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Transformative innovation policy approach to e-waste management in Ghana: Perspectives of actors on transformative changes

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Abstract

Ghana, as in many African countries, is faced with the challenge of sustainably managing electronic waste (e-waste). The country has a legal framework and is in the process of developing a public policy for e-waste management. However, e-waste management remains a major challenge due to weaknesses in the country’s innovation and policymaking process that include inability to cater for the informal sector. This article argues that the current approach to innovation policymaking in Ghana would be inadequate in delivering the goal of sustainable e-waste management. We examine the country’s evolving e-waste management regime and the multiple perspectives of actors with respect to their perceived transformative changes and show that these perspectives and expectations are critical for an e-waste policymaking process. We conclude that policy processes adopted in developing countries for e-waste management should be guided by inclusive policymaking approaches that consider perspectives from informal actors to co-create solutions.

Key words: transformative innovation policy; policymaking; sustainable e-waste management; actors’ perspectives; transformative change; Ghana

1. Introduction

Ghana, with a population of over 29 million people, is one of the countries in sub-Saharan Africa (SSA) that is a major recipient of discarded electrical and electronic equipment, particularly from Europe, North America, and China (Azuka 2009; Daum et al. 2017). A situation that has been described by Sovacool et al. (2020) as the decarbonisation divide where neo-colonial relationship serves as channels for the global movement of electronic waste (e-waste) from the Global North to the South. The situation is further compounded in the West African nation by the increase in the importation of cheap and used electrical devices, electronics, and equipment that have reduced lifespans, with an estimated 15 per cent shown to be totally non-functional (Owusu 2017; Sovacool 2019).

Yet, managing the e-waste requires policy approaches that are grounded on sustainability principles and underpinned by Science Technology Innovation (STI). It has been argued that better management of e-waste can contribute to the achievement of environmental, social, and economic benefits (Cucchiella et al. 2015), and the transformative innovation policy (TIP) approach is an example of policymaking that focuses on achieving environmental and social benefits alongside economic objectives (Daniels and Ting 2019; Daniels et al. 2020). Besides, the Agenda 2030 that birthed the sustainable development goals (SDGs) and that calls for transformative change also demands for a rethinking of how STI (henceforth innovation) policies are framed, formulated, implemented, evaluated, and governed. This is because implementing the SDGs requires STI (IATT 2018; Schot et al. 2018), which in turn demands a rearticulation of the framing for innovation policies. Transformative change in this context is understood in the sense that it is the change that transforms ‘many systems, and in the end also the structure of the economy and society’ (Schot and Steinmueller 2018: 1563).

It is recognised that the challenges posed by e-waste are multiple and relate to sustainability, product innovation failure, environmental degradation, and pollution. However, in this article, the focus is on the challenge of creating an innovation policy framework that addresses e-waste management with a large proportion of informal actors. Thus, we use the Transformative Innovation Learning Histories (TILHs) methodology to examine e-waste management in Ghana. The TILHs are a method that employs mixed qualitative techniques in social science research and have been used for both...
research and policy reflection (see further elaboration of TILHs method in Section 4).

Ghana’s Ministry of Environment Science Technology and Innovation (MESTI) is in the process of developing a national policy to sustainably manage e-waste. For STI to play its role in achieving of the SDGs, it would be important to consider approaches to e-waste management policy that meets the requirements of, or addresses key issues related to the role of STI for the SDGs. However, there is evidence (see e.g. Amankwaa et al. 2017; Bartels and Koria 2014; Sovacool 2019) suggesting that the policymaking processes would follow business as usual—where policies are formulated by ‘experts’ with a focus on economic factors and excluding the marginalised and informal actors in the innovation space. Hence, this article makes a call for the use the TIP approach for e-waste policymaking.

Using empirical data about e-waste management in Ghana, this article aims to contribute to the literature by answering three research questions: (1) what is the nature of e-waste management regime the country? (2) what are the perspectives of key actors in the e-waste management regime? and (3) what inputs are needed for the formulation of a transformative e-waste policy?

To answer these questions collectively, we argue that the current framework for e-waste management in the SSA country is inadequate for managing e-waste. Inadequate because there is no e-waste policy in place, and although there are laws in place, the laws are not enforced. Moreover, we argue that the on-going e-waste policymaking process does not take into proper account perspectives of the large proportion of informal actors in the sector. And that if the status quo continues, the country’s ability to achieve the SDGs or effectively manage the escalating environmental and health problems from e-waste will be significantly hindered. Furthermore, we argue that although policymaking is essential in addressing the current e-waste challenge, Ghana’s policies and approaches to policymaking are weak with respect to transformative policymaking. Hence, a TIP approach is needed to formulate, implement, evaluate, and govern e-waste policy.

The remainder of the article is structured as follows. Section 2 presents the TIP approach while providing definitions for key concepts such as sociotechnical system, regime, and niche. Section 3 presents some perspectives on e-waste management from the global, African, and Ghanaian contexts. Section 4 is dedicated to a description of the empirical methods used to collect qualitative data for the article. Section 5 describes and discusses the evolving e-waste management regime in Ghana. This is followed by analyses of the multiple perspectives of actors in e-waste in Section 6. Following from the analyses, Section 7 highlights key input towards preparing a transformative e-waste policy. The article concludes in Section 8.

2. TIP

TIP is an emerging approach for understanding and practicing innovation policy in which the aim is to apply innovation to tackle grand societal and environmental challenges such as those enshrined in the SDGs. Furthermore, TIP seeks to be inclusive, to promote deep learning, and above all to produce systemic change (Boni et al. 2019). TIP can be used as a framework for analysing, making, implementing, and evaluating innovation policy and is borne out of a process informed by previous experiences in innovation policymaking, implementation, and evaluation as well as experiences in addressing global challenges. This article’s focus for the TIP approach is on policymaking.

In adopting the UN 2030 Agenda, STI was identified as a ‘key means’ (IATT 2018: 1) and ‘a central tool’ (Walsh et al. 2020: 1) to achieve the SDGs. Moreover, there is recognition that STI has the potential to transform several elements of the global system needing change; however, there remains a consensus to be reached on how to formulate, implement, and govern innovation policies that address these global systems. It has been argued that there is need to re-direct STI and conventional approaches to innovation policy towards transforming sociotechnical systems (Schot et al. 2017). The functioning of society involves a cluster of interlinked social and technical elements that are collectively referred as a sociotechnical system (Geels 2002; Sorrell 2018). Typically, social technical systems comprise technologies that are embedded with social, political, and economic dimensions (De Haan et al. 2014) and are extremely complex with no owners (Savaget et al. 2019). Within the sociotechnical system, there are rules, norms, beliefs, and expectations that ensure a seeming stability of the system. These are collectively referred to as sociotechnical regime, and when there is a major transformation of the regime or system, it is called sociotechnical transition (Geels and Schot 2007). The sociotechnical niche refers to an area where learning and innovation takes place without the constraining powers of economic and political pressures. It is a protected space (Geels 2004; Lawhon 2012). These are important concepts for transformative policymaking.

The adoption of the seventeen SDGs marked the intent and commitment of the global community to pursue a better future, which requires transformation. The formulation and implementation of innovation policies for transformative change have been proposed as a means to contribute to the processes of bringing about the transformation envisaged in Agenda 2030. TIP has been acknowledged as a ‘success factor for overcoming the implementation failure of ambitious challenge-driven policy ambitions such as Agenda 2030’ (Schot et al. 2018: 2). But innovation policy ‘needs to transform itself’ (Daniels et al. 2020; Schot et al. 2018: 3).

Schot and Steinmueller (2018) have observed that although existing framings of innovation policies have evolved over time and are still relevant, they are incapable of addressing the negative ramifications of the sociotechnical systems that they have helped to establish. Some of these ramifications include environmental degradation, increasing socio-economic inequality in society, and unsustainable development. Accordingly, ‘it is time to articulate more forcefully and to experiment in practice with a framing for science, technology and innovation policy that emphasises sociotechnical system change’ (Schot and Steinmueller 2018: 1554). Hence, the need for TIP. But TIP, the emerging framing (Schot et al. 2017), follows from two other preceding framings.

The first framing—innovation for growth—prevailed between the 1950s and 1980s and focused innovation policy at overcoming market failure due to inadequate investment in Research and Development (R&D). Policies in this era sought to provide incentives for private and public investments in R&D to ‘produce socially and economically desired levels of science knowledge’ (Schot et al. 2018: 3). Ghana has been through the first framing where the focus of STI development and application was geared towards the promotion of R&D for economic development (Quaye et al. 2019a; UNCTAD 2011) in line with ‘tapping the potential of science and technology for prosperity and nurturing… mass production and consumption’ (Schot and Steinmueller 2018: 1555). The second framing of innovation policy, the National System of Innovation,
emerged due to shortcomings of the first framing that conceived the evolution of technology and development as a linear model. In the second framing, emphasis is placed on the use of knowledge, commercialisation, and interconnectedness among several actors of innovation in a system. This framing is marked by policies that seek to build and/or strengthen linkages in the innovation system. However, the system of innovation framing does not take sufficiently into consideration unintended consequences of innovation on society and/or the environment (Schot et al. 2018, 2017; Schot and Steinmueller 2018). In this way, the undesirable externalities of innovation have not been anticipated within policies/innovations. They must be addressed separately through other regulations. In respect of Ghana’s STI experience with the second framing, the evidence is that it was only after the 2000 policy (i.e. 2010 and 2017 policies) that the second framing is reflected in public policies for innovation. In considering the objectives of the three policies (2000, 2010, and 2017), the third frame for innovation policy does not feature in the country’s innovation policies.

The shortcomings of the first and second framings gave impetus to the emergence of the TIP approach, which ‘involves a questionning of how to use science and technology policy for meeting social needs and addresses the issues of sustainable and inclusive societies at a more fundamental level’ (Schot and Steinmueller 2018: 1555). This framing for STI has the potential to promote transformation of systems and societies in ways that foster environmental sustainability, achieve more equitable income distribution and help address other social challenges including gender, inequality, and exclusion (Daniels et al. 2020; Schot et al. 2017; Schot and Kanger 2018; Schot and Steinmueller 2018).

Transformative innovation policies, seek to address, among others, four types of failures, namely directionality, policy coordination, demand-articulation, and reflexivity (Schot and Steinmueller 2018; Weber and Rohracher, 2012). From Schot and Steinmueller (2018), the absence of a way of socially choosing alternative pathways to development means we have a directionality failure with policy. Hence, in the TIP approach, the issue of finding direction is the starting point and it demands a process that ensures a collective setting of priorities among stakeholders/actors. The TIP approach affords all stakeholders the opportunity to question already embedded views in prevailing sociotechnical systems.

Inability to horizontally coordinate policies from different domains, for example during policymaking/implementation, is called policy coordination failure. The TIP approach includes addressing such a failure. It is understood that transformative change is about transforming many systems, which ultimately includes the structure of the economy and society. Given this recognition, the TIP approach is to ensure that there is proper coordination of cross-cutting policies such as environmental policies, tax policies, economic, social, and employment policies. In addition, the TIP approach in addressing the policy coordination failure includes considering the fact that policies have geographical dimensions—local, regional, national, and international—and therefore that should be taken into considerations. Schot and Steinmueller (2018) propose that the TIP approach should integrate interventions to address the coordination failure at the point of developing the pathways—directions.

Lack of capacity to monitor, anticipate, and involve all actors in a self-governance process of policymaking and implementation gives rise to the reflexivity failure. Associated with this failure is the inability of actors to question the fundamental assumptions of their perspectives. Thus, on reflexivity, the TIP approach does not only seek to address the failures just mentioned, but also to stimulate actors’ ability to look from a distance at their own embedded practices that drive collective behaviours and sociotechnical change (Schot and Steinmueller, 2018).

3. Perspectives on e-waste management

3.1 E-waste policy in the global context

In order to answer the research questions, and for a better appreciation of e-waste management in Ghana, an understanding of the global and regional contexts is important. E-waste is now a critical global environmental health issue due to its accumulation and the inadequate policies for managing it (Kumar et al. 2017). It is increasingly overtaking other wastes such as municipal solid waste (Chen et al. 2011) with 53.6 metric tonnes of e-waste generated globally in 2019. Of this global figure, Asia generated 24.9 metric tonnes, Europe 12 metric tonnes, the Americas 13.1 metric tonnes, Africa 2.9 metric tonnes, and Oceania 0.7 metric tonnes. In absolute terms, the order is that Asia generates the most e-waste followed by Europe, the Americas, Africa, and Oceania. However, in terms of per capita, Europe ranked first, followed by Oceania, the Americas, Asia, and Africa (Forni et al. 2020). About 20 per cent of the global e-waste is recorded to be collected and recycled (Balde et al. 2017) and the final destination of 70 per cent of the e-waste generated globally is either unreported or unknown (Perkins et al. 2014).

Although Africa does not rank high among the regions in terms of the generation of e-waste, the continent remains a major recipient, resulting in what scholars have referred to as the ‘decarbonisation divide’ where wastes generated in advanced and high-income countries are deposited in poorer countries, particularly in Africa (Sovacool et al. 2020: 2). The challenge associated with e-waste does not only lie in the volumes generated, but it also lies in the ‘rapid increase’ in the amount of waste generated (Perkins et al. 2014: 287). Over the years, the technology and electronics industry has grown in large proportions globally with new inventions and productions daily. Meanwhile, Cucchiella et al. (2015) project that the total e-waste produced will grow at a rate of 3 per cent annually. This growth in e-waste can be attributed to innovation failure, which necessitates appropriate innovation policy.

Cognizant of the global challenge of managing e-waste, an agreement was signed by the United Nations International Telecommunication Union and the Secretariat of the Basel Convention in 2012 to reduce the negative environmental impact of electronic waste through proper collection and recycling of hazardous materials contained in that waste (UN News 2012). Furthermore, a number of UN entities have formed a coalition for greater collaboration in the area of e-waste management with goals that include among others: ‘countries joining global and regional legal instruments and adhering to standards in the area of e-waste’; and ‘awareness and greater engagement of key e-waste stakeholders at the global, regional, national and municipal/local levels’ (International Telecommunication Union 2020). Thus, the engagement of various actors is important, even at the international level, for managing e-waste.

At the 2015 UNs Sustainable Development Summit, the world community adopted the 2030 Agenda, which came with a set of 17 SDGs and their corresponding targets numbering 169. Subsequently, the SDGs have been taken to constitute a grand development policy. The demonstration of the SDGs for transformation is remarkable; whereas these goals express a desire to direct the
world to a better future, they also call for transformation—‘fundamental change’ (Schot et al. 2018: 2). Therefore, the SDGs offer potential to transform the prevailing and dominant (unsustainable [Walsh et al. 2020]) approaches to economic, social, and environmental challenges (Stevens and Kanie 2016). But the world community has to understand and agree that there is the need for fundamental ‘deep structural’ (Sachs et al. 2019: 805) changes in order to achieve the SDGs. Such understanding can be facilitated through the TIP approach.

3.2 Managing e-waste in Africa

As noted earlier, Africa is not a major contributor to the generation of e-waste globally. However, the continent is a major ‘receptacle’ (Daum et al. 2017: 2), with Ghana and Nigeria being the main recipients (Feldt et al. 2014). Africa is struggling with managing e-waste sustainably, whether locally generated or emanating from elsewhere. Many African countries are facing challenges such as unsafe handling practices (Okoh and Daniels 2016) and disposal of e-waste dominated by an informal sector that is ill-equipped (Quaye et al. 2019b). Printed circuit boards (PCBs) are central components of electrical devices and account for about 3 per cent of e-waste. PCBs comprise metallic components (such as aluminium, copper, gold, iron, lead, silver, and tin) and non-metallic components (such as epoxy resins, glass, and fibre) that are difficult to recycle (Meng et al. 2018). In the process of recovering valuable fractions from e-waste in the informal sector, there is smashing and burning of components in open spaces. These are unsafe methods of handling e-waste. In South Africa and Nigeria, for example, acid is used to extract precious metals such as gold, platinum, palladium, and silver from PCBs, and the situation is the same in North Africa (Seitz 2014; Ikhlayel 2018). In Algeria for instance, data on e-waste are rarely collected because there is no separate management system for it and hence, it is ‘collected together with household waste and bulky refuse’, with the eventual disposal done by the informal sector where no environmental standards exist (Seitz 2014: 18).

The interest of the informal sector in recycling e-waste in Africa is founded on the fact that there is a market for precious metals found in e-waste. It is considered that several precious metals can be found in PCBs in much higher concentrations than they do occur in their ores. Since these precious metals have higher chemical stability, resistance to corrosion, and electrical stability, they are most suitable for use in electronics. Hence, under proper recovery methods, the growing quantity of e-waste in Africa can be transformed into ‘a secondary resource of precious metals’ (Meng et al. 2018: 147), which could lead to job security for some informal actors. However, although informal actors dominate the e-waste recycling/handling in developing countries, they are often overlooked when considering cities’ solid waste management structures (Ikhlayel 2018). This has therefore prompted scholars to call for the integration of the informal actors in e-waste handling into municipal waste management structures (Fei et al. 2016), and to re-orient traditional waste management policies to allow for resource recovery from wastes (Parajuly et al. 2018).

3.3 Challenges of e-waste management in Ghana

In this section, we shed more light on our research question ‘what is the nature of the e-waste management in Ghana?’ E-waste activities in the country generate between US$105 and 268 million US Dollars annually and provide livelihood options to at least 200,000 people across the country (Oteng-Ababio et al. 2014). To reiterate, as is elsewhere in SSA, e-waste operations in the country is dominated by the informal sector and contributes to the local economies. However, the unsafe working environments associated with their operations present dire occupational hazards (Srigboh et al. 2016). The informal sector is ‘booming’ because of increasing availability of e-waste that is generated both locally and originating from the international community due to increasing demand for second-hand (used) electronics from the developed countries (Amankwaa et al. 2017).

Besides, the ails of e-waste in SSA go beyond the issue of addressing the informal nature of activities in the sector. Other factors are implicated, such as environmental degradation and air pollution, health impacts on the informal sector actors involved, and contamination of food and water sources, with implications on nutrition. Several studies have shown the impact of e-waste activities on the environment (see e.g. Caravanos et al. 2011; Tue et al. 2019). Since the Agbogbloshie area is home to thousands of people who work at the e-waste site, including women who sell water and food; residential communities that house Agbogbloshie workers and their families; greater populations are continuously exposed to the various hazards, including exposure to toxic elements (Srigboh et al. 2016). Studies conducted in the Agbogbloshie area have found elevated range of blood lead levels among e-waste workers, with even greater recordings among workers performing open-pit burning (Amankwaa et al. 2017). In addition, the study noted the ‘worrying’ fact that women who provided catering services to workers were exposed to the lead poisoning. This is critical for child development since a study by Bellinger (2013) has found a negative effect of prenatal exposure to lead on child development.

In spite of the abundant literature on e-waste, the focus of such literature has been on human health and the environment with little on policy. Even where policy has been the centre of focus, little emphasis has been given to the ‘the intangible quality of life of those involved in the e-waste industry, as well as […] policy strategies for protecting it’ (Daum et al. 2017: 2). This is partly due to a lack of proper understanding of the e-waste management regime. Thus, a proper understanding of the regime will be helpful in an e-waste policymaking process.

4. Method

In carrying out the research to collect empirical data, a choice was made to use e-waste management as the illustrative case study that helps unpack the social, development, and policy challenges. The case study approach entailed use of the TILHs methodology, which has been found useful for conducting research and policy reflection, and with greater usefulness for processes of co-creation in innovation policy research (Daniels et al. 2020).

The TILHs involves mixed methods divided into two steps: (1) gathering multiple human accounts and documentation of a transformative innovation process taking into consideration the role of policy and (2) jointly constructing, within a team, written accounts and timeline based on recollection and documentation. These two steps are important for the purposes of, first, allowing participants in transformative innovation processes to recognise transformative elements in, for instance, the e-waste sector, to record and reflect experience, and to conceive of ways to improve their future performance. Secondly, the method helps participants to develop an understanding of how the transformative innovation happened, and
identify factors that led to success, particularly the role of policymaking, and areas for improvement.

A team of researchers at the Council for Scientific and Industrial Research (CSIR)-Science and Technology Policy Research Institute (STEPRI), University of Ghana, and Science Policy Research Unit at the University of Sussex applied the TILHs on Ghana’s e-waste sector. Operationalising the methodology started with a review of literature and policy documents on STI and e-waste. This review culminated in a mapping of the country’s STI development process, innovation and policy ecosystem (Quaye et al. 2019a), and the identification of relevant actors in the e-waste sector. Actors identified were categorised into e-waste (scrap) collectors; government agencies including local government authority; researchers, academia and development partners; and private sector and Non-Governmental Organizations (NGOs) actors. The review also contributed to justifying the selection of e-waste as the case study and informed the subsequent focus group discussions (FGDs) and workshop.

The next step involved the collection of empirical data through FGDs and a national workshop. Four FGDs were organised on 25 April 2019 in Accra with the four categories of actors identified in the e-waste sector. On average, there were nine participants per FGD, with each session lasting for about an hour. Among the questions posed to engender discussions included: Who was involved in the transformation pathways in e-waste system? Why were they involved in the transformative events in the e-waste system? How did the actors contribute/participate in the transformative events? What were the results? Were the results transformative? If yes, in what sense? Each of the sessions was recorded, transcribed, and analysed to draw themes and synthesised. The FGDs helped to better understand stakeholder experiences regarding the evolution, pathways, and activities that have contributed to the e-waste management system over time. Furthermore, the FGDs enabled a deeper understanding of the multiple perspectives of the various actors.

Following the FGDs, a national workshop was held at CSIR-STEPRI on 26 April 2019 in which the various actors—including e-waste dealers, innovators and entrepreneurs, researchers, policymakers, development partners (Gesellschaft für Internationale Zusammenarbeit and the European Commission)—were brought together. The workshop unpacked multiple perspectives with respect to transformative changes that actors perceived as either impacting or having the potential to impact e-waste management; challenges; ideas on how to achieve sustainable e-waste management; and prospects for a TIP approach to policymaking. Hence, the transformative changes reported in Section 6 were thus from the point of view of the actors. Through the FGDs, the national workshop group sessions, and literature review, multiple human accounts, and documentation of transformative innovation processes were gathered. This helped to construct written accounts and timelines of transformative (innovation) events in the e-waste management in Ghana over a period of 19 years (2000–19).

Schot and Steinmueller (2018) have argued that experimentation on the TIP approach ‘should be a priority in any consideration of current science, technology and innovation policy’ (1555). This partly accounts for the choice of a case study on e-waste (Daniels and Ting 2019). This is not only to build on insights and lessons from other country cases that have utilised the TIP approach to policy research (Daniels et al. 2020), but it is because the West African nation does not have an e-waste policy, which gives the opportunity to use this experimentation to contribute towards the e-waste policy process. Moreover, e-waste was chosen as the case study because it offered better opportunity to achieve broader a societal goal, including achieving inclusivity.

5. The evolving regime of e-waste management in Ghana

The discussions in this section help to answer the research question on the nature of e-waste management regime in Ghana. The country’s current management of e-waste is characterised by a sociotechnical regime that has the tendency to support and reinforce a heavy top-down formal institutional approach, which, in several ways, is not inclusive as we found during the FGDs. This sociotechnical regime comprises conventions, rules, and norms that guide ways in which e-waste is handled with particular technologies and the everyday practices of the importers, producers, collectors, state agencies, scientists, civil society organisations, and business people who participate in the regime. The rules have been codified in some ways through an Act of Parliament, a legislative instrument (LI), and Environmental Protection Agency (EPA) guidelines. However, some of the practices in the regime are contrary to what the rules say. For instance, collectors are banned from burning e-waste components; however, the practice of burning still prevails at the Agbogbloshie site (see Fig. 1).

To illustrate another impact of the heavy top-down formal approach, there was a decision to construct an integrated e-waste recycling facility at Agbogbloshie. The choice of technology for this facility was informed by heavy-top formal managers’ perspective whose objective was to ensure sound disposal and recycling of e-waste. On this score, technical guidelines were developed (rules of the regime) to guide the management of e-waste. MESTI received technical assistance from a development partner to produce an e-waste policy, with such assistance including facilitating capacity building and training for the informal players in the e-waste value chain; and providing tooling support and technologies for dismantling e-waste. Yet, while this intervention was aimed at ensuring inclusion, the choice of technology for tooling and curriculum for training was informed by a top-down formal perspective.

Notwithstanding, there have been significant interventions in e-waste management in Ghana. The most significant is the formulation of laws to govern the regime. As depicted in Fig. 2, the country promulgated the Hazardous and Electronic Waste Control and Management Act (ACT 917) in 2016. Following, the Hazardous, Electronic and Other Wastes, Control and Management Regulations (LI 2250) was passed in the same year. ACT 917 provides for the establishment of a national e-waste plant with the involvement of private waste recyclers to manage and recycle e-waste. This law has imposed on the regime a certain direction with respect to the role of technology in e-waste management, whereas a TIP approach would allow for a process of co-developing and determining directions. Besides, the development of technical guideline on e-waste in 2018 went to further support and buttress Act 917.

As another piece of evidence of the role that rules are playing in the e-waste regime: the Government of Ghana contracted a private sector actor to construct and operate an electronic waste recycling plant. The aim was to collect at least 40% of e-waste generated for re-cycling, and it would serve actors such collectors, EPA, managers of e-waste collection centres, and those involved in dismantling, recycling, and disposal. The contract agreement took on board an integrated e-waste management approach guided by the legal...
frameworks governing e-waste management. That is, ensuring compliance with the Act 917, LI 2250, and the EPA’s technical guidelines.

At the moment, what has been described as Ghana’s e-waste management regime has not achieved a stable state and therefore, it is not locked-in any particular sociotechnical trajectory, because the system that exists and which organises activities, and structure relationships among the different actors/groups are in a state of flux. There is yet to be total alignment of the regime’s actors’ expectations and practices ‘through shared understanding of priorities’ (Lawhon and Murphy 2011: 358). Notwithstanding, it is clear that there are interest groups seeking to pull the trajectory in alternative pathways. This is more so because of the multiple perspectives that the regime actors have.

*Figure 1. Open burning of e-waste components to retrieve copper wires.*

*Figure 2. Transformative history time line of e-waste sector in Ghana.*
6. Multiple perspectives of the actors

6.1 E-waste artisans—collectors and dismantlers

In every decision-making process that purports to be inclusive, there are multiple perspectives of various stakeholders and actors. In this section, we focus on the second research question by discussing some perspectives of actors involved in Ghana’s e-waste evolving regime. The multiple perspectives that the study sought to account for were based on the transformative innovation changes that the various actors identified as having taken place and those that they expect to see in order to be assured that e-waste management is satisfactory.

From e-waste collectors, their perspectives included the formation of an association that is registered with the Registrar General’s Department (see Fig. 2). This is significant for the informal sector because it is one of the major issues that the collectors raised, that they face a similar fate in addition to them not owning the e-waste they collect. Since they are sponsored, the sponsor owns the equipment and they have to pay for the e-waste they collect. According to the collectors, they face a similar fate in addition to not owning the e-waste they collect. Since they are sponsored, the sponsor owns the collection and therefore decides how much to give to the collector after re-selling to a dismantler/recycler. These issues, as raised, border on the livelihoods of collectors, where one hand due to their inadequate access to capital, they remain in a cycle of poverty and/or are exploited by sponsors who have capital to invest. In this regard, an expected transformative change for collectors would be their ability to access working capital on reasonable terms to facilitate their operations.

Also, bordering on livelihoods of collectors is the issue of protection and assurance of jobs, particularly youth employment in the e-waste value chain. The direction of the heavy top-down approach to e-waste management is to formalise the informal sector. As shown in Fig. 2, there have been several interventions in that regard since 2000. However, collectors, dismantlers, and others who constitute the majority of the informal sector expressed fears that they would lose their jobs and sources of livelihood should the formalization rules and guidelines be applied fully. The ACT 917, LI 2250, and technical guidelines stipulations are seeking to insert, through stringent measures, technical requirements in the sociotechnical regime that will exclude most of those currently participating in the informal sector. So a transformative change for the collectors would include their ability to participate fully in the evolving regime.

Collectors also shared other challenges they face. They noted that there is a public perception that collectors are petty thieves who pick (scrap) items from residences and properties without permission. Yet, the collectors pointed out that it is a wrong perception. Because a lot of the scrap they collect are paid for, they often negotiate with owners of the items and pay before collecting for dismantling and retrieving useful fractions. Therefore, they called for advocacy in the direction of engendering attitudinal change among Ghanaians about e-waste collection. Allied to the issue of buying e-waste is that there is no standard pricing for the items they pay. Thus, the establishment of a transparent mechanism through which prices of e-waste components can be determined would be a transformative change with positive impacts for actors in the informal sector.

6.2 Government agencies

From the perspective of government agencies acting in the e-waste sector, a transformative innovative change identified includes the establishment of a legal framework for managing e-waste. This legal framework includes the passing of ACT 917 into law and the subsequent formulation of the LI 2,230 with its accompanying technical guidelines. For the e-waste sector, these laws and guidelines are the principal rules. Nevertheless, it is important to point out that despite their existence, it is conventions and unprescribed practices that prevail due to the fact that the laws are either not practicable and/or not enforceable. For instance, the technical guidelines provide that a ‘collector shall be registered with the relevant MMDAs [Metropolitan, Municipal, and District Assembly] and, where in an association, with the EPA’ (EPA 2018: 7). However, there are
collectors who do not belong to any association and yet have not registered with the EPA. Perhaps, they are unable to fill the forms prescribed by the technical guidelines as they are uneducated. Such a challenge is clearly an outcome of the heavy top-down approach and therefore could have been avoided with a TIP approach, which emphasises inclusion and bottom-up approaches.

Regardless, according to government agencies, another transformative change is that the legal framework has provided a definition for what constitutes e-waste; provided for the advance collection of an eco-levy from importers of electronic equipment; and established a fund to support e-waste management. This fund will also support key trade associations such as the Ghana Union of Traders’ Association, the Association of Ghana Industries, and Media and research organisations.

In addition, government agencies felt that there is significant gap in the availability of infrastructure to treat and recycle e-waste; they also had concerns about the sustainability of an incentive scheme in place and the need to change the attitude of the informal sector and general public regarding e-waste handling and disposal. The identification of a proper framework is for an informal–formal interface and low-tech tooling and upgrading methods of dismantling e-waste. In addition, the protection of jobs, particularly ensuring youth employment for the informal sector, is one of the expectations of government agencies. However, regardless of this rhetoric, formal actors have acted to the contrary by pushing for steps to formalise the informal sector without supporting the informal sector to prepare adequately to meet required standards.

6.3 International development partners

International development partners have either partnered with government agencies or single-handedly rolled out a number of interventions in Agbogbloshie area to support the management of e-waste in Ghana. Among such interventions are the Environmental Sound Disposal and Recycling of e-waste in Ghana, Sustainable Recycling Industries programme 2015–2018, Switch Africa Green, Ghana Cleaner Production Centre capacity building, awareness creation, and establishment of training platforms. Some of the outcomes of these interventions include the establishment of incentive schemes to deal with both positive and negative fractions of e-waste, which has also contributed to reduction in the burning of e-waste. In addition, there is an objective to help government to re-brand Agbogbloshie, which has obtained a bad reputation locally and internationally due to e-waste handling in the area. Perhaps, it is this objective that is driving government agencies’ pursuits to formalise the informal sector at all cost.

The involvement of international development partners is good, but it must be viewed critically since development partners are not always neutral. There could be the tendency to want to reproduce neo-colonial relationships that want Ghana to receive e-waste, thus, making the Global North cleaner and the Global South dirtier, which has been called the ‘decarbonisation divide’ by Sovacool et al. (2020: 2). Although there was no evidence from this study, there is evidence of the decarbonisation divide through e-waste in Ghana (cf. Sovacool et al. 2020).

6.4 Private actors and NGOs

From the perspective of the private sector and NGOs, a transformative innovation change would be the ability to turn trash into treasures through recycling, upstream cycling, and to provide alternative livelihood sources from e-waste management. As previously discussed, there are a substantial number of actors in the informal sector, mainly comprising collectors and dismantlers; however, issues of job security and better incomes are challenges that must be addressed. Hence, for the private sector (comprising mainly of the formal waste management and e-waste recycling companies), the ability to turn e-waste into ‘treasures’ through industrial scale recycling would provide better job opportunities and improved incomes for the collectors. This could constitute a transformative change, but there is tension since the industrial (mechanical) scale could lead to job losses because of automated processes that require less human labour.

E-waste management activities in Ghana are male-dominated although there are women in the sector who mainly provide auxiliary services—such as catering, petty trading, and stall attendants—to the main actors in the informal sector. Aligned to addressing gender issues in the provision of livelihoods, a transformative change envisioned by the private sector and NGOs is to ensure that improved incomes for the informal sector also benefits women, and that women are encouraged to participate in the other aspects of the sector that are considered lucrative, not only limited to auxiliary aspects. Thus, one private sector actor said:

From our interactions [at Abgogbloshie], we realized that there are a lot of women around there who don’t have any work to do apart from cooking for the people there, so we decided to ask them to be our collectors. So, they collect what [the circuit boards] we want, we pay them [for their service] and turn them [materials] into useful things. Also, there are children in that part of Accra and most of them do not have education just for the simple fact that they can’t afford school. So, we dedicate 2 percent of sales from our company to contribute to the education of these children - Private Sector Participant.

From the private sector and NGO actors, the existence of a mechanism to support early stage innovators to grow through the provision of shared internet infrastructural support would be a transformative change. Such a mechanism would serve a cluster of early stage innovators and offer green energy support services. It would also create learning opportunities for early innovators and find solutions to negative value fractions when e-waste components are dismantled. Of course, there is unanimous agreement on the need to introduce low-tech plants to upgrade methods of dismantling to replace the crushing method prevalent in the informal sector.

7. Towards a transformative e-waste policy

From our analyses of literature on innovation policies and the empirical data collected, we argue that e-waste policymaking process needs to adopt the TIP approach. Using this approach for the formulation of public policies on innovation (including e-waste) would harness the power of innovation as a driver to achieve not only sectoral goals and objectives, cross-cutting policies in environment, trade and industry, labour and employment, city planning, and sanitation, but also to address critical societal, social, economic, and environmental challenges. Ultimately, the TIP approach would engender inclusive policymaking that considers perspectives from informal actors to co-create solutions.

Theoretically, Ghana’s e-waste sector has a sociotechnical system that at the moment is considered undesirable insofar as it does not contribute to the sustainable management of e-waste. Hence, a transition is required in the e-waste sector. But how can such a transition be provoked? Our view is that the goal of e-waste...
management should be to steer the prevailing sociotechnical regime in a different direction that should be co-determined by the various actors, especially the informal actors. This, we argue, is the role for the TIP approach that allows for attention to be given to the power relations between the formal top managers of the sector on one hand and the informal actors at the bottom on the other. Thus, it is important to understand the perspectives of all actors in e-waste management. This situation does not only apply to Ghana, but to other countries in SSA where managing e-waste is also challenge.

Through empirical methods, this paper has identified challenges from the perspectives of actors. These include the absence of a national policy although there are laws. The e-waste policy being developed should take into consideration critical issues such as changing attitudes among the population with respect e-waste disposal, and while seeking to formalise the sector, ensure that there is improvement in income generation and livelihood sources for actors in the informal sector. There is substantial infrastructural gap for treating and recycling e-waste. This requires innovative business models coupled with innovative incentive schemes in an e-waste policy to attract potential investors in e-waste management. This should be done with the mindset not to exclude actors in the informal sector, but to integrate them to achieve inclusivity and to co-create solutions.

While this article has observed that Ghana’s e-waste management regime has been set to proceed in a certain direction because of the laws passed by government for e-waste management, and since there is no e-waste policy, there is yet an opportunity to question the perspectives and views that the laws reflect by adopting a TIP approach to the e-waste policymaking process. This is because, using the TIP approach, can facilitate collective setting of priorities among stakeholders/actors towards policy formulation. On this basis, when all actors, especially the top-formal institutions, have taken an outsider-look at their own embedded perspectives and practices, and questioned the fundamental assumptions of their perspectives, there would be a realisation that multiple directions are possible in terms of sustainable e-waste management. That is, there should not be only one direction for achieving sustainable management of e-waste.

One of the problems identified by government agencies was infrastructure gap in managing e-waste. Hence, to address this gap through, an e-waste policy intervention, for example, a sociotechnical dimension should be considered. Because by doing so attention would not only be given to the technological aspects of infrastructure, but attention would also be given to the social, economic, and environmental dimensions as well. This is where the TIP approach would be useful. By facilitating to ensure that there is appropriate policy coordination, the solutions to the problem of inadequate infrastructure would not be considered as just a technological problem, but social, economic, and environmental ones too.

It is our belief that many countries in SSA can learn from Ghana’s case to formulate policies to sustainably manage their e-waste, not because the socioeconomic and policymaking characteristics are similar in SSA, but because there are compelling lessons. For instance, the need to consider multiple perspectives in policymaking, though seen as a widespread practice, does not often include the consideration of informal actors’ perspectives. Another lesson is the need for the co-creation of policy directions and solutions to e-waste policy.

8. Conclusion

The need for a new practical framing for innovation policy is imperative in developing countries (Daniels et al. 2020) and this is because developing countries, such as Ghana, face the problem of growing economic inequality, and exclusion of some actors in the innovation policy processes (Daniels et al. 2017; Prahalad 2012), particularly actors in the informal sector. This article contributes to improving understanding of the ways that the TIP approach to policymaking can be applied to e-waste management. The findings call for an interrogation of the strategies being adopted for e-waste policymaking. From the analyses of the multiple perspectives of actors in the e-waste management regime, it is evident that continuing with business as usual to policymaking would result in e-waste policy that excludes the perspectives and critical actors, especially those in the informal sector. This is true for Ghana as it is for other SSA countries. After all, the problem of sustainably managing the growing amount of e-waste is a problem for other developing countries as well.

Moreover, managing e-waste is a multidimensional challenge that requires a new policy approach to transform the sociotechnical system around it. Multiple actors are involved in any e-waste management regime. These actors and the views they hold should influence and contribute to shaping any innovation policy seeking to address e-waste management.

Future research could focus on policy experimentation on e-waste management, implementation, evaluation, and new ways of governing e-waste policies drawing from the TIP approach. Lastly, a study on establishing a mechanism for collecting and keeping data on e-waste in SSA is recommended.

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Conflict of interest statement

The authors have no conflicts of interest to declare.

Notes

1. Including environmental and e-waste policies as types of STI policies
2. A community in Accra, the capital city of Ghana, and it is one of the foremost and biggest places where high volumes of e-waste are handled.
3. Such as transporting e-waste components by unapproved means, for example bicycles and push carts.

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