling, where he lives with his wife, who works at the nearby market.

3. Second-hand markets

When old electronic or electronic equipment is disposed of in Ghana, much of it does not go directly to Agbogbloshie. There is a system in place where these goods first go to small refurbishing-shops, where people will try to repair the items and re-sell them. In the case of already working items, this entails simply tidying up and otherwise restoring them, such as wiping computer hard-drives. Things that cannot be repaired are used for spare parts, and only that which cannot be used at all is given to the collectors who transport it to Agbogbloshie. Apart from the shops in Old Fadama, the second-hand market is mostly centred around a part of Accra called the Kwame Nkrumah Circle, and known locally as just ‘Circle’ and home to a bustling market with a huge variety of stalls and products, often open long into the night. Not much repairing or refurbishing takes place here; it is mostly stalls selling various products, which includes used electronics. Much of the rest is clothes, and most items are second-hand, something Accra is well known for and the locals have a particular name for: *obroni wuawu*, “dead white man’s clothes”. The Tip Toe Lane especially is where second-hand electronics are found. Most sellers have small stalls and keep their valuable goods behind glass showcases, but there are a few proper repair shops as well, and most offer both laptops/notebooks and mobile phones as well as repair of these. (61)

Broken mobile phones and laptops, sold at a stand in Old Fadama. The products are unusable and intended for recycling, and hence sold to recyclers and not consumers.

View of the street the mobile phones are sold on.

The price for a refurbished laptop in working condition ranges from approximately 700 to over 2000 cedis, depending on the specifications, and their age and condition are difficult to judge; like any good salesman, the stall-owners of course insist they are more or less brand new and hardly used and in perfect condition. Brands include HP, Dell, Asus, Acer, Lenovo, Samsung and MacBook, with the latter often fetching a premium price. There is also a huge market specializing in second-hand car parts in the Abeka-Lapaz area, especially along the long Darkuman road where essentially any part of a car you can think of can be found in some stall, from blinkers to engines. Second-hand electronics are sold as well, further down the road and continuing along the sides of George W. Bush Highway. Mostly old TVs, stereo equipment and white goods are found here, and there is also at least one refurbish-shop repairing and selling old computers and laptops. (62)

The stalls selling such goods are not nearly as plentiful or as tightly concentrated as those specialized in car parts in this area, and instead intermingle with all the other stalls, which like at Circle offer many kinds of consumer goods, again primarily second-hand.

Small computer repair shop in Old Fadama.

Another view inside the computer repair shop.

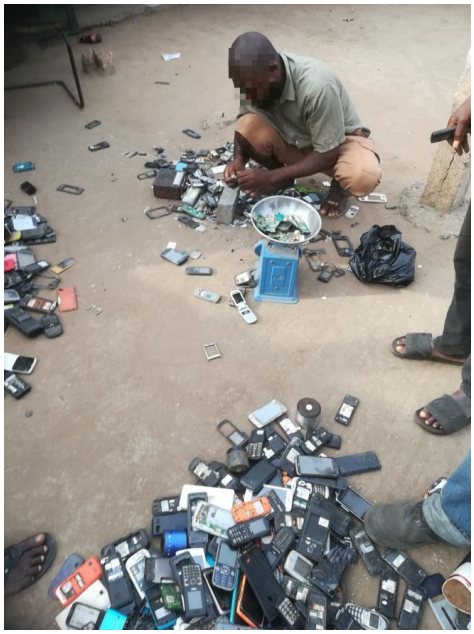
Many similar stalls offering second-hand electronics can be found scattered around the city of Accra, especially at market hubs like Kantamanto and Kaneshie; selling ICT equipment, smartphones and other electronic goods. The same is true for plenty of small computer repair shops, like *Bugi Computers* or *OK Laptop* in the Osu neighbourhood. (63)

According to several sellers of second-hand electronic products I spoke with, their products are commonly sold untested, and are sold cheaper because of this. If a potential buyer insists on a functionality test, the seller will provide it if he is able to, but that will increase the price. Some sellers are located in places where they have no direct access to electrical outlets and cannot test their goods. Sellers try to get what they can repaired if they know, or strongly suspect, that it is not functional, and sell it on to scrap dealers if it cannot be fixed or used for spare parts. (64)

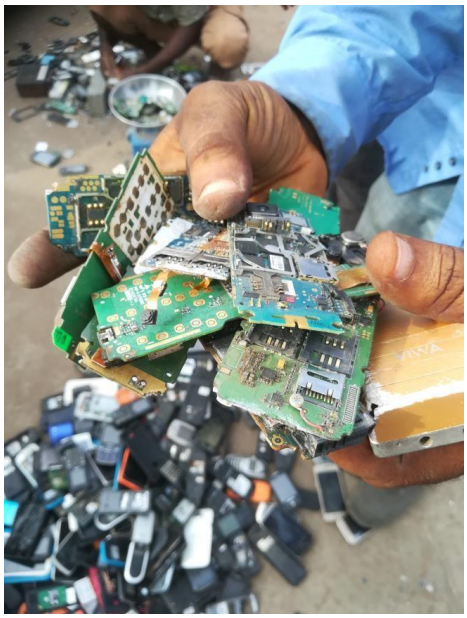
Sooner or later, though, when things break down, they all wind up at Agbogbloshie. Modern electronic equipment has become increasingly difficult to repair, and this previously longer chain of events has become much shorter, something which Mr Akuffo, Mr Dogbevi and Mr Anane all confirm and agree on. As a consequence, the second-hand electronics markets of Accra have become smaller and are not as numerous as they were ten years ago. (65)

Cooking pots made from e-waste, for sale at the market.

Cupboards made from e-waste.



Man dissembling mobile phones.



PCBs from mobile phones.

Grills made from waste

Man making cooking pots at Agbogbloshie.

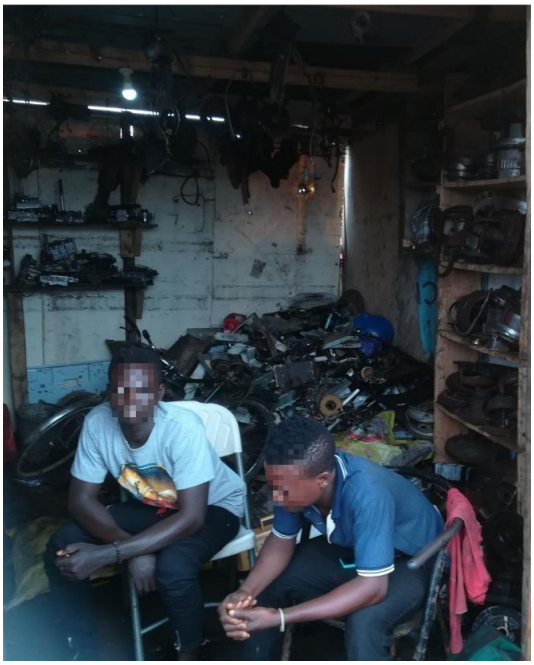
4. Conclusions

The picture that emerges of the life of the workers and residents of this area is bleak, yet there are interesting ways in which that bleakness is at times broken. There is abject poverty and wretched working and living conditions, but also a living community of creative people using hard-won skills and knowledge to improve their conditions to the best of their abilities. The work is difficult and dangerous, yet people still laughed and made time for both simple pleasures and spiritual growth. It is crucial, for the sake of the people of Agbogbloshie, to neither reduce them to victims and ignore everything else that they are, nor focus wholly on their creativity and ignore the squalor they live and work in. My research focuses on the social and environmental impacts of e-waste work, and as such focuses on particular aspects, but there is clearly more to this complex story.

All in all, my impression is of an isolated community of an impoverished underclass, toiling to eke out a modest living, whilst providing the city and both local and foreign industries with valuable services and resources. Many are stuck in a poverty trap, enticed by an abundance of available work with a quick pay-off, but ignorant of long-term health effects and the wider impact on their communities.

Employees and dependants, WEEE-related informal sector in Ghana	
Total number of collectors and recyclers (Accra)	4500-6000 people
Total number of collectors and recyclers (Ghana)	6300-9600 people
Employees in the refurbishing sector (Accra)	10 000 – 15 000 people
Employees in the refurbishing sector (Ghana)	14 000 – 24 000 people
Total employees: informal refurbishing and e-waste management sector	**20 300 – 33 600 people**
Countrywide dependants, incl. families, either partially or fully (e-waste collection and recycling)	37 800 – 57 600 people
Countrywide dependants, incl. families, either partially or fully (refurbishing activities)	84 000 – 144 000 people
Total countrywide dependence / number sustained by informal sector	**121 800 – 201 600 people**

Table 6.2. *Pwamang's above estimations would mean that between 1.04% – 1.72% of the urban population is somehow dependant on e-waste related work. He also estimates that the informal e-waste sector indirectly contributes between 105 and 268 million USD to Ghana's economy (2013 numbers).* (66)(67)



Shops selling spare parts shop in Agbogbloshie.

One particularly important theme that emerged, and was observed throughout my visits to the Agbogbloshie area, is the importance of informal structures as the basis for the recycling business. For any individual worker it affects everything from acquiring employment to begin with, to tool acquisition, apprenticeship placements, position in the various hierarchies, and therefore ultimately how much money they are able to make. For the business as a whole, it affects everything from the way knowledge and skill is transmitted and retained, to the way that both money and materials flow through the network, to the establishment and expansion of operations. Therefore, simply "formalising the informal", as Mr Kotoe said, is not as straightforward as it may seem. The informal business network at place in Agbogbloshie has its own properties and internal logic; it relies on different ties and relationships as well as different obligations and reciprocative expectations, with tradition and bonds of kinship being far more important.

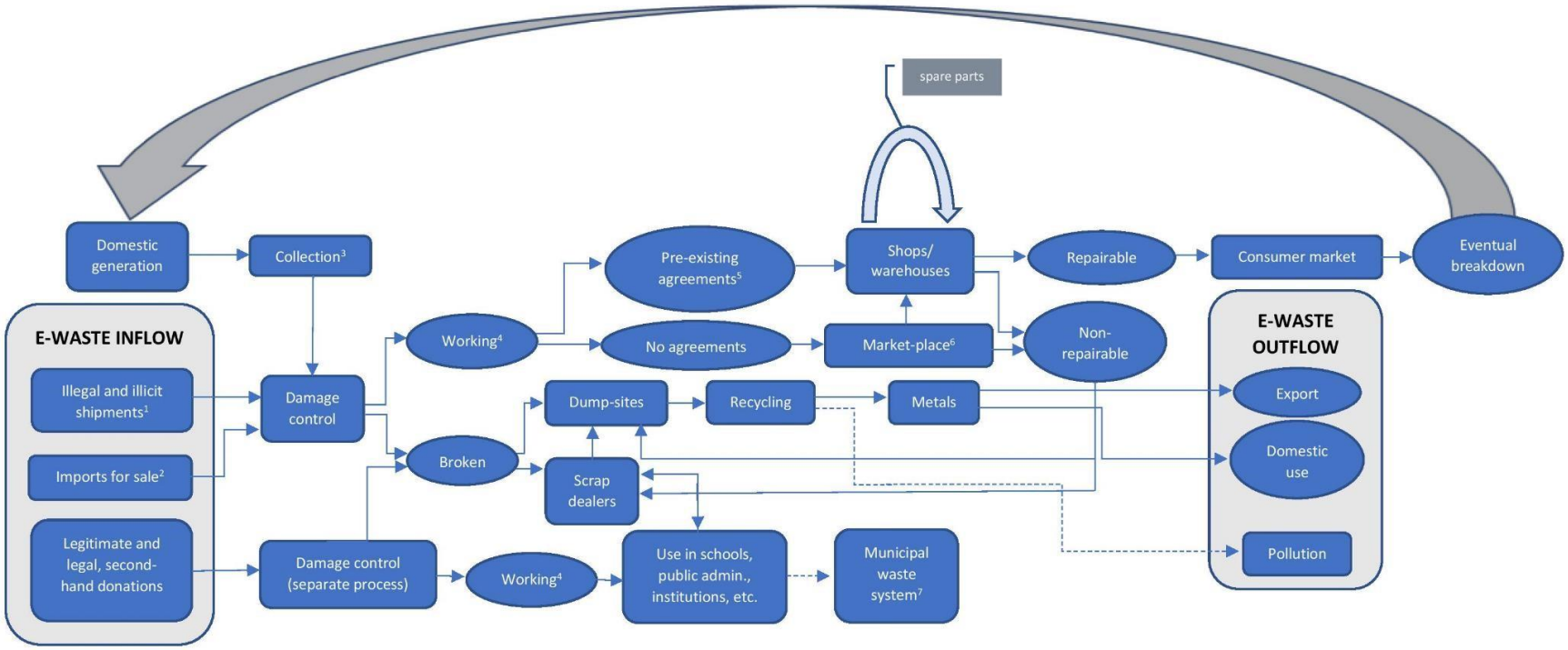
As such, this manner of doing business is arguably incompatible with formal, and imported, models such as those suggested by German investment banks interested in building the new recycling facility. One cannot just import a ready-made solution from elsewhere that does not take local conditions into account or adapts to them. Formalisation is not only a possible threat to livelihood, but potentially to the way of life at Agbogbloshie itself, and could potentially alter the culture, as well as the power-

structures, in place. As will be discussed later in the thesis, particularly in Chapter 12, the informal structures of Agbogbloshie have been subsumed under capitalism and altered by it, becoming a kind of useful resource that provided a ready-made framework for the recycling industry to develop within. But the same structure also stands as a possible hurdle to further development, since such development represents the aforementioned potential threats, and the people invested in maintaining the status quo have the political clout to resist external pressure to change. The tension between the traditional structures and modern capitalist industrial structures exists simultaneously with the compatibility of the two that enabled the establishment and flourishing of Agbogbloshie: there is a contradictive and dualistic relationship in place.

In this regard, my MFA approach is limited, as it conceives of the chieftains and their men as the equivalent of bosses and managers in any firm, concerning itself only with their impact on the flows. This presumes an equivalence between the modern and traditional roles that is only half-true; for while they do serve the managerial function, their role cannot be reduced to it without leaving much removed from the analysis. A proper ethnographical study of the experience of waste workers, and the traditional way of life of the people of Agbogbloshie, would be required to fully map the way in which the contradiction between the traditional and modern shape the informal recycling industry. Here I am able to offer merely a glimpse of this.

It should also be noted that I have merely established the situation as it is in general, and that true understanding requires several more pieces of the puzzle. Another part of the puzzle lies in examining the recent change and development occurring in Guiyu in China, as this will allow for a better understanding of potential development paths. This will be done in the following chapter. Additionally, to truly understand the impact that e-waste work has on workers and denizens, one must look at the consequences for their health, which I will do in Chapter 8. Lastly, Chapter 9 will consider Sweden in order to map fully the differences of different stages of development. Only once all the pieces have been laid out can a full analysis of the situation at Agbogbloshie proceed.

Figure 6.2. *Material flows of e-waste in Agbogbloshie as mapped by the author. This simplified overview does not show entropic loss nor contamination in any detail.*



1) This would include technically illicit shipments posing as legal donations, i.e. use of the loophole 2) Often sent or brought in by relatives abroad. 3) Collection is almost exclusively informal in practice. 4) That is, lacks external damage and ***appears****, after a basic check, to be likely working. 5) Deals with exporters or local shops, etc. 6) Informal industrial market for those in the business; material is sold outside the harbor, to local shops and electronics dealers, etc. 7) Historically close to non-existing processing in municipal waste systems, with plans for change.*

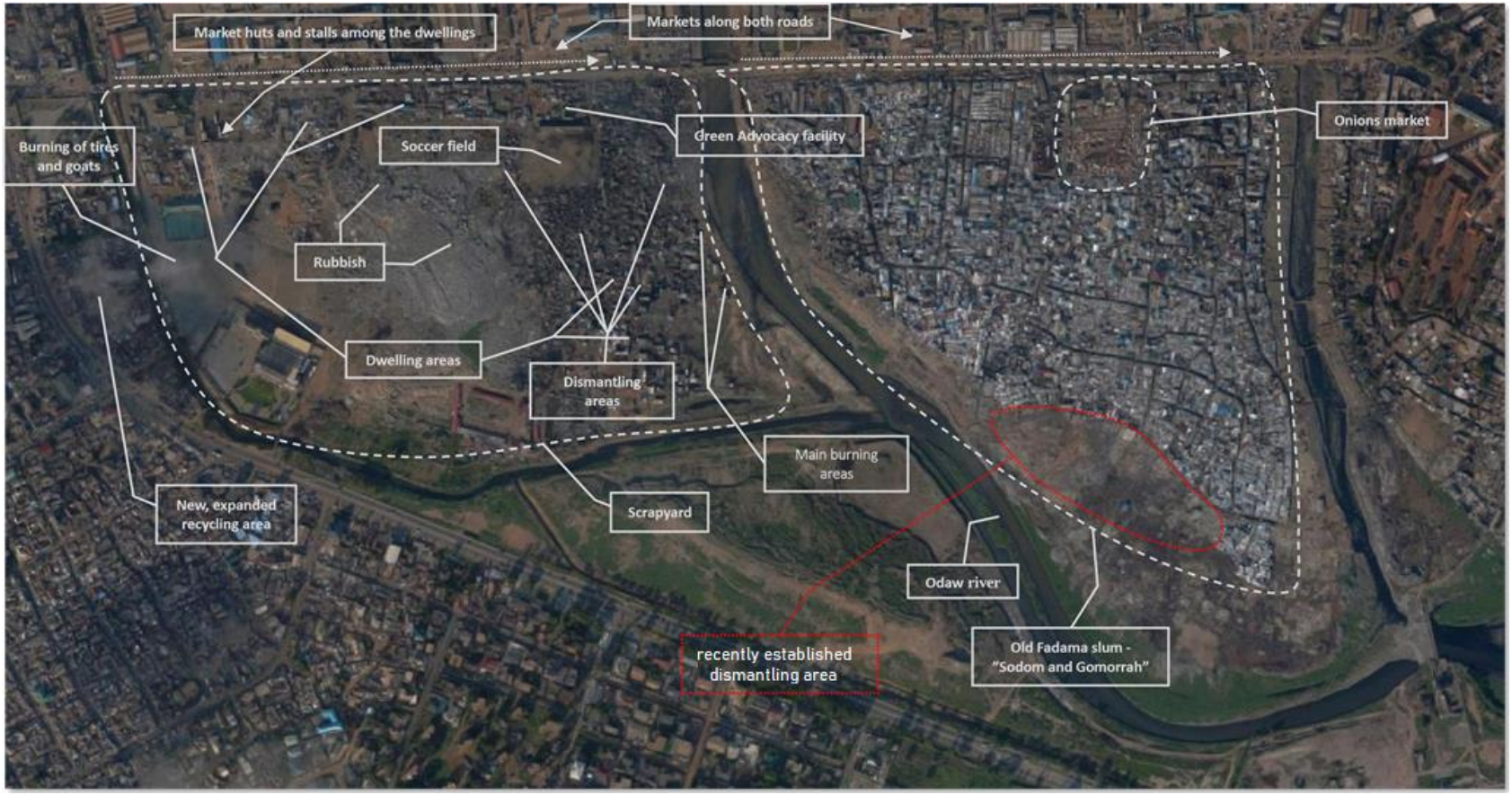


Figure 6.3. *Map of the Agbogbloshie area. Image by Google, annotated by the author.* ***Markets:*** *The market above the Scrapyard mostly has onions and yams, and the market above the slums focuses more on goods produced using e-waste, like the grills and cupboards. The market stalls within the dwelling area of the scrapyard sell spare parts and cooking pots. The Onions Market is called the 'Onions Market of Agbogbloshie' and is a proper market with many stalls, mostly selling the obvious but also yams.* ***Burning:*** *Burning often taken place along the rubbish areas as well, but is concentrated to the banks of the Odaw.* ***Rubbish fields:*** *The landfills are filled with various refuse, including foodstuffs, from the slum and dwellings. Goats forage here, searching for food scraps.* ***Dismantling areas:*** *Dismantling takes place all over the scrapyard, but is concentrated to this area.* ***Recently established dismantling area****: began expanding around 2008 and fully established around 2013.*

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Chapter 7

Conditions of the Working Class in Guiyu

Much like the Agbogbloshie case-study, this is a micro-ethnographical account of the conditions of the working class in Guiyu. The same combination of participant observation and interviews was used for data gathering, with similar limitations encountered, e.g. the language barrier and lack of access. Since my visit occurred after the building of the Industrial Park, I focus on the changes that have occurred, and rely on other sources and accounts from locals to understand the pre-2013 conditions. The Guiyu account is briefer and is meant to serve as a comparison to Agbogbloshie and aid in the understanding of how informal e-waste sites are established and develop, rather than stand on its own. Nonetheless, I attempt broadly to paint a similar picture as in Agbogbloshie of the lived experiences, views and attitudes of workers and locals.

1. The situation at Guiyu

1.1. The early history of e-waste recycling in Guiyu

Guiyu is a small town, made up of a cluster of small villages, with a population of 150,000 and situated in the Guangdong province of southern China. It is part of the Shantou prefecture, the site of an old treaty port that still remains the only major port in the eastern part of Guangdong. (1) Originally a community subsisting on growing rice, the town became a centre for the informal recycling of e-waste around 1995 and developed into a major hub in the global trade of e-waste. (2)(3)(4)(5) The details surrounding the beginning of the recycling industry in the town remain elusive, however, with one 2014 scientific report dating the beginning of small-scale recycling work back to the late 1980s. (6) What is known for certain is that Guiyu was until recently the largest e-waste dump in the world – a town defined and dominated by e-waste. During the height of the recycling operations, there were at least 3000 and perhaps as many as 5000 small, often family-run, recycling workshops in the town along with around 300 larger companies. In them, people worked breaking apart, cooking and melting electronic waste in pots and pans. Toxic smoke billowed out from improvised aluminium chimneys and covered

the city in a blanket of noxious fumes, and large sacks overfilled with e-waste littered the streets in which children played. (7)(8)(9)

I spoke about the early days of Guiyu with e-waste expert Mr Jim Puckett, formerly of Greenpeace and now Executive Director of the Basel Action Network (BAN), an NGO dedicated to preventing the export of toxic waste to developing countries and to the upholding of the Basel Convention. Mr Puckett was the one who first 'discovered' the e-waste trade in Guiyu in 2001, following a trail of rumours among recyclers in the USA. At that time, nothing apart from vague rumours was known about Guiyu, and only one story had been published about it in the Chinese media. According to Puckett, nobody he had spoken to in the US government, or the US recycling industry, had bothered to look at what happened to the e-waste that was being exported, though many were familiar with export taking place and US e-waste winding up in China. With the help of colleagues from Greenpeace, Puckett obtained footage of the situation in Guiyu, and later travelled there, gathering data which later became part of the 2002 BAN documentary *Exporting Harm.* That documentary was the first time that the e-waste situation in Guiyu was exposed to Western eyes. A CBS 60 Minutes episode, *The Wasteland*, followed in 2008 and the issue garnered widespread attention. The informal e-waste recycling industry was already well established in Guiyu at this point in time, and Mr Puckett describes the conditions in the city at this time as horrid: dirty, smelly and enormous in scale. (10)

As the documentaries make clear, the conditions at Guiyu at this time were very similar to what Agbogbloshie continues to be today, with footage showing massive amounts of e-waste piling up all around the town, mostly on the outskirts of the villages Guiyu consists of, but also in workshops in the town centre. Most of the roads were dirt roads, people lived in shacks, other kinds of refuse and unrecyclable parts of the e-waste was dumped outside the recycling sites themselves. Local waterbodies were polluted and clogged with refuse and e-waste components, and young children ran around the area playing with debris. The documentaries also claim that the migrant workers abandoned their land and came to Guiyu instead, around 1995-1996 when the recycling industry really took off. They made around 8 USD per day according to the 2008 CBS documentary, but only 1.5 USD per day dollars according to the earlier BAN documentary. (11)(12)

At the height of the e-waste industry's dominance in Guiyu, an estimated 100,000 people of the total population were migrant workers engaged in some aspect of e-waste recycling, or around

80% of families. (13)(14) Entire families, both men and women and their children, were to some degree involved in all parts of the recycling process. (15)(16) Former rice fields were being used as open-burning sites for e-waste. (17)(18)(19) As at Agbogbloshie, the recycling processed employed primitive and crude techniques based around manual dismantling such as chipping plastic, followed by burning or melting away plastic components. Burning of cables and wires was also common, and unlike at Agbogbloshie acid baths were used to recover valuable metals such as gold, and printed circuit boards were 'grilled' on makeshift coal grills for the same reason. Another difference, compared to Agbogbloshie, was that no refurbishment took place; at least no report, either from media or academia, mentions it, and the investigations done by Mr Puckett and the BAN did not find evidence of it, despite actively searching for it. Though it is possible that some refurbishment did take place, the complete lack of any observations of it likely means that it was not nearly as widespread as it is in Agbogbloshie. (20)(21)(22) All recycling work was largely done without any protective gear, though gloves and masks were occasionally used by a few. Ventilation was provided by only household fans, which lead to high levels of exposure to the various fumes produced. Apart from the air pollution caused by the fumes and smoke, which was also carried by wind to the heavily populated Pearl River Delta Region, the heavy metal contaminated acid was routinely discarded into local water-bodies or local soil after being used. Burning and dumping of unwanted e-waste and remains that could not be recycled was common as well. (23)(24)(25) Water quality was so poor that locals refused to drink it, and drinking water was instead transported into the town by way of rickshaws loaded with large plastic containers. However, local water was still used for other things such as to wash vegetables, and fish from the local waters was consumed by the locals. (26)(27)

1.2. Government intervention and the Industrial Park

A major change to the way e-waste was handled in Guiyu began in 2013, when the local government approved a plan to construct a 1.5-billion-yuan industrial park, meant to house the city's recycling workshops and provide better and more environmentally friendly recycling methods. It was dubbed the *National Circular Economy Pilot Industry Park* and has had a major impact on e-waste recycling in Guiyu. (28)

Yet such a solution did not always seem possible. Jim Puckett describes the long ordeal to convince local authorities to do something about the Guiyu problem as very frustrating and

riddled with conflicts, denial and refusal. The government seemed to him determined to stop the information about Guiyu from getting out and spreading, even banning documentation of the events from being shown at the Basel Convention. He claims that the mayor of Guiyu had both his own policemen and a local motorcycle gang threaten and intimidate both researchers and journalists and confiscate their material. (29) The aforementioned CBS 60 Minutes documentary, *The Wasteland*, captured such an event on camera. The journalists and investigators, including Mr Puckett himself, can be seen being threatened and later chased but ultimately getting away with their cameras intact. The documentary also reports that the mayor forbade them from filming the actual recycling and tried to mislead them by leading them to a single, small and comparatively clean recycling operation. (30) However, after about 15 years, the government finally relented. Puckett is uncertain why the sudden change in attitude occurred but claims his "gut feeling" is that a push from presidential level was what made it happen. (31) The information on what actually motivated the change has not been made public, but according to local media reports, research on the environmental conditions on the site from various local universities, among them the Shantou University Medical College and the Sun Yat-sen University, revealed serious problems which convinced the local government to tackle the issue. (32)

Crucial to the construction was the involvement of the Asian Development Bank, the ADB. In 2011 the ADB, the Chinese Ministry of Finance, and the Guangdong Province entered into a joint venture that had as one if it's goals to "study environmental improvement in rural areas and small cities". A 2013 ADB report on the matter reveals a concern with the severe pollution caused by Chinese industrialization and urbanization in general, and the impact of e-waste specifically; referring to the practices in Guiyu as "shockingly unregulated". The report shows an awareness of both the source of the e-waste being mainly Europe and the USA and the primitive methods employed and their impact on health and environment, including heavy metal and PBDE poisoning. (33)

Additionally, the report corroborates Mr Puckett's view of a disinterested government; the description being worth quoting in its entirety: "In the Guiyu e-waste recycling industry… under the weight of huge economic interests and the inertia of habitual behaviour, there is a kind of wait-and-see attitude towards both pollution remediation, and industrial upgrading by those engaged in the local industry, local government, and even public opinion. In other words, eco-consciousness, and industrial transformation and upgrading have a long way to go." (34)

Entrance to the Industrial Park.

The construction of the park aimed to tackle the environmental problems in Guiyu and become a model for environmentally sound e-waste recycling and was financed largely through a massive ADB loan of 200 million USD. (35)

In December of 2015 the park stood ready; an enclosed area around 0,45 square kilometres in size where e-waste recycling is not done in the open air but inside the many large buildings on the park grounds. Around a quarter of the existing workshops moved in; Zhuang the *South China Morning Post* reporting Pinghui of that "[m]ore than 1,200 workshops made the move, becoming 29 big recycling operations after a succession of mergers." (36) Given that there were as many as 5000 to begin with, one might suppose that the rest are no longer in business. According to Guiyu locals I spoke to, those that did not move into the park indeed went bankrupt or simply moved elsewhere. (37)(38) Mr Puckett, based on his investigations with the BAN, confirms that most recyclers did not move into the park and claims that, given that they were mostly migrant workers, left the area. (39) This likely occurred because using park facilities costs at least 6000-8000 yuan per month in rent, which reduced the income of workshops and pushed many into unemployment. (40) A report from David Stanway of Reuters corroborates this, and adds that the local government has taken steps to reduce the impact on the small-scale operations by selling environmental protection equipment and renting new buildings at reduced costs, all according to an interview that Mr Stanway conducted with Zheng Jinxiong, the vice chairman of the commission that runs the park. Zheng also adds that 150,000 tonnes of e-waste were processed in the park in 2016, increasing to 180,000 tonnes in 2017, though that was only up to August. (41)

The report also reveals that, apart from the local government, private companies have also invested in the park: "TCL Deqing has invested 50 million yuan in a production line for dismantling household appliances…." and that "[a] subsidiary of China Energy Conservation

and Environmental Protection Equipment Group also invested 100 million yuan in a circuit board recycling facility." (42)

When the park opened up, non-mechanical methods of recycling were banned outside the park area, creating an effective monopoly on most forms of recycling and making rents a major source of revenue for the local government. Around this time, restrictions to e-waste import were enacted, with crackdowns on rule-breakers following. (43)(44) In 2016, 421 people were arrested over suspicion of e-waste smuggling. (45)

Presently, domestic production of electronics seemingly accounts for all of the waste found at Guiyu. A lot of the waste comes through from nearby Hong Kong, and some from distant Tianjin. Though there are rumours of continued illegal import, the BAN confirms that they have thoroughly checked the waste at the new park and believe the import ban to have been successful, as they found no evidence of foreign imports among the waste. (46)(47) Recycled plastic and metal are sold to Chinese industries, and I found no indication that it leaves the country in any noteworthy amounts. However, the idea of the waste being foreign seems to live on in the minds of some of the people living and working in Guiyu, many of whom indicated to me that they feel that their country and themselves are being taken advantage of by the West. (48)(49)

One can only speculate as to what triggered the decision to construct the park. No official statement or document details, or in any way describes, the process that led from denial and refusal to a sudden and massive move towards improvement. My belief is that the Chinese government simply failed to prevent the cat from slipping out of the bag – they realised that information and knowledge about Guiyu had spread across the world and that it was harming the Chinese image globally, and decided and decided not only to rectify it, but also to use it as an opportunity to show their capacity for environmentally sustainable development. Guiyu was declared a pilot project for a circular economy and is clearly pushed as such in the official narrative; a symbol of the Chinese government's ability to rectify environmental problems. The narrative of sustainable economic development narrative too is widespread, namely, that more economic development will increase funds for more environmental clean-ups. Almost everyone I spoke with, including the common workers, expressed a belief that more economic development would lead to continued improvement of the local environment. There is no evident concern about potential negative environmental impacts of economic development, which are of particular importance in ecological economics and held to be unavoidable by the

‘steady-state’ and ‘degrowth’ camps of environmentalist theory and activism. Though it could well be argued that a particular kind of economic development caused the environmental damage to begin with, criticism of economic development is absent in the public mind; I find it in no official address nor in the minds of people I speak with. If someone is blamed for the problem, it is the foreign powers that exported the waste, not the Chinese government that took it in.[44] At most, the local government is blamed for handling things poorly in the beginning. (50)(51)

2. Living and Working in Guiyu

2.1. The city of Guiyu

Streets of Guiyu, rickshaws unloading recycled material into a larger truck.

As I arrive in Guiyu in April of 2018 together with my guide and translator, Mr Jiambin Deng of the South China Agricultural University, I find a transformed city that nonetheless still bears some scars from its past. Most recycling activity that took place in the city centre has left it, and only a handful of workshops are left. In the city centre, there is no sign of either toxic waste or appalling working conditions. The city is overall relatively clean and well developed, and the spaces previously occupied by recycling workshops have been rented out to other business. In fact, there is little sign of e-waste except for the occasional litter and of course the bags outside the few remaining workshops. Were it not for the constant sight of trucks, rickshaws and bikes hauling e-waste around, one might even momentarily forget Guiyu’s past. (52)

[44] Note that all media reports quoted or referenced in this chapter show an absence of the kind of criticism here described.

These transports can constantly be seen driving up and down the streets, fully loaded with recycled material or material intended for recycling. Mostly one sees plastic, which is to be expected as plastic is the main component of most electronic goods in terms of volume. A transport worker hauling plastic earns about 4000 yuan per month. The transports stop at various stations around the city, easily identifiable by the weight-bridges outside, in order to load up on more material. Occasionally one spots the smaller transportation vehicles unloading their cargo onto larger trucks.

E-waste workshop in central Guiyu

Small bits of recycled material most often litter the streets just outside the stations and, to a lesser extent, the roads most frequently used for this kind of transport. A lot of the transportation is local, e-waste being hauled to and from the city centre and the industrial park. There is a limited amount of space at the park, so e-waste is kept in storehouses and then brought back when needed. Storage is cheap, and e-waste is considered an investment, worth stocking up on. (53)(54)

In the city centre I only found a single shop selling second-hand electronics, mostly spare parts. The owners claimed their business was unconnected to the e-waste stream that wound up in the park and told me that they got their goods from other sources. I neither saw anything indicating that any widespread refurbishment or second-hand trading takes place, nor heard any claims or even rumours about it. (55)(56)

E-waste in a pile outside a recycling shop in Guiyu. This shop is also outside the park.

Overall, Guiyu is not the nightmare that is described in various reports, documentaries and articles referenced in the beginning, and certainly rather cleaned up – but nonetheless there is a lot of junk of all kinds lying around. Here and there I see garbage spewed out over the street. Right as I am observing the trash in the street, and the trash and waste in the nearby river, a woman walks out of a small local business carrying a bag of household waste, heading towards a garbage can in the street. To my surprise she walks right by the trashcan, ignoring it completely, and opts to instead, quite nonchalantly, dump the contents of her trash-bag into the river. Yet it must be reiterated that the image of the Guiyu that was, with heaps of waste laying all around the city and smoke coming from the workshops, is quite far from the Guiyu I observe, at least not in the city centre. It is for the most part a normal little town, with nothing outside of the ordinary being immediately noticeable. There is certainly no appalling poverty and the city is developed, the people drive nice cars and lots of little shops line the streets. The only signs of e-waste in the city centre are the aforementioned bags outside the remaining shops. The casual observer might not even notice the above average levels of filth. (57)

Two average Guiyu streets during the evening and the day.

2.2. The Industrial Park

The new park is at the edge of the city, with a few workshops just outside it. Beyond the park is farmland. (58) A river flows nearby, and the plastic bags used for transportation are washed in a big basin, which then flows back into the river. (59) The park is a vast complex of large industrial hangars, smaller cave-like rooms and big, multi-storied houses. Each is filled to the brim with e-waste, reaching almost to the ceiling. A multitude of large sacks, over-flowing with e-waste, stand outside the buildings. Inside, people are working on dissembling the waste by mechanical means. Their tools are simple: hammers, screw-drivers, wire cutters, pliers, etc. This is intentional; it is meant to be low-tech in order to keep the costs down. The protective gear is likewise very basic; gloves and mouth-mask are worn by almost everyone, while protective googles are less common. Workers I speak with confirm that protective gear of any sort was not commonplace in the past, and that people used to do this sort of work without any protection at all. But despite the increased protection, it is not uncommon for workers to become sick, and kidney stones were the most commonly mentioned affliction. (60)(61)

Fully loaded rickshaw just outside the industrial park, transporting mainly plastic.

Further inside the hangars, obscured by heaps of waste, I find workers submerging motherboards and other devices into vats filled with a corrosive substance. The work with acids baths is considered the dirtiest and most harmful to workers. The workers claimed to be unfamiliar with the exact nature of the mixture, which was prepared by someone else. At least they are unwilling to share this knowledge when I inquire, as it seems to be a trade secret of sorts, though it is likely to be some variation of *aqua regia* according to the *Exporting Harm* documentary and one 2017 Chinese media report from Bendi News. (62) Aqua regia is the mixture of nitric acid and hydrochloric acid, in a 1:3 ratio, known to be able to dissolve gold and platinum even by medieval alchemists, and used for gold extraction by e-waste recyclers

all over the world. The process begins with washing or submerging chips and boards in the acid; thereby dissolving the precious metals they contain. Another chemical, like sodium metabisulfite, ferrous chloride or oroxalic acid, is added later to make the precious metal precipitate and settle to the bottom of the containers used. A muddy, clay-like substance is usually the result, since the boards and chips are commonly covered in dust or dirt that also precipitates. This is then collected, and in more sophisticated settings might then be filtered, but in practice the mud is more commonly instead melted into tiny beads of somewhat pure gold. I was not able to find out which method is currently employed in Guiyu, though the more primitive one was used in the past. (63)(64)

Unloading e-waste. One of the hangars in the background.

A look inside one of the hangars.

The protective gear of the workers labouring with the acid is no different from that of other workers, and above them are fans that lead the air away into filtering instruments meant to reduce the environmental and health impact of the emissions. Despite the fans, the ventilation is rather poor and the air reeks of a strong chemical smell, which hurts my lungs even after a mere minute of breathing it. (65)(66) Past the hangars is a road lined with smaller, cave-like rooms. According to the workers employed here, these are rented by smaller firms, usually families, while larger companies rent out the hangars. The workers in the smaller rooms are most often self-employed, while those in the hangars are salaried workers.

The hangars specialize in bigger pieces of e-waste, and the rooms in smaller pieces, with the former selling smaller components to the latter for further disassembly. Just like in the hangars, people in the front are working with mechanical disassembling, while chemical recycling takes place in the back. The same conditions, with present but inadequate ventilation fans and only basic protection, apply for these workers. (67)(68)

Regardless of where it takes place, the end product of this particular recycling work is metal extraction; I saw bales of copper wire awaiting transport away from the park. (69) Mr Zheng clarified, in the previously cited report, that some of this material is first smelted into “semi-finished ingots”, that are then transported to Jiangxi province and facilities that allow further processing. (70)

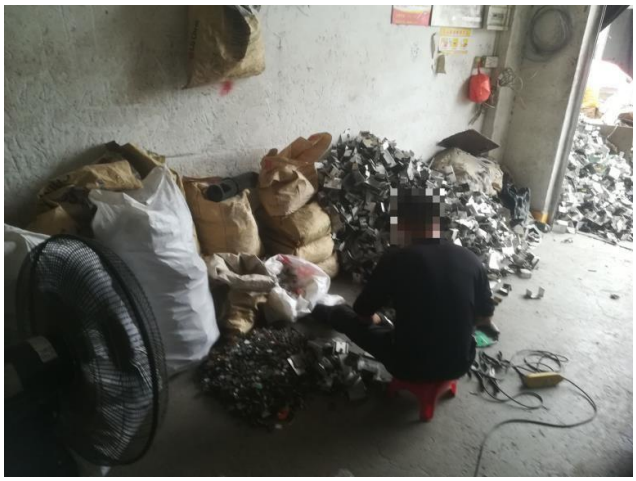
Bales of copper write in storage – awaiting transport.

There are also several newer, multi-storied concrete buildings present at the park, looking almost like apartments at first glance. The same type of work takes place here as well; the mechanical work visible and out front, and other work obscured. Each building seems to belong to, or is rented by, a particular company, with different companies specializing in different types of e-waste. The conditions inside each of these warehouses thus all differ a bit, given that they have different standards, some being just like the hangars and others quite a bit neater and cleaner. (71)(72)

The bosses are not always present at the park, though both conversations with workers and the sight of expensive cars on site indicate that they often visit to inspect the work. Chinese media reports claim that they have begun moving out of Guiyu altogether, only making occasional visits to inspect their businesses. (73)(74)(75)

Pile of e-waste being dismantled with only basic tools.

Workers dismantling e- waste inside a hangar using basic tools.



Just inside one of the smaller, cave-like rooms. Worker dismantling using electrical tools.

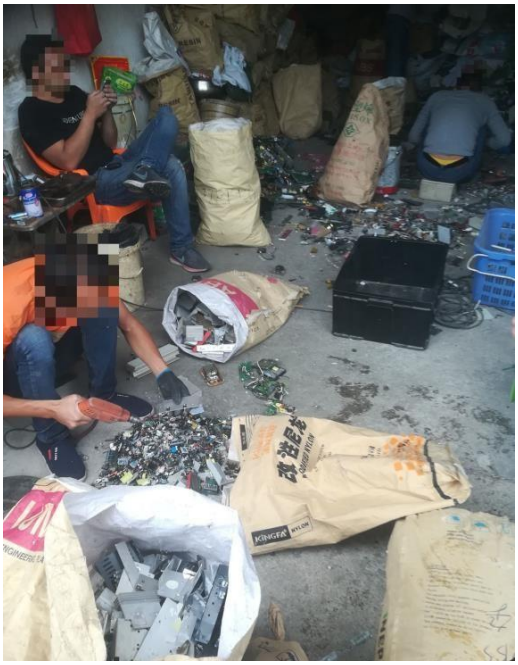
In the back of the same workshop, submersion in a chemical compound. Note the ventilation.

I am told those still on site are in a completely separate building, but I am denied access to it or to them upon inquiry, with my translator becoming so uncomfortable that he refused further attempts to ask. In fact, I am actively discouraged by several workers from attempting to speak to the one suit-wearing boss I see walking about. Low level managers and overseers are on site, some just watching over the work, and some taking part in it themselves. Those a bit higher up tend to keep

away from the work in order to avoid the fumes, sitting instead where the air is better and drinking tea while observing the workers through surveillance cameras. I am told this is because payment is per day, so surveillance is necessary to ensure worker compliance. Bosses are mostly locals, while the ordinary labourers are migrant workers, and there is a huge gap in income between the two, with ordinary labourers making 100-200 yuan per day. Nobody I speak to among the common workers knows how much the bosses make exactly, though they believe it to be much more than they make. It seems to be enough to afford luxury sedans and, according to both the aforementioned media reports and rumours among workers, big houses far away from Guiyu. There is a widespread conviction among locals and workers; that a small amount of people become very wealthy dealing with e-waste while others work very hard for very little.

The 'apartment-looking' hangars.

A look inside one of the hangars.



More work using electrical tools. Outside the smaller workshops.

Apart from workers and managers, private merchants also visit the park, buying the disassembled components for use in making new electronic products that they export to other countries, mainly in South East Asia. One approaches me and chats a bit about his work, but quickly loses interest when he realizes I am not in the business myself. (76)(77)

Another view inside a hangar. Worker dismantling e-waste in the background.

2.3. The Longgang District

Although the new industrial park has replaced most of the e-waste work in Guiyu, is not the only place where major recycling occurs in the town. Outside Guiyu proper, perhaps a half an hour walk from the city centre, the Longgang District retains most of the old recycling activity, though now focused on mechanical dismantling and processing plastics arriving from the park.

Nurdles, plastic resin pellets, are made here; they serve as the raw material for almost all commodities made of plastic, and these will be shipped off to feed domestic industries. A toy manufacturer in the nearby city of Chenghai buys a lot of them. (78)(79) Local workers confirm that the area has transitioned to plastics recycling and manufacturing. This is part of the same government initiative as the industrial park and aims to clean the area up while boosting economic development. (80)

Small workshops in Longgang; piles of e-waste outside in bags

More small workshops, e-waste in bags outside.

Though the entire area is not wholly devoted to recycling, and one can see apartments and little shops here and there, the recycling business dominates the landscape. Signs of it are seen everywhere, and one does not need to take many steps from some kind of recycling-related building before one reaches another. (81) The Reuters report mentioned previously states that around 1,500

household workshops crowd this small neighbourhood. (82) Lots of waste can be seen all over, including a great deal of non-electronic garbage. Bits of plastic sit in piles outside the little houses or are strewn all over the streets. Everyone I speak to confirms that the city centre looked something like this a few years ago. Many of the buildings are decrepit and some seem altogether abandoned, though one can also see some re-building taking place here and there, and a few modern plastic factories cropping up. The river going through the area is being cleaned up, and a lovely little park on the outskirts stands in stark contrast to the rest of the neighbourhood. (83)

Outside a modern plastic factory in Longgang.

Do illegal forms of recycling occur here? Certainly, none that I see directly, and I am assured by everyone I ask that only legitimate work occurs here. Many of the buildings huddle close together, with narrow passageways between them, and plastic coverings over the entrances obscure the vision. Unlike in the city centre and at the industrial park, there is no work taking place just inside the entrances and I am denied entry into any of the buildings by the respective dwellers. Passing by the houses one can hear the sound of work inside, but I only catch brief glimpses of workers. I believe it would be easy to hide anything unsightly, should one wish to, and I snap up rumours that secret and illegal businesses still operate, despite the crackdowns. (84)(85) The above-mentioned Reuters report is from January of 2018, just a couple of months before my visit, and states that the burning of plastic still occurs in Longgang. (86)

There is an incentive for it; the cost of running a home workshop is only one tenth of doing business in the park, so there is money to make for those willing to take the risk. But while I do find sacks filled with plastic that has clearly been melted, I find no evidence that it was melted outside the industrial park, nor do I notice the particular smells of either burning plastic

A small park in the cleaned-up area.

or the chemical recycling of electronic waste. Careful observation reveals that the chimneys on the workshop which used to lead the noxious gases outside have all been removed, and the holes covered up with cement. Were such work to occur here, it would produce a powerful smell made even more easily detectable by the lack of ventilation, but such an odour is completely absent at Longgang Neighbourhood. (87) A BAN report confirms my observations, and BAN's own investigations find no evidence of illegal recycling. (88) Without a way to avoid the smoke and gases, the work is far more damaging and dangerous, and combined with the crackdowns it certainly creates a strong counter-incentive to the potential money to be made. Though conclusive evidence either way eludes me, my final conclusion is that it is extremely unlikely that illegal activities still go on here, given that simply moving them elsewhere would be so much easier. If they do occur, they are likely to be rare and very small-scale; an exception rather than, as it was a few years ago, the rule.

3. Conclusion

It has been shown that the Guiyu Industrial Park represents an improvement over the unregulated and informal recycling of the past. The history of the change at Guiyu is also a history of struggle over the natural world and working conditions – the local government went from vehemently denying the existence of the problem to reluctantly admitting it in the face of overwhelming evidence and outside pressure to actively investing in a kind of solution. Though the effectiveness of that solution can be questioned, and one can certainly see remaining problems, it cannot be denied that the local environment, worker safety and conditions, and enforcement of laws has changed for the better.

Both from the government and the local media, there is a notable and intentional push of a broadly ecological modernisation type of narrative: economic development has increased local wealth and made available funds for a clean-up of the environment, which will expand as economic development continues. An environmental Kuznets curve has seemingly emerged, with the environmental damage done in the past being cleaned up as the area develops. Even the locals are committed to this idea, and so was my guide.

This view, however, ignores several factors. Not least of these are the, as of yet not fully known or understood, long term consequences on the health of people and environment that the years of primitive recycling has caused. The eco-modernist view would also ignore the long struggle to push for the change, and the years of denial that preceded it. Real economic development, in fact,

begins with the government involvement; before that, there was squalor and poverty in Guiyu and not economic growth. Environmental degradation existed, but as a consequence of primitive and unsound methods, and not of industrial development. Environmental degradation did not lead to economic growth that then enabled a clean-up up the environment. Rather, massive government investments financed largely though loans from an investment bank, coupled with a new and strictly enforced legal framework, allowed for both economic growth and some clean-up of the environment, and were motivated by pressure on the government to take responsibility.

China is a state both stronger and richer in resources than Ghana and was therefore able to bring the change into being, once the political will to do arose. Nor did the Chinese government face resistance from the locals, for though some businesses moved or went bankrupt, most were migrants who had no deep ties to Guiyu in particular. Nor was their work bound up in a particular culture or way of life. Traditional structures like those seen in Agbogbloshie are entirely absent in Guiyu. While many of the small businesses before the park were family owned, there were no larger kinship-based networks headed by informal, yet constitutionally empowered, chieftains. If any of the locals wanted to resist the change, they did not have the political clout to do so.

With the recent suggestion for a new recycling facility at Agbogbloshie still in the works, the question is what kind of change will occur there, and if any lessons can be drawn from the Guiyu case in spite of the differences? A comparison with a modern recycling facility in Sweden in Chapter 9 will further serve to enable an understanding of the development of informal recycling and its possible futures, the analysis of which Chapter 12 will then be devoted to. To understand the true impact of e-waste, however, first requires an understanding of the effects it has on health, on which the following chapter will focus.

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Chapter 8

E-waste Contaminants and Health Impact of Recycling Work

E-waste work carries consequences for worker health. Both in Agbogbloshie and pre-Park Guiyu, conditions and working methods were similar, and thus the health impact itself was similar. As will be shown, the recent improvements at Guiyu have not necessarily resolved the health issue, as many of the medical problems e-waste work has caused have long-term effects that will impact even the children of former e-waste workers. As such, understanding the full impact on the health of workers and communities is paramount to understanding the e-waste issue. This chapter will briefly go over and summarize medical studies done on e-waste workers and place them in a social-scientific context by utilizing them to further the analysis of e-waste.

1. Health impact at Agbogbloshie

The kind of informal, unregulated and uncontrolled e-waste recycling taking place at Agbogbloshie, a place that is also lacking in proper infrastructure and equipment, leads to the release of persistent organic pollutants (POPs) and heavy metals into the environment. (1) As Man et al., describe it, such substances “may be re-distributed, bioaccumulated and biomagnified, with potentially adverse human health effects”. (2) In the same vein, Amoyaw-Osei et al. report that “[l]ead, cadmium, mercury, plastics, plastics with brominated flame retardants, leaded glass, and glass among others entered the environment without treatment in significant volumes”. (3) A study by the Ghana Health Service in collaboration with Green Advocacy Ghana and the Ghanaian EPA found “significantly elevated levels... of barium, manganese, selenium and zinc in the urine of e-waste workers” as well as significantly elevated “blood serum levels of barium, cobalt, chromium, copper, iron, selenium and zinc”. Lead levels where expectedly low, given that “lead resides predominantly in the erythrocyte and not the serum portion of human blood”. The majority of e-waste workers had no knowledge of the potential dangers or long-term health effect their work might have and used no protective gear. Health problems experienced included various bodily

pains, headaches, chest problems, rashes and itching, coughs, joint pain, nausea, and painful urination. (4)

Caravanos et al., confirm that manual work with e-waste recycling can lead to exposure to heavy metals, acid gases and plastic-derived compounds such as PAHs, PCBs, PCDDs and PCDFs. (5) Exposure to these contaminants "can result in long term, often irreversible, effects such as infertility, miscarriage, tumours, endocrine diseases and birth defects... [t]he workers often suffer from cuts, coughs, headaches, upper respiratory problems, rashes and burns". (6) A 2014 report states that 22,000 people died due to different forms of pollution in Ghana in 2010; far exceeding the 16,000 HIV-related deaths in the same year. (7) Of course, far from all of that is due to WEEE, but the figure nonetheless demonstrates the severe consequences of pollution.

Worth noting is that certain e-waste related contaminants are not commonly found on other, non-e-waste related, polluted sites. These include beryllium, lithium (which mainly comes from batteries), antimony (from flame retardants) and gadolinium, indium and silicone (from computer chips and LCD monitors). (8) This means that e-waste contamination is a unique environmental problem, having its own specific consequences, and cannot necessarily be equated with other kinds of contamination.

As mentioned, a common practice at Agbogbloshie is the burning of plastics in order to access the metals present in WEEE. This practice has several crucial consequences, which would not occur were other recycling practices used instead. Firstly, during the burning of copper cables with PVC-casing to extract the copper, the copper acts a catalyst for the formation of the highly persistent carcinogens PCDDs and PCDFs during combustion, which can bioaccumulate in humans and wildlife. (9)(10)(11)(12) In the Greenpeace investigation of chemical contamination in Accra due to e-waste, PCDDs and PCDFs were found in the open burning sites at moderate levels, but in very high levels in the nearby lagoon; close to 1000 pg/g TEQ compared to 20 pg/g TEQ in moderately contaminated locations outside of Ghana. The spread of the contaminants is in part due to the monsoon periods in Ghana, which flood the flatland where Agbogbloshie is located. 45 The rain likely carries all the contaminated surface soil and dust into the Odaw River and the adjacent lagoons. (13)

Additionally, the trace elements of heavy metals found in plastics, which are usually not bioavailable, are released through burning and the related practice of acidic dissolution. While the latter is not employed at Agbogbloshie specifically, it is common at other informal recycling

[45] TEQ = Toxic Equivalency Factor

locations around the world. These heavy metals include tin, lead, nickel, zinc, antimony and cadmium; their concentrations in plastics are more than 1000 mg/kg, or over 100 mg/kg in the case of cadmium. (14)(15)(16) The aforementioned Greenpeace investigation found high concentrations of zinc and tin in the soil near and at Agbogbloshie, though it ought to be noted that inorganic tin is harmless unless ingested in extremely large quantities. PCBs, PAHs, phthalates and many alkanes/alkenes that are also found in WEEE can likewise be released during the burning of plastics. PVC-burning also releases hydrogen chloride; "a corrosive gas that can be acutely toxic through inhalation". The same is true of other chlorinated plastics. (17)

Lastly, PCBs, long banned compounds, can also be formed during PVC-burning. PCBs simply seem to be an unavoidable by-product of the manufacture of PVC-plastics; the Dow Chemical Company has for instance given the following formal statement to the US Environmental Protection Agency:

> "The technology to prevent the formation of trace quantities of PCBs does not exist in most instances. PCBs can be formed in trace quantities any time when chlorine, in any reactive form, comes into contact with carbon or compounds of carbon at elevated temperatures". (18)

Also, despite the ban, PCBs are nonetheless still found in much of the older equipment, much like other banned or restricted compounds such as PBDEs in Europe. PBDEs, commonly used as flame retardants in EEE, can affect the thyroid function of living beings. (19)(20)(21)

The smelting and re-casting of lead at Agbogbloshie is a crude process that involves "no downstream processes" that can handle the "hazardous fractions", leading to an improper disposal. (22) There is hence a high level of lead contamination in both ambient air and topsoil in and around the site. Air concentrations that are four times higher than what is permissible by the US EPA were found, and the levels in the soil where above US EPA standards as well; 15x higher at the worst. The highest reading for airborne exposure among workers was 20x the acceptable level.46 The soil that is the most contaminated with lead was found on the site where burning of plastic takes place, and also along the Odaw River. (23)(24)

Despite the known presence of contaminants and hazardous substances at Agbogbloshie there are, thus far, no studies about the longer-term effects that those substances might have on the workers or residents. Fortunately, many studies have been done in China on the effects, and possible effects,

[46] The *Threshold Limit Values* (TLVs) set by the American Conference of Governmental Industrial Hygienists (ACGIH).

of exposure to such contaminants due to those methods of recycling; given that informal recycling is done in more or less the same way at both locations, we can use the Chinese studies to make conclusions regarding effects for informal recycling regardless of geographic locations, provided that we can confirm that the same practices using the same physical materials occur. A few caveats must be observed, of course, for example, that there seems to be no employment of acids for recycling at Agbogbloshie, so any effect specific to the use of acids may safely be discarded for Agbogbloshie.

Another crucial caveat is the delayed effects of exposure to hazardous materials. Effects can range from the immediately visible (e.g., burns) to the short-term (e.g., problems with breathing), but other possible effects might only manifest in the very long-term – cancer, for instance, could take a decade of regular exposure to manifest. Even then, it is hardly a guaranteed fate that anyone who works with e-waste will suffer; rather the risk of developing tumours would increase, with the exact outcome requiring follow-up studies over many years. We may be in a situation where we have not yet begun to see the strongest impact of this kind of recycling – but it may well be just around the proverbial corner. Consider, as has been stated, that 90% of Ghana's health budget is devoted to addressing malaria, and that there currently exists no preparation for the potential problems that might soon manifest due to informal recycling. With around 50,000 people living around Agbogbloshie, and contaminants spreading even further by air, water and through food, what is going to happen when people begin manifesting illnesses for which there is no preparation or room in the budget to handle? Ghanaian environmental journalist Emmanuel K. Dogbevi worries that this lack of serious and visible short-term consequences makes it easier for many people to ignore the problems. In other words, that no serious cancer 'epidemic' has yet struck Agbogbloshie makes people relax and assume that the head-aches and breathing issues are the height of the consequences. In reality, he argues, it will inevitably begin to happen given what we know of the pollutants, it just takes time. (25)

2. Findings of Chinese studies

The e-waste work in China diverges from that in Agbogbloshie in the following ways: use of acid baths (not observed at Agbogbloshie), use of coal mixed with contaminated river sediment as fuel when burning (styrofoam is the most common fuel at Agbogbloshie), and the sweeping of toners from printer cartridges (not observed at Agbogbloshie or mentioned in any reports). Otherwise the work is quite similar, involving

the burning and melting of plastics and cables without much protective gear or ventilation; mechanical disassembly sans protective gear; improper disposal of unsalvageable material; and the smelting of lead. This means, of course, that, while the health impacts will not be identical, they will be similar enough that we can make reasonable assumptions about the health impacts of the Agbogbloshie case based on evidence from China, especially if we can confirm the presence of the same hazardous materials and recycling practices. (26)

There are many different studies on hazardous material exposure and its health impact on Chinese e-waste workers, particularly concerning Guiyu. They tend to identify high levels of contaminants, confirmation of serious and debilitating short-, medium-term and long-term effects, and solid indications that e-waste work is the main or only cause of exposure. The research was done before the establishment of an industrial park at Guiyu, and hence represents the consequences of completely unregulated and informal recycling of the Agbogbloshie kind. In greater detail, the studies show:

- Extensive pollutants in unusually high levels at recycling sites, including heavy metals (cadmium, cobalt, chromium, copper, nickel, lead, zinc, mercury, and manganese) and Persistent Organic Pollutants (POPs, e.g., dioxins, furans, PBDEs[47], PAHs[48], PCBs[49], PCDD/Fs[50], and PVCs[51]), with arsenic also present. One particular PBDE used commonly as a flame retardant, BDE-209, had a 79-3973 times greater level in Guiyu than a control done in southern Sweden, while PCDD/Fs levels in the air were 1.5 and 3.1 times greater than controls in nearby Guangzhou and Hong Kong, respectively. (27) The average concentration of one particular PAH, BaP[52], was 2-6 times higher than in other major cities in Asia. (28) The PAH in question is “regarded as an indicator of carcinogenic risk”. (29) Air levels of chromium, copper and zinc were 4-33 times higher in Guiyu than in controls in various Asian metropolitan cities, with a study confirming that this was “not due to vehicle emissions, but due to emissions from the heating and burning of e-waste”. (30)(31)

- Exposure takes place via breathing contaminated air, skin contact whilst working, and eating contaminated food and drinking contaminated water, with the expected bioaccumulation and biomagnification occurring at each trophic level and magnifying the toxic effect. (32) Contamination was present in the surrounding rivers and waterbodies used

[47] Polybrominated diphenyl ethers
[48] Polycyclic aromatic hydrocarbons
[49] Polychlorinated biphenyls
[50] Polychlorinated dibenzodioxins
[51] Polyvinyl chlorides
[52] Benzo(a)pyrene

for drinking water, fishing and crop irrigation. PCB was also present in the milk of nursing mothers. (33)(34)

- Workers had high incidences of: “skin damage, headaches, vertigo, nausea, chronic gastritis, and gastroduodenal ulcers”. (35)(36)

- “More than 70% of children have blood lead levels above 10µg/dL” in Guiyu, a level which is hence above “the United States Centers for Disease Control and Prevention (CDC) and World Health Organization (WHO) level of concern” and is furthermore “detrimental to neurodevelopment which includes impaired cognitive function, behavioral problems, attention deficits, hyperactivity, and conduct problems.” (37) A similar study put that number at around 82%, with the highest concentration being as much as 32.67 µg/dL. (38)

- New-born children of workers and residents of Guiyu had “higher levels of toxic chemicals (lead, cadmium, chromium, nickel, and PBDEs) in blood and placenta”, adding that “developing fetuses and infants are particularly vulnerable to toxicants”. The “[c]oncentrations of cadmium, chromium, nickel and PBDEs […] were higher than those of controls although not as significantly elevated as lead.” (39)

- Adults suffered conditions including asthma and cancer, which were believed to be “attributable to preconceptual and prenatal environmental exposures” to these toxins. (40)

- A study of births from 2001-2008 in Guiyu found higher risks of adverse birth outcomes, most significantly perhaps a four times higher risk of stillbirth. New-borns from Guiyu also had significantly higher levels of lead in umbilical cord blood (CBPb) than the norm, almost five times more in fact, with more than half of them above the aforementioned maximal acceptable level of 10 µg/dL. The study confirms “significant associations between CBPb of neonates and parents’ engagement in e-waste recycling, residence in Guiyu and duration of residence” concluding the findings to be the result of “occupational and environmental exposure”. (41) Blood levels of lead in Guiyu children were generally significantly higher, and increased with age, likely due to older children being outside more and thus being exposed to more contaminants. (42)

- The concentration of lead in the surface water of Guiyu was eight times higher than the maximum safe concentration, defined by the US EPA as 65 µg/L, while river sediments in the area had a lead contamination of between 28.6 and 590 mg/kg, while the US EPA’s defined ‘probable effect level’ is 82 mg/kg. (43)(44)(45)

- Dust collected from recycling sites handling printed circuit boards (PCBs) had lead levels 330 times higher than control samples from sites not handling e-waste. (46)

Dozens of studies done at the Guiyu site, over a period of over a decade, have similar and congruent results, diverging only somewhat in the exact concentrations of pollutants found. (47) (48)(49) The kinds of persistent toxic substances (PTSs) found at Guiyu "share the same characteristics of being persistent, toxic, bioaccumulative, and able to travel long distances through different media". (50) What is meant by persistent is that their "average life in water is above 2 months; average life in soil above 6 months; average life in sediments above 6 months, average life in air above 2 days". (51) Bioaccumulation, and the related concepts of biomagnification and bioconcentration, are the processes whereby contaminants are concentrated in organisms, such as through the food chain. In the simplest terms: a fish is exposed to pollutants, and when a predator of that fish subsists on a diet of contaminated fish, the contaminants are concentrated in the predator – and continue to concentrate further in the predator on the next trophic level. (52)

The overall health impacts that are the result from exposure to these contaminants have been documented as occurring as a direct consequence of e-waste work. They include, in addition to those mentioned above: "[r]eproductive disorders, developmental deformities, cancer", and also "breathing ailments, skin infections, and stomach diseases" (53)(54); "endocrine and nervous system disruptions" (55) ; "changes in cellular expression and function, adverse neonatal outcomes, changes in temperament and behaviour, and decreased lung function" and "increases in spontaneous abortions, stillbirths, and premature births, as well as reduced birthweights and birth lengths", with "evidence of greater DNA damage" in those that lived in Guiyu compared to controls. There was also a plausible, but not confirmed, impact on thyroid function. (56)

Lastly, research from the Shantou University Medical College add that "workers in the e-waste industry in the Guiyu area suffer from headaches, dizziness, itching, rashes, nausea, insomnia, memory loss, and also had significantly higher incidence rates of conjunctival hyperemia." The local government of Guangdong eventually took all these issues seriously, which shaped their decision to construct the industrial park and attempt a clean-up of Guiyu. (57)

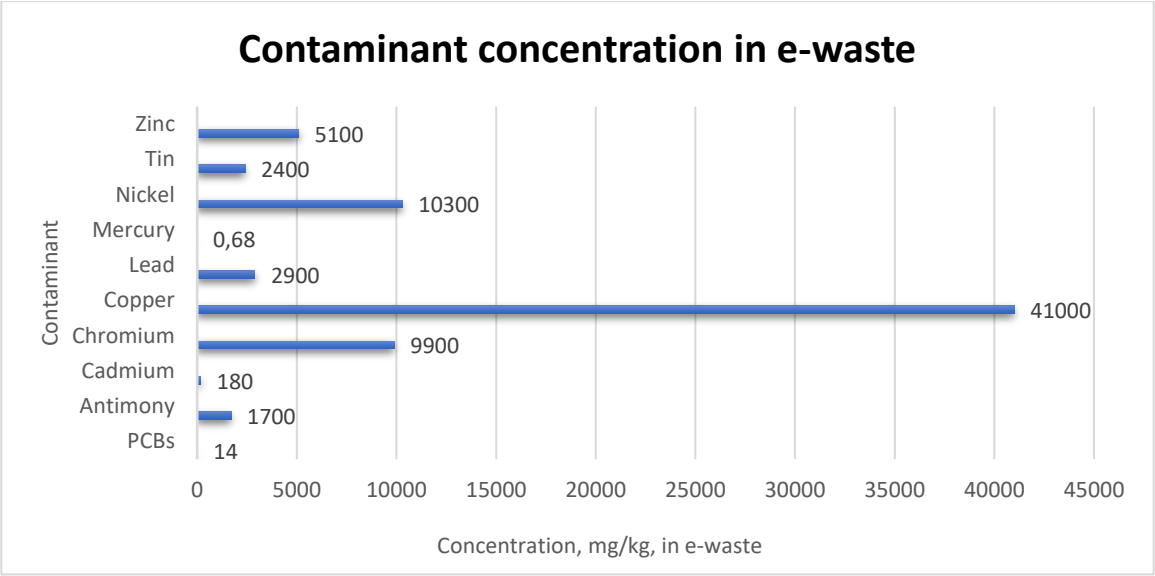

Diagram 8.1. *Typical concentration (mg/kg) of common contaminants in e–waste, as per Robinson 2009.* (58)

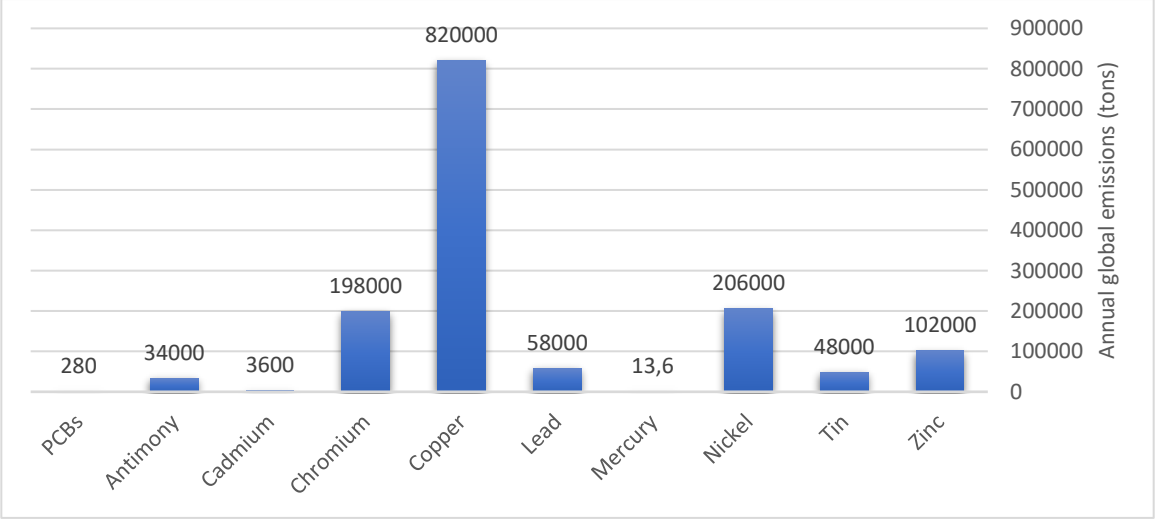

Diagram 8.2. *Annual global emission from e–waste for 2009 in tons, assuming a global WEEE output of 25 million tons/year as per Robinson, 2009* (59)

3. Final comments

What has been covered here would, in all cases, be confirmed outcomes, where care has been taken to ensure that exposure is specifically due to e-waste and no other sources of pollution. The research covered does not consider possible future complications. Exposure to many of the same toxic and hazardous substances, both heavy metals and plastic-derived compounds, here mentioned has

already been confirmed at Agbogbloshie in the preceding section. Similar methods of recycling are employed and most obvious short-term consequences, headaches and respiratory problems among the workers, have also been confirmed. There is little doubt that the health impacts of informal recycling at Agbogbloshie will be very much the same as in pre-industrial park Guiyu, and the health impacts seen cannot plausibly have any other explanation than the established working conditions and recycling practices.

Recall too that much of the exposure to hazardous materials is technically avoidable, that is, not a necessary aspect of recycling but a consequence of *informal* recycling, of the specific conditions at places like Agbogbloshie, including both the practices and the lack of protective gear, ventilation, etc. Harm is not merely being exported but *created in situ*. It is prudent to recall the words, from Chapter 2, of biologists Richard Levins and Richard Lewontin, when they ask "[d]o poor people get tuberculosis because of the Koch bacillus, or is the Koch bacillus one of the ways that poverty kills?" (60) That is, do people develop health issues because of informal recycling, or is informal recycling one of the ways that poverty kills?

Having now established the full impact – socially, environmentally, medically and economically – that informal recycling has on people and communities, it is possible to move on to a deeper analysis of e-waste. But what of formal recycling, in modern facilities that lack the aforementioned problems due to sound processes? Can the solution to the informal problem simply be better technology and more regulation? For the purpose of answering that question, I will engage with an overview and analysis of Sweden, where e-waste recycling has one of the highest standards in the world. As will be shown, though this avoids the problems outlined above, strict regulations and high costs can also create incentives for export of e-waste. There are, after all, reasons that developed countries are the source of much of the e-waste found in developing regions.

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Chapter 9

E-waste Handled Right? The Case of Sweden

1. The Swedish legal framework

When Green Advocacy Ghana began its work, they received funding from the Nordic Fund, and in 2011 they sent people to Sweden to learn more about proper e-waste recycling. Sweden was seen as a model, that could be used as an inspiration and a long-term vision for Green Advocacy's work. Their journey to Sweden included collaborating with *Boliden*, a mining and smelting company that is also one of the world's largest e-waste recyclers, as well as the recycling companies *Kuusakoski Recycling* and *Sims Recycling Solutions.* The collaboration also included the e-waste management NGO *Elkretsen*, and the Swedish EPA. In 2012, experts from Sweden where sent to Agbogbloshie to provide on-site training for personnel there. (1) Worth mentioning is also that Mike Anane claims that he has found no Swedish e-waste at Agbogbloshie in the last 8 or so years, though e-waste from other EU countries, including the other Nordic countries, continues to show up. (2) This is likely due to both Sweden's developed system of handling e-waste in general, but perhaps also due to media reports on the e-waste issue and a familiarity with it among decision-makers. (3)

Sweden has a system of producer responsibility for handling e-waste, which is written into law via *Regulation (2014:1075) on producer responsibility for electrical equipment* (Förordning om producentansvar för elutrustning). The regulation means that whoever puts electrical or electronic equipment on the Swedish market, or an approved representative with power of attorney, is responsible for caring for the product once it becomes waste. Note that the legislation does not include the volumes of pure domestic retail or domestic distribution. Producers must also register with, and report data to, the Swedish EPA. (4)(5)

In this system, municipalities and counties cooperate with the producers to collect e-waste. The cooperative system is called El-retur ("electricity return"), and involves three major organizations; *Avfall Sverige* (the Swedish Waste Management and Recycling association), *Sveriges Kommuner och Landsting* (a nationwide employer and member organization for all the county councils and municipalities of Sweden) and *El-kretsen* (lit. "electrical circuit", but also referring to the circularity of recycling work; a private, non-profit firm co-owned by 19 different industry

associations which sells its services to those producers affected by the Swedish producer responsibility law of 2001, so that the producers can meet their legal requirements). (6) These organizations work closely together with individual producers and recyclers to ensure proper handling of e-waste.

Collection from households is done primarily through staffed municipal recycling centres, but most municipalities also have several other collection systems, usually near stores and residential areas for ease of access. Stores selling electrical and electronic goods have a legal responsibility to accept electronic waste given to them since a new regulation, SFS 2014:1075, was passed on October 1 of 2015. Larger electronic stores are obliged to accept any electronic waste equipment smaller than 25 cm, even if the person handing it over is not a customer of the store in question. Smaller stores will accept one piece of waste for every one product purchased, and in no case does the consumer pay anything for this service. Battery manufacturers are responsible for collecting, processing and recycling all batteries in Sweden, regardless of when they entered the market. (7)(8)(9)(10)

Avfall Sverige describes the recycling process itself in the following manner in their official publication Svensk Avfallshantering ("Swedish Waste Management"): (11)

> "Electrical and electronic waste is pre-treated, sorted and disassembled before processing. Pre-treatment takes place at certified plants, which then send the waste to final treatment or recycling. Components with hazardous substances are taken care of in approved facilities. Once the environmentally hazardous substances have been removed, much can be recycled. Plastic casings are incinerated in energy recovery plants and metals are sent to smelters for recycling. Recycled copper, aluminum and iron are used as raw materials in new products. Computers, mobile phones and other IT products contain small amounts of precious metals that are also recycled, for example some circuit boards may contain gold and/or silver. Fluorescent lamps and low energy lamps contain mercury. These products are therefore treated by way of separation in a closed process. Mercury is handled in a safe and controlled manner while the fluorescent powder can be reused in the production of new light sources. Metal and electronic waste goes to specialized recycling companies that recycle metals and recycle plastic. The glass is cleaned and recycled. Other types of lamps such as incandescent light bulbs and LED-lamps are treated in the same process as fluorescent lamps and low energy lamps. Batteries are sorted based on chemical content before they are sent for recycling or disposal."

Mr Mårten Sundin, Head of Marketing at El-Kretsen, acknowledges that the whole reason his company exists is the producer responsibility law: “many of our customers (i.e. trademark owners/manufacturers/ importers) are small firms and usually their main reason for joining us is that they are forced by legal requirements. Of course, that does not mean that they are reluctant, and in fact many are quite positive, but the legislation is usually the main reason to join.” However, he does believe that genuine concern and a different set of values can grow from the basis of the legal requirement, and thinks that a lot of the larger actors have taken a conceptual step forward and “no longer look at producer responsibility as a must, but also as a tool for moving towards more circular flows”. They show what he considers “a genuine interest in how we develop our business and how we can help them move forward on these issues” and make demands of their own, such as the standards El-Kretsen sets for their recyclers.[53] (12)

Part of this kind of assistance can be seen in El-Kretsen’s initiative, *Green Electronics Summit.* The summit focuses on the concept of circular economies, and is their attempt to gather together representatives of the industry and discuss the developments taking place and, as Mr Sundin puts it, “spur each other with good examples, and learn from each other how to best combine electrical products with sustainability”. (13)

El-Kretsen also cooperates with the Swedish *Environmental Protection Agency* especially with questions of an international character, such as trying to spread Sweden’s success, and Mr Sundin cites a recent ambitious cooperative project in Brazil as an example. (14) Yet he is careful to point out that El-Kretsen has no illusions that the Swedish model can just be copied, believing that to be impossible due to differing geographical, political and economic conditions. “Poverty, and countries with a high proportion of informal sectors, are strong risk factors for [the prevalence of] hazardous waste management”, Mr Sundin argues. He adds that “unwillingness and lack of knowledge” about proper waste management can be found in all countries, and while El-Kretsen can do little about the former they do try to help with the latter. The goal is simply to share experiences and assist other countries in finding something that works for them. To Mr Sundin, there are always some universal lessons he believes can be gathered from the Swedish success; one being a clear division of responsibility between state, municipality and producers. The other being a clear legal framework that is consistently enforced. (15)

[53] Note: all interviews with Swedish experts were conducted in Swedish, and all quotes were translated into English by the author together with the interview subjects.

Mrs Britta Moutakis, recycling advisor at Avfall Sverige, considers the issues of places like Agbogbloshie very complex, but agrees with El-Kretsen that proper legislation, and measures to ensure compliance with it, together with a clear division of responsibilities and working infrastructure (collection sites, treatment facilities, etc.) are important factors for establishing a successful e-waste collection and recycling system. The EU extended producer responsibility for e-waste, in Sweden organized through the two producer responsibility organizations El-Kretsen and Recipo, have been very important to Sweden's success; these two organizations are both approved by the Swedish Environmental Protection Agency. (16)

2. Swedish recycling and refurbishing in practice

One of the locations that Green Advocacy Ghana visited as part of their visit to Sweden was the Sims Recycling Solutions (SRS) recycling facility in the Swedish town of Katrineholm. SRS is an international e-waste recycling firm, with locations all across the globe, and their factory in Katrineholm is one of the largest in Sweden and handles e-waste from all of Scandinavia. They cooperate with various Swedish municipalities and the Swedish EPA to ensure compliance with the laws and demands on recycling. Last year, 30,000 tons of e-waste were recycled at the Katrineholm facility, all of which comes from either large firms or local waste transfer stations, as SRS does not deal directly with waste from private citizens. (17)(18) The facility relies a modern and sophisticated approach to e-waste recycling, typical of Sweden, and is considered something of an ideal method by Mr Akuffo and Green Advocacy Ghana. (19) I visited the site and spoke with Managing Director Mr Sargon Chanko, with the aim of comparing the Swedish approach with that of Guiyu and Agbogbloshie. The difference is staggering, and hard to understate.

Inside the facility.

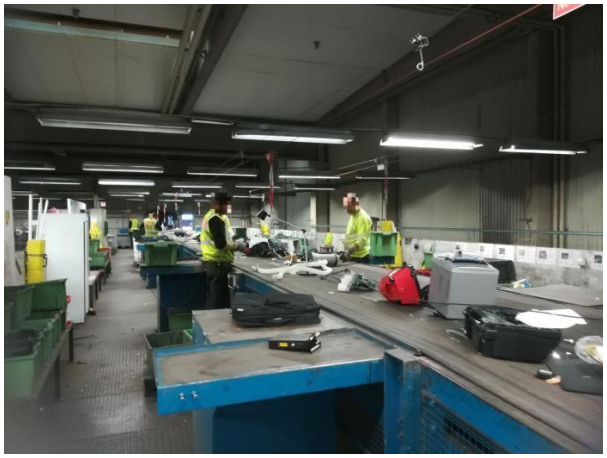
Firstly, the attention to worker security and health is far greater; workers are equipped with hardhats, protective goggles and gloves, steel-toed shoes, and safety jackets. Even I as a visitor had to wear such protective equipment while on site. First-aid kits are located here and there, and emergency eyewash and safety shower

stations are in place near workstations where a risk of harm from hazardous chemical substances exists.

Fire extinguishers and sprinklers are installed, and recording and monitoring via CCTV is used to ensure worker safety. Furthermore, the tools used in the manual disassembly are more advanced, with every sequence of the dismantling process having specific tools for the task.[54] (20)

Smaller appliances are separated from larger ones.

The e-waste is hauled in, separated based on properties like size and age, with larger equipment and the older cathode ray tube TVs needing somewhat different treatments. A crucial part of the recycling process is the environmental remediation that follows, in which the e-waste is placed on a conveyor belt with workers along the sides manually disassembly it and removing potentially hazardous materials such as batteries and engines. The goal is to prepare the e-waste for the automated processing that comes next. (21)



Different stations for manual processing of smaller appliances. Note the protective gear.

The great reliance on automation and machinery is another stark difference that separates Sweden. A set of huge machines is used to shred the e-waste into small pieces, which are then sorted into different piles depending on content; notably aluminium, plastics, copper, iron and motherboards.

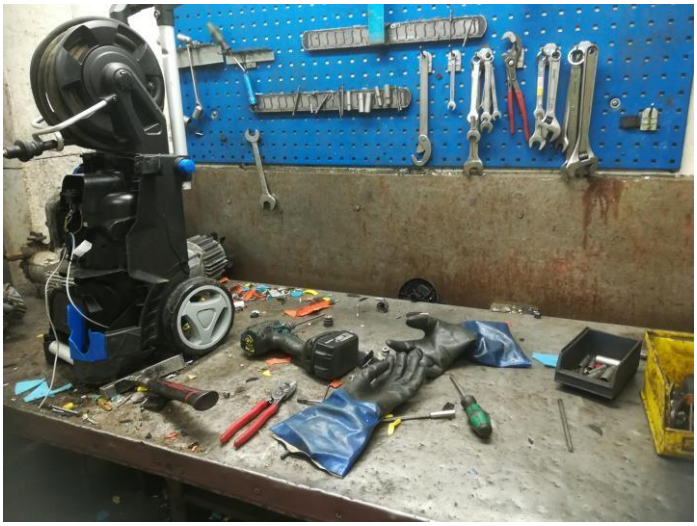
These are then shipped to different locations for further processing, including to the aforementioned Boliden AB. Hazardous materials are shipped to Fortum Waste Solution in the city of Kumla for further processing, while plastics are exported to mainly Asia and Canada. (22)(23)

[54] Fires are a common hazard in the business, due to the heat accumulating from friction in the machines and the flammable nature of the materials, especially lithium batteries. In fact, SRS's old factory in the city of Norrköping completely burned down in 2007. Currently, SRS invests a lot of money in finding ways of preventing fires, but they still occur almost every day though usually they are small and easily and quickly manageable.

Workers dismantling TVs and computer screens. Note the protective gear. Official SRS image, used with permission.

Old TVs continue to be collected despite not being sold on the Swedish market for many years.

SRS also refurbishes equipment, mainly computers and mobile phones, for re-selling on the second-hand market – 50,000 items where refurbished in 2017. Equipment is seldom repaired, unless the damage is minor, clearly visible and easy to address; something like missing buttons or a damaged hard-drive. The main task of refurbishment is instead to make sure the equipment works and is in good quality and has its data storage wiped. Most of their equipment is sold on the European market, and only rarely do they sell on other markets. (24)



Station with more advanced dismantling tools. Hazardous materials are removed here. An emergency eyewash and safety shower station are just nearby.

Security, environment and health are the "three pillars" of the business model, as Mr Chanko puts it, and this is a concept that applies to SRS internationally and not just in Sweden. He claims that the company prides itself on placing high demands on their own business, going beyond what the law demands and even trying to influence the system to make even greater demands. This includes not handling cash, carefully weighing and registering everything that enters and leaves the facility and ensuring that there is a record of everything done. SRS also does audits and controls to ensure that the material they export is handled in accordance to both their internal standards and legal demands. This makes business sense, as Mr Chanko explains, since more and stricter regulations and demands helps get rid of irresponsible competitors who gain something of a competitive advantage simply from not being beholden to the same restrictions. (25)

3. Final remarks

Conclusively, the differences between e-waste recycling in Sweden and the informal approach in Agbogbloshie and formal yet primitive method in Guiyu are astounding. In terms of worker safety and risk management, regulatory and legal framework, environmental impact, recycling efficiency and even profitability, the Swedish case shows a clear supremacy. The recycling of e-waste, clearly, need not be hazardous or environmentally harmful practice, but a way of closing the loop of a circular economy. It is even possible to turn a profit doing so, to the point that recycling actors actively seek more and better regulation of their industry. The question is then raised: is this possible to achieve in Agbogbloshie or Guiyu, are these possible futures of informal e-waste sites in the manner that Green Advocacy seemingly hopes? Furthermore, if profitable but environmentally friendly recycling is possible, what of the supposed conflict between capitalism and nature that I declared to be central to this thesis – what use is an environmentalist critique of

capitalism if eco-friendly capitalism is possible? A deeper analysis is needed to address these questions, and Part IV of the thesis will be devoted to analysing the findings from the case-studies and secondary literature. I will begin in the following chapter, by examining closer the Guiyu and Sweden cases in order to high-light the imperfections and the connection to the global e-waste stream and show the limits of regulations in managing the problem.

Worker removing hazardous materials, emergency shower station visible in the background. Official SRS image, used with permission.

The end result: processed e-waste.

The remains are shipped to smelting companies for further processing, mainly to Boliden.

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Chapter 10

The Limits of Regulations: Lessons from Sweden And Guiyu

The aim of this chapter is to begin the deeper, more abstract analysis of e-waste that can be built on the observations made in Agbogbloshie, Guiyu and Katrineholm. Out of those three, Agbogbloshie represents the truly informal and unregulated recycling of e-waste, whereas Guiyu is a formalized yet still 'primitive' system relying on basic tools and Katrineholm is the most modern and technologically advanced way of recycling e-waste. Yet, technology and formal structures cannot in and of themselves resolve the e-waste issue, as this chapter aims to show: the underlying structural problems remain, and indirectly connect even the improved sites to Agbogbloshie.

1. Further reflections on Guiyu

Considering the development that was shown in Chapter 7, it is undeniable that vast improvements have taken place in Guiyu, but equally undeniable that it is the common people who are carrying the burden of that improvement. The workers are still being poisoned, though less so thanks to some ventilation and basic protective gear, and they still carry primitive tools and inadequate protective gear. They nevertheless work in rooms with insufficient ventilation and breathe in toxic fumes for the duration of their working day. The impact on health and environment of past mistakes largely remain and have not even been sufficiently mapped, the exact long-term consequences of what occurred not yet fully understood, though as we saw in Chapter 8 the effects that have been mapped are very serious.

Several locals I spoke to, including an older couple that operated a store selling repaired second-hand electronics, told me about their concerns for their own and their children's health. They all feel uncomfortable being close to the workshops due to the smells. Locals also seemed aware of and concerned with other environmental problems in the area, such as the soil and rivers being polluted. The e-waste was a part of these concerns, but not the whole problem. People tended to see the past import of foreign waste as China having been exploited as a dumping ground, the already problematic local environment being even further worsened. Yet even the more critical voices acknowledge that an improvement has taken place, and the division is over whether the government is doing enough or not. For some there's a sense of quiet optimism, hope that perhaps further economic development will lead to even more funds to clean up the

area even more. As was made clear before, nobody really questions the idea of further economic development as a solution to the problem; an idea actively pushed by government and media. (1)(2)

The key is seemingly one of economics, of finding the right balance of just enough technology to minimize harm but not so much that the cost soars and the venture becomes unprofitable. Among other things, the quite sophisticated air filtering system demonstrates that advanced technology is available; the reliance on low-tech solution is an intentional cost-reduction move. What has emerged in Guiyu after the government intervention is an outcome that is better than unregulated market chaos, but one where the forces of capitalism still make themselves known. Despite the strong Chinese government's influence, profit maximization still remains the order of the day. The government has merely shifted the way in which that goal is achieved.

The vast changes that have taken place make it clear that some consideration of environmental sustainability has taken place, and that there are regulations and initiatives in place that do protect the people and the environment. But it is worth pointing out that such measures have also had the side-effect of lining the pockets of the government, by way of the labour and rent payments of workers. Nor are the regulations so numerous or cumbersome as to be a hurdle to the local businessmen who have made a hefty profit on e-waste trade, and can be spotted cruising around the park in their BMWs, Mercedes and Lexuses – all while the commoners have become poorer. (3)(4)

Air filtering system, right outside the smaller buildings/rooms.

Another issue is flow displacement. Despite the effort to alleviate the old problems while keeping costs down, the industrial park, and related initiatives such legal demands, have clearly raised the price-tag for e-waste handling in Guiyu. This means that an incentive now exists to export the e-waste elsewhere. Indeed, Jim Puckett and the BAN have used GPS trackers to follow the shift in the e-waste flow and confirm that much has started going to Hong Kong. The BAN *e-Trash Transparency Project* found 48 different electronics junkyards in Hong Kong with the help of GPS trackers. Many more were seen during BAN inspections to the area, and the current estimation is that there are between 100-200 such sites in total, most of which are in the rural parts of the New Territories. The report explicitly states that Hong Kong "may become the next Guiyu, if action is not taken quickly". (5) The KCTS9 documentary *The Circuit: Tracking America's Electronic Waste* features Mr Jim Puckett visiting the Hong Kong scrapyards, uncovered by way of the GPS trackers mentioned in Chapter 3. (6)

The old smuggling stations there have now become e-waste stations themselves, with the Hong Kong government not doing nearly enough, according to the BAN. (7) This combination of already established

networks and arrangements and a lack of enforcement of the Chinese import ban on e-waste is likely the explanation for the otherwise developed region that is Hong Kong turning into a new e-waste hub.[55] It is worth reiterating that it is in the New Territories of Hong Kong, especially the largely rural and undeveloped areas around Ping Che, that the new scrapyards have been established. Already a site where unregulated and even illegal business operate, most notably pirate petrol stations, it makes for a fitting 'green site'. (8) Some e-waste is also going to Taiwan, Pakistan and Thailand, and though things are still in flux Mr Puckett acknowledges that these places can become new sites, even suspecting that the Chinese businessmen who had their operations in Guiyu have simply moved them to other parts of South-East Asia. (9)

Additionally, illegal e-waste business still occurs despite the crackdowns. The aforementioned Reuters report states that court documents from the cases of e-waste smugglers caught in Guiyu suggest that gangs planned schemes meant to launder e-waste cargo. They intended to ship "scrap mobile phones and computers… from Hong Kong to the North Korean port of Nampo… [where] they would be dismantled, stripped of identifying features and smuggled to the Chinese border port of Dandong, from where they were sent to Guiyu, classified as domestic waste." (10) The economic incentives can be too strong, despite the laws. Chinese ships travel all over to world delivering goods and, as professor Wang Jingwei of Shanghai Polytechnic University puts it, have the choice between returning home empty-handed or taking a risk and loading up on valuable electronic waste that others are eager to get rid of. (11) This economic incentive is at times openly confirmed, as we can see from an editorial in *The Economist*, wherein the editors argue:

> "The best way of recycling waste may well be to sell it, often to emerging markets. That is controversial, because of the suspicion that waste will be dumped, or that workers and the environment will be poorly protected. Yet recycling has economics of scale and the transport can be virtually free – filling up the containers that came to the West full of clothes and electronics and would otherwise return empty to China." (12)

Both in the far more troubled past and today, the people involved rarely know either where the e-waste comes from nor where exactly the recycled materials will go – both ends of the process is handled by middle-men who ask no questions and have no answers. Once waste is classed as domestic, and stripped of identifying markers, it is non-distinguishable from legitimate waste. Hidden tracking devices are useful for mapping general flows but cannot catch individual rule-breakers.

[55] As stated in a report by the UN University StEP initiative: "[u]nder the 'One Country, Two Systems' policy, China, as party to the Basel Convention, only performs customs control for mainland China. Hong Kong is responsible for implementing separate controls on the transboundary [sic] movement of hazardous wastes. Legislation in mainland China thus does not apply to Hong Kong." See: Wang F, Kuehr E, Alquist A, Li J 2013, 'E-waste in China: A country report', StEP Green Paper Series.

2. Lessons from Sweden

In Chapter 9, I chose to use Sweden as an example of e-waste handled right for several reasons, not the least of which is Green Advocacy Ghana's praise of the Swedish approach and their hope to emulate it. The laws, regulations, and policies in Sweden are also comparatively strict and well enforced. In many ways, the Swedish approach represents the ideal way of handling e-waste.

Speaking personally, as a long-time resident of Sweden, I am also very aware of certain cultural and societal attitudes to sustainability that further enticed me to examine the Swedish case more closely. This cultural aspect partly escapes academic analysis, lest one is to devote many years to social anthropological studies and is certainly not the topic of my thesis but ought to be born in mind. One might need, perhaps, to experience directly that strangers will indeed tell you off for littering or even recycling incorrectly – and be frustratingly polite about it. My impression, at least, is that environmental sustainability is quite simply important to most Swedish people and has long been embedded into the politics and policies on both a national and municipal level. Indeed, it has been a part of basic education for so long that there is a certain instinct to it for most people. Therefore, despite my otherwise critical approach in this thesis, I do not doubt the sincerity of the people I have spoken with, or their intention; I will not insult them by insinuating that this is no more than some kind of 'greenwashing', business as usual but with an air of supposed sustainability, at least not intentionally. The dedication, hard work, and strict adherence to guidelines by all those I spoke with demonstrate to me a genuine belief in the basic principles of sustainability and responsible recycling. However, that does not preclude the existence of underlying forces towards opposing ends, though it may stifle their expression to some degree.

In Sweden, a culture that places great importance on sustainability is combined with effective and appropriate legislation. There exists an ordered institutional structure, well established public-private partnerships with well-meaning private actors and dedicated civil servants, and there are arrangements that make compliance easy for the ordinary citizen. Despite the flaws, Sweden is still a good example of handling e-waste right and is an understandable inspiration. And yet, it is apparent that Sweden too faces the problem of illegal e-waste exports, as was covered already in Chapter 3. I was also told so repeatedly by the very people whose job it is to prevent it, and the official statistics make it abundantly clear that it happens, though they are silent on the details. Despite all the effort, despite so much being right on paper, non-negligible volumes of e-waste still leave Sweden every year. Why?

The incentive in Sweden is ostensibly the same as for any developed country, namely, either to make money by reducing the cost of recycling or by getting paid for the valuable materials without having to take costly and time-consuming responsibilities for them. I certainly sympathize with Mrs Moutakis's point when she claims it is misguided to blame the work on rectifying the e-waste problem in developed countries for what we observe in developing ones. It would at best be a very shallow analysis that fails to consider the many

positive effects that proper regulations can have, as shown throughout this thesis. But the increased costs and demands do push companies to cut corners or save money by moving the handling elsewhere or sell it to someone who will. The interconnectivity of the global flow cannot be ignored, and as we saw in the Guiyu case, e-waste flows will shift when conditions are no longer favourable. The Swedish EPA is clear about this, and about the motivation for illegal exports being purely economic. In a 2010 report, they argue that: "[i]n OECD countries, labour costs are higher and health and environmental legislations are stricter than in the countries that may receive the illegally exported waste. This means that recycling requires more time and resources in OECD countries. Thus, by exporting the waste to non-OECD countries, the exporter can recover valuable components such as gold and copper at a lower cost than in an OECD country".[56] (13) The existence of this incentive cannot be denied any more than the benefits of regulation, creating a paradoxical situation in which the solution can exacerbate the problem, through geographical displacement. The underlying issue is that the e-waste stream is *global* while both legal regulations and technical improvements occur mostly on the national and supranational level – even an international agreement such as the Basel Convention is not wholly global and certainly not globally enforceable in practice.

A more direct, and simpler, answer would be 'money', or, perhaps more correctly: 'capitalism'. If an incentive exists to do something, for example, one can turn a profit, there will always be someone willing to do it regardless of the preventive measurements or counter-incentives put in place. If an entire social system is founded foremost upon the principle of profit acquisition, as capitalism is, one should expect that unscrupulous means of acquiring profit will exist, their prevalence determined by the severity of the consequences regulating bodies enact (or lack thereof). Certainly, that means that such outcomes can be reduced through regulation and control, but as long as the underlying goal (i.e. the profit-motive), remains the same, any regulation or counter-incentive merely becomes part of a cost-benefit analysis on the part of potential actors. It is unavoidable that *someone* will at *some* point decide that the monetary benefit of illegal e-waste export outweighs the potential cost of getting caught. But we must delve deeper than this simple answer, because left at this stage it is little more than an ethical critique of greed as a moral condition afflicting unscrupulous individuals.

Forgoing a proper, political-economic, critique of the capitalist system in favour of a moralistic critique of greed has unfortunately been characteristic of mainstream ecological economics since its conception. As shown in Chapter 2, important figures of mainstream ecological economics, and the foundational texts they have authored, omit direct inquiry into the driving forces of the capitalist system. They fail to be materialists in their social science, substituting a robust critique of the system for an idealist critique of ethical values, without seeking to understand the material causes of those values. For there is a difference between greed existing as a personal flaw, a matter which is not the concern of this thesis, and 'greed' being transformed into a mechanism that is built into the very core of the system, and made into an economic law so that even

[56] Author's translation from the original Swedish.

the most selfless individual must either act in accordance with that law or find themselves at a disadvantage in the competitive market, and potentially replaced by those more willing to abide by the rules of the game. In a sense, Mr Chanko admits to this, when he speaks of the challenges a scrupulous actor faces when competing with less scrupulous rivals who are thus not restricted by the same rules and demands.

In fact, I would suggest that we cannot truly speak of the 'greed' of capitalists at all, as the process is automatic, mechanical even. It is both wholly impersonal and wholly independent of the moral inclinations of the individuals involved. It is divorced from conscious and deliberative actions and the forethought that informs them and takes on a life of its own. 'Greed' is a property of thinking and feeling beings and cannot be a property of capitalist accumulation as a system, and therefore discussions of morality and ethics, while I do not deny their importance, cannot help us explain either the nature or the source of the drive for profit accumulation under capitalism, and the impacts it has. Arguably this is the very point Marx was trying to make in the first volume of *Capital* when discussing the 'General Formula' for capitalism. (14) Money, really, is the ultimate product, accumulation of the exchange-value it embodies being "the driving and motivating force" and "determining purpose" of market activity. (15) Considerations of use-values of any sort, including the use-value the natural world has for its inhabitants, do not enter into the equation at any point. That is what distinguishes the particular historical character of circulation that produces *capital* out of mere money. So crucial was this insight into the inverse nature of commodity circulation under capitalism as compared to feudalism, that it entered mainstream ecological economics discourse, indirectly through Georgescu-Roegen's discussions of commodity circulation and directly through Herman Daly's use of the M-C-M'/C-M-C model. (16)(17) Though, as I have argued elsewhere, in both cases without being placed on the proper historical materialist grounds. (18)

As is shown by Mr Chanko's honest comment on the problems he faces with his less scrupulous competition, what we would call a positive outcome is certainly sometimes possible to achieve even with profit as a motive; it is possible to arrange laws and regulations so that a firm *benefits* from them and actively seeks to enforce stricter oversight over itself and its own industry. In this case, oversight gets rid of irresponsible rivals and financially rewards the compliant. But an outcome like that cannot be guaranteed and is in any case a function of several overlapping factors, including the regulatory structure exerting control over pure market forces. It is a case of *real* forces not being *actualised*; it does not diminish the potential danger of those forces any more than a well-constructed cage diminishes the inherent danger of the tiger it imprisons, and in fact the case merely cements the importance of profit maximization as the preeminent driving factor. This difference in the incentive model is ultimately what separates Sweden from Ghana. The underlying driving force – the profit motive – remains the same, it just expresses itself differently in Sweden. But it is neither a stable nor universal arrangement.

The specific institutional and regulatory structure in Sweden incentivizes, quite successfully, proper e-waste management for larger firms. But it thereby also creates, inadvertently, an incentive for smaller actors who

cannot live up to the strict demands simply to ignore those demands and hope to avoid detection due to their very smallness. The crucial thing is that the regulatory structure is not the cause of either outcome, but merely shapes in two opposing ways the expression of the underlying cause, which remains for all firms involved the twin motives of profit maximization and survival on the market. Hence, if we are to understand the specific phenomenon of illegal shipments of e-waste, we must understand the complete context in which it occurs, i.e. both the regulatory structure that shapes the observed outcomes, but above all the general laws of capitalist political economy that ultimately cause it.

It is, of course, possible to construct a narrative according to which capitalism is blameless, and culpability is instead placed on the imperfections evident in the Swedish system, and which have been laid bare in this chapter. Despite having a very well developed and commendable system in place, flaws are still evident: the e-waste problem is not taken seriously enough by many municipal supervisory authorities, the customs and the police either likewise underestimate the seriousness of the issue or simply lack the necessary resources for thorough control and enforcement, and national regulating agencies allow smaller actors to forgo proper scrutiny. One could argue that this is the source of the problem, and that the solution lies in educating the authorities and providing them with the needed resources, much like Mrs Moutakis and Mr Chanko in fact suggest. In other words, the solution is essentially more of the same: improving the existing regulations and making sure they are better enforced.

Within mainstream ecological economics and ecological modernisation approaches, this line of thinking is prevalent. For as shown in Appendix 1, it is common for foundational texts within the field to analyse policies and regulations, and often suggest stricter ones as solutions, but refrain from delving deeper than that. I would suggest that this is to conflate the *cause* of a problem with the institutional arrangements that permit and shape its *expression*. It is too focused on half the equation, the institutional and regulatory structure, but not the other and perhaps more crucial half: the underlying economic forces. As already stated, the prevalence of an issue such as illegal shipments is determined by the nature of the laws and regulations in place, and, if one accepts that, then it ought to be obvious that stricter and better enforced regulations will tend to reduce the pervasiveness of the issue. The real is not always actualised and may be limited in the degree to which it is, but that does not in and of itself disprove its existence. Perhaps, if we imagine a perfect system, it might even eliminate it completely. But even in that case, it would be the occurrence that is eliminated, namely, the *expression* of the underlying causes, not the underlying causes *themselves*: even a perfect cage does not eliminate the tiger but merely contains it. As long as the underlying causes remain, people will have reason to try to avoid or break the law in order to turn a profit and, if the system is anything less than perfect, they will occasionally succeed. It is trivially true that the closer we get to a perfect system of laws, regulations and enforcement in a society, the fewer illegal activities we will find. But we must acknowledge that perfect implementation is a will-o'-the-wisp that can never be achieved in practice. The failures of this broadly eco-modernisation approach cannot be excused with it not being implemented well enough, when perfect implementation is not practically feasible. Nor is the possibility of improvement of

the current state of affairs a reason to neglect the question of *why* the illegal activity occurs; what drives and motivates it. I argue that the answer is, ultimately, the laws of the capitalist economy.

Additionally, experts in Sweden acknowledge that it is difficult to simply import the recycling process from a developed country to a developing one, where local conditions differ significantly. I believe that Mr Sundin and Mrs Moutakis in fact underestimate how significant those differences can be, and that proper legislation, clear division of responsibilities, and working infrastructure may not be that simple to implement. There may be no universal principles at all; no practically useful lesson may be possible to gather from Sweden concerning Agbogbloshie. It is not by accident that a country like Ghana lacks the structures Sweden has; it is the outcome of real circumstances, and as long as these circumstances prevail, the emergence of the conditions needed for proper recycling is bound to be hindered. Technological fixes and improved regulations cannot be offered as blanket solutions without understanding what caused, and what perpetuates, existing conditions to begin with. The intercommunity of e-waste flows, and their tendency to shift to find more favourable conditions, means that even eventual solution of the problem at one location merely implies its geographical displacement elsewhere.

It is crucial to recognize that capitalism is not just an idea, it does not just exist in our minds, but entails real, concrete phenomena that both restrict and shape our ways of thinking and acting. “People”, after all, “make their own history, but they do not make it of their own free will, not under circumstances of their own choosing” but must instead deal with “already existing conditions, passed on from the past”. (19) In other words, what enables the outcome observed in Sweden, namely, illegal shipments occurring in spite of commendable efforts to prevent them, is not just the currently existing regulatory structure in Sweden but the specific social arrangements and relations of production in the capitalist system – precisely because they lead to the separation of production decisions and ethical considerations. Because the atomistic, competitive nature of the capitalist market sometimes *necessitates* actions that would, were it not for the aforementioned separation, be regarded as unethical. That is, the actors who contribute to illegal shipments are small actors, motivated as much by *survival* as by profit. They face competition from large recycling companies with far greater capacities and much more advanced technology at their disposal, so that a major ‘advantage’ of the small actors is precisely that they are so small as to fly under the proverbial radar and avoid detailed government oversight of their business. By ignoring regulations, be that through minor infractions or by outright involving themselves in illegal e-waste shipping, they increase their chances of staying afloat on a market that they might otherwise find themselves being ousted from. If they do not, they are at a competitive disadvantage in respect to both the large firms and other small businesses that are more willing to cross the line.

Ethical critiques of capitalism serve a function, for they are directed against the veil that obscures the nature of capitalist production. Such criticism is needed in order to, as Marxist theoretician Gareth Dale puts it, “uncover contradictions in the dominant ideology, to lay bare their connections within society’s mode of

production and to comprehend their obfuscatory workings" (20). I have not spared such criticisms in this thesis, nor do I think that proper critique of a system is possible without exposing its human and social impact. The intention of showing what is arguably the worst-case scenario, Agbogbloshie, was precisely to draw attention to the injustices embedded within the system. Yet if one is to do more than deliver a moralizing critique of greed, one must scrutinize the underlying forces that drive the economy and avoid the ethicist's fallacy of confusing appraisal and explanation. It does not logically follow from an outcome being unethical that changing or preventing it is a matter of adjusting people's personal ethical values. Illegal shipments from Sweden and worker's suffering at Agbogbloshie are two interconnected, and ethically highly questionable, outcomes of the global e-waste trade, but they are the result of inherent systemic failure and not anyone's personal moral failings nor simple regulatory insufficiencies. The precise nature of the mechanics of capitalism, as they pertain to electronic waste, is what the following chapters will expound on.

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Chapter 11

The Social Embedding of E-waste Flows: A Marxist Perspective

To ‘socially embed’ flows of e-waste means to understand the socio-economic system these flows are a part of. From a dialectical stand-point, the flows and the context, though they can be analytically separated, form a part of the same overarching whole, and neither can be fully understood without the other. This chapter seeks therefore to answer the question of what e-waste *is*, not only in the technical but also in the social sense; its meaning and role.

1. E-waste flows, cars and second-hand goods

The contested narrative about the volume of in-flow of e-waste at Agbogbloshie have already been discussed, but what can my fieldwork tell us about the flows, if anything? In my view, what direct observations on site imply about volumes is problematic for four reasons. Firstly, both sides of the argument have direct observations and each contests the validity of the other. Secondly, as I have observed, the recycling activity has spread out from Agbogbloshie to other areas, and thus total activity at Agbogbloshie does not necessarily reflect total e-waste activity in Accra; nor does total activity in Accra represent total activity in Ghana, as other sites exist across Ghana. Consider that according to the report *Socio-economic assessment and feasibility study on sustainable e-waste management in Ghana*, “Agbogbloshie contributes about 40% to 60% to the total e-waste processing in Ghana”, making it by far the largest, but far from only, recycling site. Thirdly, and related to the final point (below), outside events have affected the activity at Agbogbloshie, such as the tragic flood, fire and the organized evictions and demolition. Even if such events had temporarily lowered the activity at Agbogbloshie it would not mean that a lower total import of e-waste into Ghana is occurring. Fourthly, it is quite simply doubtful that any observer could, simply from the activity and bustle at Agbogbloshie, correctly deduce the difference between 500 containers per month and 200 containers per month – especially if that observer has not been observing Agbogbloshie since before 2012 and could compare the events then and now. Such an observer could certainly not deduce the original *source* of the e-waste.

Yet from careful consideration of the actual work we can nonetheless deduce some things about the flows, which I believe contradicts some aspects of both standard narratives. The question concerns the presence of cars and other vehicles at Agbogbloshie; firstly, in much of the importist narrative, the presence of non-e-waste junk at the scrapyard is all but ignored, as Oteng-Ababio et al point out. (1) Secondly, part of the denialist claim is that the recycling of cars has all but replaced recycling of ICT equipment.

My observations at Agbogbloshie revealed to me that cars, busses, bicycles, old generators and so forth are indeed present, and that ICT e-waste only makes up part of the junk present – though there is still undeniably plenty of it. However, one must consider the fact that dismantling computers, televisions, phones, etc. is much quicker and simpler to do as compared to the other goods, which careful observations of the actual work done and conversations with the workers revealed. Dismantling of ICT equipment requires only basic tools like hammers and screwdrivers, and dismantling a single television or computer takes only a few minutes even for a single worker. Cars take a lot longer to dismantle, and are of course also more visible and easily spotted, especially since they often have several workers dismantling them at once. In other words, the *stocks* of cars may indeed be greater than stocks of ICT equipment at any given time, but the size of the *flows* of the latter ought not to be underestimated, given the much faster mass flow rate.

For these reasons, ICT waste will rarely form big piles sitting around at Agbogbloshie, though some such piles are indeed observable. Most of the time though, it comes in, is dismantled, and the waste that cannot be used (such as plastic) is disposed of while the valuables are sold and shipped off. Much of such work is also done in the commercial district of the Old Fadama slum, where the repair shops are located. Given the closely linked nature of recycling and refurbishing, this is to be expected, as repairers are inclined to first check ICT equipment for possible spare parts even when the products are clearly broken beyond repair. A lot of ICT equipment winds up filling both their storage spaces and those of refurbishers all across Accra, waiting to be repaired or used for spares – its status as “waste” therefore uncertain and contestable since there is a chance that it might be used at some point in some way.

When shipments of this kind of waste arrive, at least a dozen or so workers will get to picking through it and deciding on its use. The entire process is quick, which is unsurprising given the higher relative value of ICT equipment in terms of mineral content, and hence this kind of waste does not stay on site for long, rarely more than a few hours if even that. A car, on the other hand, is far harder and more time-consuming to dismantle, and cars will therefore remain on site longer.

Iron, the metal found in the greatest quantity when dismantling cars, is also the metal that fetches the lowest price for the workers. The copper in various cables, found in both cars and ICT equipment, is prioritized.

There is also the question of what e-waste *is*, exactly. While there certainly are a few standards definitions, none of these include cars – but perhaps they should. Perhaps the perceived prevalence of cars at Agbogbloshie ought neither to be ignored nor taken as disproving the e-waste problem, but something that requires us to re-examine and re-define what e-waste is. Cars are, after all, full of electronics, and more modern cars also have on-board computers. Yet the technical definition means that cars, unlike that which is currently and legally defined as e-waste, can be exported to Ghana despite the Basel Convention prohibition. Given such a prohibition and the work done by both governments and NGOs to ensure the compliance of it, is it really so strange to find that something which is legally not e-waste – but still very similar to e-waste – finds its way into Ghana? Cars, I would argue, are simply just another way to get around the law. Or rather, perhaps, a way of adapting to it. Car dismantling and recycling is similar enough to standard e-waste recycling that it can easily be done with the equipment, tools and knowledge already present at Agbogbloshie – so all the facilities, organisations and infrastructure and other capacities required for car recycling are already in place. There is an incentive among the people to do the work, especially considering growing worries about the future of the e-waste business, and unlike e-waste proper it is still perfectly legal.

Lastly, a new investigation by the UN University and BCCC-Africa even revealed that used cars are used to smuggle in illegal e-waste into Nigeria, which is hidden in the cars. Likewise, Swedish and Norwegian media reports have employed a combination of investigative journalism and GPS trackers to demonstrate conclusively that used cars filled with e-waste are illegally shipped from Scandinavia to Nigeria and Gambia. (2) Though no evidence exists as of yet of it occurring in Ghana, both the geographical closeness to Nigeria and similarity of the e-waste situation in the countries should be a reason for suspicion and gives a whole new twist to the problem of used cars arriving to Ghana. (3)(4)

1.1 The disagreement on flows of second-hand electronics

Related to the question of what constitutes e-waste is another aspect of the narrative presented by denialist scholars, one where I am, however, in some agreement; the focus on second-hand goods,

namely, functioning or broken but repairable electronics that wind up being sold throughout Accra rather than going to Agbogbloshie.

As has been discussed, there is disagreement on the data here as well. Given that uncertainty, I will avoid basing my argument entirely on any of the flow estimations, though the importist claim of approximately 15% of goods being broken and unrepairable seems very likely. Yet there are two crucial points to remember that are divorced from figures on exact flows. Firstly, to reiterate, both importists and denialists acknowledge that some portion of declared second-hand electronics are broken beyond repair at arrival, and hence that some e-waste enters Ghana despite the law. [57] Any non-negligible amount of e-waste entering the country is a problem given that it is illegal and causes such harm, which again nobody denies. Denialist scholars such as Peter C. Little, Josh Lepawsky and Grace Akese, who are challenging parts of the Agbogbloshie narrative, make it clear that they merely wish to clear up misunderstandings due to a commitment to truth, and certainly seem otherwise to take the issues at Agbogbloshie very seriously. An excellent example is Little's article in *Toxic News* where he both vividly describes the hardships of Agbogbloshie workers and the horrific conditions of the place, and casts doubts on the techno-optimistic proposed solutions. (5)(6)(7)(8)(9) Yet in some passages it comes off as trying to minimise the problem and shun Western responsibility; such as Lepawsky's claim that e-waste originates from other developing countries or Little claiming that the "idea that it's monitors and Apple computers showing up [at Agbogbloshie] is a total distortion", despite my observations and documentations of the contrary. (10)(11) In light of the questionable data these conclusions are based on, these emerging alternative narratives deserve more critical scrutiny in non-flow related matters as well.

Secondly, the things that are functioning or can be repaired do not have particularly long life-spans and inevitably wind up at Agbogbloshie, or places like it, when they finally break down. The report Ghana *e-Waste Country Assessment* gives an optimistic lifespan of up to two-years, though that is a 2011 number, and electronics, especially ICT equipment, have become more difficult to repair since.[58] (12) Mike Anane believes that the lifespan in 2018 can be as short as a few months but averaging around half a year for ICT equipment in relatively good condition. The flows of second-hand electronics could hence be argued to be a problem even if none of it was technically e-waste, and as has been shown second-hand import is correlated with increased levels of domestic e-waste

[57] Broken down electronics that *can* be repaired are currently legal. BAN argues that this is yet another loophole; see *Repairing the "Repairables Loophole" in the e-Waste Technical Guideline,* Submission by the Basel Action Network (BAN) to COP12 Basel debate over the Technical Guideline on the Transboundary Movement of e-Waste.
[58] For an independent expert judgement on the matter, see for example iFixit's repairability scores, *www.ifixit.com/laptoprepairability*

generation. The effect it has on the people and the environment is the same, as is the original source. The fact that locals are skilled enough to breathe a few more months or years of life into these items does not absolve first-world countries of responsibility, and implying that it does amounts to almost punishing the locals for their skills in repairs by burdening them with the entire responsibility for the damage the electronics will eventually do. Mr Akuffo of Green Advocacy Ghana believed the commitment of the German government to finding a solution was due to them recognizing the role that German shipments of electronics to Ghana had played. (13) Initiatives and investments like those display a measure of understanding for the situation and a willingness to take responsibility, even if they do not tackle the underlying problems. Narratives that imply that responsibility for used first-world electronics falls to the Ghanaians alone for little more reason than that they touched it last are not only ethically questionable but have been shown to be based on incorrect assumptions. To Mike Anane, it is simple; the Basel Convention bans the import of e-waste making it against the law, and the law must be upheld in spirit as well as letter – barely functioning second-hand equipment must not be used as a loophole. Mr Anane believes that responsibility from the developed countries which are the source is lacking, and fears that that their commitment to finding a resolution is merely lip-service. (14)

Though researchers such as Little and Lepawsky have made contributions to the field and raised important questions, the aspect of their research that brings in a new narrative ought not to be unquestionably accepted merely because some flaws in the mainstream narrative have been revealed as well, especially given how that narrative can be misused to direct attention away from the underlying causes of the problem.

2. The ‘unequal exchange’ and ‘maker-spaces’ of Agbogbloshie: a Marxist response

An important, non-flow related, argument from the denialist school is Little’s idea that Agbogbloshie and places like it are not endpoints, but “places of revaluation and transformation… [t]hey’re really boundaries and edges”. In this, he has a genuine point in that revaluation and transformation does occur and plays a significant role, embodied for example in the creative *Agbogbloshie Makerspace Platform.* The AMP is a “participatory design project” that gathers together engineers and locals and holds various workshops and creates tools, stating that their agenda is “collective action: join hands to prototype tools and co-create a hybrid digital-physical

platform for recycling, making, sharing and trading". They take issue with the 'denigration' of Agbogbloshie "as a toxic e-waste dump", claiming that what they see is instead "an urban-scale open-air manufactory – an action-oriented maker ecosystem where materials and components reclaimed from end-of-life equipment feature as inputs for making new products." (15)

Yet, a dialectical standpoint allows the acknowledgement of Agbogbloshie as a place of renewal and creativity, *and* as an endpoint and a toxic e-waste dump. For Agbogbloshie and places like it are demonstrably endpoints of a kind; not for everything, and, of course in terms of physics, there are no real endpoints since neither matter nor energy can be destroyed – but we must remember that *form and functional organisation* of matter can end; after all, if not, we ourselves would never die. Form and function *do* stop and end at Agbogbloshie, as do the parts of the waste that are not recycled. The plastics and the chemicals created through the burning thereof and the heavy metals that are not recovered remain there. It remains in the soil and air and water, and wrecks the environment; it disperses into the flora and fauna, damaging both that life and those economically dependent on it; it poisons the people and remains inside them just like the diseases, injuries and scars they accumulate remain with them and on them. The people, too, remain. Stuck in poverty, stuck in a cycle they cannot break, unwittingly perpetuating it every time they try to help a friend or relative by bringing them to Agbogbloshie and teaching them to recycle e-waste.

One can certainly speak of 'creative revaluation', 'transformations', 'innovation' and 'creativity' in connection with Agbogbloshie. Emphasizing this perspective is important. When a man has nothing, and learns to work garbage out of necessity, when he builds out of garbage a hut to dwell in and even a place to worship, it is certainly fitting to call him 'creative' for this efforts and label them 'architectural innovation'. The attempts on the part of scholars such as Little and organisations like the AMP to recognize the inhabitants at Agbogbloshie as creative craftspeople and not just exploited and displaced workers is ostensibly well-intentioned. It is also very interesting, genuinely empowering and – crucially – very true since there is plenty of creativity to be found at Agbogbloshie, and many very talented people live there. They have shown themselves capable of feats of great skill and ingenuity despite a lack of formal education. But the analysis must not stop there, lest this innovative viewpoint ends up abstracting away and obscuring the real consequences and full lived experiences of the people there.

The reality is that they *are* exploited and displaced workers regardless of how creative they are in that work, and that is a crucial part of their living conditions. It is what shapes the expression of their ingenuity, the reason why their skill is applied to repairing discarded Western computers for

a pittance instead of being well-paid engineers. *Mater artium necessitas,* and we may certainly permit ourselves to be impressed by whatever *art* is conjured up, but not at the cost of neglecting to examine the *necessitas* that begot it. A claim to wish to reframe the Agbogbloshie case to focus away from victimhood has a point. Yet, in a sense, it is also an admission of cherry-picking data, of constructing a narrative by way of intentionally ignoring the things that do not fit into the story one wishes to present. It is certainly important to point out the creativity at Agbogbloshie; a fifteen-year-old boy who manages to repair a computer, deemed broken in the West, with no formal education deserves some recognition. A man that manages to learn the skill needed to build functional grills from pieces of e-waste, and make a living selling them, ought to be commended for his abilities. A community filled with such people and with such creativity and intelligence deserves to have that acknowledged and have that be a part of their story. In this much of the standard importist narrative fails, especially on the part of the media, painting the denizens of Agbogbloshie almost universally as victims only. But both creativity and victimhood are only *parts* of the story; neither represents the whole. A proper scientific investigation must not ignore the victimhood and the suffering which are the foundation of the creativity; which necessitate it and dictate its expression.

The political implications of how scientific research is done, specifically *what* aspect of a phenomenon is studied and *how* it is framed, were discussed in the second chapter, and one point especially is worth reiterating: the politically obfuscating effects of certain ways of framing research that hide an unexamined ideology. The claim that Agbogbloshie ought to be reframed as a ‘makerspace’, and that the creativity of its inhabitants should be focused on rather than their victimhood, is an implicit denial of the other factors that shape their lives; an obfuscation of the social injustice and political decisions that have caused their situation. Research done in such a vein could, even unintentionally, provide implicit support to the existing social order by not holding it responsible for the reality we observe, and might fall prey to the mistake of ignoring how the right kind of social change could alter the conditions at Agbogbloshie for the better. Hence this case illustrates practically the kind of conflict and tension between idealist and materialist conceptions of reality, and approaches to science, that was discussed in Chapter 2.

2.1. A historical materialist perspective on violence

My contribution to ‘postcolonial discard studies’ is to do a ‘creative revaluation’ of the ‘electronic necropolitics’ of the Agbogbloshie ‘makerspace’ and the ‘pyropolitics’ thereof, and I will attempt

this through a Marxist approach that grounds it in the lived reality of Agbogbloshie's people. (16) Little's words, that I redeploy here, much like the use of terms like 'increase in entropy' used in ecological economics, risk diminishing what happens to human beings in places like Agbogbloshie. Even though creativity does flourish, and entropy does increase, the work at Agbogbloshie represents more than an 'increase in entropy' or an expression of creativity but is something that harms workers. The same holds for related concepts in ecological economics, such as 'unequal ecological exchange'. It can certainly be said about all the terms used to paint Agbogbloshie in fairer colours without fundamentally changing what occurs there. While such terms represent important, but partial, truths, one could also describe the Agbogbloshie case as simply violence being done to people in order to profit – no different than old fashioned rifle-and-bayonet colonialism, just that the lead finds a different way into the victim's body. Marx called this the "antagonistic and murderous" side of domestic industries; motivated by the "cheapness of the human sweat and the human blood" which are "converted into commodities". (17)

'Unequal exchange' certainly describes a phenomenon that is, essentially, one of violence or at least involves violence, but my concern is that the language might diminish the damage done and perhaps even paint it as an unfair (unequal) form of trade, which invokes the idea that it can be rectified, made just through regulation or the proper instance taking responsibility (such as the corporations producing commodities being responsible for their recycling). It is a fairer paraphrasing in a way; it does not actively hide the violence but neither does it make it central to the analysis. The violence risks remaining in the background, implied but never directly confronted. In contrast, Marx is not sparing with the language he uses when describing similar conditions in the English industries of his time: *miserable* wages, *abuse* of labour, *robbery* of living and working conditions, *brutality* of overwork, the industries as *dens of misery*, the *horrors* of domestic industry and the factory system, the *ruin* of the family of the worker. (18) These words are no less applicable to Agbogbloshie, and as the following chapter will show there are a great deal of similarities between what Marx observed and what occurs in the informal recycling industry.

Though the issue is not the terms or language itself, but the lack of direct confrontation with the underlying violence. My critique here must not be taken as one of the theory *as such*; instead I wish to ensure that the violence is not consigned to the background in it. That the theory is an exploration and explanation of the violence, a way of understanding it better, and never forgets the violence that occurs. Used in such a way, the theoretical tools supplied by ecological economics and by the importist school alike are powerful tools, and I will employ them in the following

chapters to both deepen the understanding of the Agbogbloshie phenomenon and connect it to the world-system.

Yet there is a reason that I chose begin the analysis here, in Agbogbloshie. The analysis must unfold from the observed and occurring phenomena on the ground, from the lived experience of the workers and habitants of Agbogbloshie and the conditions they face in their daily lives. As we progress in levels of abstraction from the lived reality of the people of Agbogbloshie towards the close of the system, we must continually ask ourselves: at what point are the e-waste dump-sites just cases of violence, and not an unfair trade/exchange – not just 'export of environmental damage', but of imperialism? Entropic increase is after all unavoidable when one recycles, but it is somewhat misleading to call it any kind of 'export' or exchange when a lot of the entropy, both quantitatively and in terms of its qualitative properties, would be entirely avoided if the recycling is done in proper, modern facilities. Damage to environment, society and health is not merely geographically displaced but *created*, since it would not have occurred at all if recycling was not shifted to Ghana because it made economic sense – is this not violence done to a 'colony' in order to profit?

Consider also, from a historical materialist viewpoint, the previously discussed claim that cars are replacing ICT waste at Agbogbloshie. Even ignoring my explanation of why this is possibly inaccurate, it is at best a technically correct but practically useless distinction. What matters, in the historical materialist perspective, is the actual *effect*, which is established and observable, and the *source* and *cause* thereof, which are both established, especially given that newer cars are more and more computerized. What I mean by the 'actual effect' is the sum total of effects that the import of used cars has on the environment, health and well-being of the people at Agbogbloshie given the current conditions there, and the means by which recycling is done. Practically speaking, those effects are much the same as those of e-waste because the material components of the cars that are being recycled are very similar, and the methods of recycling almost identical. In other words, it matters not whether a cable comes from a car or a computer; it is still the same plastic that will be burned to get to the same copper and will release the same toxins when burned. The current legal definition distinguishes the two – but a definition based on the material properties, the tasks involved in recycling, the specific kind of labour required, the chemical reactions created upon burning, and the impact of the toxins released on human health and local environment and so on, would put this distinction into question. By such a definition, used cars and e-waste are practically indistinguishable, especially given that 'e-waste' is already a very broad term that encompasses

many different products with different properties, the common theme being that they are electrical and contain hazardous materials – which of course applies for cars as well.

Lastly, one could argue that a computer is no less a computer when its parts are embedded in a car and not a laptop or desktop casing. The idea of what constitutes a 'computer' must be expanded in an increasingly digitalized world; which in turn necessities the same expansion for e-waste, to one based on the *actual effects* and not legal distinctions. Looking only superficially at data and claiming that cars have displaced e-waste risks missing the effects, and causes thereof, actually taking place in Agbogbloshie, and by way of a possibly technically correct assessment fail to see the proverbial forest for the trees.

In conclusion, this chapter has shown the shift and perspective and understanding that is possible when the e-waste phenomenon is examined from a dialectical and materialist perspective; both the understanding of that e-waste is and its role is better understood when it is connected to other phenomena such as second-hand electronics and cars. Additionally, we can better understand its role in the complex socio-economic context, how it is simultaneously a resource and a form of waste, much like the people of Agbogbloshie are at once creative innovators and exploited workers. Continuing in this manner, the next chapter will analyse the development and history of Agbogbloshie from a historical materialist perspective.

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Chapter 12

A Historical Materialist Account of Agbogbloshie

This chapter will apply Marx's analysis to Agbogbloshie, beginning with the establishment of the site and continuing with a closer look at the labour relations present, and ending with a class analysis approach to the development of informal e-waste scrap-sites. I will here rely chiefly on Marx's own analysis in Volume 1 of Capital; not because other Marxist approaches are non-existent, but because it bears to be underlined how relevant this over 150 years old analysis is to e-waste and how well it explains Agbogbloshie.

1. A Marxist view on the establishment of Agbogbloshie

Marx traces the creation of new cities during the Industrial Revolution to the multifaceted rift between town and country under capitalism, and the antagonism between the two, which includes the ecological rift that scholars like John Bellamy Foster have expanded into a much broader analytical tool and that has been invoked elsewhere in this thesis. (1) But in examining Agbogbloshie's roots, let us return to Marx's original concept, which relied also on the division of labour between town and country, leading in time to differing ways of organizing labour. Marx posited that the established relations of productions within the towns, most importantly the guild system, became a hurdle for the development of industrial capital through the restrictions and regulations they enforced. Capitalists seeking to escape the restrictions of the urban guilds looked to the countryside, where they found not only spaces that offered the freedom their industries required, but also labour in the form of peasants and natural amenities in the form of water. Weaving was an important industry at the time, the skills required for it were also present in the countryside. (2)(3)(4)(5) In this vein Moore, though in the context of agriculture, also discusses why the metabolic rift widens: "[t]he ceaseless accumulation of capital requires the ceaseless expansion of the proletariat", and new wage-workers are sought out since the cost of labour in the 'old' sites has grown since the bargaining power of workers has increased – itself a consequence of there being no alternatives to wage-labour, and people thus becoming more dependent on it. (6)

Marx's theory is complex, rooting the above trends in the rise of the merchant capitalists and the trade between towns and its effect on industrial development. He analyses also the obligations and social order of feudalism and the ways in which the new sites, free of these fetters, became an antithesis to the established towns and represented a completely new social order that came into conflict with the old one. (7) Yet for our purposes, we need only draw out five major themes in order to examine Agbogbloshie, which I believe is a modern counterpart to the establishment of industrial cities in the early history of capitalism, given that its roots lay in a period of increased industrialisation of Ghana and the expansion of Accra. What the establishment of a new industry in the countryside outside any existing city offers the capitalist is: 1. freedom from regulations, 2. readily available labour that possesses 3. the necessary skills, 4. a readily available organisation structure, and 5. free access to the eco-services the industry needs. However, it also offers a hurdle of its own, since the established, traditional hierarchies present at Agbogbloshie mean that the site is not wholly free of the fetters of pre-capitalist obligations and social order. These, much like the guilds, may themselves become hurdles to the development of industrial capital.

Although the currently existing environmental regulations in Accra area have been shown to be rather lax and not currently enforced, at least when it comes to e-waste, environmental regulations and laws did still exist and are cited by Mike Anane as a major reason that the Agbogbloshie area became a dumping ground for various rubbish even before e-waste. Being located in, what was at the time, undeveloped Ghanaian countryside made it isolated from any kind of oversight. Combined with a lack of knowledge among the local population on the importance of wetland biodiversity and wetland sensitivity to environmental harm, the Agbogbloshie area was an ideal site for dumping waste. Once it was established as such, the e-waste flowed there naturally since it was the closest waste dumping site to the Tema port, where most of the waste arrived. (8) The people living there in the very beginning may not have offered much in the way of a source of labour, self-sustainable and relatively few in numbers as they were at the time, but this changed once the ghetto had come into being later on, especially with the influx of refugees in 1990s and the widespread unemployment and poverty that followed. Initially, the government believed that the refugees could be re-located back to the Northern Region but that fell through, and the people suddenly became a cheap and reliable source of labour for recycling the e-waste that had begun to flow in. (9)

It is difficult to determine whether or not the skills needed were partially present at the time, or developed from scratch, out of necessity. The people living in Agbogbloshie when the e-waste first began to arrive were hardly expert computer repairers already, but the general skills involved in

repairing, re-using and refurbishing was likely present – and thus also the drive and capacity to apply them to electronic waste. Using second-hand goods of all kinds is common throughout Ghana and the wider West African region, with second-hand markets of all kinds common throughout Accra. So is repairing and re-using to the best of one's ability; Mike Anane called it simply a part of the culture of impoverished people in Africa and an approach they had to adapt out of necessity. (10)(11) Gaetano Speranza argues that it is part of tradition all across Africa, and scholars like Lisa Parks and Steven Jackson have shown how this way of thinking adapts to the newly available ICT technology. (12)(13)(14)

On the other hand, one could argue that the *lack* of certain skills was important for the development that occurred. Both the people traditionally living in the area, and the refugees from the north, mostly lacked formal education and the skills needed to find employment in a metropolitan area. The refugees did not speak English or even the local tribal languages of the Accra region, a situation that remains relatively unchanged even today. Hence, they had, just like today, little option in how to support themselves – e-waste work was what put food on the, sadly often merely figurative, table.

Additionally, I would argue that the Agbogbloshie area offered a particular eco-service as well: that of a natural waste-sink. The importance of that eco-service is stressed in ecological economics, given that it conceptualises the economy as a sub-system of the global ecosystem on which it relies. (15)(16)(17)(18)(19)(20)(21) Everything extracted from the Earth must hence sooner or later come back to it in some form, with recycling only delaying that inevitable outcome somewhat, making the natural world's function as a sink for waste an indispensable one. (22)(23)(24)

As has been covered, ecological economics, and its chief proponent Daily in particular, argues that our planet's capacity to function as a waste sink is finite and that the filling of global waste sinks is a more pressing problem that the depletion of resources, where Agbogbloshie serves as a pressing example of an overused waste sink.

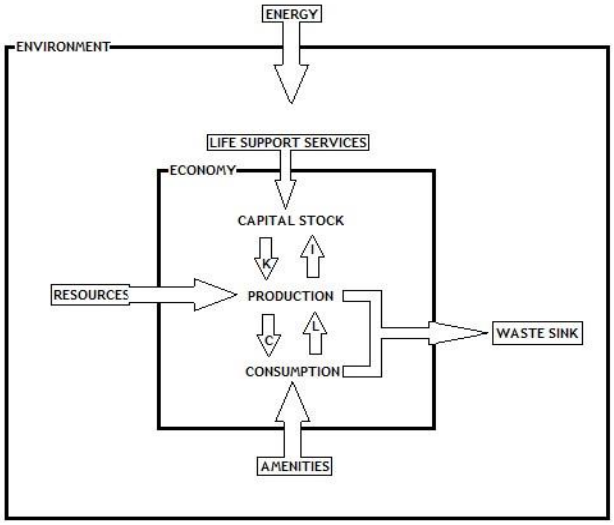

Figure 12.1. *Basic schematic of the way ecological economics conceptualises the economy. By the author, based on Common et. al. 2005. K=capital , I=investment , C=commodity consumption , L= Labour-power*

1.1. The traditional structure at Agbogbloshie

Lastly, somewhat unlike in the cases Marx covered, the pre-capitalist tribal order prevalent at Agbogbloshie did not, in my view, come into a direct conflict with this new emerging industry. Rather, I believe, the tribal order entered into a symbiotic relationship with the emerging industry and provided the institutions, structures and organizations necessary – representing what organisational theory would call a set of skills embedded in the organisational structure. (25) However, this symbiosis required the inevitable change of the old order into something different, a change which of course began in the early history of colonialism and continued as the capitalist mode of production spread in Ghana. Marx's argument, deployed for European feudalism, can be redeployed here as well, if is adapted to the Ghanaian context.

The dissolution of what Marx believed was an original unity between humanity and nature reaches its peak in the commodification of land, an act that tears up feudal bonds and cements capitalist relations in their stead, giving rise to the alienated form of labour. Labour, that is, where the direct producer is separated both from the product of their work and the process of production itself, being instead coerced to produce in accordance to the law of value. What one might call the 'higher' forms of estrangement, namely, from one's species-essence – *Gattungswesen* – and from other workers follows, Marx argued, from this initial separation in the daily toil of the labourer in their day-to-day life.

As Marx put it, the “domination of the land as an alien power over men is already inherent in feudal landed property” since the serf is tied to the land, an “adjunct” of it, while the lord is in practice more inherited *by* the land than he inherits it and is hence just as tied to it, though in a different manner. Yet, “there still exists the semblance of a more intimate connection between the proprietor and the land than that of mere material wealth.” Though Marx has little patience for romantic notions of feudalism or any idealized conception of *noblesse oblige*, he nonetheless recognizes the undeniable connection that transcends money between the lord and his land; it is his “inorganic body”. (26)

Even though this connection is based on the power to appropriate labour and products, and hence on an early form of privatization that ultimately leads to alienation under capitalism, it is still differentiated from capitalist private property through the obligations placed on the lord. Or rather, I would argue, it is placed on the lord’s *lineage*, his bloodline, which becomes even more important in the context of Ghana. It is not an individualized ownership as under capitalism, but a caretaking role – even duty – that belongs to the family; after all, the land inherits the lord as much as the lord inherits the land.

In West African cultures, including the Akan and Ga people who live in Ghana, there exists a concept of ancestral spirits that watch over the world, but also one of 'reincarnation' which differs from modern (mis)conceptions surrounding this idea. Similar spirit-centred beliefs once existed among the predominantly Muslim Hausa people who make up a large part of the Agbogbloshie population after the refugee migration, and though no longer explicit or literally held, the beliefs nonetheless remain an important aspect of their culture and tradition. (27)(28) In these views, rather than a soul literally coming back from the dead to inhabit a new body, characteristics of forebears are sometimes imbued into their descendants; an essence of a person is thus carried onward through the bloodline indefinitely. The process is not a morally determined one, that is, a reward for just behaviour in a 'previous life' or an opportunity to make amends, but a more precarious and selective one that nonetheless implies a carrying forth of obligations. In a world where the forebears both continually witness one’s deeds and, partly, live through one, obligations to land and community can be argued to be strengthened, as authority is placed more on the lineage than the individual. In fact, Ghanaian philosophers Kwasi Wiredu and Kwame Gyekye argue that in this world-view “one is required to make concrete material contributions to the well-being of one's lineage” and to aid one's community in order to even achieve *personhood*; that is, in order to become an individual fully, one must aid the community. (29)(30)(31)(32) This connection with the past and community is exemplified in the tradition of keeping and housing the royal stools, symbols of the power of

Akan chiefs, in so-called ‘stool-houses’ after the chiefs die. There they become part of various rituals connected to the soil and land, analogous to rites the chief was obliged to intermittently preform in life, as well as symbols of the royal lineage. (33)

The result in any case is a more long-term, caretaking perspective towards the land, despite the existence of surplus-extraction and a degree of limits on personal and political freedom for the underclass. I argue that this takes a particular form in traditional West African society, where the nobility’s bonds are more communal and the people enjoy conditions of greater individual freedom than European serfs.[59] For Marx, even the appropriation of labour and product is direct and based on a personal connection between labourer and lord in a traditional society; they are bonded to him “by ties of respect, allegiance, and duty” that are themselves rooted in and legitimized via tradition and custom. In West Africa, *ritual* is also a cornerstone of these ties. The serfs, or their Ghanaian equivalent, are therefore themselves connected to the land via the lord/chief and via participation in traditional rites, and it is *their* ‘inorganic body’ as well – producers are unified with the land, and thus not estranged from the process and product of their labour.

The lord/chief, for his part, “does not try to extract the utmost advantage from his land”, for such “is *nobility’s* relationship to landed property, which casts a romantic glory on its lords.” Marx, of course, does not believe this to be an expression of a noble personal character, but a result of particular material conditions that evaporates as soon as conditions change. With the arrival of capitalism, the bond is broken; “the marriage of convenience” then takes “the place of the marriage of honour with the land” while the land itself will “sink to the status of a commercial value”.

The bonds of the chieftainships in Ghana began to erode with the arrival of colonialism and capitalism, long before the arrival of e-waste, but they nonetheless persisted in some form especially in the rural areas. The transformation of traditional society in these areas that occurs with the arrival of e-waste is a microcosm of the grander process taking place in Ghana over the centuries, and a mirror to the European case. Though certainly with its own particular variations, the overall evolution of the bond between land and lord is fairly similar; honour is replaced with

[59] The kingdoms of West Africa had systems of clientele analogous, but not identical to, European serfdom, with disagreements within academia over whether they are a form of feudalism or an independent but somewhat reminiscent system (see for instance: Goody J, 1963, *Feudalism in Africa?*, Journal of African History). As Howard Zinn argues in his *A People’s History of the United State*s (2017, Harper Perennial), and Chris Harman similarly in his *A People's History of the World* (2008, Verso), the West African forms of feudalism were generally milder in character and allowed for more personal freedom. Relying on the works of Basil Davidson and Pius Onyemechi Adiele, they go so far as to argue that European serfs – at least in terms of personal freedom – had more in common with African slaves.

convenience and long-term obligation with short-term profit maximisation, as the land becomes a means to accumulate wealth.

Marx's argument is that the ties are transformed and eventually broken because capitalism demands it; the full development of the productive capacity of capitalism is not compatible with even the *appearance* of honour and duty that transcends the material. Yet this outcome is not a necessary one, but merely what Marx's observed in his case-study of European feudalism. It is difficult to determine the exact reason for the apparent survival of traditional hierarchies in Ghana, albeit in altered form. It may be due to capitalism not yet having fully developed in all of Ghana, or due to the complexities of colonial and post-colonial society and the roles that the traditional enclaves played there. In the case of the informal business of e-waste specifically, the organizational structure it provided were beneficial, while the ties of obligation had been sufficiently eroded or altered as to not be a hurdle. The chiefs at Agbogbloshie express their concern for land and people through managing and maintaining the informal recycling industry, with little worry in practice for environmental or health-related issues. (34)(35)

In some ways, the subsuming of traditional structures to capitalist ends, was a way for those structure to maintain relevance; to survive into the modern, capitalist world by adapting to it – altered in a significant way but nonetheless still present. Full-scale modernisation to a *full industry* implies also the adaptation of fitting capitalist structures, threatening the traditional ones with their final extinction. The conflict present at Agbogbloshie, and the resistance to change, is therefore over both livelihoods and *way of life*; two different power-structures are on a potential collision course. There is a clear contradiction in how traditional structures enabled the establishment of the recycling industry, and were a valued resource in the same, while also standing as a hurdle to a full industry. Unlike the case of the first subsumption of the traditional system to capitalism, capitalism does not necessarily demand the further development of Agbogbloshie, as it serves as pivotal role in the world-system as is. One cannot therefore not conclude that further development is inevitable; merely that there exists a pressure towards further development which is countered by other factors.[60]

Lastly, while it was land's value in growing crops that mattered in most historical cases, in the e-waste case it is the aforementioned function as waste-sink which came to be the most valuable

[60] As mentioned in previous chapters, exploring this issue goes beyond the limits of a MFA model, and requires a proper ethnographic study of Agbogbloshie society.

‘resource’ of the land. Why did this come to be in the first place? For people facing poverty and a daily struggle for their livelihood, environmental matters are not pressing, especially when consequence are far removed in time and few other options exist. Nobody living in the Agbogbloshie area when waste was first dumped there could have predicted the situation today, and even now the exact consequences are unknown and contested even by experts. Those living there today are well aware of at least some of the problems and hope for change, but they are limited by the conditions of existence which they face. They must carry on working to make a living; their concerns are immediate and short-term not only due to an inability to fully grasp long-term consequences, but due to a structural inability to act otherwise.

1.2. Why Agbogbloshie?

In the light of what has been covered, the origins of Agbogbloshie are actually rather simple; in the early case we have a vast, pristine wetland with a low population and no environmental regulations that collide with nearby urban expansion and the combination of a growing amount of rubbish and a lack of capacity to properly handle it. This leads to the establishment of Agbogbloshie as a general waste dump. Later on, when e-waste starts flowing in, we have an already established dumping ground with an organisational structure already in place, in the vicinity of a major port, and an influx of refugees that lack a means of subsistence along with a continued lack of regulations and oversight, colliding with a growing influx of potentially valuable e-waste from both the nearby port and the city of Accra, and no official capacity to handle it properly. With all those factors coming together, it would have been surprising if the waste had *not* gone to Agbogbloshie.

Agbogbloshie did not develop into a major industrial city like the Manchester that Marx and Engels lived in and analysed. Yet it did grow into a small town where almost 50,000 people live and work, and the national centre of a peculiar kind of industry; even an important global hub of that industry. An industry that has continued to spread across Ghana and employs around 30,000 people today in Accra alone. By using Marx’s perspective and understanding, both the material needs of the people and the antagonisms involved we can better understand what propelled a small wetland-cum-ghetto into the spot which has garnered it so much attention today: a combination of many factors and happenstances that came together in just the right way to make the conditions favourable for the observed development. E-waste is a global stream, and the cheap and primitive recycling thereof is a geographically shifting industry that will seek out spaces that have conditions favourable to its establishment and flourishing, such as low costs and a lack of regulations. It will remain as long as

those condition remain, and should they disappear, it will seek better conditions elsewhere. With the anticipated shifting conditions in Agbogbloshie's future, the conditional existence of the e-waste recycling industry must be born in mind. For with the successful establishment of a state-of-the-art recycling facility, the implementation of strict environmental laws and the creation of alternative jobs for the e-waste workers, the conditions that gave rise to the Agbogbloshie situation would all be more or less gone – and the question arises as to where the e-waste stream will shift next, and if counteracting tendencies will prevent this development.

2. The Agbogbloshie 'working class'?

It is interesting to note the degree to which the specifics of class formation at Agbogbloshie confirm the model Marx created for 19th century England, specifically the concepts of 'modern manufactory' and 'domestic industry'. For while one can generally confirm that the workers at Agbogbloshie are working class in the sense that they possess nothing but their labour to sell, a more careful look into their particular situation reveals much about the way the work is organised.

To begin with, the form that labour takes at Agbogbloshie is that of piece-work: workers are not paid a traditional wage based on labour hours but are paid based on how much they recycle. This arrangement impacts both the nature of the work and its organisation. Marx argued that "[w]ages by the piece are nothing else than converted form of wages by time", often in fact existing side-by-side with time-work in many industries and hence really "only a modified form of time-wage". (36) Yet, Marx notes, among the "characteristic peculiarities" of piece-work is that it is more exploitative and allows the capitalist greater control over the work, forcing the worker to work harder and maintain a higher standard of work, without the necessity of direct oversight. Because "the quality and intensity of the work are here controlled by the form of wage itself, superintendence of labour becomes in great part superfluous." Therefore, this kind of work is the foundation of what Marx dubs 'domestic labour', that is, work traditionally done out of private homes, commonly in the country-side or otherwise removed from the factories, in which "capital conducts its exploitation in the background of modern mechanical industry". (37)

The domestic labour Marx analysed was chiefly lace-making and straw-plaiting in England, but the concept is clearly analogous to the work taking place in Agbogbloshie; it is separated from the factories and carried on largely independently, with the discipline from the wage-form negating the need for direct oversight. Likewise, there exists a "personal interest" on the part of the worker "to

lengthen the working day, since with it his daily or weekly wages rise", and indeed the working hours at Agbogbloshie were long, and work often continued long into the night. Another similarity is the middle-men observed at Agbogbloshie – for Marx argued:

> "Piece wages… form the basis of the modern 'domestic labour'... as well as for a hierarchically organized system of exploitation and oppression. The latter has two fundamental forms. On the one hand, piece wages make it easier for parasites to interpose themselves between the capitalist and the wage-labourer, thus giving rise to the 'sub-letting of labour'. The profits of these middlemen come entirely from the difference between the price of labour which the capitalist pays, and the part of that price which they actually allow the worker to receive... On the other hand, piece-wages allow the capitalist to make a contract for so much per piece with the most important worker – in manufactures, with the chief of some group, in mines with the extractor of the coal, in the factory with the actual machine-worker – at a price for which this man himself undertakes the enlisting and payment of his assistants. Here the exploitation of the worker by capital takes place through the medium of the exploitation of one worker labourer by another." (38)

These so-called *parasites* and *head labourers*, as Marx dubbed them, are clearly seen in Agbogbloshie in the form of the higher-ups who buy and transport the extracted metals.[61] Neither bosses nor managers in the traditional sense, they do not oversee the work directly, but mediate the disciplinary function of the law of value through the wages they pay. Lacking the wealth and power of those highest in the hierarchy they are not capitalist, but a middle-class of privileged workers who are still exploited by, and dependent on, capital, but able to command a higher piece of the total profit for themselves. Of course, being part of the traditional structure in place, these men more than just managers or head-workers but I focus on the position they occupy in the social dimension through which the materials flow.

Furthermore, the piece-wages of the common Agbogbloshie labourer are kept low by the low "cost of production of labour-power", namely, "the cost required for the maintenance of the labourer as a labourer, and for his education and training as a labourer", which Marx argued determined ultimately the price of labour-power. (39) This has several reasons. As we have seen, the workers

[61] Note that 'head worker' is used in some translations, and 'most important worker' in others; the original German however is *Hauptarbeiter*, which literally means 'head worker', contrasted with *Hilfsarbeiter,* i.e. 'assistant worker'. I believe that the original German distinction better underlines both the power disparity and difference in roles than the 'most important worker' designation of some English translations.

in general endure a poor living standard, often living in shacks on or near the scrapyard grounds with very little in the way of amenities. What training they have is given to them by other e-waste workers and acquired whilst working, and their tools and equipment are simple and relatively cheap. This already keeps the cost of their labour-power low. In addition, many are seasonal workers who either supplement their e-waste income with farm-work, or use the e-waste work to supplement their agricultural work. As Marx argued, the supplementation of wages by way of other forms of income drives down the wage floor as the capitalist is simply able to get away with paying less without compromising the labourer's ability to actually work. (40)

The general living and working conditions of the Agbogbloshie workers also conform to those Marx observed; exploitation, he argues, is "carried out in a more shameless manner", largely because "the substitution of machines for muscular power... is almost entirely absent", that is. the work is almost exclusively manual. Marx believes that the absence of mechanisation forces particularly harsh exploitation in order to make the manual labour competitive, one so harsh in fact that it comes to care little for the very lives of the workers; "... the less the social productivity of labour and the technical basis for the combination of labour processes are developed in that branch, the more does the *murderous* side of this economy emerge [emphasis added]." The workers, in Marx's case predominantly women and children, are also "subjected quite unscrupulously to the influence of poisonous substances". Isolation from the general population of workers, combined with the aforementioned lingering influence of the traditional hierarchies, may additionally undermine the ability of Agbogbloshie workers to demand higher wages. After all, as Marx argued, "workers' power of resistance declines with their dispersal; because a whole series of plundering parasites insinuate themselves between the actual employer and the worker he employs". Additionally, Marx, quoting the *Children's Employment Commission*, mentions "small cottages" and "small pantry-like rooms" as the living and dwelling conditions for the industries he describes, where the "foulness of the air produced… are sometimes extreme".[62] Not to mention the "injurious effect of the drains, privies, decomposing substances, and other filth". (41) The description is quite fitting for Agbogbloshie, and what we have seen in terms of inadequate housing, exposure to hazardous waste, the predominately manual labour, and even the heaps of refuse and other filth near the dwellings.

Marx argued furthermore that the constant competition with the factory system necessitates a lowering of wages in order to make the domestic industry competitive. I would add that in the e-

[62] Marx cites: Second Report, 1864, pp. xxix-xxx

waste case, the domestic industries compete both against the factory system, represented by ‘proper’ recycling in modern facilities, and with other similar recycling industries abroad. As has been argued, the e-waste stream is not permanently bound to any particular place, and will shift with conditions, necessitating competitive wages to keep those conditions favourable to attract flows for informal recycling on which the local economy has become dependent.

Another similarity between Agbogbloshie and the situation in England that Marx described, is that children and young adults are employed in these kinds of domestic industries. The reason being that the immediate need to supplement the income of their families takes precedent over long-term needs that could be facilitated by education, which is made possible by a lack of laws regulating school attendance (or a lack of enforcement thereof); as noted before, truancy is a serious problem at Agbogbloshie. Children and young adults, being thus ‘free’ from both ordinary wage-labour and other obligations, are available as a cheap source of labour for the domestic industry.

Women, however, are not directly involved in the work at Agbogbloshie but serve supporting functions in providing food and beverage for the workers. This differs from the domestic industries Marx analysed, where women were dominant and men scarce. The cause for the difference is to be found in differing conditions: in the England Marx analysed, women served the function of a kind of auxiliary army of labour, able to supplement the demand for certain products via domestic industry, whilst the men were largely employed in the factories. Women's high degree of exclusion from factory work 'freed' them up for the domestic industry, much as lack of proper education freed up the children. Additionally, domestic production could be kept cheap as wages need not match those of labouring men, seeing as they were most commonly supplementary to the wages the men brought in, and therefore did not need to comply with the ‘natural minimum wage’ that Marx argued in favour of, that is, the cost of the worker to sustain themselves. It was therefore not a gender issue *as such*, but the particular consequences that the prevailing family structures and gender division of labour had on the material conditions that gave rise to the overrepresentation of women in the domestic industry.

At Agbogbloshie, we find that the same approximate conditions that applied for women in 19th century England apply to the e-waste workers, who thus fill a role similar to that of women in England. First, they are for the most part, for various reasons including lack of education and language barriers, not part of the main work-force in the Accra region and hence 'free' and available for e-waste work. Second, as noted, their work can be paid below normal wages, making them into

an auxiliary army of labour able to provide capital with a needed service though a cheap and informal system.

The Agbogbloshie working class clearly distinguishes itself from the traditional proletariat, rooted in straightforward factory production, but a more nuanced reading of Marx illustrates just how much their experiences map to the working class of the England of early industrialisation, and points to an underlying universal nature of capitalist expansion, veiled at times behind the specific conditions and particularities of distinct regions and periods of time. However, I would argue that two things truly distinguish the Agbogbloshie working class from the classical proletariat.

Firstly, their work is uniquely positioned at several points along the manufacturing chain, 'betwixt and between' extraction, recycling and production. They are part of a line of employment which, in the global abstract, possesses a relatively cemented and secure position, as the need for the combined recycling-extracting work is likely only to increase as production of EEE keeps growing whilst the traditional sources of the necessary mineral components become more and more exhausted. Yet concretely, meaning in the case of specific groups of workers at specific sites, they instead occupy a precarious, conditional and temporary position in a shifting global stream, dependent on a very particular set of conditions coinciding.

Secondly, consider their position in relation to other classes. Not only are they not directly confronted by capital and are partly bound up with the peasantry, as discussed above, but they are also uniquely connected to the local merchant class. For, apart from the workers at Agbogbloshie, there exists also a kind of impoverished *petite bourgeoisie* that supports itself through the refurbishing of EEE goods or the manufacture of household goods from e-waste materials. They mostly own their meagre means of production and are *de facto* small-scale merchants, yet they are conceptually, ideologically and materially separated from the *haute bourgeoisie* and instead bound up with the working class with whom they not only share living and working spaces but depend on for materials. In the case of refurbishers the symbiosis, and overlap, between them and recyclers is particularly close, both depending on and supporting the other in a line of work where the divisions necessarily blur.[63]

[63] It would also be possible to draw parallels between Marx's argument about moral degeneration in the domestic and modern manufacturing industries with the conditions described in the Old Fadama slum, where drug use, crime and prostitution are widespread. I will, however, refrain from making a moralistic argument here, and merely point out that there exists a possibility to draw parallels here as well.

2.1. Health, livelihood and the fishing industry

A specific example may best illustrate both the connection between the body of the worker and his surrounding environment, and the inherent class struggle of e-waste work: that of the former fisheries. Though concerns about local livelihoods are often cited as a reason for a cautious approach to e-waste reduction, it can in fact be established that e-waste has actually destroyed Ghanaian livelihoods, though it is not possible given the existing data to determine whether it has destroyed more than it has created. What can be established is that the e-waste industry has eliminated the fishing that took place in the lagoon before the e-waste business, and is also adversely affecting the fishing along the coast that still occurs in places like the Chorkor area of Accra, since the waste flows downstream to the nearby sea. The Odaw river, which flows through Agbogbloshie, was also an important fishing ground for the surrounding communities, but since the recycling activities started, the flora and fauna has vanished. (42)(43)(44)

Mr Mike Anane even commented, somewhat tongue-in-cheek, that fishermen working in the area are as likely to catch old computers as they are fish. The coastal fishing industry is an important activity both in terms of income generation through sales, and by providing the people with fish for direct consumption. The negative impacts include “smaller, sicker, and sparser fish stocks” as well as indirect impact on human health via fish and seafood consumption and is something that has been observed since 2002. (45)(46)(47)

Not only have the yields decreased but selling is also more difficult due to the fish caught there being deemed unhealthy by potential buyers, according to local fisherfolk. (48) Though the effect is certainly to blame on other forms of waste too, having accumulated in the area since the establishment of the Old Fadama slum many years before the e-waste problem, the cumulative effect on commercial fishing has been devastating, and the role of e-waste cannot be ignored. PCDD/Fs, PBDEs and heavy metals are contaminants that come from e-waste specifically and have been found in great concentrations in the sediments of the water. This poses a hazard when the pollutants are released into the water, with one study warning of the potential for “deleterious effects on the behavior, physiology, metabolism, reproduction, development and growth of many aquatic organisms”. (49)(50)(51) The ingestion of aquatic fauna so polluted poses clear dangers for the people dependent on fishing.

Furthermore, an official report by the Ghanaian Ministry of Lands and Forestry also confirms the livelihood importance to locals of wetlands such as the old Korle Lagoon: "[w]etlands… have been traditionally used by the local populations as a source of the basic necessities of life, ranging from building materials, hunting and fishing areas, as well as sources of water", adding that farming, livestock grazing and procuring of timber and fuel-wood are other key uses of healthy wetlands. (52)

Fisherfolk in the nearby Densu Delta. (Source: twoyearsinaccra.blogspot)

The economic value and livelihood impact of healthy wetlands and wetland biodiversity is well established within ecological and conservation literature, and ought not be ignored in favour of a narrative that pushes the very reason for the wetlands decline, e-waste, as a source of livelihood so crucial that it must not be interfered with too harshly. (53) This only serves to worsen the problem down the line, and risks becoming too convenient an excuse for non-interference or merely sparse interference. When even the EPA openly admits that the new 2016 law is not enforced due to worries about livelihood impact, questioning what 'livelihood' means becomes important. It is certainly true that immediate and stringent enforcement of e-waste laws with no viable alternatives will force thousands into unemployment and poverty, and the EPA's concern about this should not be interpreted as something negative. Yet that does not detract from the need for provisions of alternatives that enable enforcement, rather than a prolonging of a status-quo that is unsustainable in the long term. 'Livelihood' ought not to be used as a reason to perpetuate the existence of an industry that might eventually kill people, and which has demonstrably already destroyed previously well-established livelihood sources. Livelihood sources which, it bears emphasising, were more sustainable and environmentally sound as well as better for the health of workers and residents.

Additionally, the case exemplifies the wide-reaching impact of the conflicts present at Agbogbloshie, and illustrates how the surrounding natural world, through a metabolic process, is quite literally part of the organic body of the worker. When entire fisher-folk communities are threatened, both by the destruction of their livelihood and health hazards, we can witness the impact

of the figurative ‘communal body’, as fisher-folk become gradually alienated from one another and their traditional way of life.

3. The “Hour of the Machine”

3.1. The development of scrap-sites

As has been shown, the development of the informal recycling businesses follows very closely the kind of development seen during the industrial revolution in England, which Marx described and analysed in the first volume of *Capital*. As we saw in the Agbogbloshie case, and which holds true for Guiyu as well, it begins with the so called ‘greensite’, a remote or rural area where a new business can establish itself without the interference of the regulatory institutions that might be encountered in the city, and where there are ample resources available in the form of both labour and natural amenities. This develops into a system Marx called ‘domestic industry’, a form of ‘modern manufacture’; characterised by a low level of technology, piece-wages, long working hours, poor living and housing conditions for the workers, and functional independence from the larger factory system.[64] Additionally, some work would commonly be done at home after the working-day proper is finished.[65] Here is where our analysis of Agbogbloshie stopped, for that is seemingly how far the development there has come, but there is more to Marx’s story.

Domestic industries and outwork eventually begin to develop into proper, full-scale industries; Marx observed that “[t]he cheapening of labour-power, by sheer abuse of the labour… by sheer robbery of every normal condition needed for working and living, and by the sheer brutality of over-work and night-work, finally comes up against certain insuperable natural obstacles.” (54) In Guiyu we saw this limit reached when conditions became so bad that the local government felt pressured to intervene and improve them, whilst in Agbogbloshie the limit has arguably also been reached since interventions have already occurred and more are planned and continuously pushed for. The Green Advocacy has set up its workshop, as well as a small health station, and a new ‘Technical Training Centre’ has been constructed very recently, not to mention the government plants for a state-of-the-art recycling facility. In both cases the development is what Marx would

[64] “In Marx’s analysis ‘manufacture’ still had its original meaning of made directly by human labour, or handicraft production, while the term ‘machinofacture’ was used to describe modern industry (corresponding to the way the word manufacture is used today). When Marx refers to ‘modern manufacture’, he therefore means modern handicraft production, which is distinguished both from traditional handicraft and modern industry.” (55)
[65] At Agbogbloshie, some people would do some minor work in their sheds, such as stripping cables.

have expected, for when the final point is reached then “the hour has struck for the introduction of machinery, and for a thenceforth rapid transformation of the scattered domestic industries… into factory industries.” (56) That is precisely how the change begins in both Agbogbloshie and Guiyu: the introduction of machinery, that is, the passing from manufacture to *machinofacture*. In Guiyu this has advanced much further and developed into an actual recycling industry already, whilst in Agbogbloshie we are seeing the first, trembling steps toward what may potentially develop into a similar result, though that depends on countervailing forces and will take time. The stronger, and wealthier, Chinese government simply had a greater ability to affect the change sooner and steer it in the necessary direction, while at the same time never facing any potent counter-pressure from locals interested in maintaining the status quo.

In his observation of England, Marx regarded the Factory Acts as hastening the process of development; the various laws and regulations in place at Guiyu, and being put in place in Accra, are the modern equivalent, at least in terms of their function in the development process and not their content.[66] The neoclassical 'Kuznets curve' concept would indeed lead us to expect improvements in welfare, equality and even environmental quality after an initial decrease of the same, as production improves and wealth increases; just as can be observed in Guiyu and is beginning to occur at Agbogbloshie to some degree. In other words, the initial worsening of conditions is part of a process that leads to increased industrialisation and boosted productive capacity, leading to more overall wealth in society and hence enabling the rectification of the aforementioned conditions for the better. At the same time, a more affluent working population is able both to concern themselves more with their surroundings, including environmental health, and to put more pressure on institutions to address such issues. (57)(58)

Marx, however, in a way argues in the opposite direction, though his argument does not necessarily contradict those of Kuznets as such but adds another dimension to the process. The improvement of conditions that the Factory Acts created, Marx argues, actually helped the industrial development along, though in the short-term they of course negatively impacted those operations whose sole source of profit was the “[u]nlimited exploitation of cheap labour-power”.[67] The regulations do so by forcing firms towards innovation and increased adaptation of automation in order to maintain levels of production, since unlimited exploitation no longer remains an option; they “artificially ripen the material elements necessary for the conversion of the manufacturing system into the factory system… at the same time, because they make it necessary to lay out a greater amount of

[66] The Factory Acts regulated the employment of children, daily working hours, and work-place conditions.
[67] And, one presumes, regulations to the same essential effect.

capital, they hasten the decline of the small masters, and the concentration of capital".[68] (59)

It is in the nature of the atomistic structure of capitalist markets that the interest of specific, individual firms does not always match the interests of capital as whole. In fact, the limited scope, risk-aversion and short-term perspective of individual firms may make them blind to opportunities, or prevent them from acting on possibilities, that are beneficial for capital development due to limits set by their own self-interest. Marx noted how businessmen raged against regulations in the Factory Acts that eventually wound up leading to innovations that greatly benefitted their industries. (60) This is entirely rational on the individual level, since the altered conditions of that kind are uncertainties that are threatening to each individual capitalist, who may find himself losing out on profit or even entirely ousted from the market. Innovation, therefore, must occasionally come in the form of pressure and regulations enforced from above, which is exemplified quite well in the Guiyu case. The intervention of a strong government completely transformed the industry, much to the distress of businesses that saw their profits decline or go bust, and to the benefit of those who profited and the industry as a whole. As was noted previously, it was not economic growth that spurred environmental clean-up in Guiyu, but the other way around, since before the government-imposed clean-up, there was no economic growth of note but merely misery and environmental destruction.

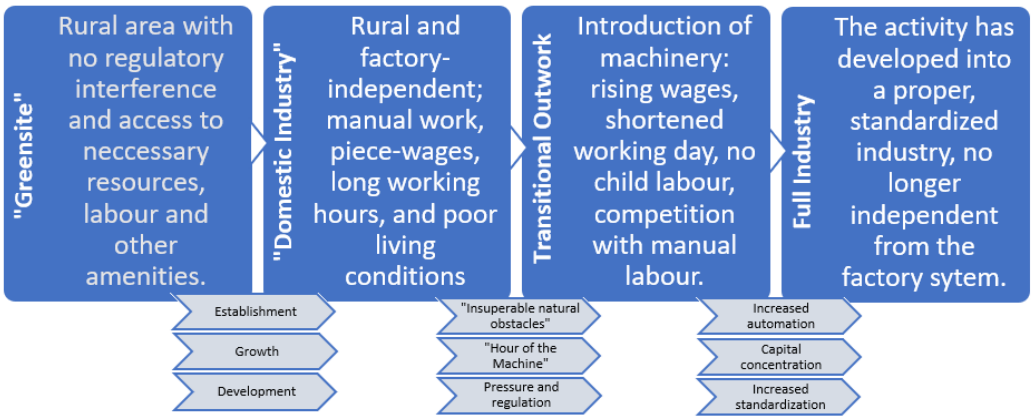

Figure 12.2. *Simplified process-chain showing development from 'greensite' to full industry in the Marxian model.*

[68] Marx here gives the example of the match-making industry, where the Factory Acts made it impossible to employ young boys constantly to dip matches in phosphorus, since this exposed them to poisonous vapours, which then necessitated the invention of a machine to do the dipping. Likewise, the Factory Acts forced an improvement upon earthenware manufacture in the form of better stoves and faster, pressure-based method for clay-slip production in lieu of time-consuming evaporation, leading to a steep rise in earthenware production.

The passage towards large-scale industry, and the introduction of more regulations, also tends to eliminate irregular working hours and standardize the working day, improving also job security for workers who no longer depend on the whims of capitalists or market demands for securing work. As in the previous case, these regulations are typically seen as threatening by individual firms, who see the lack of security and the irregular hours as advantages that allow them more flexibility. Marx, however, argues that the actual need for such levels of flexibility is limited in reality, and that economies of scale and increased mechanisation have the ability to account for most uncontrollable circumstances, and in a more beneficial way. The regulations, again, might strike against individual firms but do not harm capital as a whole, but instead serve to curbs the "meaningless caprices of fashion" that "fit in very badly with the system under which largescale industry operates" – thus pushing firms even further towards standardization, automation and capital concentration, driving development as a whole forward. (61)

Regulations, then, can hasten the adaptation of machinery. When the hour of the machine strikes, we are to expect, Marx argues: removal of children too young to properly operate the machinery from the industry, a rise in wages for more skilled workers using the mechanisation yet a lowering of wages for those who do not, eventually leading to competition driving away any remaining manual labourers, a modest reduction in the length of the working day, and lastly a complete dominance of women in the industry. (62) As has been explained previously, the gender division does not apply to the e-waste industry. The first four effects, on the other hand, have been observed at Guiyu. At Agbogbloshie, too, the modest introduction of machinery has already caused frictions and undermined the ability of those not using machines to compete. Indeed, concern over driving them out of business is one of the issues that is causing resistance to change.

With the introduction of small machinery, the transition to large-scale industry begins, going through transitional forms, the specific nature of which is highly context-dependent. To begin with, the use of machinery necessitates increased concentration of the activity, as it makes more sense to have the machines needed for the work all near one another, and as a consequence the activities can no longer be spread out but are instead confined to one location. In the Guiyu case, this corresponds to the Industrial Park, which has concentrated activities formerly spread all over the town. Activities in Accra are already relatively concentrated to Agbogbloshie, even if minor activity occurs elsewhere, though one might expect that mechanisation may do away with the latter. Increased use of machinery also increases reliance on capital, as it is no longer possible for workers to own their own meagre means of production, i.e. the basic tools that are sufficient for informal e-waste recycling; the common worker can simply not afford even the smaller mechanical tools, e.g.

wire-stripping machines. An influx of greater amounts of capital becomes necessary; in the case of Guiyu, this was provided by the local government together with development banks. In Agbogbloshie, it was provided first and in a small measure by the ENGOs, with plans for a much larger capital infusion through a cooperation between the Ghanaian and German governments with development banks.

Finally, increased capital infusion makes the use of larger and more sophisticated machines possible, cementing the transition to an industry proper. The technological level will, of course, vary with context; in the e-waste case it is a key competitive advantage of the informal method that it is cheap and simple, and therefore even in its most developed and formalised form it cannot rival the sophistication of recycling in developed countries, lest it do away with its main advantages. Thus, even in the Guiyu industrial park, we see only haphazard use of the most basic protective gear, a continued reliance on simple, mechanical work using basic tools, and small machinery, even though far more advanced technology is available.

In a way, Guiyu 'skipped' the transitional period because there was no need to wait for capital accumulation; once the local government had decided to make a change, the necessary resources were provided, and the change was enacted swiftly. Agbogbloshie has attempted the same swift change, but failed thus far, and despite promises and expectations the modern recycling facility has yet to be built. It is possible that the government will come through, of course, but it is also possible that conditions are not favourable and that the project will be delayed as Agbogbloshie goes through a slower transitional phase or remains stagnant and stuck in its current phase. The aforementioned Green Advocacy initiatives, and related workshops, can be seen as the first steps in a potential transition, but do not guarantee it. There is an understandable pressure for Agbogbloshie to develop along similar lines as Guiyu, but also a countervailing pressure for it to remain the same. Not only is the reputation that Agbogbloshie has gained so far overall quite negative, but it has already led to both pressure for change and some actual change; even though, admittedly, not much is different in practice yet. Legislation has been altered, small machinery has been introduced, and there are crack-downs on smuggling by both the government and concerned NGOs. Worth noting is that other countries have also strengthened their commitment to combat e-waste smuggling; in my personal communications with Swedish officials they mentioned Agbogbloshie specifically as a reason for their commitment to proper e-waste management. Though the real effect of these changes has yet to be felt, one must acknowledge the possibility of a change similar to that in Guiyu occurring at Agbogbloshie as well.

By legitimizing the industry, while still keeping it comparatively cheap as in Guiyu, Ghana might potentially be able to handle not only their own growing domestic generation of e-waste, but also profit from foreign waste. The possibility exists for imports to be legally permitted, the stigma of the informal recycling no longer applying to a state-of-the-art facility, and what used to be characterised as the dumping of hazardous waste to a poor country could be re-characterised as affordable but environmentally sound recycling that generates income for a developing country and creates jobs. As long as the recycling remains cheaper than in developing countries, there would be an incentive to keep exporting to Ghana, especially with the stigma and associated bad PR removed. Yet, some of the flow would inevitably diverge just as it has for Guiyu, though one cannot predict how much. It is plausible that some flows would remain or instead originate from other developing countries in the region or be generated domestically. The specific outcome cannot be predicted, for neither Marx's model, nor my use of it, describes a linear or unavoidable development, but shows how these industries tend to develop when the conditions are right for that development to take place. As has been argued before, in Agbogbloshie the traditional hierarchies and organisational structures in place may serve as a potential hurdle to further development, and should development occur it may increase costs to the degree that flows largely shift away from Agbogbloshie. All that can be done is to identify the forces at play; depending on how the clash of power and influence plays out in practice, different outcomes are possible.

The counter-narratives of scholars such as Peter C. Little and the focus they give to re-casting Agbogbloshie as a place of innovation, recycling and reuse, take on an interesting hue in light of the above speculation. It becomes, though unintentionally perhaps, part of the process of legitimizing the recycling business and hence a part of its development into a full recycling industry: a narrative that supports the transformation of Agbogbloshie, by way of recognising opportunity where more cynical narratives only see disaster, and by highlighting the creativity present. In Guiyu, massive government intervention after years of international pressure has been recast as a story of how economic development leads to improved environmental conditions; a simplified narrative which is, strictly speaking, incorrect but has nonetheless caught on. Perhaps the conception of Agbogbloshie as a 'maker-space' may become part of a similar, legitimizing narrative?

Though, as seen in Guiyu, a fully developed recycling industry is still fraught will problems, it is undeniably a vast improvement over the conditions of informal recycling. Nevertheless, the nature of e-waste as a flowing resource distinguishes it from the industries Marx analysed, and places a limit on development – reaching a similar standard as a developed region would increase costs to

the point that the flow would seek other sites. Though properly enforced regulation can evidently decrease this, it cannot do away with the underlying tendencies.

3.2. A final note on class relations at Guiyu and Agbogbloshie

The stories of Agbogbloshie and Guiyu can be told as stories of success or of failure or hybrids of both, all depending on one's point of view and what aspects one highlights. I have chosen to tell the stories as I saw them, and perceive the events unfolding though the eyes of the workers and common people. I have done so because it is the lives and stories of these people that tend to get forgotten when large sums of money become involved, and corporate and government interest follows. I have also elected to use Marx's classical account of domestic industries in the England of the Industrial Revolution as a comparison and rely on it exclusively. This is not because there is a lack of Marxist literature on the topic of industrialization or the transition from 'greensite' to outwork to full industry, but a choice made in order to highlight both the class formations involved and the way in which the informal recycling industry follows closely the development in 19th century England. My point is to illustrate precisely how accurately Marx's observations onto 21st century Ghana and China, for even though there is a separation in time, space and culture, the conditions *vis-à-vis* capital are quite similar. The organization of the labour, its geographical placement in relation to other industries, the tools employed, the lack of safety, the form that wages take, the regulations and the involvement of the government and the effect that has on development, etc. – all of it proceeds exactly as Marx described. There are unique, local and particular expressions that the underlying forces take, causing differences such as the gender division of labour. Yet even those can be accounted for within Marx's original framework, and it is the same underlying forces at play in all instances, merely the expression changing somewhat.

Yet I cannot claim to tell the *only* truth possible to gather, because this issue is far too complex for such claims. But, to me, what is ultimately clear is that the there is no one story about either Agbogbloshie or Guiyu that anyone could present with which nobody else would challenge or disagree. The struggle between different narratives, and the interests behind them, are part of the story. The people living there, the people working there, the governments both local and national, the various foreign interests who dump their e-waste there (or used to, in Guiyu's case), the domestic industries fed by the recycled materials and the various environmentalist NGOs, organizations and interests – each has their particular stake in both the sites and the e-waste industry, and their own particular story.

Firm A: modern factory

Firm B: handicraft production

Consider two firms producing the same product or service, which takes 2 hours to make for one worker. One, A, introduces modern machinery along with other similar firms on the world market. The other, B, does not. Manufacturing 1 unit of commodity now takes 1 hour for a worker at firm A (and most other firms), while it still takes 2 hours at firm B. From a value perspective, the socially necessary labour time (SNLT) has now decreased to 1 hour of labour per unit of commodity; thus, the exchange value of the commodity has been halved. The commodities from B have the same value as A; workers at firm B now put in 1 productive hour that adds value and 1 'waste' one hour – i.e. that second hour does not add value, since value is not imbued through the physical act of labour but given through the social relation, expressed here as the SNLT. The second hour is inefficiency, it is extra time the worker has to spend to make up for lacking technology that exists in firm A. From the perspective of the capitalist who owns firm B, however, value is neither obvious nor a concern. What he is immediately confronted with is the fact that he cannot place as many products on market as A and is getting a lower share of the profit. He can elect to invest in the same machinery, but that is not the only option. He can also pressure his workers to work harder, or work longer hours; he can also cut costs by lowering their wages. By so doing he can, in fact, remain competitive with firm A despite a lack of machinery.

Imagine then that firm B exists in another country. The laws, regulations, public relations, etc. that confront firms A and B differ; not only is B able to make use of the above strategies to remain competitive, but B can cut certain corners and perform certain actions that A is barred from doing, such as setting extremely low wages or ignoring environmental impact. Add to this barriers to entry, trade regulations, prohibitive capital investment costs, etc. and we may very well find ourselves in a situation where firm B manages to remain quite competitive with firm A – even to the point where another firm, C, in need of the product or service A and B provide might find it cheaper to go to B.

For the capitalist owner of B, the options confront him as a cost-benefit analysis. He cares neither for time nor value and is in fact wholly unaware of these underlying, background phenomena of capitalism at large. For his individual firm, he is concerned only with his ability to attract business, and whether an investment in automation is preferable (if it is even a possibility) to methods of pushing his workers even more – like a piece-wage system, or the employment of workers who can subsidize themselves so that even lower wages can be paid.

The individual worker is confronted merely by the need to work harder and longer to make ends meet. His extra time working, above the SNLT, does *not* add value or provide a profit to the capitalist – rather it is a form of *superexploitation*, and it is that superexploitation with is the source of profit for capitalist B. That is, it allows capitalist B a larger share of the total surplus value 'pool' of capitalism but does not in itself add to that pool. The *Organic Composition of Capital*, the ratio between labour-power and fixed capital, is different between the two firms – but Marx's argument of rates of profit falling due to increased amounts of constant capital applies to society, i.e. it impacts the SNLT, and the rate of profit of *all* capitalists, including those who do not personally get on board with mechanization. It is *not* possible for the individual capitalist to extract additional surplus by way of forfeiting automatization and relying on labour. Exploitation of workers through surplus extraction does not occur on the level of the individual firm; this is a simplified assumption made in Vol. 1 of Capital which is dropped later on. It is in Vol. 3 that we are confronted with competition between capitals, the equalization of the rate of profit across industries, and the fact that it is capitalists *as a class* that exploit workers *as a class*.

Figure 12.3. *Brief overview of value generation under capitalism. By the author, based on a personal reading and interpretation of the three volumes of Capital*

Different people and the organizations they are part of embody different discourses that are ‘materialized’ (that is, come to have a material impact) through their actions. Different beliefs and attitudes, and the conflict between different narratives, therefore have a materialist component to them. Consciously or not, some of these narratives are supportive of the interests of capital; either explicitly, or implicitly by failing to hold it accountable for what occurs at the recycling sites.

The truth is not necessarily non-existent or relative, merely obscured behind these interests and at times difficult to get at. In order to justify my particular outlook, I will fall back on Lewontin’s and Levin’s *postulate of partisanship* in scientific matters: “[w]e should not pretend or aspire to a bland neutrality but proclaim as our working hypothesis: all theories are wrong that promote, justify, or tolerate injustice”. (63) Similarly, we can turn to Marx himself and his famous words on philosopher’s missing the point by merely trying to *interpret* the world, when the point it to *change* it. (64) Hence the point here is not what particular story or angle best encompasses some abstract notion of ‘truth’. The point is that we can observe a history of oppression of common working people by way of surplus extraction, cost-shifting and consequence-shifting; we can observe a history of the degradation of nature and profit taking precedence over environmental concerns, and we can observe that it follows a familiar pattern at different locations. We can observe an improvement – however small in Agbogbloshie’s case – taking place, but only after a long history of struggle and resistance, and even then, arguably, because the improvement suits the changing needs of capital. We can observe that despite this improvement, worker exploitation and environmental degradation continue in somewhat diminished form, even in Guiyu where the change is quite dramatic. Plainly, what we observe is class struggle: conflict over both the natural world and human well-being from groups that have differing interests in the natural world and in people. Maja van der Velden and Martin Oteng-Ababio state, in contesting the idea that the experience of Agbogbloshie workers is somehow uniquely appalling, that “[t]he vulnerabilities experienced by the people of Agbogbloshie are terrible in and of themselves, but they are morally unbearable precisely because they are a normal part of the global economic system that sustains modern overconsumption.” (65) In other words, Agbogbloshie is just a particular example of informal e-waste management, which is itself only a particular example of exploitation of workers and nature under capitalism. As Foster observed, a crucial contribution of *Marxist* political ecology, or *Marxist* ecological economics, is the recognition of the natural world as a site of class struggle; that is that groups that live under different economic conditions, with differing relations to the means of production and subsistence, will inevitably have different relations to the natural world. (66) Though divergent in the details, Agbogbloshie and Guiyu show the same forces at play,

different power dynamics and strategies having led to different outcomes, at least for the time being.

It is not as simple as a shallow understanding of Marx would lead one to believe, with a clear ‘workers vs. capitalists’ dynamic, involving instead governments, NGOs and a multitude of differing corporate interests. Yet it is a conflict over what the natural world and the people living in it constitute and if and how they are to be ‘used’. The main contradiction, that between the poorest workers and the richest businessmen, has been laid bare, but the struggle over the natural world is not limited to that phenomenon alone. Consider the fisherfolk in Chorkor area of Accra and the e-waste workers at nearby Agbogbloshie; one might suppose that given their similar economic conditions they are simply both ‘workers’ in the Marxist analysis, but consider then the difference between the two in terms of relationship to the means of production and subsistence. The fisherfolk work with, and are dependent for their livelihood on, the very water bodies that the e-waste work destroys – work that the Agbogbloshie residents themselves rely on for *their* livelihood. Though technically part of the same broad class category, a more sophisticated *relational* view of class reveals the contradictory relationship between them. Nonetheless, in another sense they are one and the same, for the e-waste workers were from the beginning displaced farmers and hunters themselves and as the e-waste industry grows it is likely that Chorkor’s fisherfolk will have no alternative than to become e-waste workers themselves.

Consider also how both Marx and H T Odum, one of the founders of the field of systems ecology, both argued, though each in their own way, that low wages in underdeveloped nations are made possible through 'nature's subsidies'. (67) Yet, what is clear now is that recycling work can not only survive low wages due to subsidies but can *itself* become a kind of 'nature's subsidy' apart from agriculture, though in an indirect way. People live not off the fruits of the land, but on an industry that destroys the natural world and is in fact only possible and profitable because it does so. This would mean that the kind of quasi-petit-bourgeois system seen at Agbogbloshie, based on people repairing and selling electronics, would also be a kind of 'natural subsidy'; an alternative to wage-labour made possible through exploitation of nature. This places those workers in a more precarious, and exploited, position than the traditional petit-bourgeois, giving them not only different dependences but having them share in similar environmental and health consequences as do those working directly with e-waste.

The role of the Agbogbloshie and Guiyu workers is – in my view – a clear example of an emerging *environmental proletariat*, though they are certainly not unique in belonging to that category. Fred

Magdoff and John Bellamy Foster coined the term to refer to an underclass “concerned with the totality of material conditions, from the human relation to nature through production, to the broader community environment”. (68) Building upon the dialectical unity between nature and humanity – as part of the same wholeness – and on the class conflict over the natural world, we are led to regard the human body itself as a site of environmental history, and thus likewise as a site of environmental class struggle. If our relation to the natural world is part of our humanity, then people cannot be understood outside that relation: the natural world as a site of class struggle is therefore by necessity a struggle over our own bodies and selves, and not a struggle over something external. The 'externalisation' of the natural world in our conceptual approach is the manifestation of our estrangement from it, and intimately bound up with the estrangement of labour that is the foundation of capitalism. In connection to the informal domestic industries, the 19th century simulacrum to the informal recycling, Marx remarked that the profit in them lay in the low, miserable wages paid, and they were in effect “the cheapness of the human sweat and the human blood which were converted into commodities”. (69) The 'environmental proletariat' is, arguably, the sub-class in which the above tension is manifested most clearly; whose bodies carry the most obvious signs of the class struggle over them, and on whom our antagonistic and alienated relationship with nature has left the greatest impact.

The analysis of the case-studies themselves now being complete, the influence of the capitalist system on global e-waste flows has been established, as has the place of e-waste workers among the global proletariat. Scrap-sites have developed, and continue to develop, very much in accordance to the way Marx himself expected new industrial sites to develop, subject to the same political-economic forces. It is therefore imperative that those forces themselves be analysed. The role of Part IV of the thesis will be to connect the global flow of e-waste to the global flow of capital, and to analyse its role in the world-system.

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Chapter 13

Towards A Marxist Ecological Economics

In this chapter I will explore the theoretical advantages and possible advances in understanding that can be gained through the application of an ecological economics perspective, that is, by recognizing the political-economical system as a sub-system of the ecology. This viewpoint is one I have used as part of the foundation for my thesis, and it has both explicitly and implicitly been a part of it at every point, from the formulation of research questions to shaping my observations and interview questions, to my analysis. However, here I will take a more explicit look at the theoretical contributions of, and discussion within, the field of ecological economics as such, and how they can contribute to a better understanding of e-waste, and how in turn the e-waste phenomenon could influence the debates within this school of thought. My hope is to contribute to the burgeoning field of *Marxist* Ecological Economics; one that, in a sense is to Marxist political economics what mainstream ecological economics is to the neoclassical school of economics.

1. Idealist and materialist concepts of the natural world

Let us begin, first, with distinguishing how a Marxist Ecological Economics would view the natural world and how that would differ from the mainstream approach. In their ground-breaking work, *The Ecological Rift*, Foster et al., contend that perception of the natural world is popularly expressed in two major ways, one rooted in philosophical idealism and the other in an overtly mechanistic and reductionist approach to science. (1) These conceptualisations are both complex and internally contested, making it hard to easily divide them into two clearly defined camps. At stake are two general tendencies that manifest themselves in different ways, that must be addressed in a highly abstract manner. It is such an abstraction that can allow us to observe and understand what myriad divergent phenomena share and what drives them.

For Foster et al., the first of these, the “idealistic conception” of the world, is characterised by the expectation of harmony in nature and our (potential) 'oneness' with it. This conception usually has a very spiritual approach to the natural world, and a great deal of admiration for groups that are understood as living closer to, or 'in balance with', nature, while modern day society is generally

seen as being apart from nature and as something that disturbs it. (2) One might argue, from a Marxist point of view, that the idealist view in many ways embodies human alienation from the natural word. It is understandable that human beings create a view of ourselves as being parasites or outside of nature, because capitalism as a system creates the appearance that we are. Marx clearly pointed out how capitalism treats the natural world as a ‘free gift’, concerning itself only with the “productive power” it provides, and is unable to place any other value on the natural world.[69] (3)

In contrast, the so called 'crude materialism' of the mechanical world-view, present in much of modern ecology and biology, is characterised by what Levins and Lewontin dub 'physics envy'. (4) Physics is seen as the ideal of science, giving rise to the inclination of other sciences to mimic its methods as a means of achieving legitimacy. Thus, certain methodological choices, rather than being considered simply suitable ways of approaching given problems, are elevated to nearly a requirement for the label “science”. (5) To a certain extent, this crude materialist conceptualisation also sees human society as being apart from the natural world. Though admittedly dependent on the natural world, humanity and its environment are still conceived of as separate 'things'. Alternatively, the natural world is seen as something to be used by humans, seen clearly in how it is treated within neoclassical economics. Even in ecological economics is this evident; Georgescu-Roegen's production function is an improvement over the neoclassical, which does not take the natural world into account at all. Yet, the natural world is still viewed as only a source of inputs. (6) Though reliant on it, we are still apart from it. It is in reference to mainstream ecological economics that Burkett originally uses the specific term “crude materialism”. (7)

The dialectical view of the natural world overcomes the above outlined dichotomy. It views humans and our society as neither apart from nature nor 'one' with it in some metaphysical sense, but as a part of the same wholeness, including contradictions and disharmony, with no 'natural balance' to speak of. It focuses not on 'things', but on processes and relations. Hence it is able to handle the conditions of complexity and constant change that are hallmarks of the ecosystem, making it a more suitable method for the field of ecology and by extension also ecological economics. In recognising that humans are a part of the natural world, a dialectical approach also acknowledges that alteration of the natural environment is inevitable; a part of the very process of life. We create our environments as much as we are products of them; a realisation that may force us to take responsibility for *how* we alter our surroundings through how we arrange our society. To quote

[69] As Burkett discusses at length, this is often unfortunately taken as an endorsement from Marx's side of such a treatment of the natural world. In reality, Marx actually emphasizes the rift that exists between humanity and nature under capitalism. (8)

Levins and Lewontin, we “decide what kind of a world we want to live in and then try to manage the processes of change as best we can to approximate it”; humans are a part of a *process* that alters both nature and our society, the exact outcome of which is undetermined. (9) Through dialectics we are able to see a tension between the *actual* and *potential* outcomes that goes unaddressed in the contemporary debates on future technology, recycling and waste in ecological economics. How can the solution to the recycling problem lie in future technology, when even the recycling technology we already possess is not being used to anywhere near its full potential, and the cheaper alternative of shipping waste to developing countries is what is actually being employed instead?

Related to this, critical realism rejects both the physics-envy of social scientific approaches that seek determinant laws of society analogous to the laws governing nature, as well as the subjectivist schools of thought that devote themselves entirely to ideas and meaning without reference to, or at least not much focus on, objective reality. As Sayer puts it, it “proposes a way of combining a modified naturalism with a recognition of the necessity of interpretive understanding of meaning in social life” and “seeks to avoid both scientism and ‘science-envy’ on the one hand and radical rejections of science on the other”. Buch-Hansen and Nielsen suggest that critical realists “advocate a perspective that cuts across natural science, the humanities and the social sciences” without thereby neglecting their differences. As such, it is an approach that fits well with the aims of this thesis, and the use of my dialectical approach, that has the explicit intention of breaking the false dichotomy between crude materialism and idealism. Though I here consider critical realism only in relation to the social sciences, it has of course been proposed as an approach fitting to the natural sciences as well and is hence fitting to break the dichotomy between the social and natural sciences discussed in Chapter 2.

2. The materialist dialectic and ecological economics

Any “crudeness” aside, the inherently materialist nature of ecological economics is evident in its most basic assumption and approach; that the natural world is included and given a proper place as the basis of all life and all economic activity. The economic system is imagined as a sub-system of the ecological system, on which it depends for resources for inputs, and inevitably waste-sinks for outputs. Yet, with few exceptions, the work of non-Marxist ecological economists tends to be only partially materialist in that society is still analysed in largely idealist terms.[70] It is this tendency that

[70] The work of Juan Martinez-Alier is an excellent example of such an exception, though one could argue that it shows

I intend to critique here, in order to advance through that critique a fully materialist ecological economics. (10)(11)

A good example is renowned ecological economist Herman Daly, whose approach to social science leads to responses that ultimately fail to locate the actual, namely, *material*, causes of economics growth. Instead he portrays it as a moral failure rooted in shallow materialism and greed, dubbed 'growthmania'. His criticism turns toward both the hegemonic economic theory's support of growth and invocations of moral and spiritual bankruptcy on behalf of both economists and Economics as a science, and society at large. (12)(13)(14) This is to commit the ethicist's fallacy and confuse appraisal and explanation. It does not logically follow from a behaviour being unethical that changing or preventing said behaviour is a matter of changing ethical values. (15) It is to neglect the underlying forces that drive the economy and is insufficient to explain the true cause of capitalism's tendency towards economic growth.

In many of the other great figures of ecological economics, a similar trend is observed; there is certainly a concern with social issues and causes for growth, but no in-depth analysis or investigation of the socio-material basis. A good example is a classical essay in the ecological economics tradition, Georgescu-Roegen's *Energy and Economic Myths.*[71] (16) In it Georgescu-Roegen, much like Daly, argues that the overall cause for growth can largely be blamed on prevailing paradigms within Economics as a subject, hence the "economic myths" part of the title of his essay. Economics, such as it is, simply cannot grasp the limits of growth as its models exclude the natural world and its associated real limits, such as those imposed by thermodynamics. Both Daly and Georgescu-Roegen conflate real economic processes with the theories describing them. Certainly, there is an overlap between said processes and the theories, since many policies are made on the basis of advice from economists. Yet for-profit firms in competition on a capitalist market do not need an economic advisor to tell them that they must make a profit, and that growth in matter-energy throughput is a good way to do so – the driving forces of capitalism will make sure that happens. When such advice influences policy, that certainly helps, but it is not what *drives* the process.

Georgescu-Roegen also lists eight points for a bioeconomic program which he considers key to preventing growth. The points, while certainly excellent suggestions in my opinion, betray a lack

Marxist tendencies despite not being explicitly Marxist.

[71] Georgescu-Roegen and Daly are good examples since they are authors of what Spash calls "foundational books" of ecological economics; namely Daly's 1977 *Steady-State Economics* and Georgescu-Roegen's 1971 *The Entropy Law and the Economic Process.* (61) For more examples, see **Appendix 1** for a brief overview of this matter in the ten most cited articles in the journal *Ecological Economics*.

of a deeper, materialist analysis. On the first point, Georgescu-Roegen suggests that a prohibition against military spending could be reached "without any difficulty", ignoring even the political, let alone the possible economic, causes for military spending.[72] (17) Georgescu-Roegen also criticises consumerism and makes the radical suggestions to abolish fashion altogether in the fifth and sixth points, but without asking why exactly these things exist, instead calling consumerism a "morbid craving" and fashion a "disease of the mind". The same moralistic critique as Daly's is employed. In both instances, Georgescu-Roegen also suggests that people should *first* stop wanting these products, and that manufacturers will *then* stop producing them. The burden of change is hence placed on the consumer and ignores how capitalism shapes our consumption; it is blamed in fact on the *mind* of the consumer and neglects the *material* causes of such cravings. Lastly, in his seventh point on the lack of durability in goods, there is no analysis of why manufacturers are short-sighted, or how the profit motive negates durability by providing a disincentive to produce long-lasting goods. From a capitalist perspective, a shoe that must be thrown away as soon as a single lace breaks is the ideal shoe, as long as competing products are not more durable, since a new one must then be bought.[73]

While Georgescu-Roegen does recognise the root of social conflicts in material conditions, even comparing himself to Marx in this aspect, for him such social conflicts are given biological roots rather than being the outcome of a specific mode of production. He dismisses the Marxian idea that (at least certain) social conflicts are historically limited and can be overcome, posing instead conflict as a universal human condition that follows from the Laws of Entropy:

> "...the struggle for life which we observe over the entire biological domain is a natural consequence of the Entropy Law. It goes on between species as well as between the individuals of the same species, but only in the case of the human species has the struggle taken also the form of a social conflict." (18)

On the Laws of Entropy, he bases a theory of historical, economic and social development, reducing thus the social not merely to the biological but going further and proposing that the biological is itself an outcome of physics. (19) It is worth recounting Popper's famous statement, "[a] theory that explains everything, explains nothing". To Georgescu-Roegen, to paraphrase the most classic of

[72] Marxist economist Ernest Mandel, for instance, suggests in *Late Capitalism* that military spending is a countervailing factor to Marx's 'tendency of the rate of profit to fall'. Tony Cliff also discusses the connection in *Perspectives of the Permanent War Economy*. This is not to mention the many theories of capitalist imperialism within the Marxist tradition.

[73] A discussion on 'planned obsolescence' will not be had here, but the idea is accepted enough to be a part of the mainstream debate to a degree. See for example the work of Slade, Bulow, Waldman, or Iizuka. (22)(23)(24)(25)

Marx's quotations, the history of all hitherto existing society is the history of entropy. In other places, he does recognize the need for less 'arithmomorphic' economic models that are more adapted to human psychology and take cultural context into account, and also supports his own take on dialectical thinking. (20)(21) To accuse Georgescu-Roegen of a complete lack of social-scientific materialism or an utter devotion to reductionist models would be to tell an outright lie; yet traces of both can be seen in his writings, especially as regards the social sciences.

The critique that Clark and York level against adherents of deep ecology and the Gaia hypothesis, I level at ecological economics, namely, its criticism is "divorced from its social-material influences… [c]hange becomes a matter of adjusting values and developing the proper eco-ethics, and from there, it is assumed, changes in the social structure will follow". (26) The failure to address matters such as the source of profit or the cause of the drive towards growth, weakens both the explanatory and predictive power of ecological economics. To borrow from Engels; to make a science of ecological economics, it has first to be placed upon a real basis. (27) But it is not enough for that basis to be the realities of thermodynamics or the conditions of eco-systems; the social scientific aspect must be materialist as well. In other words, the problem is methodological, and pertains to the lack of certain categories and tools in the oft-mentioned pre-analytic vision of ecological economics rather than any form of analytical error. Such tools can be found within the approach of Marx and Engels, and can be summarized with a quote from Burkett:[74]

> "What Marxism really does is overcome the material-social dualism [...] within ecological economics. While endorsing the materialist element [...] Marxism points out that its effectiveness is undercut by the failure to analyse production as a social (class) phenomenon. To treat nature as simply a capital asset in a production function, conceived as a social-relational black box, is to adopt the abstract-ideal method of neoclassical economics... The economy is thus interpreted in crude materialist *and* idealist terms." (28)

Stephen C. Lonergan, in the paper *Marx and Energy,* sums up the issue with an 'orthodox' Marxist approach to ecological research; it is "primarily concerned with the organization of capital: the forces of production and the relations of production. Ecological systems are recognized, but only in relation to man's social existence." (29) It is precisely this that I seek to address by using a Marxist approach that, just like ecological economics, places the economic system within the

[74] See also chapters 3 and 4 of Burkett's *Marxism and Ecological Economics* for a deeper discussion on the crude materialism of ecological economics.

ecological one and recognizes the economy as a sub-system of the ecology. Another good summary of my own intent can be found in Robert Kaufmann's *Biophysical and Marxist Economics: Learning From Each Other*: "[t]he schism between biophysical and Marxist analyses of economic production is reflected by their different emphasis. Biophysical economists emphasize the physical aspects of production. On the other hand, Marxist economists emphasize valuation and distribution. This separation is unfortunate; economic phenomena reflect a complex interaction between the physical laws that constrain economic production and the social forces of valuation and distribution." (30) Related to this, Peter Custers argues that "...waste factors have not been incorporated into the structure of Marxian thought even today", waste of course being is central to my thesis (31)

Yet this does not mean that I will join the choir of academics who are blaming Marx for this neglect. Lonergan's aforementioned essay sates: "...if one cares to analyse Marx's letter codes and formulas for the individual and social accumulation of capital, in particular as laid down in Capital Volume Two, one cannot fail to notice that they neither expressed how the natural world's resources are drawn upon to shape capitalist production, nor did they express how the natural world is continuously abused in order to dispose of the harmful by-products of capitalist mining and manufacturing." (32) True, of course, but Marx describes the capitalist view, a view that does not consider the natural world in any way, treating it as something that is just *there* for the taking. It is a correct way of describing capitalism, not an endorsement of it. Marx did at times leave this descriptive mode of writing in order to comment on how negative this abuse of the natural world is in reality – but being a theorist of capitalism, and capitalism being a system that disregards the natural world, one cannot blame Marx for sometimes excluding it from his models. This does not make an ecological reading or re-imagining of Marx impossible; it is merely an oversight at most. But while an ecological Marxist model that includes the natural world would be more *objectively* correct in a sense, such a model would need to be explicit about it describing what lies beneath the veil of capitalist relations of production; that it *does not* represent an accurate picture of how capitalists see things or how capitalism treats the natural world.

As the same author says later, "from its material (i.e. *physical*) side, the capitalist economic process is not circuitous, but unidirectional since it generally results in waste factors that neither existed at the start of a production cycle, nor can uniformly be ploughed back to the capitalist manufacturing process as commodities"; just like Georgescu-Roegen argued. (33) However, the movement of capital and its accumulation, the non-physical aspects of the economy, *are* undeniably circuitous. Indeed, that author acknowledges that the process "is not purely circuitous or circular but consists

in combined movements – both circuitous and non-circuitous"; or rather is either circuitous or non-circuitous depending on the level of abstraction and *what one is looking at*. (34)

3. Recycling in the framework of ecological economics

The views on, and debates regarding, waste and recycling found in ecological economics are quite relevant to e-waste recycling. Daly, for example, has argued that the waste absorption capacity of the environment is a major limit to economic growth. (35) However, I am critical of the sometimes overly abstract approach ecological economists take. Following the example of ecological economists such as Martinez-Alier, who uses specific cases in order to examine how abstract theories play out in practice, we can use the Agbogbloshie and Guiyu cases to investigate ecological economic theories on recycling.

To begin with, what is meant by 'waste' is crucial. Georgescu-Roegen differentiates between 'waste' and 'garbo-junk'; the latter being things like broken bottles or old newspapers – things that can, in theory at least, be recycled. (36)(37) Pure waste, however, refers to the (presently) unavoidable waste-products of manufacturing; matter lost to friction for example. Peter Custers argues from a Marxist standpoint that "...both capitalist production and capitalist consumption emanate in forms of ultimate waste, – the one being ultimate waste in the form of depreciated means of production…. the other being ultimate waste in the form of depreciated means of consumption…". (38)

Even though Custers cites e-waste specifically as an example of this ultimate waste as depreciated means of consumption, I would argue that e-waste is in fact not 'ultimate waste', because it retains usefulness. Although the use-value it was originally created to serve is no longer one it can fulfil, it is still useful and can be transformed, through a social process, into a resource in itself; workers treat it as an 'urban mine' to extract minerals. The pollutants that such work produce, however, are an 'ultimate waste'; but the result of production and not consumption. As the author himself states: "Marx was uniquely aware of the fact that manufacturing processes themselves involve the consumption of commodities". (39) In that case, consumption is not necessarily a completely conceptually separate phenomenon, but simply another step in the production process.

Note that Marx and Engels also speak of the related concept *non-economic labour,* labour "lost in the increased heat given off by the body, etc." and in the "conversion into other forms of energy as a result of friction, etc." (40). They are referring here to entropic dissipation through friction. While this relates to labour and friction, the concept can be expanded and applied to material waste, which

is inevitably a part of production given that the 2nd Law of Thermodynamics prevents perfect conversion of anything: there is always a loss to entropy.[75] Waste is an inherent part of manufacturing, both during the process and when the commodity is eventually used up and becomes waste.

These concepts are useful because they underline the practical impossibility of total recycling (every atom, no dissipation). The important role of thermodynamics and entropy in the analysis of ecological economics is precisely why that impossibility is noticed – within a neoclassical framework it is likely to go unnoticed, hence the tendency for that school to suggest complete recycling (and the related concept of 'reversibility') as a solution to environmental problems. (41)(42) But this does not, as is sometimes attempted in ecological economics debates, need to be established as physical law in order for its practical inconvenience (in the foreseeable future) to be highlighted – all too often these debates wind up being about what might be possible in the distant future. (43) The e-waste case circumvents the aforementioned debate and shows that even the technology we possess today is not being fully utilized even though it is technically available. The controversial '4th Law of Thermodynamics' that Georgescu-Roegen introduces is not necessary in this case, because one is not arguing that waste is any kind of ahistorical, universal, inescapable or permanent feature of industrial production that will remain even in any given science-fiction-like scenario conjured up by advocates of complete-recycling-as-saviour. The argument is instead that waste is a feature of industrial production *as is,* in the real world of today and the near future. I take issue with Georgescu-Roegen's 4th Law on historical materialist grounds. While it is admittedly a kind of materialist argument, it winds up looking away from actual, real-world conditions – the conditions on the shop floor and the experience of the labourers – arguing instead based on abstract physical laws about what can or cannot be possible given advanced technology of a distant, imagined future wholly unconnected to actually existing production processes as they are.

Marxist scholar David Schwartzman is worth quoting here: “[t]wo of Georgescu-Roegen’s examples of 'unavailable matter' arising from the inevitable friction inherent in any physical process are rust and broken glass. ... So we are to believe that even with available energy these wastes cannot be efficiently turned back into iron and glass bottles respectively!” (44) I would argue that Schwartzman here completely misreads Georgescu-Roegen; Georgescu-Roegen's point was rather that the laws of thermodynamics ensure that 100% of each resource cannot be turned back; the process of recycling will itself have waste. There is no possibility of a perpetual circle; it all turns

[75] Entropy always increases in an isolated system.

to waste *eventually*; and, thus, matter is continuously lost in the production process. Yet Schwartzman raises a crucial point: clearly, efficient, solar-based recycling can prolong the life-span of useful matter significantly since less will be lost over time. Hence he raises the question of the *qualitative* properties of the recycling actually taking place; we cannot avoid losing molecules to friction in production even under a non-capitalist or otherwise ecologically sound industrial system but perhaps we can avoid extreme cases like Agbogbloshie; and perhaps that is more important than a few stray molecules.

Paul Burkett also highlights the importance of the qualitative nature of recycling, noting that Marx's value analysis shows that capitalist firms do have an incentive, and feel competitive pressure, to avoid unnecessary waste of materials, and to recycle materials insofar as it is profitable to do so. This, however, occurs within the overall dynamic of ever-growing matter-energy through-put and otherwise anti-ecological forms of material production and consumption. Additionally, the potential profitability of recycling itself says nothing about the pro- or anti-ecological character of capitalist recycling operations themselves, which as we have seen depends on their qualitative material forms and their spatial distribution. (45) That is not to say that there is not something very sound even in the abstract arguments of Georgescu-Roegen and other ecological economists. I believe that their most crucial point is that if we begin making present policy based on unfounded assumptions about near-magical sci-fi technology that *might* one day exist, we show both naivety and irresponsibility. An economic system which *requires*, i.e. cannot in the long-term work without, the possibility of 'technomagic' that saves us from its side-effects, cannot be said to be sustainable in any meaningful way.

Related to this, Georgescu-Roegen said that “what is true for one dead lake is not true for *all* dead lakes [emphasis added].” (46) This concerns the idea of 'reversibility'; it may, in theory, be possible to restore a place like Agbogbloshie to a healthy wetland given that social objectives change and that the right technology exists, and enough time is allowed for it to happen. In the most simplified terms possible, this would work by cleaning up the hazardous waste and then transplanting flora and fauna from nearby wetlands that are similar to how Agbogbloshie used to be. However, considering the larger picture, we cannot restore a dead planet, since restoration *requires* that other similar but thriving ecosystems exist. A 'techno-fix' approach is therefore, even when possible, only useful in specific cases. Such specific solutions do not solve the problem in its entirety: even if there was a technical fix to Ghana's e-waste problem, for example a cheap and simple yet sustainable method of recycling and/or way to repair the environmental damage done, consider that Man et al., argue that market forces ensure that “e-waste will always run on the least resistant path

to places with lower labor cost and less stringent environmental enforcement". (47) That is, as has oft been repeated, e-waste flows will simply move to the next place with the right conditions, causing the same kind of harm.

As I have argued in this chapter, there is an unfortunate lack of analysis and criticism of capitalism in much of ecological economics – though clearly this is not true of the whole field. Mainstream ecological economics all too often simply tries to substitute a robust social-scientific critique of capitalism with the supposedly easier task of just showing it to be scientifically impossible in the sense that it attempts to violate the laws of physics; infinite growth on a finite planet. Even if it did, it does not mean that capital accumulation would just stop because the owners of capital realize that they cannot keep doing what they do forever. The underlying assumption of that reasoning, I believe, is that if the *idea* of the impossibility of endless growth were to take root in our society, attitudes and values would change to match. It is idealism posing as materialism, for there is no materialist analysis of society; merely the naïve notion that the internal mechanisms of capitalism will stop dead if only people understood thermodynamics. Even if ecological economics was correct in all of its assumptions and assertions, capitalism is driven by other forces than the understanding of science that policy-makers and owners of capital have. In response to this tendency, and following in the tradition of *political* ecological economics, I have attempted to place the events unfolding in Agbogbloshie and other sites like it in the context of global capitalism.

Rather than abstract discussions on the limits physics places on recycling, it is more important for a Marxist approach to consider the role of recycling for a capitalist economy. This is exactly what Burkett does, when he considers recycling in a discussion on profit-motivated incentives to be environmental: "[t]his incentive encompasses the development of more efficient and profitable methods of recycling the matter-energy by-products of production." (48) While he has a point, I would argue that profitability comes first and foremost; efficiency only possibly occurs, and only as a bi-product of being profitable. My cases clearly illustrate that capitalism does not mind primitive, hazardous and inefficient recycling as long as it comes cheaply and has the desired result, in short, one can 'get back' resources into the production chain and get rid of non-functional or old goods. Recycling under capitalism is as driven by profit like any other venture, and formal recycling in modern facilities becomes a real option only when it turns out to be profitable, like it turned out to be in Sweden due to specific conditions and institutional and legal arrangements that overlapped in just the right way. Recycling then also becomes a resource in itself; we saw this firstly in, again, Sweden, where the aforementioned arrangements had created a situation where proper e-waste recycling not only cost firms nothing, but they could in fact expect to be financially

compensated for such activities. Rising mineral prices combined with efficient recycling meant that recycling plants were willing to pay well for e-waste. Secondly, as we saw in Accra, there existed a conflict over the iron scrap, with the Ghanaian government openly stating that they banned the export because they want to keep the metal for use in Ghanaian industries, much to the detriment of scrap dealers who now lose profit. This highlights the very conditional nature of e-waste as a resource. Once e-waste passes a certain value, and/or world mineral deposits and prices change sufficiently, e-waste can rather quickly go from being burdensome waste to being a coveted resource– a dialectical shift from quantitative to qualitative.

One must also consider how much primitive e-waste recycling there *would* be if it was legal and not heavily regulated? In other words, the quest for efficient recycling cannot necessarily be said to be a component of capitalist competition *as such*, but of capitalist competition when restricted by government regulations – that is what creates the context in which proper recycling can be profitable. Were it not for such restrictions, who is to say that a great deal of recycling would not be done Agbogbloshie-style?

The informal recycling of e-waste I have explored also illustrates another, related, point, having to do with *decoupling* and *dematerialization.* These are two related concepts within ecological economics that refer to the idea that an increase in matter-energy through-put and GDP growth, two things that are evidently and irrefutably linked historically, are not inherently and necessarily linked together but can be decoupled so that, in the future, we can have GDP growth without an increase in matter-energy through-put. This would solve the apparent problem on infinite growth on a finite planet and allow the economy to potentially expand forever without thereby placing a greater strain on the environment. The suggestion on how to accomplish decoupling usually involve more efficient use of matter (doing more with less) and an increased production of so-called *immaterial goods*, such as the service industry – a dematerialization of the economy. (49) The debate on whether or not decoupling is physically possible and practically feasible has raged for quite a while in ecological economics; Robert Ayres being an example of a reputable ecological economist who is in favour of decoupling being possible and Herman Daly being an example of an at least as reputable ecological economist who disagrees with the idea. (50)(51)

Computers and other kinds of ICT equipment are commonly taken as examples that support dematerialization, which is understandable given their development in the last 70 years and how they clearly illustrate the possibility of doing more with less (matter and energy). Computer programs and apps, and services based on them, also imply a dematerialization of the economy.

However, this appearance is dispelled at the e-waste dumping sites, and it is made clear that the ICT-industry is heavily reliant on physical manufacturing; a simple fact that is unfortunately neglected on occasion. Perhaps the ability to access remotely so many services and the increasing importance of information give impression of immateriality. We cannot touch, feel or smell computer programs – to the direct user they appear to not be a material product at all. When something is stored 'in the cloud', we perhaps forget that this is not something that is literally happening in the sky, but that the information is stored on a real, physical hard-drive somewhere – as is *all* the information available on the Internet. But informal recycling showcases the material side of the ICT-industry and 're-materializes' what was supposedly de-materialized. All information technology requires real, physical objects, and as the ICT-industry expands so does the production of said objects, and nowhere is one confronted with that reality more starkly than in the ICT graveyards that places like Agbogbloshie constitute.

Not only is this part of the economy as material as any other but it presents unique challenges for, and places its own unique burdens upon, the environment. The consequences to both human and environmental wellbeing showcased demonstrate practically in what way the filling up of global waste-baskets is a pressing limit to the growth of matter-energy through-put. Additionally, the argument can be made that improper recycling: failure to adopt in all cases the most technologically effective recycling method that exists, itself becomes a limit to growth, since it leads to an *overflowing* of the waste-sinks. That is, waste comes to accumulate at a “much higher rate than the waste sink can deal with” leading to dispersal into the surrounding ecosystem, and a much greater damage done. (52) If all ICT-equipment were properly recycled, or even manufactured in such a way as to minimize the presence of hazardous waste in it, a greater amount could go into waste-baskets before a limit was reached, and the *overflowing* of the waste sink could be avoided. As I have argued previously, and hope to conclusively show with this thesis, there are of course specific reason why that is not the case.

Conclusively, I have shown a Marxist Ecological Economics to make theoretical sense and offer a valuable perspective that can be of benefit to both mainstream Marxist political economy and mainstream ecological economics. The specific advantages to the study of waste have also been made clear, as has how the perspective change offered can impact central debates within ecological economics. Firstly, there is not really any such thing as a truly immaterial good. Secondly, as was asked in the beginning of this chapter, the solution to the problem of recycling cannot lie in improved future technology, when the technology we already possess is not being utilized potential and we instead ship e-waste to developing nations. Waste takes a particularity destructive form

under capitalism since considerations of cost out-weight those of human and environmental well-being. The question of waste does not become an abstract attempt to guess the properties of future technology and whether or not full recycling will be possible, but a problematization of the decisions we make in the here and now, their short- and long-term effects, and their underlying causes. Far from resolving environmental issues, recycling may create its own problems. Likewise, ICT equipment does not represent a decoupling from the material economy, but merely permits that illusion while remaining as dependant on manufacture and disposal as any other industry and generating its own unique environmental problems. Therefore, I believe that my research in fact settles these long-going debates, and contributes generally to Daly's side, i.e. against perpetual economic growth enabled by perpetual recycling, and against complete decoupling of economic growth from matter-energy through-put.

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Chapter 14

E-waste in the World-system and Unequal Ecological Exchange

In this chapter, the global flows of e-waste are placed into the context of the theory of world-systems, with the aim of establishing the flow as a particular form taken by unequal ecological exchange. This lays the foundation for understanding e-waste flows from a value theory perspective and connect it to the underlying forces of capitalism in the following chapter. The fundamental concept of unequal ecological exchange is reminiscent of the purely economic theories of unequal exchange from which it was originally developed; i.e. that more is exchanged for less. In the ecological case, we deal with nature's products or the use-values derived from nature, being thusly traded, in some way, less for more.

1. Unequal ecological exchange in the world system

Looking at e-waste trade as part of a global chain lets us place informal e-waste recycling in a *world-system* context, allowing for the analysis of economic roles of geographical regions in the global network and the unequal ecological exchange that takes place. Note that, despite my disagreement with them on the nature of flows, Lepawsky's and McNabb's point that “the international trade in e-waste does not break down along simple divisions between rich, ‘developed’ nations of the ‘global North’ dumping e-waste in the ‘global South’” is one that I think needs further examination. Their conclusion that “highly regionalised patterns exist” is important and should push us into re-thinking 'core' and 'periphery' in the world system. (1) This is especially true in light of the somewhat oversimplified Annex VII/non-Annex VII definition that the Basel Convention uses. Rather than imagining simply that some nations as a whole are either core or periphery, we ought to focus on geographical regions and their mutual relations. My conceptualisation of core-periphery relations therefore pertains to regional roles in the world system. As Gellert argues, “the geographic locations of extractive economies do not necessarily coincide with the core and periphery of the world-system so much as with struggles over benefits of the world-economy... What distinguishes extractive locations are the ways socionatural

configurations are disrupted and altered." (2) More developed nations tend to have both better technology and stricter and better enforced legislation, but this is not guaranteed nor need it confirm to national, rather than regional, borders – compare 'developed' Mexico and 'developing' China, as per OCED/Basel Convention divisions; not to mention various regions within China itself.

The concept of ecological unequal exchange builds on economic unequal exchange: David Smith summarizes the core concept, referring to Emmanuel's and Amin's foundational work on the topic, stating that they "argued that the essence of core exploitation of the poor, underdeveloped regions of the periphery is transmitted through the unequal trade of low-value and less-processed goods from the periphery in exchange for expensive finished products from the core". (3) Bunker expanded this, arguing that it was the "unbalanced flows of energy and matter" from periphery to core that illustrated unequal exchange better than did price or labour time. (4)

Jorgenson and Rice are among those scholars who recognize the basis of ecological economics as compatible with, and in fact beneficial to, world-systems theory, since capital accumulation is the driving force in the dynamic of the world-system, but accumulation itself is founded upon the eco-system of which the economy is a sub-system. (5) Recall that the recognition of the economic system as a sub-system of the ecology is the basic premise of ecological economics – and once it has been accepted, the argument could be made that neither the concept of unequal ecological exchange nor that of world-systems are complete or meaningful without each-other. Every instance of production equates also some kind of 'addition' to, or 'withdrawal' from the natural world, and every instance of production also has a place within the world-system. As Hornborg explains, "[t]he unequal exchange underlying machine technology can only be revealed by exposing, beyond the monetary price tags reified by conventional market ideology, material asymmetries in the net flows of biophysical resources gauged in terms of alternative metrics such as energy, matter, embodied land (ecological footprints), or embodied labor." (6) Or in other words, "wastefulness and unsustainability of industrial resource management is made possible by displacing environmental impacts to other areas, populations, or social categories".[76] In order to grasp the one, we must grasp the other.

What role do informal recycling regions occupy in the world-system? Or, in other words, what is the general tendency of which they are the specific expression? What Smith calls the "new industrial division of labor" amounts to a 'flight', or migration, of certain tasks and industries to

[76] Unequal ecological exchange also takes the form of what has been called an 'environmental deficit/overdraft' or 'environmental load displacement'. (7)

low-wage areas that also possess other properties that make them more suitable for such tasks. This is a simple consequence of how markets work under capitalism, a “path of least resistance” to capital accumulation is naturally found through the competitive process. (8) The urban mining of e-waste is the specific form that phenomenon takes, and informal recycling of e-waste is an even more specific form of urban mining. While some regions have made a shift towards manufacturing of “higher value-added items that employ sophisticated technology”, nonetheless “many peripheral countries remain primarily export platforms for simple low-technology, labour-intensive goods made by low-wage unskilled workers”. (9) Informal e-waste recycling as urban mining occupies a somewhat contradictory position in that division, given that it is low-wage, unskilled labour being applied as part of the production cycle of high value-added technological products. E-waste is a ‘node overlap’, in the sense that two pivotal points in the chain of commodity transformation, extraction and disposal, are linked together and occur simultaneously.

Jorgenson and Rice also note the tendency for developing regions to occupy a dual position in the world-system, on one hand supplying resources for the industries in developed regions, and on the other being a waste-sink for their refuse. (10) E-waste, then, is peculiar in the manner that it happens to be an example of both of these occurrences at the same time. The peculiarity of that position bears further investigation. One possible approach is that of Ciccantell, who argues that an important challenge faced by developing regions is the “problem of access to cheap and secure sources of the raw materials used for heavy industry.” (11) There is logical tendency to “deplete the closest, cheapest, and most secure reserves of raw materials” first, which then requires the seeking out of new and often more distant sources of resources to supply domestic industries.

In this light it makes sense for developing countries to seek to circumvent the search for distant resources – and hence also the need to rely on foreign sources – and keep access to a local resource source to feed their growing industries. Urban mining can offer a solution and allow the maintaining of political control over the resource. Additionally, one would avoid, at least to some small degree, the necessity of the large, risky and very long-term investment required to establish new extraction projects. Given the availability of cheap domestic labour, combined with a lack of strong regulations regarding either the environment or the labour-force, it makes strategic sense to rely on e-waste. Considered a waste product by those who provide it, and hence obtained at low cost or even for payment, it can be transformed into a source of materials and employment.

A congruent idea is to be found in Bunker, who has produced seminal work on extractive regions and unequal exchange. Bunker argues that peripheral economies are predominately extractive,

whilst core economies are productive, and analyses extractive industries through a Marxist approach. The main thrust of his argument is that extractive economies, unlike productive ones, cannot benefit from economies of scale or increased efficiency in the same manner. The very nature of extractive industries as dependant on a finite amount of mineral wealth extracted from a site means that “unit costs tend to rise as the scale of extraction increases” and as the amount of resource left diminishes, “[g]reater amounts of any extractive commodity can be obtained only by exploiting increasingly distant or difficult sources.” (12) While Bunker never specifically mentioned urban mining, the phenomenon can be seen as a natural response of capital to the conundrum he outlines. Informal recycling sites are often richer in minerals than typical extraction sites and require significantly less capital investment and machinery; most commonly there is close to no machinery at all and only very primitive instruments. Even the industrial park at Guiyu, though now a formal recycling site, had far less machinery than a mining venture would require. This type of urban mining also relies on cheap labour, and the workers are paid piece-wages in line with how much they collect. Lastly, taking Agbogbloshie in particular as an example, no capital investment was required to start up the extraction process, since willing collectors and a fitting organisational structure were *already there*.

One problem of Bunker's analysis, that Hermele highlights, is how unequal exchange can take place when mineral resources become more expensive and ought to provide a greater revenue, also becomes moot. (13) Resources do not become progressively more expensive to extract in the urban mining case; Bunker's dilemma is resolved, and capital is ensured a continuous stream of resources at steadily low prices. My own contribution is to highlight the importance of the 'mode of disposal'; my counterpart to Bunker's 'mode of extraction', which itself was meant to harken back to Marx's 'mode of production'. Since the dumping grounds are also urban mining sites, where extraction takes place as well, the general thrust of Bunker's analysis applies rather straight-forwardly, as seen above, the only difference being that the linking of disposal to extraction resolves the dilemma he proposes that capital encounters.

1.1. ‘Dark value’ and unequal exchange as anti-wealth

Frey’s analysis of the place that hazardous materials, among which he explicitly includes e-waste, have in the world system is worth quoting at length:

> “Centrality in the world-system allows core countries to impose their anti-wealth on the periphery. Transnational corporations (TNCs), for instance, export some of the

> core's hazardous products, production processes, and wastes to the peripheral zones of the world-system. Since few peripheral countries have the ability to adequately assess and manage the risks associated with such hazards, the transfer of hazards to the periphery increases the health, safety, and environmental risks facing many peripheral countries… Political and economic forces operating within and between countries promote the transfer of core-based hazards to the periphery. In efforts to create markets and reduce costs, core-based TNCs have moved hazardous products, production processes, and wastes to locations in many peripheral countries. Many peripheral states have enacted trade policies that encourage TNCs to transfer their hazards.[77] In turn, various international organizations (World Bank, IMF, and the WTO) have implemented policies that promote TNC export practices and policies of peripheral states… Many peripheral countries are willing to accept dangerous manufacturing processes and the recycling of dangerous wastes such as ocean-going vessels, e-waste, and automobile batteries." (14)

Marx argued that capitalist firms are driven by competition to introduce mechanization, automation and organizational innovation as ways of increasing the productivity of labour. The more that can be produced and brought to market, the greater the profit that the individual firm can make. (15)(16) Since the capitalist class treats nature as a 'free gift', there is no reason not to increase matter-energy through-put as far as possible; as long as doing so does not somehow reduce profits. However, despite the capitalist class treating nature as a 'free gift', raw materials needed for production are hardly literally free of charge for the individual capitalist, who instead obtains them at a cost that cuts into his profit. It is logical for the capitalist to seek to obtain material and energy inputs at the lowest possible price.

Moore argues that this drives capitalist expansion towards obtaining 'ecological surplus', or "Cheap Nature", namely, low-cost matter-energy inputs, including cheap labour in the form of subsidized labour or even out-right slavery. (17)(18) A kind of ecological imperialism drives territorial expansion into the periphery, but eventually the free appropriation of nature begins to exhaust the 'ecological surplus'. Due both to lower supply in general, and a greater difficulty in obtaining raw materials necessitating greater investments in, for example, mining, prices for raw materials rise, and capitalist profits are reduced.

[77] Consider Ghana's ICT policy

Clelland deepens the analysis of the exploited position of the periphery by introducing the related concepts of ‘surplus drain’ and ‘dark value’, neither of which refers to surplus or value in the classical Marxist sense, but act as an expansion of unequal exchange. (19) Hornborg argues that the “wastefulness and unsustainability of industrial resource management is made possible by displacing environmental impacts to other areas, populations, or social categories”. Hornborg calls this a 'zero-sum game', though the implication of these terms is of an overall *negative* result, at least for one party. (20) Concepts such as 'negative use value' (in Marxist theories) and dis-utility (in ecological economics) become relevant here as well and could be considered related concepts that express the same phenomenon but apply to it a different label. A similar line of reasoning forms a part of Bunker's theories regarding extractive economies.[78]

What differentiates the dark value flow concept is that it is situated as a form of periphery super-exploitation; a specific form that super-exploitation takes, or perhaps rather a group of specific mechanisms through which it occurs. It is the invisible value-added from “super-exploitation of peripheral labour, households, and ecological resources”; the “invisible surplus flow” which is “collected by buyers in the form of cheap commodity prices”. (21) Clelland identifies the core mechanism of the capitalist world-system as profit maximization based on cost minimization, compelling a continuous expansion of capitalism into new areas and regions, both geographical and conceptual, in search of lower costs and new markets. It is a system by necessity borne out of colonialism and imperialism, and one that is “defined by exploitative relationships… [w]ithout surplus drains, there is no core, no periphery, no world-system as we know it.” Additionally, costs are continually externalized in various ways and kept from impacting production costs. (22) As Foster and Holleman put it, “[t]he more developed countries have larger ecological footprints but less domestic environmental degradation within their borders, while less developed countries have smaller footprints and more environmental degradation within their borders”, namely, a case of successful shifting of environmental burdens and their associated costs. (23)

Much like Benton et al., Moore argues that this increasing unavailability of key resources at low costs can actually impact production costs despite these externalizations and create a crisis for capitalism. (24) Foster et al., argue in a different direction, that capitalism will seek to overcome these resource limitations in various ways, such as seeking alternative resources or new sources. Another pressure would be the need to dispose of broken-down commodities – so that urban mining

[78] It ought also to be noted that Bunker, despite the sophistication of his analysis, fails to use the use/exchange value dichotomy of Marx; a distinction so useful that even a noted critic of Marx such as Daly has taken up using it in his ecological economic analysis. Bunker also rejects Marx's value theory altogether, while in contrast Foster, Burkett and Moore have argued that value theory is integral to a Marxian ecology.

hits two birds with one stone. One does not need to pick a side in this particular argument to recognize that the hunt for cheaper resources, and the possibility of increasing costs, can be a pressure on capitalists to which urban mining is one potential solution; a different way to exploit 'Cheap Nature', that is, an *innovation in exploitation*, a new kind of dark value flow.[79] It is not classical raw material imperialism from the traditional periphery but a new way of doing what Moore argues underpinned capitalism expansion before and during the industrial revolution, and what Clelland argues sustains the core-periphery system itself. (25)

Whether this resolves the resource pressure, or if that pressure is serious enough to cause an actual crisis for capitalism as Moore claims, I will leave aside here – my argument is strictly that that capitalist firms search for low cost resources and low-cost disposal, and are pressured to innovate in the form of urban mining that addresses both issues to some degree. On the debate between Moore, Benton et al., and Foster et al., on the threat and impact to capitalism, I will return in the next chapter. For the moment, consider that whether it is merely a pressure on the individual capitalist to lower costs, a pressure on capitalists as a class to secure cheap inputs and cheap disposal, or counters the tendency of the profit rate to fall; the phenomenon is ultimately clearly grounded in capitalist accumulation. E-waste is one part of this, informal urban mining being an especially innovative way to combine the need for both material resources and waste-sinks.

'Core-periphery' is thus *not* a strictly geographical or spatial category, but one of surplus relations – it is not merely the case that surplus flows from periphery to core, but that this flow is what *defines* them as 'periphery' and 'core' respectively. Viewing core-periphery relations in terms of surplus transfer allows us to see the complex networks that surplus flows form; no longer are we dealing with a simplistic view in which core *nations* such as the USA or UK transfer harm to and import benefits from periphery nations such as Ghana. While it is true that "whole states that contain major surplus collection points may be designated as core states", we can also have flows both within the same country and between countries and even going 'in reverse'. (26) Whatever region is at the losing end of a flow or exchange is defined as peripheral and vice versa for the core; periphery/core regions not strictly following national borders does not undermine the theory and is, in fact, to be expected to be more common the more capitalism spreads and develops. Thus, we might have expected a strictly national division of flows to China in China's more distant past but

[79] The debate between the different schools of Ecomarxism is complex and long, and would require a thesis of its own to do it justice. Moore even argues that it is a countervailing force to the tendency of the profit rate to fall, itself largely determined by the changing technical composition of capital as mechanization and automation rises. It is certainly a theory worth exploring.

given the rapid development of China we would rather expect the opposite nowadays.

E-waste flows are a specific case of dark value flows; specifically, they are the result of a combination of "under-remunerated or unpaid inputs from… the informal sector" and "ecological and human externalities that are 'economically free' to capitalists." (27) Consider the manner in which Agbogbloshie workers subsidize their e-waste work with seasonal agricultural work, or vice-versa. This can form dark-value chains in which the waste-worker is subsidized by cheap food, for example, which the farmer can provide because he is being subsidized by unpaid female labour, which is provided because the woman underpays for childcare allowing her more time to work. There is also a drain on the local economies, through the displacement of people that could have been employed in the formal sector and boosted the local economy: young boys, for example, often miss school and associated opportunities to work with e-waste instead, creating a kind of internal 'brain drain'. Hence the exploitation does not occur only at the level of the e-waste worker but is systematic in nature and affects the whole society of the peripheral region. The e-waste worker is merely a particular symptom.

What is often overlooked in the analysis of the global networks in the world-system is the role of *disposal*. Hopkins and Wallerstein's classical definition of global commodity chains, for example, defines them as "a network of labor and production processes whose end result is a finished commodity", missing that waste and pollution are equally the end result of production, as much as commodities are. This oversight is hardly intentional, but crucial since it betrays a kind of blindness to waste in the literature on world-systems and unequal exchange. (28) Jorgenson and Rice also note that waste-sink-based research of this kind is "much more limited". (29) They quote Roberts and Parks, and Stretesky and Lynch, as two notable exceptions, but they deal with carbon emissions, which are far easier to quantify. (30) Quantification issues could indeed explain, in part at least, the lack of research on waste-sink exchange. Nevertheless, it very much is a form of unequal ecological exchange; a "usurpation of sink-capacity or waste assimilation properties of ecological systems in a manner enlarging the domestic carrying capacity of more powerful developed countries to the detriment of developing countries."[80] (31) In the absence of simple quantification, an alternative approach is needed to help illustrate the occurrence of sink-related unequal exchange: that of *entropy*.

[80] 'country' is best substituted with 'region'

2. Unequal entropic exchange

Using an ecological economics framework, one can also conceptualize pollution as entropy: the main sources of contaminants at Agbogbloshie, plastics and heavy metals, are not particularly dangerous when they are a part of commodities, that is, when they have *low entropy*, when they are ordered. It is when they are dispersed into nature and people, that is, have *high entropy* and are disordered, that they become hazardous. They come to have high entropy through the informal recycling process, for example, through burning. In other words, the total entropy of Agbogbloshie as a closed system increases in order to transform e-waste into low entropy useful matter (e.g. copper) and high entropy pollution – using local energy, including biophysical energy, namely, labour.

The useful, low entropy resources then largely leave the country, or at least leave the underdeveloped region in order to feed domestic industries in more developed regions of Ghana, whilst the high-entropy pollution stays. Total entropy in developing regions has thus increased, whilst the total entropy in developed regions has decreased, for they have shipped off useless and relatively high-entropy broken goods and received in turn useful, low-entropy resources. Export and import of e-waste connect developing and developed regions into a 'closed system' in entropic terms; that is, entropy can be displaced by way of increasing in the developing region and diminishing in the developed region. E-waste trade offers developing regions a kind of 'spatiotemporal fix' for both environmental issues and their industrial demand for minerals. (32)

As discussed previously in Chapter 13, I would agree that waste-as-entropy is a necessary component of industrial production, at least given current technological levels. Since energy and matter are not – in fact, *cannot* – be destroyed during production, but only transformed into the finished product, and since the transformation cannot be 100% due to the 2nd Law of Thermodynamics, the difference must dissipate. This of course can only hold for cases where there is a potential hazardous pollutant involved: boiling water does lead to dissipation in the form of steam, for example, but that can hardly be considered a 'pollutant'. Additionally, even the worst pollutant would become a non-issue if we found a way of neutralizing it; what constitutes a pollutant is thus contextual and depends on the technology available. Both quantitative and qualitative differences will of course depend on how production and recycling actually take place, but nonetheless thermodynamics requires that total entropy increases for any given system. Burkett notes that the "inevitable cost of arranging greater order in one part of the system (the human economy) is creating a more than offsetting amount of disorder elsewhere (the natural

environment)" – here he establishes the absolute necessity of an increase in entropy, yet the social determinant of its quantity and quality is indeterminate. (33) Part of this quality are the pollutants involved and the geographical location at which entropy increases contra decreases, as mentioned above.

The entropic perspective on pollution highlights a specific form of unequal ecological exchange; the unequal *entropic* exchange. Scholars of unequal ecological exchange, such as the aforementioned Hornborg, normally take a quantitative approach to unequal ecological exchange, seeking 'alternative metrics' to money that are able to verify empirically that unequal exchange takes place, and gauge its nature and severity. The approach, however, has its limits in the e-waste case. With the introduction of entropic exchange, it may be tempting to attempt to quantify such a thing as another metric of unequal exchange, but it would be an inaccurate measure. This is because the entropic dispersal takes on a particular and damaging form at places like Agbogbloshie; *through* and *into* human bodies and the local environment. It is that unique and troublesome *pathway* of the entropic dispersal, and not merely its quantity, that is central to the analysis. Likewise, it is not the quantity of the energy used to recycle that is of import, but the fact that its source is human labour and small fires made by burning styrofoam. The issue is further exacerbated by the fact that a lot of the entropy, both quantitatively and in terms of its qualitative properties, could hypothetically have been avoided if the recycling had been done elsewhere, or done differently. The additional entropic increase – and the damage to environment, society and health that is causes – is then not merely geographically displaced but *created*.

What an entropic perspective on pollution allows us to do is move beyond the quantitative view of unequal exchange, onto one that is also qualitative and context-bound. One where the networking, through trade, of geographically distant locations into a unified 'system', for the benefit of one end and to the detriment of the other, represents more than mere inequality in a series of exchanges, but a systematic impoverishment of the ecological and human health of regions. Second-hand equipment, e-waste and goods derived from it constitute a host of different objects with different entropic properties, and thus differing levels and types of usefulness.

Pollution is not a side-effect nor an accident, but an inescapable and central necessity of the process, where its precise nature and quantity is shaped by class relations and the position of regions in the world system. A lowering of entropy for one set of objects – the turning of e-waste into resources – necessitates the increase of entropy for the total system; the dispersion of pollution from the e-waste. When the 'total system' consists of two separate regions linked together via trade, and the

developed region has its entropy lowered and the developing region has its entropy increased; pollution is ‘traded’ for resources. Seen from an economic perspective, it can be considered an ‘unequal exchange’, in which one party receives less value than the other – but from an entropic perspective, one party receives only benefits while the other only gets disadvantages. It is a form of ecological exploitation. The reason that the ‘trade’ happens at all is because a developing party is at a disadvantage in the world system; it is impoverished and, given that it does receive some economic benefits from the trade, it is incentivized to do it. The developing party is therefore, in a sense, trading away the wellbeing of its people and natural environment for money. Out of economic necessity, it is taking upon itself both the displaced entropy of the developed party, and the additional entropy created, for a share in the profit generated.

Nonetheless, there is an undeniable quantitative dimension to the energy and entropy involved, and a qualitative view is not meant to negate that but simply expand it and underline the importance of context. For example, it is interesting to note that H T Odum, the father of systems ecology known also for his pioneering work on energetics, used what he called *emergy values*, his term for 'embodied energy', that is, the total energy required to produce a commodity, to illustrate different forms of unequal ecological exchange taking place. He notes that “emergy values for products from rural countries in relation to price are higher than in developed countries in relation to price because more of the support of labor comes from the landscape without payment”. (34)

This is essentially the same concept that Marx took note of, and that was used in Chapter 12; that supplements and subsidies from nature through, for example, farming can artificially lower the minimum wage, by enabling the worker to live and reproduce on a wage that is technically lower than that required to maintain themselves. Odum notes a quantitative, energetic side to this: subsidising with agricultural work in practice meant that a person had to spend more physical energy in total to sustain themselves and their family, since they had to do their wage-labour *and* agricultural work on top of it. Working with informal recycling becomes a kind of 'nature's subsidy' much like agriculture, though different in a crucial way. People live not off the fruits of nature, but on an industry that destroys the natural world and is in fact only possible and profitable because it does so.[81] Hence the importance of the qualitative aspect is shown, since the same bodily energy exerted working with agriculture and working with e-waste have two completely different impacts on environment and health.

[81] The kind of (quasi)petit-bourgeois system based on people repairing and selling electronics would also be a kind of 'natural subsidy'; an alternative to wage-labour made possible through exploitation of nature.

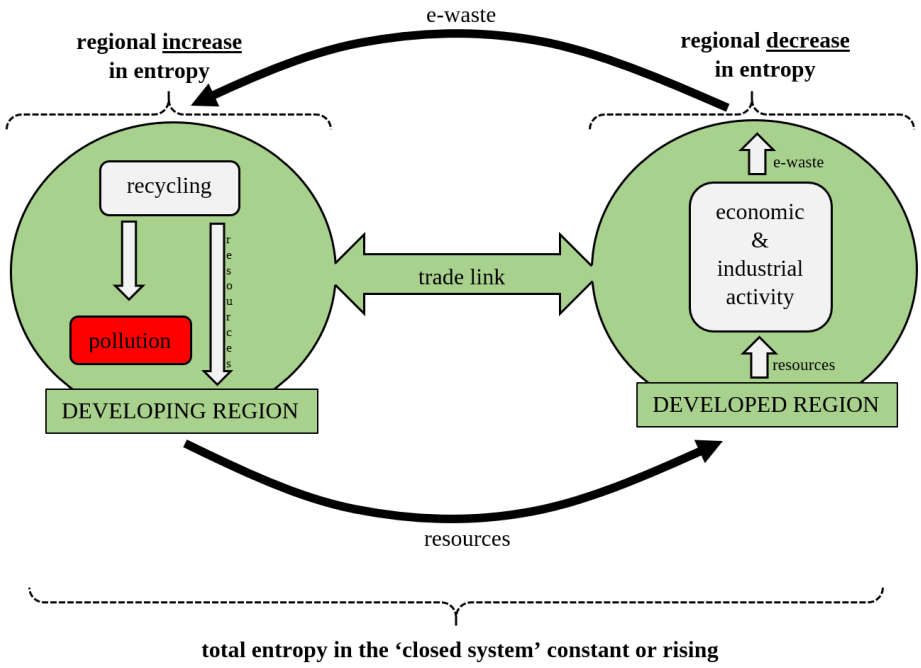

Figure 14.1. *The laws of thermodynamics dictate that total entropy cannot decrease in a closed system. However, entropy can be decreased in one part of a system as long as total entropy in the system as a whole increases or remains constant. Trade links two regions together, forming the equivalent of a 'closed system'; medium-level entropy e-waste is transported from the Developed region into the Developing, and low entropy resources flow in the reverse direction, while high entropy pollution caused by recycling remain in the Developing region. The Developed region shifts its entropic burden onto the Developing region – in a sense, pollution is being traded for useful resources.*

Additionally, Odum called the "EMERGY of one type required to make a unit of energy of another type" by the term *transformity*. (35) As Foster and Holleman note, "[g]oods with higher transformity represented dated inputs of energy (including entropy or dissipated energy) that went into their production. Higher transformity was associated with the emergence, at higher levels of production, of more useful products, i.e. in forms more accessible to human beings." (36) That is, useful products of lower entropy require more energy expended to lower their entropy into that useful state.

Though a simple approach to quantified illustrations of unequal ecological exchange for waste-sinks still eludes us, entropy could potentially offer an alternative, as long as the qualitative aspect is considered. However, a quantified model of that unequal exchange would require far more exact knowledge on flow quantity, sources and directions than is currently available – and given the

issues of gathering the data, as covered in Chapters 3 and 4, sufficient amounts of exact information may never be available for e-waste in particular. Approximations may nevertheless be worth exploring, as projects such as BAN acquire more and more data on flows in the near future.

3. Use-value and class conflict: approaches to unequal ecological exchange

Hornborg raises the important question of whether matters of ecologically unequal exchange are "best conducted in terms of asymmetric flows of 'values' or in terms of asymmetric flows of biophysical resources", himself siding with the latter. (37)

As my case-studies illustrate, there is also an 'exchange' of sorts of waste sinks, health impact, and other qualities that go beyond just quantifiable biophysical resources. Use-values, as well as *negative* use-values, illustrate a *context* – technological, social, and historical. What is really occurring is that things useful for human activity are flowing; their relation to human activity matters, not just their physical properties in isolation from society. In other words, the two cannot be separated; exchange of useful things (be that labour, materials, land, etc.) and exchange of resources and the creation of exchange value; it is all part of the same cycle. Hornborg would disagree, arguing that if one chooses to "refer to asymmetric flows of energy, materials or embodied land as an unequal exchange of 'use values'" then one "confuses physics and economics." (38) But we live in a human economy, and the amount of "joules, tons or hectares" of something that is not useful for human activity is not of our concern. In fact, I am left wondering how or why a joule, ton or hectare of something that was not at some point useful for someone to some end wound up in the economy to begin with. It would not be a part of the economic sphere if it did not at some point have a use-value to someone. Flows of energy and matter in the economy always have some purpose, some end, some history, some relations; socially embedding means only recognizing that fact.

Note that neither joules, tons nor hectares measure use-values, since use values are not quantitative in Marxian economics, and hence not measured at all; a certain quantity of material is *not* a certain quantity of use-value. Rather, certain things have use-value, either to people, communities, factories, firms, nations, or another agent, and some of these things are of such a nature that their quantity can be measured in joules, tons or hectares. We may certainly say that there is a greater use-value in $2x$ joules of energy than in x joules, all else being equal, but this is not the same as a

quantitative measure of use-value; and as discussed previously, there is a qualitative aspect to content with as well: not all joules are the same. That is, *x* joules from solar energy do not equal *x* joules from coal or *x* joules from a human setting fire to some styrofoam – they are certainly the same in strictly quantitative terms but their social aspects, including environmental impact, is different. They are embedded in different contexts and part of different relations, and without knowing these relations we cannot understand the nature of the flows even should we know their quantity. Without quantitative estimates of matter-energy flows and their direction, we lack an empirical basis for analysis; without social embedding of the flows we cannot understand their relations or their meaning. A use-value perspective prompts, in fact necessitates, the question: why is a certain material, at a certain time and place, extracted, transported and so on in a certain quantity? In order to produce a thing, of course, which provides use-value for the consumer and allows the producer to accumulate exchange value. From the perspective of the producer, the material itself has 'use-value' in so far as it enables his production and hence ultimate goal: exchange value accumulation. A value perspective does not negate the biophysical dimension, it embeds it socially into the capitalist system, places it in the context of exchange value accumulation.

That dimension of social dimension of flows of matter and energy cannot be neglected. Measuring the quantity of flows can certainly tell us a lot, but I believe that Hornborg is mistaken in his assertion that they are the “only tools we have to demonstrate the occurrence of ecologically unequal exchange.” (39) Discrepancies in these measurements are a part of showing that ecologically unequal exchange occurs, certainly, but we must also consider qualitative aspects in the environment and society. Metrics on their own, as abstract numbers, are meaningless from a political economics standpoint – it is what they concretely represent that matters – and what they concretely represent is a class-conflict over use-values.

Flows of matter and energy *are* value which has taken on a particular form. One cannot analyse them as ‘freely floating’, separated from real economical processes; to ‘socially embed’ MFA is to embed it into the economic system, namely, capitalism. It is to recognize all material flows in the economy as moments in the over-all cycle of accumulation. Consider the classical M-C-M’ formula. Between the initial investment M and the final surplus appropriation M’, there is the C of commodity production. And the C entails, practically, various flows of matter and energy. Things are either on their way to become commodities, or otherwise be a part of the process that churns them out, or to become the capital and infrastructure that enables commodity production, or they have been used up as either of the above are being in some matter disposed or recycled. Material

flows are hence a part of exchange value accumulation and, therefore, represent some form of use-value to someone (or are *represented* as it at some point, in the case of disposal). It is hardly strange that materials have different use-values depending on whom one asks, for 'use-values' are contextual. This realization is crucial for the Ecomarxist view of nature as a site of class struggle: nature has wholly different 'use-values' for the capitalist class than it has for the vast majority of humanity. For the capitalist class, nature is useful as a means of continuing the cycle of production and enable continued capital accumulation, and for humanity as a means of living, reproducing and flourishing. For the individual consumer they have use-value in so far as they form an end product that satisfies some need. There is also the *potential* use-value something *could* have had, had it been used differently. It is in this potential that a conflict over use emerges, rooted in the different interests of the classes.

Hence a wetland outside of the Ghanaian capital of Accra has ‘use-value’ for humanity in providing various amenities, such as being a source of biodiversity, a source of livelihood (e.g. fishing), being aesthetically pleasing, having spiritual significance or whatever else is in the realm of human well-being and flourishing and beyond strictly quantitative measurement. The same wetland has none of the listed potential use-values for capital, to which it instead is simply a place where waste can be dumped and new resources acquired for a low price, with no regard to how any of the humanity-benefiting use-values are impacted. Yet the wetland cannot serve both purposes at once, because the two uses are mutually exclusive. It is this conflict over what kind of use-value something has, and for whom, that is at the heart of the Ecomarxist recognition of the natural world as a site of class struggle.

The advantage of this use-value based perspective is that it allows us to see both biophysical resources and the natural world itself – specific sites, ecological niches, amenities and so forth – as sources of use-value, potentially either nurturing human flourishing or enabling continued capital accumulation. We are not limited to strict ‘flows’ of matter or energy in establishing ecological unequal exchange but can look to all the aspects of the capitalist economy that enable and perpetuate accumulation. A site being used as a combined waste-basket and mineral source is not merely a hub in a flow or a node in a network; a centre of accumulated stocks of waste and source of outflow of resources. It is itself a part of the infrastructure of accumulation, with a particular role and use that stands in contradiction to other potential roles and uses.

Of course, use-values cannot be measured or quantified directly, so as a proxy we can rely on different indicators and measurements; not only quantities of matter, but their *specific* flows and

the social and environmental impact of these flows – and then gathering from that inequality taking place, and how use-values differ for the different actors involved, i.e. a socially embedded material flows analysis. The various empirical indicators, thus, do not in-and-of-themselves provide a full picture, but they can be used to support an explanatory narrative. Measurements and matter-energy flow schematics are hence an illustration, and a quantitative expression, of unequal ecological exchange: the empirical that is evidence of the actual.

This contextualization, and the specific pathways that flows take, are crucial. The central issue is neither that the total labour hours or the energy expended differs quantitatively from a state-of-the-art recycling facility in Sweden and those informal methods used in Ghana. Nor is the amount of matter in the flows, strictly speaking, an issue. What matters is the *qualitative* differences: that the energy expended in Ghana is consumed by people setting fire to styrofoam and melting plastics over it in pots and pans in order to get to the metals. It is the fact that burning PVCS produces toxins that would not have been produced at all in a modern recycling facility. It is the fact that the toxic materials from the dumping site at Agbogbloshie also contaminate the local food production by way of fumes being carried by wind to the nearby food market. That the flows of, say, led or copper go *through* people's bodies and *through* their local environments.

There is a particular type of exchange that is occurring here, that a value-approach reveals. Environmental and social harm, *negative* use-values, are 'exported' to another country, and in turn use-values are 'imported' given that benefits are transferred from one country to another. These benefits go both to the capitalists, in the form of greater revenue and access to the materials required for production, but also indirectly to all the inhabitants in the form of a healthier local environment and people. Our various indicators, like quantity measurements and flow mapping, help us demonstrate that this has occurred. We cannot quantify the use-values themselves, but we can nonetheless identify a disproportionate exchange that bears an undeniable class dimension. To recognise that the benefactor is usually a developed region while a developing region loses out is to recognise the imperialist and colonial dimension of the issue. To realise that the inhabitants who benefit are disproportionately the capitalist class, while the inhabitants who are harmed are, to use the classical term, *the proletariat*, is to recognise the class dimension of the issue.

In truth, to speak of the natural world as having *use*-value implies an instrumental view of nature, as both separate from mankind and a source of resources for us, presenting the class conflict as merely being over what kind of resources nature should be 'mined' for. It is not an error on my part that I select this entry point, for it is fitting given that capitalism has an inherently instrumental

view of nature. We must proceed, as Marx did, from actual material conditions, and those conditions are that nature *is* instrumental and a resource supply. Once it is recognized that another view of nature is possible, another 'use-values' attributable to it, that stand in contrast to the capitalist view, it is also possible to move entirely beyond the instrumental view. Use-value conflict is therefore not the end-point of the analysis, but a necessary step needed to highlight the contradictory relations human beings can occupy in vis-à-vis nature, and the class dimensions involved. From within the instrumental view inherent to capitalism, we are able to negate the instrumental view by highlighting 'use-values' in nature that go beyond strict *use* and to our own condition as human being, our *species-essence*. Like class itself, instrumentalism is a historically limited relation that falls apart with the system that upholds it. We are able to move, conceptually, to the end-point of the analysis. This brings us back to Marx, and the idea that Saito expresses as the formula *humanism = naturalism*, and that Marx himself expressed when he wrote that "…communism, as fully developed naturalism, equals humanism, and as fully developed humanism equals naturalism". (40)(41)

Having established these differences in use-value perspective, it is clear that the usefulness of nature to capital is as a means of enabling exchange value accumulation. This allows for a further shift in perspective, using value theory analysis in order to connect e-waste flows to the underlying driving forces of capitalism. This necessitates a re-imagining of the concept of value from an Ecomarxist perspective that explicitly considers the role of the natural world in value creation.

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Chapter 15

Value-theory and the Ecomarxist Approach

1. Nature, labour and exchange value

The task now is an ecological re-building, or re-imagining, of Marxian value theory. Firstly, I will begin with the question of if, and how, the natural world is a source of exchange value, where I contend that it is not and that the nature-value relation must be understood in other terms.

Marxist researcher Peter Custers asks “...how Marx’s theory of value can be adapted in such a manner as to integrate the natural world's contribution to value creation and the unfair use of it as dump”? (1) This, I believe, cannot be done without contradicting everything in Marx and misinterpreting the concept of value completely. The natural world is quite obviously necessary for all economic activity, as ecological economics stresses and I unreservedly accept. The natural world is, to put it simply, *useful* for capital because it provides resources, amenities and services needed in production – but exchange values “do not contain an atom of use value”! Exchange-value, Marx argues, is merely the relation, mediated through commodity exchange, between the individual labours of those engaged in it, in an equalised or universal, form; it is labour exchanging for labour. Exchange value is simply the interrelation of different forms of labour; Marx would call it tautological to say that labour alone is the source of exchange value and it only needs to be argued in favour of because some theories insist on nature’s contribution to exchange values. (2)

That the natural world is used (and destroyed) does not necessarily affect value or price in any way other than it might make future acquisitions of natural resources more expensive to the capitalist. In fact, I would argue that the lesson to learn from Marx's value theory is precisely that the natural world has no role in creating exchange values, and since capitalists are primarily concerned with the creation of exchange-values they have no general incentive to care for the natural world. In *Marxism and Ecological Economics*, Burkett makes a similar point, observing the need to “inquire into the social-relational origins of the dualism between allocation and scale, that is, between private and collective values. How is it that people have become so alienated from nature that their dominant form of exchange, the market, places no value on environmental sustainability?” (3)

The natural world is obviously crucial for production, but is treated as a free gift within capitalism. It contributes to the production of use-values, but not exchange values. It is possible that it can affect the distribution of surplus (much like other hurdles to capital, such as taxes and tariffs), or possibly even affect the rate of profit (as Benton et al., suggest), but that is not the same thing. In fact, at the level of the individual capitalist, the more of the natural world's 'free gifts' you appropriate, and the more you successfully externalise environmental harm, the greater your revenue. But what about the level of the whole economy? The kind of theory that Custers asks for suggests that it is within the interest of capitalists that they do not destroy the natural world, as doing so undermines their own surplus accumulation – similar to how technological progress does, and driven by the same atomistic drive for profit. I believe that I can re-state this theory, without contradicting Marx, as environmental destruction being a potential hindrance to profit, in the same matter as worse worker health, regulations, taxes, and lack of resources (that is, the less of the natural world there is left to appropriate freely). As I have shown using a brief example with silver and gold, a lot of potential revenue is indeed lost at the e-waste dump sites when primitive recycling techniques are employed that cannot capture the valuable metals as efficiently.

Hence my argument is that, rather than having the same relationship with value that labour does, the use and appropriation of the environment has an indirect impact on profit – and just like in the case of worker health through lack of security, spare time through long working hours, and so on, the environment is an area of class struggle. Whether or not there is any impact on profit depends on how successful the workers are in forcing concessions from the capitalists – environmental responsibility and the like on the part of capitalists is really no different in this way than the eight-hour working day or workplace safety. Custers assumes a direct relationship between the natural world and value, and even though this is intended in a strongly environmentally positive way, it actually undermines the role of the natural world as a site of class struggle. Indeed, it misses the social quality of value and its historical limit, and imbues in it an ever-present essence.

Burkett, in his book *Marxism and Ecological Economics*, summarizes this point excellently: "...capitalistically-induced crises in the conditions of human development do not necessarily mean crises of capitalist reproduction... For capitalist production, all that matters is that labour-power and material conditions be separately available in forms that can be combined as commodity production by wage-labour. Given this precondition, capitalist reproduction does not depend upon any particular limit to the entropy level in its matter-energy environment." Burkett also adds: "[t]o have value, labor must be objectified in use-values whose production requires specific forms of low entropy matter-energy. Yet, from the standpoint of the system as a whole, these requisite natural

resources have no value." (4) That is, no *exchange* value; this says nothing about their use-value. Clearly, they also have a specific use-value for the capitalist in the sense that they are a pre-requisite for accumulation taking place at all.

Note also that Burkett uses the word "necessarily" above, meaning that he does not inevitably contradict Benton, as the scenario Benton describes *can* happen. Burkett merely points out that the two things are separate, and the one does not always lead to the other. In fact, Burkett argues that environmental issues can indeed cause "crises of capital accumulation, as the demand for materials (including energy sources) periodically outstrips supplies – leading to rising costs, falling profits, and even physical disruptions of production due to the non-availability of essential raw and auxiliary materials. Such materials-supply disturbances reflect an inner tension between the value-creating and material dimensions of capitalist production." (5) However, unlike Benton, Burkett does not believe the aforementioned to pose a serious threat to capitalism itself as a system. Degradation of the natural world can in fact be a source of profit, informal e-waste management being a clear examples of this.

To reiterate, exploitation of the natural world can be said to be a pre-requisite for the exploitation of labour, so that even though it does not produce exchange value it is a foundation of its production. Kaufmann argues along similar lines:

> "From a biophysical perspective, labor is not the primary, self-renewing force described by Marxists. While labor does reproduce, labor does not create or recycle its own energy. Instead, the existence and reproduction of labor and capital depends on a continual input of low-entropy energy... Energy cannot be created by labor or physical capital, but instead must be recovered from the environment." (6)

Kaufmann also makes the same point when arguing against the way that Marx is interpreted as dichotomizing the "relation between humans and their environment", arguing that "a biophysical analysis indicates that the natural world's role in economic production changes with the 'social phase of existence' and therefore is a dynamic participant in the dialectic governing the extraction of surplus value." (7) While, as covered above, I am critical of the view that the exploitation of the natural world affects exchange value, there is nonetheless merit to the above line of reasoning.. As Levins and Lewontin make clear, alteration of the natural world is common not only to all phases of human development but to all life since all lifeforms to some degree both alter and create their environments. (8) Yet precisely how this is done, and what role the natural world takes, differs: within capitalism, the natural world takes the very specific role of being a basis for capital

accumulation. What role it has changes, of course, the way it is treated. This reasoning is therefore merely an extension of Marx's historical materialism.

One can also argue that Marx *does*, in a way at least, include nature and the natural world in his value theory. The 'physical subsistence element' (food, housing, clothing, and so on) of the value of labour-power can be said to be, in a sense, a biophysical basis for value.[82] Marx of course does not reduce it to that, including instead ‘a historical and moral element’ to the above; and of course, even the exact nature of the 'physical subsistence element' and especially its value may change with history, culture, technological development, geographic location, and so forth. Its basis is however biophysical; it *must* exist in some form, as labour-power is merely (those specific forms of) matter-energy converted by the human body and expressed as concrete labour.[83] The point is that Marx includes it, though not necessarily as something that can be specifically calculated and separated out from the moral and historical element, but as part of the same social-natural process that serves as the basis of the value of labour-power. It is thus not an ahistorical or reductionist, but a *dialectical* inclusion. The different forms of labour, skilled or unskilled, of course matter as well, making energy-reductionism impossible.[84]

Marx also states that there is an “ultimate or minimum limit of the value of labour-power ... the value of the commodities which have to be supplied every day to the bearer of labour- power ... so that he can renew his life-process”. To determine this, Burkett argues, Marx adapts the work of energy physiologist Hermann, an ‘energy income and expenditure’ framework: “...the biochemical compositions of energy income and expenditure, and their degree of compatibility with nutritional and other metabolic functions, help determine whether any given work process is consistent with the healthy reproduction of the labourer”. (9) The type and intensity of labour affect the needed biochemical forms and quantity of energy income, as does how well rested the worker is from past labours; the worker is not an engine, after all.

The above discussion is also related to the ideas of humanity's place in Nature, and the division between the social and natural. J W Moore, in *Transcending the Metabolic Rift,* attempts to connect these two ideas:

> “If we look beyond the binary of labor and nature in favor of ‘labor-in-nature’, we can see this binary resting on the (Cartesian) re-coding of human labor power as ‘social’.

[82] This is by necessity an instrumental way of considering nature: the use-value of nature to capital is that it supplies it with resources needed for production, including the resource of labour.
[83] Marx: “conversion of living substances into motion as it applies to the nature of man”. (10)
[84] Engels speaks of this in *the Dialectics of Nature*. (11)

> But is not human labor-power eminently socio-ecological? The intergenerational (re)production of labor-power is itself a 'natural cycle' whose socialized flows are registered in the determination of socially necessary labor time. From biorhythms (proliferating shift work) to bioaccumulation (rising toxicity), on closer inspection we find it challenging indeed to determine the boundaries of the allegedly social and the seemingly natural." (12)

The metabolic concept is hence a dialectical framework, dealing with *relational* as opposed to substitutional distinctions between the natural world and society; a non-Cartesian distinction. Using such a framework we can better consider both human-natural relations in general and the role of the natural world in value creation more specifically – but also see the necessity of moving beyond the academic division between natural and social sciences. The framework of Burkett, Foster and Moore combines the metabolic rift analysis within the theory of value, showing the two to be intricately linked.[85]

2. Alienation, value and the ecological rift

2.1. Alienation in the ecomarxist project

Firstly, it bears noting that when Marx wrote in German, he used two different words when referring to what is most commonly translated as 'alienation' in English, *Entäusserung* and *Entfremdung*. There is dispute within the literature as to whether or not Marx used the terms to denote different things, though as Sayers notes, "Marx sometimes uses 'Entäusserung' to describe the way we relinquish ourselves in our products, and 'Entfremdung' for the way in which these products become hostile forces working against us; but he also uses the terms interchangeably." (12)(13) Rather than speculate on Marx's intent, I would suggest that it may be conceptually useful to distinguish *Entfremdung* from *Entäußerung* in order to grasp the idea of alienation better, both as it develops through the writings of Marx, and as it is expressed in a capitalist society.

Entäußerung expresses Entfremdung but also constitutes it, maintains it. Entfremdung, interpersonal estrangement, of labour is a prerequisite in a sense for Entäußerung of it to be possible, namely, the relinquishment or commodification of labour. Though, reversely, without the

[85] Moore claims, in the same essay, that he "proceeds from the irreducibly socio-ecological constitution of 'value' itself (as process and project) – its internalization of human nature through commodified labour-power, and its externalization of extra-human nature through the treatment of nature as a free gift."

real life, practical act of selling of labour – Entäußerung – there can be no Entfremdung; no abstract sense of alienation of the ‘higher forms’, that is, alienation from one's species-essence and from other workers.[86] Likewise, our Entfremdung from nature, our abstract separation from it, is a necessary component of the Entäußerung, alienability or *sellability* of nature; its transformation from an integral aspect of human life to a commodity. Of course, simultaneously, there can be no ‘abstract separation’ without the practical actions that tear up the pre-capitalist bonds and relations to nature and cement the capitalist relations to it as a resource and a commodity in their stead.[87] One expresses the other, which in turn reaffirms and cements the former in practice.

Ultimately it is the same phenomenon, alienation, simply viewed from two different angles. What is crucial here is not the use of words as such, rather their capacity to clarify. What is crucial in instead the intertwining between the alienation of labour and alienation from nature, and how these concepts develop in Marx’s writing. Here the philological work of Kohei Saito succeeds in finding the ‘missing link’ between the early, anthropological Marx and later, historical Marx, as well as between the concept of ‘alienation’ and that of the ‘ecological rift’. Saito’s impressive work allows for an understanding of the central role of ecology and human-nature relations in Marx, and how this relates to Marx’s theory of value. (14)

Saito overcomes the contradiction between the Marxist humanist perspective, of alienation as a constant aspect of Marx's philosophy, and Althusser's position of an epistemic break between the early and the later Marx. He reads instead *The Economic and Philosophical Manuscripts* as merely a part of the *Paris Notebooks*, themselves only a part of a body of notes, excerpts and studies that show the development of Marx's ideas. Thus, alienation is cast as a part of Marx's thinking, but not as central as the humanists make it out to be, though neither entirely lacking in his later thinking. The supposed 'break' is not as complete as Althusser suggested, but the culmination of a development in Marx's way of thinking, so that a clear continuity exists between Marx's early work in which alienation is explicitly mentioned and his later work, in which it is not always invoked by name but instead appears in its fully developed form as the separation of the unity between

[86] Consider the word 'fremd'; foreign, alien, strange – the prefix 'ent'; indicating a beginning, a removal, or a conversion of something into its opposite – the suffix 'ung'; indicating a carrying out of an action or something coming into being. Entfremdung, thus, is the process of a thing becoming something strange or foreign to oneself; *estrangement*.

[87] C. J. Arthur, in his discussion of this, points out that possible translations of ‘Entäusserung’ include “‘alienation’, ‘renunciation’, ‘parting with’, ‘relinquishment’, ‘externalization’, ‘divestiture’, ‘surrender’… Where alienation of property is concerned one can use Entäusserung but not Entfremdung, the latter is restricted to cases of interpersonal estrangement.” Additionally, Arthur quotes Marx: “Selling is the practice of alienation [Entäusserung]”, and “Entfremdung... constitutes the real interest of this Entäußerung.” (15) Though it bears reiterating that Marx often used the words interchangeably at times, clearly at other times separating the two allows for a clearer understanding of the difference between the abstract notion of alienation and the practical expression thereof.

humanity and nature. That separation is perhaps made clearest today in the work of John Bellamy Foster and Paul Burkett on the 'ecological rift'. With Saito, relying on Jürgen Rojahn's philological work, thus providing us with a missing piece of the puzzle, we are able to trace and understand the relationship between alienation, labour, value, and the ecological rift in the work of Marx (16). It is here that the development of a Marxist ecology must begin, if it is to be a true unity of ecological thinking and Marxist theory rather than a coat of green painted over the red.

Here it is necessary briefly to review the intellectual project that is Ecomarxism, in the work of Foster, Burkett, and those following in their vein. It is an intended reconstruction of Marx in ecological terms, comparable to how ecological economics is a restructuring of neoclassical economics; though they share the same basic conceptual framework, the introduction of the ecological framework at the most fundamental level profoundly changes the whole. What differs in the Ecomarxist project is the assertion, backed up with philological evidence, that this is in tune with Marx's original intentions – even to the degree that it is required for his theory to make sense on his own terms. Though a controversial claim, Burkett and Foster (and associates) have spent over two decades pouring through Marx's unpublished works, notes and drafts in order to show how ecological and metabolic concepts came to inform, or were considered in connotation with, the most basic and crucial aspects of Marx's theory. (17)

Ultimately, the Ecomarxists show that the true 'transformation' is not from the anthropological Marx to the historical Marx, but to the *ecological* Marx; the one who began with a fascination with Liebig and progressed to a serious and devoted study of the natural sciences which shaped and changed his views on political economy – until an early grave stopped him. This necessitated a philological tracing of the ecological ideas through notes, marginal scribbles, letters, etc. of Marx over a long period, which I would argue has succeeded. In the sense, at least, that we can at least imagine how it is possible not only to do a 'green reading' of Marx, by which ecological concepts are merely grafted on to a relatively unchanged theory, but also to do a *value theory reading of Marxist political ecology* – a complete re-building from the ground up of Marx using the ecological concepts he very much intended to use, in the hopes of finishing, in some form, his unfinished project of Capital.

2.2. Towards a socio-metabolic value theory

Marx's conception of "labour and production as a metabolic people-nature relation" serves three main functions in the Ecomarxist analysis. (18) Firstly, it highlights the fact that capitalism is just as much subject to nature's laws as any other form of human production; Burkett, for instance conceives of production as a reordering of matter rather than an act of creation. The labour and production processes are socially organised exchanges of matter and energy between people and nature.[88] Secondly, it avoids energy-reductionism, allowing for the exploration of issues, such as the aforementioned inequality in entropy, which are certainly tightly related to energy but cannot always be reduced to pure energetics, as seen in Chapter 14. This emphasises the industrial metabolism dimension of Marx. Lastly, it forms a part of value analysis. Since commodities are products of both labour and nature, and because labour is itself an interaction with nature, the production and exchange of commodity values is both a social (people-people) and a metabolic (people-nature) relation. Commodity exchange can itself be seen as a *process of social metabolism*.

It bears reiterating that neither value nor surplus-value are the result of concrete labor or the energy expenditure thereof. There can be no energy-theory of value, like the one Podolinsky suggested and Marx dismissed, because value creation is a social process. (19) Burkett noted how any such energy-related theory of value "closely and consciously parallels the Ricardian labor-embodied theory of value, with energy replacing labor as the primary factor of production." (20) But embodied-labour theory is very different from Marx's value theory. Labour is indeed technically a form energy; that is *one* of the things that labour is. But claiming that it is *just* energy strips it of its social relations. Hence a theory which expresses value as socially necessary labour time *could* technically express it as a quantity of energy as well, but it is *not* the energy itself that creates values – just like it is not the passing of time itself that creates value either.[89] This would be to eject the dialectic from the analysis and try to interpret Marxian value theory is strictly technical, or perhaps technocratic terms, sans the social aspect of labour. But it is the social aspect of labour that is the source of value; this was the point in Marx's claim that machines do not create value. It is also why the same time or same amount of joules spent by an artisan under feudalism *did not* create value. Value is a product of a particular social relationship under capitalism. We can express it as average socially necessary working time, or in a money-form as wages, or as energy expended. But the unit

[88] Burkett quotes Griese and Pawelzeig: "Exchange of matter is taking up, reshaping, storing, and giving up of matter with an exchange of energy taking place simultaneously. The same content applies – and here lies the discovery of Marx – not only to living but also to social systems, insofar as social life is also actually life in the physiological sense, arising out of social life and developing further its material basis." (21)

[89] A different quantity depending on level of technological development, just like required labour time.

of measurement is not the thing it measures: neither energy or emergy is value any more than a liter is water.

The social nature of value is necessary in order to understand the role of the natural world within capitalism. For it is not so much that capitalism is indifferent to the natural world, as its relationship to it is one entirely founded upon the logic inherent in the law of value. The metabolic interaction between humanity and nature takes place entirely on the basis of capital accumulation. It is true, then, that nature is a site of class struggle – but more correctly perhaps it is also both a prerequisite and an outcome of class exploitation. The fact that only labour-power *creates* value does not mean that value creation *depends* solely on labour-power; capital accumulation demands the exploitation of 'Cheap Nature' and 'dark value flows', including super-exploitation of labour, appropriation of natural resources, and externalizations. It is similar to how capital accumulation requires the existence of private property, but though private property is the *prerequisite* of surplus exploitation merely owning property does not, in and of itself, *generate* any value. Only labour power creates values; dark value flows represent, and are the result of, either competition between capitals over shares in the total surplus value generated, or attempts to drive down the cost of labour reproduction and increase the rate of exploitation. To reiterate a point made in Chapter 12, surplus extraction occuring on the level of the individual firm is but a simplified assumption made in Vol. 1 of Capital which is dropped later on; in reality it is a phenomenon that occurs on the level of the whole system, and there is competition between capitals over shares in the total 'pool' of surplus generated.

As has been argued, a labourer who is partially subsidized by, for example, agricultural work can be paid a wage below the minimum otherwise required for survival, resulting in a greater surplus squeezed out of said worker. Nonetheless, it is the labour-power of that worker that generates values, *not* the agricultural work. The agricultural work allows a particular capital to benefit from superprofits by paying the worker a lower wage, but value is not created there. As Saito argues, Marxian value theory is "not simply a tool for disclosing the exploitation of workers, but rather for comprehending the capitalistically constituted 'metabolism' between humans and nature." (22)

Central to this is the divide, the rift, between humanity and nature. Though, as Moore argues and is largely supported by Levins's and Lewontin's ecological arguments, the underlying reality is one of holistic oneness, for humanity is inseparably a part of nature, and both shapes, and is shaped by, it. (23)(24) Yet this view ignores the degree to which the particular social relations under capitalism have come to possess real power; as capitalism *treats* the two as separate, they *become* separated through the processes of capital accumulation. Marx roots this separation in the rift

between social and natural metabolism, exemplified but not limited to the division between town and country. Though he begins his analysis with labour, he connects the estrangement from nature with the estrangement of labour; the former as an expression of the latter and the latter as the reification of the former – yet, ultimately the same phenomenon. Simply put: the rift does not *generate* value, so much as the rift *is* value. In an abstract sense, it is what makes the value form possible as well as what is made possible by the value form. ”Labor is”, after all, “first of all a process between man and nature, a process by which man, through his own actions, mediates, regulates and controls the metabolism between himself and nature.” (25) If labour is the mediation of socio-natural metabolism, it is not difficult to understand how the alienation of labour is the same as the rift in socio-natural metabolism – or alienation of one from the other.

The socio-natural metabolism becomes dominated by the law of value which changes it, “it disturbs the metabolic interaction between man and the earth”, molding it to fit the needs of capital and not the needs of humanity or nature. (26) A rift appears, both abstractly in the general interaction and its nature and purpose, but also concretely in the observable phenomena of ecological disruption; Marx’s prime example is the town-country divide, but the same can be said of my own examination in the industrial metabolic rift represented by e-waste. In both cases, the needs of capital guide the relation and interaction between humanity and the natural world, and in both cases the concrete consequence is physical displacement and disruption of nature. These are two sides of the same coin, a dual phenomenon the different aspects of which feed into each-other, developing in an intertwined form. As the initial alienation from nature under feudalism gives rise to alienated labour and thus the value form, the existence of value propagates further alienation from nature, separating the direct producers further from the means of subsistence and production, establishing and spreading the mode of production that eventually evolves into capitalism, where the role of value becomes that as mediator in commodity production. Marx’s work on the rift between town and country is hence not an isolated concept, but a central and foundational idea that underpins value theory, and the final metamorphosis of the concept of alienation that begins with the emergence of private property and develops through the “historical dissolution of the original unity between humans and the earth” under feudalism and early capitalism. (27)

As Levins and Lewontin argue, socio-natural metabolism as an interaction between lifeforms and their environment is simply the condition of life; it can even be said to be the definition of life. (28) As such it is neither a specific, historically limited condition nor even unique to humanity: “[t]he labour process… is purposeful activity aimed at the production of use-values. It is an appropriation of what exists in nature for the requirements of man. It is the universal condition for the metabolic

interaction… between man and nature, the everlasting nature-imposed condition of human existence, and it is therefore independent of every form of that existence, or rather it is common to all forms of society in which human beings live." (29). What distinguishes capitalism as a historically limited form of society is the rift, the alienation in the interaction. Therefore, ecological studies of capitalism naturally ought to proceed from the metabolic rift, much as classical Marxian political economy proceeds from alienated labour.

Here also emerges the 'rift' between use-value and exchange value. Use-value, too, is ahistorical, and can be argued to not be unique to humanity, as plenty of other animals interact with their environments to produce objects or things valuable to their survival (consider, for example, the beaver dam or the beehive). Exchange value, however, is historically limited, unique to the particular social conditions prevailing under capitalism. It is purely of *social* value, that is, only meaningful within the confines of a capitalist society where the conditions that created it and reproduce it hold, whereas use-values can exist also in nature, and are logically independent from mankind and capitalism. As Marx puts it, "[n]ot an atom of matter enters into the objectivity of commodities as values". (30) Even mainstream ecological economists, most prominently Herman Daly, recognize the importance of the distinction between use-value production and exchange-value production, but tend to base it in a purely Aristotelian distinction between *oikonomos* and *chrematistike*, i.e. between acquisition of wealth for a purpose (household management) and acquisition of wealth for its own sake. (31) Environmental harm is in this view done due to 'growthmania', i.e. chrematistic accumulation, which is regarded as the cause and not itself given an explanation. Through a Marxian lens, we can both explain the drive towards growth and connect it directly the separation between humanity and nature. We can hence go from from merely a green reading of Marx, to a value theory reading of ecological economics and political ecology.

As concerns e-waste, such a reading portrays it not as an isolated phenomenon but an expression of the same underlying forces, subject to the same general laws, as are all other expressions of the law of value under capitalism. Through the critical lens of a Marxian approach, a contextualisation of e-waste becomes possible that is lacking in other approaches to discard studies. As we have seen, it can be connected to the overall inclination towards unequal exchange, and more specifically to dark value flows and the flight of certain tasks to low-wage areas in the new industrial division of labour. It is a form of environmental load displacement and successful cost-shifting and externalization; the informal recycling areas embodying a dual position both as a resource supplier and waste-sink. It involves super-exploitation and resource imperialism, and in the inevitable harm done to people and environment, it involves a class struggle over both the natural world and

worker’s rights. It is an expression, finally, of the instrumental view of nature that capitalism embodies, where it is merely a resource to be freely appropriated.

More broadly, though not part of this thesis in particular, e-waste can be connected to consumerism and increasing rates of consumption coupled with decreased ability to repair as well as planned obsolescence; all facets of the continual increase in matter-energy through-put which ecological economics holds capitalism to be dependent on. In the same way, it can be connected to the role that criminal enterprises and gray markets play in industrial production.

Most importantly perhaps, it highlights the inadequacy of regulatory reform, and shows that the issue cannot simply be legislated away. If discard research on the topic of e-waste is to have any positive impact on the communities that are affected by it, the critical Marxist approach is crucial if one is to grasp fully the roots of the problem.

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Chapter 16

Closing reflections

1. Reflections on the project

It became clear to me rather early on, that a project of this kind had to be interdisciplinary to at least some degree. The e-waste problem was multifaceted and manifested in different ways. It was clear from the outset that there were economic, cultural, political and sociological factors – but also that the impact on the environment itself had several dimensions, with pollution of soil, air and water being quite obvious from even casual observation of the recycling sites. Political economy by itself was not enough to capture the whole of the problem, and it seemed to me foolish to delimit the study of a problem based on disciplinary boundaries that reality did not care about. In real life, the biodiversity of the Gulf of Guinea, the health of impoverished e-waste recyclers, and the needs of the iron-dependent domestic industries of Ghana are all connected with no regard to which discipline would be most suitable to study which area. A particular discipline can certainly be chosen as the starting point, and the chief lens through which the problem is considered, but an approach that is free to take on the tools, perspectives and insights of other disciplines is necessary to understand the whole.

This commitment deepened when I uncovered what I felt to be *pointless* gaps in the literature of metabolic social research, something that I have discussed in the beginning of this thesis. From the bibliometric analysis by Newell and Cousins identifying isolation between research and calling for a political–industrial ecology, to Wallsten's identification of a lack of social embedding of material-flows and calling for a social-industrial ecology, to Hornborg's critique of Foster and Holleman's otherwise very ambitious aim to create a merged Marx-Odum dialectic for its over-focus on energy and lack of material flow analysis (1)(2)(3), the very core of the metabolic rift analysis of Ecomarxism too seemed to be calling out for an analysis of material flows and how they relate to unequal ecological exchange and the ecological rift. Yet, for as much as influential scholars like the aforementioned have openly called for it, neither empirical work nor a theoretical merger of the kind called for had hitherto been done, and I could not think of any reason for this being so. Hence from almost the beginning the project came to be about more than merely e-waste;

though my interest in e-waste itself did not wane, e-waste research rather became the vehicle by which a new kind of approach could be constructed. The e-waste phenomenon, I realised, had a queer kind of advantage in the complexity of ways it manifested itself, which more easily revealed the deficiencies or absences in approaches used to study it. It was both a source of livelihood and of harm, both waste and resource, both legal and illegal, had both a social and a physical dimension, and affected people who were both an exploited underclass and a creative kind of informal entrepreneurs. It required an approach that could capture the complexity and contradictions of the whole of what 'e-waste' was.

In the early stages of my research, I had several different avenues of research I wished to explore, and in particular I was interested in different methods of measuring environmental impact, hoping that such an assessment could serve as empirical proof of the occurrence of unequal ecological exchange. I consider using , for example, toxic intensity; which entailed taking the resource intensity method, which measures the resources needed for the production, processing and disposal of goods and service, and adapting it for toxicity. This would measure how much hazardous material is released per weight or unit of WEEE (computer, laptop, etc.) recycled. This turned out to be problematical because I was dealing with a process that is part recycling and part waste disposal, yet simultaneously extraction. Of course, the lack of accurate data became the final nail in the coffin for such hopes, though I maintain that toxic intensity of WEEE would be an interesting measurement to obtain and calculate; and procuring the necessary data would not be too difficult. Life-cycle assessment was also considered, and I deemed it to be more suitable for the entire life-cycle of products. Given that my focus was on the semi-closed part of the loop 'disposal-recycling/reuse-production', it would not be as fitting. I would, however, argue that the results of my thesis can, potentially, be part of a wider, non-reductionist 'life-cycle ecological impact assessment' for ICT-products; but my thesis is itself was never intended to be an LCA.

I also considered making use of the Waste Absorption Footprint method, which measures the amount of land and water needed to absorb the waste produced by a given population. Apart from the aforementioned lack of data, there were other concerns with this approach. Waste at sites such as Agbogbloshie is certainly absorbed, but the eco-system is completely destroyed in the process; so, it is not a matter of safe and sustainable absorption. Additionally, measuring only the quantity of water and land does not take qualitative aspects into account, nor social impacts.

The present incarnation of the project came into being slowly, much through a process of trial-and-error and evaluation of different approaches based on a few basic criteria: did the data I could

feasibly obtain, in light of knowing much was intentionally obscured, suffice for that approach? Did it measure enough of the dimensions of the issue to be useful; namely, did it include all that was impacted by the e-waste trade? Could it be combined with the kind of politico-economic analysis that I felt from the start was necessary to contextualise the e-waste trade? From the first phase of trial-and-error assessment, emerged the more positive question *What approach could uncover what needed to be shown in order to understand fully the complexities of the issue?* Given the oft-lamented lack of data, and obstructions I faced in obtaining it, it also became crucial to employ an approach that was 'data efficient', namely, one where as much as possible could be shown with as little data as possible. It was through the twin processes of learning about gaps in the literature and evaluating different approaches that the socially embedded material flows analysis emerged as the only viable approach, and the approach that I believed could contribute most to Ecomarxism and socio-metabolic studies.

This approach was what allowed the project to continue, and I trust succeed, even in the face of some rather frustrating hurdles, because it enabled me not only to handle the uncertainties but make their causes a part of the analysis: lack of access at both Guiyu and Agbogbloshie; the feeling of being unwelcome and closely monitored for possible transgressions, in China even steered to some degree; even fearing that my inquiries may disrupt a delicate development process. After all, Guangdong had only relatively recently cleaned Guiyu up and experienced some scrutiny by Western NGOs on the matter, and Agbogbloshie was going through a phase that at least promised much change, the negotiations with German investors going on while I visited and observed. There was also the challenge on how to handle these uncertainties and issues the right way in the thesis; they could not go without mention, but neither did I want to appear as ungratefully *complaining* about people and institutions who, after all, *did* aid me and without whom the project would have been impossible. Many of the hurdles were understandable, as were the limitations placed on me given the sensitivity of the matter. But how does one report in one's thesis about, for example, a strong suspicion of one's guide and interpreter being coached or otherwise limited in what he was permitted to do, without being accusatory or neglecting to also mention that the entire Guiyu part of the project would have been a failure without the invaluable aid of said guide? Yet it cannot go unsaid. My guide in Agbogbloshie even explicitly told me that our movements around the grounds were watched, and that we could not go where the local chieftain did not want us to, though fortunately the chieftain seemed more indifferent and cautious than hostile; an attitude mirrored by the authorities at the Industrial Park in Guiyu. These incidents make up an invaluable part of the narrative surrounding e-waste sites and they are a direct outcome of – and an influence on – the

way that informal e-waste recycling operates. It is chiefly the legal grey-area in which informal recycling tends to operate, and the interest the issue has attracted from Western scholars and journalists, which has spurred this attitude among those working closely with informal recycling.

The subsequent discovery of the uncertainty in the data on flow volumes came about due to my visits and this was almost accidental. I had originally taken the data to be at least somewhat solid, given that it was confirmed and repeated in several official reports – I had even read about them in reports on e-waste from the Swedish EPA. Yet during my visits and interviews with experts, particularly the Ghanaian EPA, they could neither provide the exact source from which the numbers were derived, nor any recent updates. This prompted further digging, and I traced the numbers that, despite often being presented as exact, were at best very rough estimates – and in a few cases, off-hand remarks by people who were making qualified guesses that had then been used as the basis of calculations. It also led to uncovering the conflicting narratives present, and even claims of a hoax and outright conspiracy, which I did not dwell on in this thesis. Likewise, I chose not to focus on possible connections to the recycling industry of people associated with what I have chosen to call the 'denialist' school. Nor did I explore any of the rumour-mongering, personal attacks, or non-academic statements on, for example, personal blogs made by the people involved. Any such claims have already been disproven by way of engagement with actual academics making stronger versions of the same case. I decided that this had no place in an academic work, though to claim that it in no way impacts the matter would be incorrect. Like the aforementioned hurdles and local attitudes, this too is part of the narrative surrounding e-waste; this too is an outcome of and influence on how e-waste recycling operates. It is necessary to mention, however briefly.

This conflict over the narrative, I have maintained, *is part of the narrative*. Though I do explicitly take the importist side in the matter of volume and direction of e-waste flow, without necessarily endorsing *all* importist claims or uncritically accepting them, I have tried to make my discussion on the conflict in the thesis more nuanced than simply taking sides. It is a matter of how e-waste is framed, and how those who engage in informal recycling are portrayed, and there is validity to the point that they should not be resigned to the role of mere hapless victims in an oversimplified, sensationalist narrative that offers no real solution. Their own ways of finding solutions and adapting to the situation through creativity and ingenuity, is a somewhat neglected part of the narrative that I believe deserves to be given more attention. In the end, I suppose my answer is typically Marxist: that what we see in this narrative is the expression of class conflict combined with a lack of class analysis. A narrative abstracting away victimhood versus one wholly focused on it; a narrative defending industry interests versus one calling for industry regulations; a narrative

that recognises the creativity of workers but tacitly supports the exploitation of the same versus one demanding that workers be exploited in a more regulated fashion. Plainly, it is the conflict between neoliberalism and social liberalism, in which no truly radical voice is heard.

2. A commentary on social metabolic research

2.1. Different approaches to social metabolic research

The bibliometric study by Newell and Cousins on social metabolism identifies, depending on how one counts, either three or four ‘islands’ of metabolic research: industrial or traditional, Marxist, and the Vienna School, all of which can be traced to a common lineage. The first is rooted in the work of Ayres and Kneese and looks at industrial systems as analogous to organisms in terms of processing waste and energy. The MFA method is commonly employed, and much of the work bases itself on the ideas of ecologist HT Odum. It is thus closely connected to, via Ayres – though surprisingly not widely used in – modern mainstream ecological economics. The ecological economists who do employ metabolic research, like Martinez-Alier, are not usually rooted in Ayres but in Marx or the Vienna school. (4)(5) The Vienna school, headed by Marina Fischer-Kowalski, chiefly combines the MFA approach with a focus on large-scale socio-economic transitions, like that from agrarian to industrial society. Lastly, the Marxist island consist of the Urban Political Ecology of , for example, Swyngedouw and Harvey, and the ‘metabolic rift’ research of Foster et al and the *Monthly Review* school – these two being somewhat connected and can be thought of as either one ‘island’, or an archipelago of two very close ones. (6)

Giampietro’s work, the so-called Barcelona school, can be said to be more related to the Vienna school, but I would argue does historical materialism better – whereas Fischer-Kowalski is certainly broadly historical and touches upon the basic Marxian concepts like societal modes of production, I would question her materialism in the social-scientific sense, since the internal mechanisms of society are not scrutinized. Giampietro on the other hand looks (to an extent) at the dialectic between social and natural metabolism – though of course he might disagree, since he is not a Marxist but a systems theorist. I would say, though, that to a degree he does exactly that Richard Levins argued good systems theorists do, that is to reinvent the materialist dialectic within systems theory.

What is peculiar is the lack of overlap, even given the common history and how fitting it could be, for example, how Fischer-Kowalski’s work might be connected to historical materialist theories of

historical development. I believe this to be either happenstance, or to have some historical or ideological reasons that are irrelevant for my purposes, and not any kind of incompatibility in approach. This is shown in part by Martinez-Alier, who engages with both the Marxist and Vienna schools. I also hope to demonstrate compatibility through my own thesis.

2.2. The use of material flow analysis

In my thesis, Material Flow Analysis is employed 1) when looking at the flows in Agbogbloshie and Guiyu; 2) when looking at the flows into Ghana and China; and 3) when looking at flows in the world-system. Because the tool is quite open-ended, it can be employed at all three levels by simply defining the limits of the 'system' being studied in different ways: local, international, global.

An MFA can quantitatively establish that unequal ecological exchange occurs in the WEEE-trade, by showing the inequalities not only between countries, but between regions and most importantly between the different *classes and sub-classes* involved in the e-waste trade.[90] But while MFA schemes show *that* unequal ecological exchange and metabolic rifts exist, one must also show *why* they exist; that is partly the role of the *social embedding*. The theory of unequal ecological exchange coupled with metabolic rift analysis forms the foundation of this wider social context into which my MFA is placed. MFA schematics are hence an illustration and a numerical expression of the 'exchange-rift'.

The MFA method used in this thesis is based, explicitly, on the classical text by Brunner and Rechberger, and their four steps: (7)

1. Building: defining the system and the involved processes and materials.

The building of MFA models entailed firstly defining the geographical scope of the system, for example, the way that e-waste moves within Accra or the way it moves to and from different regions in the world-system. Secondly, that system must be placed in a particular social, environmental, spatial, and other context by way of identifying the relevant forces that affect the flows. While the forces were not analysed at this stage, they had to be identified so that analysis could proceed.

[90]For instance, the *worker*, who gathers waste; the *petite bourgeoisie* who owns the repair shops and the *haute bourgeoisie who owns the industries that get the resources.*

This was the ‘pre-analytic’ stage of the thesis: the choice of which countries and cities to focus on, but also which theoretical framework to rely on, since of course different frameworks have different ideas of what forces might affect the flows, at least at the abstract level. This cannot be known for certain before the analysis. Rather I supposed, based on my choice of theory, which forces might *conceivably* play a role. There is also a *concrete,* or empirical, level of influence; while there may exist theoretical disagreements of what role , for example, the law of value has on material flows of e-waste, observing and following the flows through-out Accra quickly reveals that the traditional chieftains play a huge role in the e-waste trade. Here the advantage of the approach in dealing with a lack of data is apparent, since only those phenomena that directly affect and are affected by the flows need be included. Chieftains can be imagined as managers of an industry, since only their effect on the flows need be known.

2. Data collection: measurement of the material flows

In the transfer of material from one process to another, ‘process’ can include geographically delimitated spaces, as well as socio-economic processes. The distinction between ‘thing’ and ‘process’ is not as clear in dialectics, but for the purpose of a model one can, clearly, quite easily separate ‘e-waste’ from ‘the various stages of recycling the same’. This is crucial, because the second-hand data I use is derived from sources that do not themselves apply a dialectical view on the relationship between *thing* and *process*; that does not make the numerical data on volumes any less useful, but it does require a thorough and critical analysis of the contexts from which the data is taken.

These contexts, upon further examination, turn out to have problems that indicate unreliable data. It is at this stage that I discovered, firstly, the lack of accuracy regarding flow volumes. Secondly, how this lack of reliability has both been ignored, with official sources often presenting rough estimates in a way that makes them appear as exact figures. Thirdly, I discovered the aforementioned conflicting narratives on flow volumes and direction.

3. Calculation: determining material flow volumes

There is, essentially, no difference between a classical MFA and a socially embedded one at the stage of calculation, other than that the latter deals with social processes, which does not impact the calculation as such – merely what is considered the constituent parts of the processes between

which materials flow. Of course, revelations on the lack of reliable data required a calculation that was explicitly a rough estimate – and an analysis that does not rely wholly on any particular volume.

4. Interpretation: analysis of the results

Though social embedding begins already in the first stage, it is at this stage that it really comes to fore, as the social context that the MFA is embedded into is analysed using the various tools I have employed.

3. The underlying philosophy of social scientific research and the methodological goals of the project

3.1. The process of combining approaches

Overall, my aim was to look at the social and environmental context in which the global flows of electronic waste are embedded and in which informal recycling thereof occurs, as well as the effect and impacts this has on people and environment, paying particular attention to the underlying economic forces that shape the relations involved. The essential research questions then boil down to: how and in what ways is the informal e-waste industry, on both the global and local level, part of the structure of global capitalism? What role does said industry play within that structure, and how does that structure in turn shape the particular industry?

The bulk of the currently existing research on e-waste focuses on either the local or the global level, exploring either conditions on the ground or how the industry connects to national and international economic systems, without the attempt to connect them to each other. While a separate analysis like this is possible – indeed I do myself begin by analysing the two areas separately – my study of literature covering both areas convinced me that much can be learned by connecting the two and understanding their interdependence and co-determination. My conclusion was that what goes on in Agbogbloshie and Guiyu are merely specific expressions of overall tendencies and forces that are at play at a higher level of abstraction.

The primary methodological goal of the project, which informed the attempt to answer the research questions, has been to construct a socially-embedded, explicitly Marxian, Material Flows Analysis

of e-waste. Arriving at this was a process in and of itself. I had to select a method that allowed me the work within the practical limitations that I faced. As mentioned previously, when I initially began the project, my hope had been to apply different social and ecological impact assessment models to e-waste. My choice of the socially embedded MFA as my analytical approach allowed me not only to overcome the lack of accuracy in data, but to make use of it: Marxian class analysis does not treat uncertainty and conflict as a hurdle to analysis, but rather grounds itself, and begins the analysis, in such conflicts.

Of course, the different tools that I employ are derived from schools of thought and disciplines that themselves make different ontological and methodological claims, prompting the question of compatibility. Crucial to stress is that the tools I employ are simply ways to think about and conceptualise things, which are not burdened by the ontological/methodological commitments of the discipline that birthed them. For example, industrial ecology, has its own distinct ontology and methodology, but the MFA tool I take from it merely means to pay attention to the way that materials flow through a system. Hence, I do not wish to merge industrial ecology with Marxism from the ground up; merely to use an MFA approach. It is a perspective that does not in and of itself demand adherence to any of the ontology or methodology of industrial ecology and can stand independently of it. It is in the definition of the system and the flows, and above all in the *social embedding* of them, that considerations of ontology and methodology come up, and I use Ecomarxist definitions.

As regards , for example, ecological economics, my argument (and that of Ecomarxists like Burkett and Foster) has been that their ontological and methodological claims do not contradict a Marxian approach, but even seem to imply one, to the point that even anti-Marxist ecological economists like Herman Daly are forced to use Marxian terms at times, while more radical ecological economists like Clive L. Spash have explicitly endorsed critical realism as the basis for ecological economics. (8) Additionally, ecological economists like Daly have argued that the most fundamental principle of ecological economics is to acknowledge the economy as a sub-system of the ecology, that is, that all economic activity is embedded in the eco-system, depending on it for amenities (including natural resources and waste-baskets.). (9) Martinez-Alier et al. define the field more precisely: “ecological economics studies social metabolism, i.e. the flows of energy and materials in the economy”, which is unsurprising given that school’s tendency to make use of metabolic tools. (10) The Ecomarxists then argue that if one does Marxist Political Economy of any kind but accepts that economic activity is a subsystem of the ecology, one is doing Marxist Ecological Economics. (11)

What I attempt, then, is not a synthesis proper, not a seamless joining together that resolves all contradictions between these various schools of thought, but rather a use of tools borrowed from several approaches within what remains a decidedly Ecomarxist framework. It is the subsuming of conceptual tools into Marxism; an expansion of Marxism using ideas from other disciplines – ideas that, as I have argued, are compatible with the Marxist approach or can be made compatible and fit well with the stated aims of Ecomarxism. I believe this to be the only kind of 'synthesis' that is possible without running into impossible hurdles and contradictions that are too cumbersome to overcome. No such problem exists in using concepts taken from, for example, industrial ecology and using them within a Marxist framework.

Mine is therefore an *interdisciplinary* approach, my aim being to integrate knowledge and methods from different disciplines. There is, of course, a *multidisciplinary* aspect to the thesis to a degree as well, that is, the use of several approaches without any direct interaction between them, at least at first: when I do my micro-ethnography in Accra and Guiyu I do not at that time involve, for example, world-systems analysis overtly. It is mentioned and I try to connect the two, but really those two aspects could stand somewhat independently – the micro-ethnography of the practices at the lowest level and the world-system analysis of the higher, international, level. This is intentional: the micro-ethnography is supposed to feed into the world-systems analysis, to inform it and contextualise it. It is the concrete social embedding that the world-system operates in, the way economic and political forces at that highest level of abstraction are expressed 'on the floor' of the industry that is informal e-waste recycling. The world-systems analysis is not wholly dependent on this context – which is made clear by the fact that some world-systems scholars have written about waste and even e-waste specifically without having that context – but it is poorer without it; understanding is lost.

3.2. Justifying the Marxian approach

This of course leads to the question of *why* a Marxist framework is used to begin with. What makes it the most fitting framework? Can a criterion be established that would allow for a comparison between the Marxist approach and the other perspectives as they are, and on their own terms – not presuming the Marxist approach from the outset to be superior and then comparing others on the basis of their failings vis-à-vis that presumed standpoint?

What is needed is a criterion or category by which perspectives can be compared so that one can said to be better than another, and *explanatory power* is used within the critical realism school,

with which I broadly align myself, and fits well in with my argument. By such a standard, the perspective of , for example, neoclassical economics would be neither wrong nor useless, but merely limited in what it is saying given that it cannot explain phenomena that it arguably ought to address. Even a vehement disciple of neoclassical economics could at least acknowledge that Marxian political economy asks different questions. For in interrogating the underlying purposes of particular kinds of research, one finds of course that a Marxian perspective is motivated differently than other perspectives; and it may be difficult to persuade non-Marxists that said motivations are better motivations *a priori*, but nonetheless Marxist research may lead to a different set of questions that a non-Marxist may otherwise not have thought to ask – and thus lead to new insights that even a critic of Marxism might find useful or interesting.

I have argued in this thesis that there are advantages to the Marxist way of thinking to any ecological research, which are rooted in its materialist and dialectical perspectives. Dialectics views the interaction between human society and nature as one in which we are neither apart from nature nor 'one' with it in some metaphysical sense, but exist as a part of the same wholeness, including contradictions and disharmony. It focuses not on 'things', but on *processes* and *relations*. Hence it is able to handle the conditions of complexity and constant change that are hallmarks of the ecosystem, making it a more suitable method for the field of ecology and by extension also ecological economics and political ecology. In recognising that humans are a part of the natural world, a dialectical approach also acknowledges that alteration of the natural environment is inevitable: a part of the very process of life. We create our environments as much as we are products of them; a realisation that may force us to take responsibility for *how* we alter our surroundings through how we arrange our society. To quote Levins and Lewontin, we "decide what kind of a world we want to live in and then try to manage the processes of change as best we can to approximate it"; humans are a part of a *process* that alters both nature and our society, the exact outcome of which is undetermined. (12) To make a specific example, through dialectics we are able to see a tension between the *actual* and *potential* outcomes that goes unaddressed in the contemporary debates on future technology, recycling and waste in ecological economics. How can the solution to recycling problem lie in future technology, when even the recycling technology we already possess is not being used to anywhere near its full potential, and the cheaper alternative of shipping waste to developing countries is what is actually being employed instead?

Nonetheless, by the standards of industrial ecology or ecological economics, or whatever else, there is nothing wrong with or lacking in these schools of thought; they lack a Marxian class analysis and materialist-dialectical perspective but this is not an oversight or a mistake – their ontological

position is simply that these things are not important or useful analytical concepts. Schumpeter's arguments on the 'pre-analytic vision' of disciplines and schools of thought holds that every analysis is preceded by a cognitive act that determines both what is to be analysed and how; this choice itself forms a part of the thinking of any school of thought – and every school of thought makes sense by its own criteria. It is difficult, then, to establish *a priori* either the scope or exact nature of analysis with no reference to empirical results. Certain advantages can be argued to possibly emerge, as I have done, but only though scrutiny of the final results can it be established whether or not the pre-analytic vision was sufficient to generate results that address and explain real-world phenomena and possess explanatory power. Thus, it is possible to, for example, critique mainstream ecological economics for not sufficiently explaining what drives economic growth, or neoclassical economics for not sufficiently explaining what causes economic crises, or ecological modernization theory for not explaining the export of e-waste for the purpose of primitive recycling. The scope of these analyses can be said to be lacking, and their framework to be flawed, because they do not explain observable real-world phenomena that it is arguably within their task to do; they lack explanatory power in those areas.

This thesis, then, is founded on my commitment to an approach that uses materialist-dialectical thinking and class analysis as its basis, but also makes use of tools from, for example, industrial ecology, because this approach can add something new in terms of understanding. Something different is revealed, which provides entry points for new questions, and new avenues of inquiry are made possible. This is not something I am wholly able to justify *a priori* other than by invoking explanatory power; the final justification can however only be the study itself. "There is no royal road to science" as Karl Marx said, "and only those who do not dread the fatiguing climb of its steep paths have a chance of gaining its luminous summits". Or, more to the point perhaps, as Marx was also fond of saying: "the proof of the pudding is in the eating."[91] My results are my way of demonstrating concretely, by producing something, the usefulness of my approach.

3.3. Facing and overcoming a lack of data

The more one knows about the social and environmental context, the better one can socially embed material flows. Given the limitations on what I could obtain, the degree to which embedding can be done is also limited. This does not invalidate my approach, but rather underlines the need for

[91] The first quote originates in the preface to the French edition of Capital Vol 1, while the other seems to actually be from Engels's *Socialism*: *Utopian and Scientific*.

more research and a need for a better understanding of the social and environmental conditions at informal e-waste recycling sites. The same is of course true regarding data on flows and their direction and volume; the better one can map the flows the more one can understand the specifics of particular sites. Of course, the simple demand for 'more data' ignores the hurdles and difficulties involved in obtaining them, which are in and of themselves a crucial area of study as the hurdles are largely intentional, or at least the product of the particular conditions and forces at play.

Although it is undeniable that my end result relies to a great extent on a relatively small number of interviews and short and otherwise limited observations, I can have confidence in the fact that my observations are confirmed by other research and echoes much of what is already said in the literature and reports from both NGOs, government agencies, journalist reports, and academic researchers. Even comparing my observations with those of researchers with whom I strongly disagree with regarding conclusions and context, or journalists whom I criticise for lack of nuance, one would still find a general agreement regarding the observed conditions. My observations of the on-site conditions can thus easily be verified by other sources; just as those sources indeed largely verify one-another. The divergent views on context, the use of other kinds of analytical tools, and the different conclusions are due to different theoretical and methodological commitments and are not caused by differences in observation time or number of individuals interviewed.

Additionally, I have found a lack of discussion in the literature about the hurdles of this kind of research. Possibly I encountered more of it; as was made clear to me in both Guiyu and Agbogbloshie, Western researchers and above all journalists are not an entirely uncommon sight, and the locals have grown quite weary of what they feel are undue outside influences, and an overall negative representation of them.

Crucial to note is also that my idea originally entailed doing a much more detailed analysis of Agbogbloshie alone. The addition of the supporting cases also had practical causes – the limits already discussed of course being a major part of that. Another reason was the absence of the kind of development I initially anticipated. At the point where I began my research, there was a promise from the presidential level in Ghana that the Agbogbloshie situation would be sorted, and that a state-of-the-art recycling facility would be built – but that project kept getting delayed over and over. During my visit, with a new administration backing the old promise, the building was scheduled to finally begin and the final discussions were being had, and the supposedly final agreements were being hashed out – which of course in itself limited my access to both the grounds and the experts. Perhaps somewhat unsurprisingly, there was yet another delay. As I am writing

this over a year since my visit, the building of the new facility has not yet begun, and I have not gotten any updates of significant changes in Agbogbloshie, though local NGOs together with the Ghanaian EPA continue to aspire for minor improvements that protect the health and safety of the workers.

In order to present a better picture of the potential ways that this informal industry can develop, I was forced to look outside of Ghana and observe places where change had already occurred – in this case Guiyu, where the cleaning up and rebuilding was already well underway, and Sweden, where world-class e-waste recycling has been well established for many years. But does the difficulty of collecting reliable comparative data on international e-waste flows itself tell us anything, that is, is the absence of data a kind of data? It is at the very least concrete proof that we do not have concrete proof. Despite official-sounding and specific numbers quoted by government agencies, the numbers that show up in official reports – and on which governments' decisions are based – I show that we are dealing with quite unreliable numbers. The flows, being illegal, are actively hidden. All one can really go on is rough estimates on the one hand, and port data on seizures on the other. One might think of it almost like estimating global flows of cocaine – there is no export/import data, just estimates based of seizures. Except that e-waste is not a priority, so there are not as many seizures as for illicit drugs, and above all: it is easy to tell cocaine from a legal substance, but how does one separate illegal e-waste from legitimate donations that happened to break? What that, in turn, tells us is not only that flows are actively hidden, but also that there are not enough resources to tackle it, nor can there ever be. It is easy to call for more oversight, but for ports and governments, fighting drug- and weapon trafficking will always take priority over seizing old electronics.

4. Various lessons from the research

4.1. Where is the rest of Marx? Avenues for future research

This thesis has focused largely on using the ideas of Marx himself, as well as a handful of Ecomarxist concepts, as its theoretical foundation. There are specific reasons for this. Firstly, there are practical limitations of time and space. I am already trying to weave together so many different things and it is therefore crucial to go back to the fundamentals, or rather *roots*, in each of these things. Marx for Marxism; Brunner and Rechberger for material flow analysis; Daly and Georgescu-Roegen for ecological economics; Wallerstein for world-systems; and so forth. Any

attempt to weave together, or find a common thread, for all of these diverse approaches would simply be impossible to accomplish within the scope of a single thesis, if one were to insist on including all of the developments and strands that each school of thought has given rise to since their respective conceptions. Even in including and relying on a particular school of Marxist thought, the Ecomarxism of Foster and associates, I do so treating the work of Foster and Burkett as foundational texts of *Ecomarxism* in particular, treating it as its own school of thought, not engaging with, say, Foster's work on monopoly capitalism.

Secondly, by looking at the fundamentals I show that this weaving together is conceptually feasible and produces viable practical results – it can then be further developed by including further developments in each included field. Of course, this raises a further problem of justification: which particular brand of Marxism, ecological economics, industrial ecology, and so on is to be chosen and woven together with which particular brands of the other fields and schools of thought? I leave this question open in this thesis.

Marxian cultural political economy, and the world-market perspective in particular, would be interesting later developments within Marxism to take particular note of. The MuSIASEM (Multi-Scale Integrated Analysis of Societal and Ecosystem Metabolism) method of Giampietro and Mayumi is a development in metabolic studies that, while requiring more precise data than is currently available, would certainly be interesting to consider. MuSIASEM has in fact has been used to analyse household waste but, given that it is a more quantitative and arguably positivist method, I had to discard the approach when the data uncertainty became clear. (13) While a MuSIASEM analysis could, of course, be applied using the approximations I arrive at for flow volumes and so forth, the uncertainty inherent in the data would make such an analysis highly questionable, or even outright meaningless given that the accuracy of the output of such an analysis depend on the accuracy of the input.

Likewise, the developments in ecological economics by Martínez-Alier et al., have diverged from the mainstream and include insights from Marxist and social-metabolic research. Additionally, theories of uneven and combined development are clearly just as relevant as the world-systems approach, and speak both to , for example, the way different geographical areas of Ghana and China have developed differently, but also to the way that different *activities* have developed unevenly. In the same vein, David Harvey's writings on the significance of place and the way that capitalism does not solve, but geographically displaces, crises is particularly relevant to the way that e-waste sites move around geographically. (14)

What I have is not the final nor complete answer; having to place limits somewhere, I placed them, for example, where I can get a coherent answer – the smallest piece that can stand on its own as an independent analysis. It can, and should, then be expanded in different directions. I have provided a starting point, not an endpoint.

4.1.1. Varieties of capitalism vs variegated capitalism

While I have not engaged in this debate in the thesis, I believe that the 'varieties of capitalism' school over-focuses on the national scale, and formal institutions at that scale, while I argue more in favour of a multiscale analysis based on regions of development and the role of informal institutions. This aligns me more with critical economic geographers and the 'variegated capitalism' school, and its focus on local and specific economic relations and how they might fit into transnational networks. (15)

To an extent, not engaging directly with this debate was a conscious choice. The varieties school of thought is simply inadequate to my approach, and nor do I really have the space to do the topic justice, so I am unable to make claims about the school as such being wrong or right. I chose rather to focus on the concrete problem and show how the focus on the national-economy and formal institutions simply does not work in the e-waste case and leads to incorrect conclusions, without making it about 'variegated capitalism vs varieties of capitalism', which would be oversimplifying to the point of error.

At first glance, the varieties school has a point, if one considers the simplified narrative: Ghana using the most basic recycling form possible, China using a better but still very labour-intensive approach, and Sweden has state-of-the-art facilities – with government institutions being involved to different degrees and different legal frameworks being in place in a system that generally follows national borders. Yet looking closer, we see that primitive methods, or links to it, exist in smaller firms in Sweden that cannot afford the strict national standards; that China *has* the economic and technological capacity to be just as advanced as Sweden but choses intentionally to keep things as simple as possible; while the otherwise very developed Hong Kong has the underdeveloped New Territories region that has become the new home of informal and primitive recycling. Meanwhile, Ghana is struggling to 'skip' several steps of development with the aid of foreign investment banks and aims to develop a state-of-the art facility without passing through the 'middle' stage that Guiyu arguably represents. The simple picture does not work, and in this I even agree with Lepawsky

despite otherwise criticizing him – and the BAN's way of seeing this issue is based on a legal framework, and not an economic-geographical one, therefore missing these subtleties.

My analysis of the value form and the metabolic rift, which presupposes the world market and also posits it, leads me to the world market or world system perspective. However, the world market is not just a question of territorialisation in national-supranational terms, but also of networks, places, nodes and scales. This is touched upon in Chapter 14, but ultimately remains undertheorized in the thesis, particularly in socio-spatial terms. Future research on this topic would benefit from the use of the world-market perspective and the variegated capitalism approach, as well as Harvey's historical-geographical materialism; emphasising networks, places, and scales over countries. The variegated capitalism approach is inherently critical of any division of capitalism according to taken-for-granted national or supra-national borders, contending this is a too rigid approach that ignores the question of scales and of uneven and combined development.

It is, after all, my conclusion on the matter that it is specific, developmentally differentiated, local regions (and the networks and flows between them) that actually matter, and is what e-waste streams really conform to, not national borders. As Jessop summarises it, "rather than describing and interpreting different forms of capitalism as if each occupied a separate silo within a segmented world market or world society, variegated capitalism highlights the scope for rivalry, competition, antagonism, complementarity, or co-evolution across different forms and their spatio-temporal fixes within a global division of labour." (16) It therefore develops the world-systems view further by detaching itself from the focus on nations and regions in favour of view of the world market as integrated, but fractally organized. This would be a more fitting framework for further exploration of e-waste, addressing the flaws in the oversimplified BAN view and providing a more nuanced picture with greater explanatory power.

4.2. The role of traditional society – what Marx missed

One matter that is of great importance to this thesis, and that is lacking in Marx's own analysis in *Capital* and is not central to his analysis, is how and to what degree an emerging capitalist system might not displace or replace, but rather combine with and subsume, existing local pre-capitalist social orders and institutions, changing their form and purpose towards serving the aims of capital

accumulation.[92] Such social orders and institutional arrangements can indeed make simpler the expansion of capitalism, working as a kind of local resource that capital can appropriate. Conversely, as has been show, they can simultaneously act as a hurdle to further development if they possess enough political power to resist change.

Related to this, Raymond Williams' applications of Marxism and critical realism to cultural studies stressed the importance of complexity and the need to take particular conditions, and the lived experiences of locals, into account. His works shows the need for Marxist approaches, especially those studying specific sites in the way that my thesis does, to be more pluralistic and sensitive to context, and not apply Marxism as in itself a complete grand narrative that contains all the answers and can be applied unmodified to any situation. The importance of the traditional structures in place in Ghana demonstrate the importance of Williams' insights. (17)

The presence of traditional structures at Ghana does not disprove, but complicates, the straight-forward interpretation of Marx's view, and is compatible with the historical materialist outlook in principle while also underlining the importance of not treating said outlook as a universal answer that is equally applicable to all cases and in the same way – something that of course Marx himself duly stressed.[93] Particular cases differ in the way that they see the universal forces of the capitalist system expressed.

I myself can only speculate on how one might make use of a Marxist approach to explain the role of chiefdoms in Agbogbloshie, and only in the broadest possible terms of someone who is not an anthropologist with a West-African speciality. In the modern chieftainship, there is often a collision between traditional expectations and the demands of modern life, best illustrated in the chiefs who traditionally were the caretakers of the land instead inviting in e-waste work – because their people depend on it. In my MFA model, chiefs take, essentially, the equivalent role of industry managers; they are the decision-makers, and their hierarchies and structures have become adapted to e-waste

[92] Marx does discuss this at times, for instance in relation to the Civil War in the USA and in relation to Russia. See: Shani T (ed.) 1983, 'Late Marx and the Russian Road: Marx and 'the peripheries of capitalism', New York: Monthly Review Press. Also Musto M 2020, 'The Last Years of Karl Marx: An Intellectual Biography', Stanford University Press

[93] I believe that the view Marx presents in the first chapter of the Communist Manifesto is, while containing a kernel of truth, quite simplified. It is here that Marx presents a view of the bourgeoisie as a force that has historically "…put an end to all feudal, patriarchal, idyllic relations" and "torn asunder the motley feudal ties that bound man to his 'natural superiors', and has left remaining no other nexus between man and man than naked self-interest, than callous 'cash payment'".

recycling. Of course, that is not all they are, but that is their role in the limited model I use that explicitly disregards much and focuses on production chains and the flow of materials.

The historically limited character of the law of value becomes particularly important here, since the law of value did not hold in traditional, pre-capitalist Ghanaian society, which has come to be subsumed under the capitalist mode of production where the law does hold. The transition is therefore from a society without the law of value to one where the law is the *driving force*; all social relations, inasmuch as they appear to remain recognisable, are fundamentally altered through this change in the underlying imperative. So it is that the Agbogbloshie chieftains retain their titles, positions, privileges, respect; even the customs, rites and symbols of office remain – but their role becomes reversed, and they ensure the continued destruction of the natural world rather than acting as its guardians and protectors, in an inversion that is simultaneously profound and paradoxically *unnoticed*. To their people they remain leaders and protectors, ensuring their way of life can continue and their livelihoods are protected. They are not challenged or dethroned, their offices are not considered corrupted, nor their duties unfulfilled. Quite the contrary, those politicians who threaten the livelihoods of Agbogbloshie denizens and clash with the chieftains risk becoming unpopular and losing elections, for to lose the support of the chieftains is to lose the support of their people.

The chieftains cannot be wholly faulted, for they do indeed fulfil their duties and traditional roles in a sense, it is just that the context in which they do so has changed with the arrival of the law of value. As Foster and Burkett argue, "[t]he logic of capitalism, associated with the law of value, is a formally rational one, which is at the same time substantively irrational, with the irrational aspects gradually taking on ever greater importance." (18)

Connected to this is the gender division of labour, again especially in Ghana, which turns out to be the opposite of what is described in Marx, though for reasons that I have argued are consistent with Marx's theory. The observed division in Ghana is largely due to Ghanaian culture being stricter about gender divisions in general, which is again not something I am personally knowledgeable about. The gender divisions can certainly not be said to be caused by capitalism, since they clearly predate it, but capitalism's development will here also be affected by pre-capitalist structures, sometimes colliding with them and sometimes making use of them, and sometimes both at once. Further research, particularly of an anthropological nature, could further illuminate the precise nature of this dynamic in the Ghanaian and Chinese cases; in particular, the traditional structure of Ghanaian society (and West African societies in general) has striking contrasts when compared to

European counterparts, as concerns for instance religious and spiritual views on land and nature, and the ties of the chieftain to the land.

Another interesting issue that came up at Agbogbloshie, though only tangentially connected to traditional structures, was the class of impoverished *petite bourgeoisie* that supported itself through refurbishing of e-waste or small-scale manufacture of household goods from it. As was stated previously, the use of all kinds of second-hand goods, and the repairing and re-using of old items, is the norm in West Africa, and markets selling those kinds of goods are common in Accra. Additionally, informal entrepreneurship is common in developing countries overall, and West Africa is no exception. (19) Though these are not traditional structures in same manner as chieftainships or gender norms, they do form a part of the cultures and informal networks of these societies that, combined with the particular political and economic conditions found in many developing nations, combine to give rise to an economy where informal approaches are customary and business is often based on , for example, familiar connections. So, it was in Agbogbloshie, where people were often recruited to work there by family or friends, who also taught them the recycling process and sold or lent them the necessary tools. Seen in this light, it is perhaps not surprising that the attempt to import the formal structures necessary for a modern recycling facility has encountered problems.

The refurbishers and shop-owners are, in the strict Marxian sense, *petite bourgeoisie* in that they own their own means of production and operate stores and shops. But being strictly technical here is dangerous, and as much as I am excited when Marx gets things right from beyond the grave, this is a case where he gets it a bit wrong as well. Technically the description fits, and these workers are indeed better off than the collectors and burners. But, unlike the industrial revolution era that Marx looked at, there is no clear separation between the industrial worker and the artisan. Instead, they work in the same industry and are interdependent. Furthermore, the *petite bourgeoisie* of Agbogbloshie partake more or less in the same misery: they work in the same place, breathe the same air, live in the same huts, consume the same food, and are vulnerable to the same economic and political forces. The ‘means of production’ that they own are usually merely a couple of quite modest and simple tools.

It therefore feels somewhat incorrect for me to employ the term ‘petite bourgeoisie’ strictly, but then again technically it does apply in terms of a somewhat better living standard, possession of specific artisan knowledge, ownership of tools, lack of direct supervision, and so on. The difference

is just smaller than Marx observed in his time, and the particular nature of the industry makes the two groups more connected and not in direct competition, but there exists an undeniable distinction that is worth pointing out, that is an outcome of the particular conditions in Ghana. As was the case with the chieftains and the gender division of labour, pre-existing structures become used as a resource – for example strong and already existing informal networks being used for recruitment, dissemination of knowledge, and aid in starting up operations.

4.3. The developmental path of e-waste recycling industries

The developments, and possible developments, of informal recycling sites are discussed in Chapter 12, and I wish to emphasise once more that this is not meant to imply *linear* development, that is, to suggest that informal recycling always develops from Agbogbloshie-style to Guiyu-style to Sweden-style in a deterministic fashion. Rather, I wished to contrast different developmental paths that are possible and compare them to Marx's theories on the subject. Yet the outward appearance of a kind of ecological modernization perspective is intentionally used as an entry point, precisely to show how and why it is incorrect; even if you fixed Agbogbloshie, another site like it would just pop up elsewhere. Starting with the appearance and outward aspect of the phenomenon and moving behind the veil into the complex underlying mechanisms, is in line with my Marxist approach.

As for future developments in practice, Guiyu is unlikely to move from where it is. As I have argued previously, the technology and finances to transform it into a modern facility do exist, and one must therefore conclude that the labour-intensive process, based on simple and primitive tools, is intentional. Unless circumstances change drastically, there is no reason to suppose further development.

The future of Agbogbloshie seems bleak, and I am presently highly sceptical that it can 'skip ahead' in the development process and reach the recycling capacity of a country like Sweden, at least not in the near future. Nor do I think it can even necessarily follow the outlined developmental process that Marx suggested and reach the level of Guiyu anytime soon. Machines have been introduced, but it has not worked out. They are, quite simply, the *wrong kind* of machine; they only work on cables and thus do not contribute to further development in practice. There is resistance from e-waste workers, who worry about change and dislike outside influence, leading to constant debates and back-and-forth negotiations, and finally political promises – even from the presidential level – have not been upheld.

I would say that the reason for the difference lies, at least to a degree, in Ghana having a weaker state as compared to China, and a stronger traditional culture – chieftains are constitutionally ensured power, and people care far more about the old structures in Ghana than in China. Politicians can go against the chieftains but would earn the ire of the people and might lose future elections if they do. And the chieftains who are involved in the e-waste trade are protective of the status quo, seeing e-waste as a source of livelihood for their people, which they are charged to safeguard. In China, the state is stronger and above all richer, and not quite as dependent on foreign investors as Ghana is.

Of course, there is corruption in both places too, with China even trying to hide away Guiyu at first, but when the cat was out of the bag, they had the political clout and the finances to address the problem themselves, allowing Guiyu to proceed quickly through this developmental phase. Marx noted in his case-studies that outside pressure and government regulations were a part of what transformed domestic industries into transitional outwork. Capital concentration, of which the huge investment that the Chinese government made is certainly an example, along with the improved automation it enables, allows for transformation into a full industry. Regulations of all kind can hasten the adaptation of machinery, and, of course just like in Marx's case, we see that some individual actors are hit hard by this and go bust, while the industry as a whole benefits.

In the final analysis these cases present clearly the tension between *actual* and *potential* outcomes. The potential is undeniably there, but that does not mean that matters will proceed mechanically forward, along a pre-determined path; neither Marxian analysis nor the critical realist approach are predictive of the future, but explanatory of presently existing forces and the conflict over *possible* futures.

5. E-waste & the Law of Value

Some final notes on my approach to analysing capitalism may be suitable. Rather than take *capitalism* as something external or given, I believe it more productive to look at the relevant *mechanisms* of the system. What makes capitalism *capitalism*, what is its essential property, if one is permitted the Aristotelian language? The fundamental aspect for me has been the *law of value* and the accumulation of exchange value that underpins it. Consider avowedly non-capitalist and socialist countries that had ecological problems (as Herman Daly often points out). What matters

is not the label applied to a system, but whether or not the law of value is in operation – and in, for example the USSR, or in democratic socialist countries like Sweden, it arguably very much was/is. My focus on the law of value has all the advantages of stealing over honest work, since it allows me to side-step entirely not only Daly's criticism and the associated debate, but also to avoid debates about the nature of capitalism vs. other economic forms and of varieties of capitalism, and focus instead on what I believe to be the central mechanism that affects the phenomenon I am studying.

5.1. Labour theory of value, or value theory of labour?

There is, within academic Marxism, a long-standing and often fierce debate on the correct way to interpret Marx's theories of value and labour, and many schools of thought that present different interpretations. These can, somewhat crudely, be divided into two major camps, though of course with many disagreements within each camp: those that think of Marx's value theory as forming the basis for understanding, or even predicting, price formation (for example, Cockshott, Shaikh, Kliman) – and those who do not (for example, Elson, Harvey, Foster). I have, quite intentionally, avoided this debate, and chosen to design my project so that no part of it hinges on whether or not value predicts price. My thesis in general, and the discussion on value in particular, is broadly consistent with both of these 'camps', since it wholly concerns the qualitative-value aspect.

Elson argues that labour, not price, was the object of Marx's theory: "[i]t is not a matter of seeking an explanation of why prices are what they are and finding it in labour. But rather of seeking an understanding of why labour takes the forms it does, and what the political consequences are." (20) Though I make no judgement on whether this was Marx's intended purpose for his entire project, it will certainly suffice as the aim and purpose in this thesis. This is not merely to avoid getting bogged down into the aforementioned debate, but because the law of value is expressed differently at the different levels that I study, where the cost-reducing competition between firms is paramount, rather than macro-level phenomena like price formation and profit-rate. My essential concern is with the way in which individual capitals compete with each other to reduce the costs of recycling e-waste; that is, the way in which the law of value is mediated through other real tendencies in the specific conditions relevant to my case-studies, and is thereby actualized in the observed phenomenon: that of capitals exploiting opportunities for cost-reduction, which either exist or are to a degree manufactured, around the world, either directly or by off-loading the problem to third parties.

For the purpose of my thesis, it also does not matter which takes central importance: the value creation by the expenditure of labour-power in the process of production itself, or its realisation in exchange, that is, its representation in the circulation of money-as-capital. This distinction has bearings on the price debate: does 'value' chiefly serve the function of a kind of regulatory force at the level of the whole market, or does it also hold true that a particular quantity of labour-power expended in production translates into a value-sum that can be mapped to price?

My thesis leaves that question unanswered and in fact does not engage with it at all, for what matters is that value cannot, either way, exist in any meaningful way without the money-form and the circulation of capital. Capital is a process; it is value in motion, and it exerts a disciplinary function – and that is equally true for either 'camp'. This presupposes the buying and selling of labour-power as any other commodity on the market; and wage-labour itself presupposes – or rather *is* – alienation, which in turn I have argued is for Marx merely the early form of the latter concept of the ecological rift. The alienation of labour occurs at the level of commodity production, whether or not value is realised at this level or not. As David Harvey argues, "[v]alue becomes an unstable and perpetually evolving inner connectivity… between value as defined in the realm of circulation in the market and value as constantly being re-defined through revolutions in the realm of production." (21)

Rather than focus on the realisation of value at the level of money circulation versus its creation in commodity production, the *socio-metabolic value* theory advanced in my thesis conceptualises both production and circulation as different metabolic processes, stressing their roots in the human-nature relationship, and ties the concept of value to the rift in this relationship. The two are mutually constitutive so that, to reiterate, the 'rift' *is* 'value'. This reading has no quantitative dimension related to price formation; a 'widening of the ecological rift' is hence conceptually tied to exchange value production and capitalist profits derived from the same, but cannot be mapped to sums of profit or commodity prices, so that *x* of natural degradation gives rise to *y* profits or *z* price fluctuations. The quantitative-value issue and the qualitative-value issue are held separate in my thesis, and I only concern myself with the latter, that is, the social-metabolic relations that lie beneath the commodity form.

However, neither does this reading disprove or clash with quantitative-value approaches. The readings of Marx that claim that commodity prices can be derived from value do not, on those grounds, make it impossible to conceptualise the historical, social or environmental basis of the labour process that constitute the qualitative-value aspect. Such readings merely assert that some

relationship exists between the quantity of labour power, measured in relation to socially necessary labour time, expended in the production of commodities that governs their market price, and that this can be empirically established.

For the purpose of this thesis, then, value matters not because I assert that it can be mapped to price, but because of the role that the law of value has in the intricate mechanism of global e-waste trade.

5.2. The meaning of the law of value

When I refer to the 'law of value', I refer to the laws of motion of capitalism and capital circulation, or what Foster and Burkett have referred to as "the system's equilibrating characteristics based on the process of equal exchange, and the distribution of class-based income forms" (22). It characterizes an economic system wherein the production of goods and services is organized around independent and competing producers who own the means of production, but use labour-power bought from those who lack anything else to sell, with the goal of making profit being the explicit incentive for engaging in production. (23) As such, it is a historically limited category, which applies to capitalism only. In contrast, in his *Capitalism in the Web of Life*, Jason W. Moore uses a broader, and ahistorical, definition of 'law of value', wherein every civilization has its own idea of what is valuable and what is not. (24) I make no critique of Moore's use, or perhaps re-definition, of the term, other than to underline the contrast with my own, explicitly historically limited use.

In a letter often referenced in debates on the law of value, Marx wrote to Kugelmann about the "necessity of distributing social labour in definite proportions". (25) The law of value is, essentially, a law governing commodity production and allocation of labour-power, presupposing that the end goal is exchange-value accumulation and posits a regulative principle between the relationship of prices of commodities and the socially necessary labour-time required to produce commodities. Althusser even calls it the "law of the distribution of the available labour power between the various branches of production", and Mandel also confirms that its function is the division of the labour force between various economic activities. (26)

The law of value, through the mediating function of the price mechanism, fulfils this role spontaneously rather than consciously, as would be the case in non-market societies through, for example, custom and ritual in traditional societies or through planning in socialist societies. (27) Market forces are the material expression of the law of value, with the price mechanism as

mediator. For, although value is ultimately created in production, it only becomes available for potential realisation when placed on the market and matched with demand backed with purchasing power.

As Jessop argues, the law is "the mechanism governing the allocation of labour time among different productive activities according to the fluctuation of market prices around prices of production that reflect the socially necessary labour time embodied in different commodities." (28). As mentioned above, this can, but need not be, interpreted in quantitative terms as labour-time mapping to, or predicting, commodity prices. Central, then, is the accumulation of profits, and the competition over (potential) profit between different capitalists as the chief incentive for investment and production, in the simplest of terms alluded to by Marx's formula M-C-M'.

Firms tend to allocate resources, including labour-power and natural amenities, according to expectations and beliefs regarding profit opportunities. Control over resources thus becomes paramount. Control over the substance of value – that is, socially necessary labour time – means the control of the source of labour-power – namely, the workers. Additionally, control over natural amenities plays a part, for though it is not the *substance* of value, it is a *prerequisite* of value creation, since labour cannot work on nothing to produce something. There are non-value elements to the law of value; class struggle is the result of tensions between the assertion of control from the capitalist class and resistance from the working class, whether that comes from control over working conditions or use of nature and its amenities: either way, the needs of capital conflict with the reality of human and natural well-being.

Furthermore, in the world-systems model, or models like the world-market perspective of Jessop and others, the law of value operates globally, and is exacerbated by the pursuit of super-profits. Different countries or regions assume different positions in this system, as has been shown, wherein some wind up particularly vulnerable and exploited.

5.3. How e-waste illuminates the global metabolic rift

The law of value is, to reiterate, the general law that drives resource allocation within capitalism subject to the accumulation drive. Yet it also takes on a particular form at the level of specific e-waste sites, as it is mediated through and shaped by particular conditions both economic and extra-economic (for example, the existing poverty but also organisational structure present in traditional Ghanaian society). The law, then, is the *specific* and *real* mechanism behind the appearance that is

the actual and empirical. The entire e-waste phenomenon cannot be reduced to it, as there are both extra-economic and economic aspects to the cost-reduction. Nonetheless, the law of value, together with the underlying accumulation drive, is at the heart of what generates the e-waste phenomenon and also what mediates the movements of the global flows of e-waste.

This of course has both theoretical and political implications. Consider the basic idea of a generally social-liberal approach, or what I have referred to as ecological modernisation, where one begins with a crude approach to production that causes environmental destruction, which then through technological and economic development, driven by good governance and proper regulations, turns into something positive in terms of both economic and ecological outcome. That is, an environmental Kuznets curve can emerge, where initial economic development causes some ecological deterioration, but the economic growth that it spurs will eventually lead to a demand for an improved natural environment, turning the curve upwards. This thesis has shown those kinds of ideas to be, quite simply, wrong. Capitalism cannot improve its relation to the natural world when its tendency towards environmental destruction is an inherent part of it, and at the core of what makes it a distinct system.

Capitalism *sans* environmental harm is the same as capitalism *sans* the law of value or *sans* alienation: a contradiction in terms at the very least. The appearance of the cleaning up of environmental harm in developed countries is not a result of economic development itself, but of a privileged position in the world-system that allows for the displacing of environmental harm to less developed areas, and even the creation of new pollution issues , for example, in the form of contaminants that are specifically the outcome of primitive recycling and would otherwise not occur. The same goes for the lofty, sometimes almost science fiction-like, hopes, present in some schools within mainstream ecological economics, which present recycling as the key to decoupling economic growth from the growth of matter-energy throughput, which is not much more than techno-optimism taken to the extreme. This is simply not the way that variegated capitalism works; it ignores the real, the underlying mechanisms.

The e-waste phenomenon manifests itself through a kind of proliferation of a complexity that is ungovernable and unregulatable, and to a degree even ungraspable. The flows of e-waste are largely hidden and invisible by their very natures, and nearly impossible to distinguish from legitimate second-hand goods, while recycled materials enter the market indistinguishable from any other mined material; the laws involved are both complex and present many legal loopholes too profound to address with simple regulatory changes, such as import into China being possible simply by

arriving via Hong Kong first; the simultaneously global and constantly shifting nature of e-waste places the scope of the problem beyond the grasp of any one regulatory agency, perhaps illustrated most plainly in the USA simply refusing to ratify the Basel Ban Amendment of the Basel Convention; the dependence of local communities on recycling work makes even limited improvements a threat to livelihoods and is faced with resistance, as we have seen in the ongoing negotiations and conflicts between Agbogbloshie locals and German investment banks.

This complexity exposes the nature of capitalism as a dynamic system, which tends to manifest itself in various ways at different scales and different localities while retaining the character of a totalizing, global system. It adapts to diverse institutional contexts, though it may simultaneously exert pressure to reshape those contexts into compatibility with itself. This, of course, is the general nature and tendency of capitalism, which may encounter resistance as well as experience various contradictions and dilemmas in practice. Hence, we encounter first the appearance of rootless flows – precarious, conditional and temporary – that are not permanently bound to any one place, but seek out conditions favourable to the establishment and flourishing of informal recycling, shifting geographically from one place to the next with changing conditions, remaining bound only to the need for low costs and lax regulatory frameworks. The reality behind the appearance is, of course, that the flows are not independent, nor do they have a mind of their own. They are tied to the needs of capital for both cheap recycling, and cheap resources to feed the growing ICT industry in the face of rising extraction costs. Both the shifting of flows to favourable spaces, and the transformation of those spaces into something even more favourable to the needs of capital, is the dynamism and capacity for differentiation of capitalism at play.

The law of value ensures that capital seeks under-regulated, and most likely underdeveloped, regions suitable for cost-saving schemes by disciplining it if it does not – the capitalist who does not cut corners in this manner has their share of the surplus they generate appropriated by capitalists who do, in the form of superprofits. It is no different than the market-disciplining of firms that are late to adapt to technological innovations. If capital cannot find suitable spaces for this end, it will *construct* them in some way or to some degree. This can occur by using state power to keep workers' rights and environmental regulation in check, as in the case of China and Guiyu's past as well as the present situation in the New Territories of Hong Kong. Or it can occur by subsuming traditional social structures towards its ends and taking advantage of a comparatively weak state lacking in resources, like in Ghana and Agbogbloshie.

Lastly, what constitutes technological development is itself tied to the needs of capital. The law of value ensures that firms that innovate by finding a cheap, cost-saving way to recycle ICT equipment and gain access to needed resources are rewarded. Meanwhile, firms that waste time and resources by using expensive and cumbersome recycling technologies are disciplined – from the viewpoint of capital they have not innovated, even though they have utilised something that might, from the viewpoint of human or natural well-being, be better technology. The solution cannot therefore possibly simply lie in future recycling technology, when the mechanisms of capitalism create a hurdle to even using currently existing technology.

In this way, e-waste and its complexity as an issue illustrates the metabolic rift precisely by highlighting the role played by the law of value. If we think of the metabolic rift as a development of Marx's early concept of estrangement, as I have argued previously, one sees first of all the personal and cultural estrangement of both groups and individuals, seen, for example, in Ghana with chieftains performing the opposite of their traditional charge of protecting the land. That itself is the outcome of a people becoming estranged from their immediate connection to nature as the source of their livelihoods; an alienation from species-essence. Additionally, if labour-power alone can be the source of value and therefore profit, nature is seen as a 'free gift', serving as a pre-requisite for value production and possibly a means by which to obtain superprofits. Therefore, destruction of nature will not *necessarily* impact capitalism *itself* – it may at times cause some crises, like a lack of a particular material or even natural disasters impacting profits, for labour after all needs something to work on. But those are particular instances, isolated events and not trends. In general, as long as there is someone to labour, and they have something to labour on, and there is some market for it, capitalism itself is safe – it will keep making profits. My case studies are just particular instances of this, and show that no matter how bad things get, as long as someone can make a profit, then the system it will keep going, if permitted to do so.

There is also an international division of labour and interconnectivity on the world market; it perhaps bears reiterating that the flows of e-waste are not connected to any particular place, and that the 'resources' that it exploits are not tied to any particular geographic location. Flows land where the conditions are right for the establishment of informal recycling, and any improvement in local conditions at one particular place simply leads to a shift in the flows. The consequence is that the problem is always just displaced, but never solved, as the solution itself creates a new set of problems. Taken together with the capitalist system's aforementioned inherent exploitation of nature, this generates an outcome in which the digital and electronic future built up as a saviour, and a solution to our problems, turns out to just bring in new problems that spread globally, with

no clear way to resolve them. Capitalism is catastrophic from its start and remains catastrophic to its end.

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Afterword

Humanism = Naturalism

I have attempted, throughout the thesis, to commit to Lewontin's and Levin's postulate of partisanship. This claims that one ought not to "pretend or aspire to a bland neutrality but proclaim as our working hypothesis: all theories are wrong that promote, justify, or tolerate injustice". This has in part been my reason, for example, for siding with the importist over the denialist side in the debate on e-waste flows, though I believe I have backed that choice up with sufficient evidence. The postulate of partisanship does not negate a commitment to the scientific method, but merely demands honesty about one's intentions, goals, beliefs and values; it assumes as given that all humans are affected by ideology to some degree and that any pretense to true neutrality is just that, *a pretense*. The choices on how we study a phenomenon, why we do it and how we approach it are always there, and it is better to be upfront about one's stance and have an open ethical commitment than to imagine oneself above or beyond ideological belief. As my choice of investigative method has been a Marxist one, that entails not only a use of the materialist dialectic but also, implicitly, a commitment to the broader liberatory project that is Marxism. It is therefore fitting to end on a brief philosophical note regarding human-natural relationships and their role in Marx.

As has been shown, the exploitation of the natural world, especially when it disproportionally strikes certain social classes, is clearly just another way in which said classes are exploited. Class exploitation itself, even the law of value that governs the movement of capital, has been argued to be rooted in the ecological rift; the alienation of humanity from nature. But I would argue that exploitation of the natural world exploits humanity in more ways than this. I would suggest that nature, meaning not only our physical surrounding but the extension of that physical world into the realm of concepts, is part of humanity – part of the same dialectical whole, and part of the experience of being human both in the strict biological sense (as a prerequisite of life, but also the building blocks of life, and through metabolism part of the same total system as life) but perhaps also in the moral and cultural sense. That is, that nature and our relation to it influence and shape us and define what it means to be human in a more philosophical, spiritual or even poetic sense. An example: the expected consequence of a particular kind of geo-engineering, meant to lessen the impact of global warming, is that the sky will turn white. (1) After millennia of art and poetry that

mentions a blue sky, will white skies take away anything from our concept of humanity or human-nature relations?

Marx conceived of labour-power as “above all else, the material of nature transposed into a human organism”, with the creation of value being transposition of that labour-power into concrete labour.[94] (2) But labour as such, even removed from the confines of the value-creation specific to capitalism, remains a universal condition, and thus the transformation of nature into humanity is part of the universal human condition. Computer scientist Steve Grand conceptualises life and humanity in a similar way, as almost a specific form that nature takes, when he states that “matter flows from place to place and momentarily comes together to be you.” (3)

Noel Castree expands on this idea of being part of nature when discussing 'selfhood', and speaks of “the idea that we can, at some point and at some level, *separate ourselves* as thinking, feeling subjects from the wider social environments in which we live.” He expresses doubt about this, asking “what if those environments, in significant measure, constitute and reproduce our characters, preferences and practices? What if they shape not merely what we ‘know’, ‘feel’ or ‘do’, but *who we are*? What if the panoply of epistemic communities we are familiar with – with their various subject matters, genres and modes of address – together provide the complex, changing and pockmarked ‘grid of intelligibility’ through which we come to define both ourselves and the world at large?” (4)

This is of course a fascinating line of inquiry, yet unlike Castree I do not venture so deeply into it nor the related question of how we relate to the natural world or how we think or feel about it. That topic is simply beyond the scope of the present thesis. In my research I am trying to say something more objective – something which is perhaps even problematic from Castree's point of view. I am trying to discuss the empirically demonstrable fact that human beings are a part of the natural world and *in what way this is true*: in my case, I have used e-waste as an example. Nonetheless, my empirical research is not wholly divorced from the more profound questions raised by Castree. In fact, despite our differences in approach, my hope is that my research can in some way contribute also to that broader philosophical discussion by grounding it in the real world. The story of e-waste is ultimately just an example of environmental harm, one used to illustrate the underlying point and to develop the Ecomarxist approach; but it is only part of a wider story of the human-nature divide.

[94] Translated in some editions as “[l]abour-power itself is energy transferred to a human organism by means of nourishing matter”. The original German is “[i]hrerseits ist die Arbeitskraft vor allem in menschlichen Organismus umgesetzter Naturstoff”, which literally translates to “[f]or its part, labor-power is, above all, natural substance transformed into the human organism”.

Though able to stand on its own, the Marxist aspects of this story best come to the fore when it is connected to the wider world.

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APPENDIX 1: A BRIEF SURVEY OF ECOLOGICAL ECONOMICS

According to a citation analysis by Costanza et. al.[i], the top ten papers cited in the journal *Ecological Economics* were the following. The description below the titles is my own brief analysis of their content. It bears mentioning that Clive L. Spash notes that "the journal *Ecological Economics* is in itself a poor and misleading guide to what ecological economics is about, exactly because it has devoted so much space to mainstream methods, studies and approaches"[ii]. Yet this very fact makes the below works representative of the debates within the 'mainstream' of ecological economics. Note that the question of why there is a tendency towards growth in a capitalist economy is not directly tackled in any of these articles – the closest issue that is usually dealt with being policies that are in favour of growth and the economic theories behind them, and the environmental impacts of growth. I believe that the very absence of a direct inquiry into the driving force behind economic growth, which ought to be the central puzzle of ecological economics, in part establishes the lack of materialist social analysis that I have asserted, at least as concerns the 'mainstream' of ecological economics.

1. Costanza et. al. – *Value of the world's ecosystem services and natural capital*[iii]

Implies that at least part of the reason that Nature is not integrated in economic decision-making and policy is that "ecosystem services are not fully 'captured' in commercial markets or adequately quantified in terms comparable with economic services and manufactured capital". Tries to rectify this by placing an economic value on all the ecosystems of the entire world.

2. Arrow et. al. – *Economic Growth, Carrying Capacity and the Environment*[iv]

Policy that promotes growth is blamed. Failure of mainstream economics to give Nature due consideration is argued to cause such policies, with the so called 'environmental Kuznets-curve' being a major culprit in this particular piece.

3. Ayres et. al. – *Production, consumption and externalities*[v]

Same as above: failure of mainstream economic analysis to include the Natural world and externalities (which ecological economics tends to instead call 'cost-shifting-successes).

4. Selden et. al - *Environmental Quality and Development: Is There a Kuznets Curve for Air Pollution Emissions?*[vi]

A classical text discussing the oft-debated 'Environmental Kuznets Curve', it does not question the cause of growth but merely discusses the impact such growth has on the environment over time.

5. Hardin – *Tragedy of the Commons*[vii]

Population growth; another classical text which can be said to lay the foundation of neo-Malthusianism within ecological economics. (Note that the assumptions regarding the nature of property, cooperation and competition were later challenged by Elinor Ostrom in *Governing the Commons*).

6. Pearce et. al - *Capital theory and the measurement of sustainable development*[viii]

Discusses a new way of measuring sustainable development that takes economic growth into account but does not investigate the cause of it.

7. Cleveland et. al. – *Energy and the United States Economy: a biophysical perspective*[ix]

The cause of overall growth is not addressed; the role of energy and fuel prices in growth is detailed and the need to include biophysical limits to growth models is stressed.

8. Grossman et. al - *Economic Growth and the Environment*[x]

Another paper on the 'Environmental Kuznets Curve', it examines the same issue without deeper inquiry into the cause of growth.

9. Vitousek et. al. – *Human appropriation of the products of photosynthesis*[xi]

Not addressed.

10. Constanza et. al. – *Natural capital and sustainable development*[xii]

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