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solving the e-waste problem

Case studies and approaches to building

Partnerships between the informal and the formal sector for sustainable e-waste management

Date: April 2020

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Disclaimer

This StEP paper has been developed within the StEP focus project "Partner-ship models between the informal and the formal sector". The paper meets the core principles of StEP and contributes to its objectives towards solving the e-waste problem. However, not all StEP member necessarily endorse the conclusions made in this publication

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Abstract

Due to rising prosperity and increased consumption worldwide, more and more waste electrical and electronic equipment (WEEE or e-waste) is being generated worldwide. The informal sector plays a significant role in the collection and management of e-waste, particularly in low and middle-income countries. While they provide a livelihood for many and contribute to high collection rates in many countries, the sub-standard recycling processes used in the informal sector also pose a major risk to human health and the environment, as well as the loss of valuable and scarce materials. Partnerships between the informal and formal sector can help to improve the conditions of e-waste management, building on the respective strengths of each sector, and providing a transition pathway from informal to formal operations.

The main purpose of this paper is to present approaches to and case studies on current informal-formal partnership models in different countries across the world. The partnership concept in this document aims to support the achievement of high recycling rates and legislative requirements, under extended producer responsibility (EPR) or other take-back systems in low and middle-income countries. Exploring potential benefits and challenges in different partnerships or alliances between formal and informal sector is of utmost importance in order to promote integrated solutions among different actors, provide social, financial and health benefits as well as to guarantee a sustainable management of waste material throughout the value chain. This paper is the result of a joint effort by members of the Solving the E-waste Problem (StEP) initiative, who conducted a review of existing e-waste partnerships. The information gathered is based on practical experience, secondary literature research as well as case studies obtained through a survey with Producer Responsibility Organizations and other initiatives in different countries.

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1. Introduction

Rapidly growing demand for electronic devices such as laptops, smartphones and refrigerators together with ever-shorter innovation and product life cycles is leading to increasing amounts of e-waste worldwide. According to UNU's Global E-waste Monitor 2017, 44.7 million metric tons of e-waste were generated in 2016 (UNU, 2017). Due to its complexity and its composition, the end-of-life management of e-waste is particularly challenging. Containing a high amount of valuable materials such as precious metals and rare earth elements, e-waste is an important source for secondary raw materials. However, hazardous substances such as lead, mercury or brominated flame-retardants pose high environmental and health risks and require a proper management at end-of-life (Awasthi & Li, 2017).

As of today, only 20% of e-waste generated globally is managed by formal recycling systems (UNU, 2017). In low and middle-income countries the highest share is managed by the informal sector under inappropriate working and environmental conditions (ILO, 2019). Often appropriate facilities and infrastructure for handling e-waste are not available locally, and as a result, informal recyclers apply sub-standard and often dangerous processes to recover valuable materials. These include burning of cables, uncontrolled disposal of non-valuable fractions, oil-leakages to the environment or amalgamation (gold recovery) (SRI, 2018).

A uniform definition for the informal sector does not exist as the experiences and perspectives vary from region to region. Generally, the literature describes informal work as "small scale [individual actions], labour intensive, largely unregulated and unregistered (often without trading licenses), [...] associated with evasion of taxes and low-technology processing" (ILO, 2014). In e-waste management, these activities are often carried out in order to earn a basic income on which to survive, therefore some of these activities can also be referred to as "subsistence activities" (SRI, 2018). The types of different actors in the informal e-waste sector vary strongly. Moreover, depending on their position in the value chain as well as their ability to organize within prevailing power structures, informal stakeholders have different levels of income. Table 1 shows an example of the activities carried out in the e-waste value chain in Cameroon.

Table 1. The informal e-waste sector in Cameroon categorized by activity

Activity	Management Type	Description	Level of revenue
Discarding	Fully informal	Consumers/ users are a major entry point of e-waste into the informal sector, they discard their e-waste in inappropriate places, are unaware of its hazardous nature and are not particularly interested in how the e-waste is treated afterwards.	None for informal workers; though consumers may sell to collectors.
Collecting	Fully informal	Individuals pick up e-waste from the streets, drains, garbage collectors, or offer to buy from individuals and businesses. They pre-dismantle new found e-waste on the spot and keep only the valuable parts.	low

Activity	Management Type	Description	Level of revenue
Aggregating & trading	Informal for the smallest equipment, semi-formal to fully formal for the largest equipment	Aggregators are at the center of the informal e-waste ecosystem. They buy from collectors or directly employ them, employ dismantlers and sell to refurbishers, sellers and exporters.	high
Dismantling	Fully informal	Dismantling is done using rudimentary techniques (open breaking and burning). Dirty and low-pay work, people usually don't do it for a long time.	low
Refurbishing	Mostly informal to semi-formal	Refurbishing is mostly done in tiny workshops. Informal refurbishers can be very talented in spite of a lack of equipment, but they work in unhealthy conditions due to a lack of awareness.	medium
Selling refurbished WEEE	Mostly semi-formal to formal	Sellers usually have fixed locations (shops), regular customers and a brand, and therefore cannot be considered as fully informal. The selling points are innumerable and present everywhere.	medium
Exporting materials	Every management type	Exporters of metals and other fractions are almost never Cameroonian. They go all the way from fully informal to semi-formal to some of the largest formal companies in the country. E-waste's exit point from Cameroon's informal sector.	very high

Although the above table specifically refers to the situation in Cameroon, similar structures can be found in other countries. Informal workers performing e-waste collection, sorting or dismantling for subsistence purposes (sometimes referred to as waste pickers or scavengers) typically form the bottom of the pyramid. They often belong to very vulnerable and marginalized social groups without alternative income generating opportunities. Others may have well established but "unofficial" businesses and generate higher revenues due to value-added activities, such as repair, refurbishment, specialized dismantling and aggregation of valuable fractions. However, these stakeholders are often not registered, face difficulties with registering their businesses, operate outside of legal controls and avoid paying taxes. The reuse value of products or components is almost always higher than the material value of the product, and e-waste collectors will first see that parts of their collection go to repair and component harvesting before entering recycling.

Integrating informal workers in waste management systems can maintain employment levels, improve working and environmental conditions and increase collection of e-waste, however, informal stakeholders are often not considered in legislative processes and remain poorly integrated into existing waste management systems (GIZ, 2017). In some countries, governments are taking actions to develop legislation to finance formal e-waste management. This is often based on the idea of extended producer responsibility, which makes producers responsible for ensuring their products are recycled at end-of-life. However, such legislation is often difficult to enforce (if enforced at all), and normally does not consider informal activities. This may lead to competition for e-waste between formal and informal stakeholders and compromise the efficiency of the overall system. Similarly, approaches which aim to ban informal activities tend to only drive such activities further underground, making them harder to track and potentially increasing the environmental impacts

(Davis & Garb, 2015). Legislation may provide the framework to encourage cooperation with and integration of informal actors, ensuring that they also may play a role in the formal waste management system.

Different approaches to integration have been described by Anne Scheinberg (GIZ, 2018a), which encompass for example:

» **Cooperation:** primarily an intention and a practical, two-sided approach for collaboration
» **Inclusion:** rather unilateral normative approach focusing on the provision of basic rights
» **Legalization:** normative, unilateral, facts-based technical and practical process, transparent and providing protection and status
» **Fiscal legalization:** Unilateral demand for legalization focused narrowly on registration in the tax system as an enterprise or free professional
» **Formalization:** Focused, unilateral, professional, moral/ethical demand or requirement for informal recyclers to take specific actions that will entitle them to participate in recycling, and will also create specific roles and functions for them to fill
» **„Paths to legalization":** Bilateral, requiring both a political and practical commitment to legalizing the profession and the person, and a commitment from the informal recycler to achieve a legal, formal, transparent relationship with authorities and institutions
» **„Structural integration":** Bilateral, practical, permanent, not project-based, and generally free of normative elements; representing a permanent change in the way things are done, who may do recycling, who has rights and obligations, and for whom the institutions are set up.

The concepts mentioned above are generally understood and perceived differently by different stakeholders, some putting more focus on legal requirements and rights, and others emphasizing flexible forms and the openness for cooperation. The partnership concept in this paper is not primarily focusing on the legal status of the informal sector in the sense of legalization or formalization, but more focused on practical forms of collaboration between informal workers or businesses with formal private companies. Such approaches may of course often also require informal actors to be prepared to "walk the paths" towards formalization, legalization and structural integration as described above.

The possibilities and forms of integrating the different informal stakeholders into formal systems vary widely. In many countries, there are numerous links between the informal and the formal sector in the e-waste value chain, such as informal workers selling materials to formal companies. Establishing partnerships can be understood on the one hand as longer-term business partnerships based on transparency and not exploiting the informality status by formal companies. On the other hand, it can be long-term agreements between informal stakeholders and producers (or their service providers) to achieve their e-waste collection targets. This may range from simple collection partnerships through to assisting with the transition to become fully formal recycling businesses. In recent years, a number of initiatives from governmental and non-governmental organizations (NGOs), Producer Responsibility Organizations (PROs) and recyclers have worked to build up partnerships between formal and informal stakeholders to enable sustainable e-waste management. Some of these have been in the context of operational EPR systems, whilst others have been based on proactive approaches of local stakeholders.

In the subsequent sections of this paper, the benefits of such approaches and experiences in various countries are described. These include not only partnerships with informal workers or businesses but also partnerships with organizations or cooperatives formed by former informal workers who have left the informality status. Various country case studies are presented. In the case of India and Peru, collaboration models have been successfully implemented in the context of EPR legislation, while in Nigeria and South Africa, functioning EPR

systems are not yet established, but recyclers have developed partnerships with informal actors. Meanwhile, in the case of Ghana, technical guidelines that were recently developed by the Environmental Protection Agency with support of international organizations demonstrate how legislation can start to acknowledge a role for informal actors in the value chain. Based on the findings of the case studies, experiences and literature review, general steps towards setting up informal-formal partnerships are outlined.

2. Why pursue partnerships between informal and formal actors?

Producers and Producer Responsibility Organizations (PROs)

Depending on the legal regulations in a country, producers or manufacturers may be obliged to comply with certain collection and recycling targets in the context of EPR systems. In addition, especially larger producers of electrical and electronic equipment (EEE) often have internal collection or recycling targets in line with Corporate Social Responsibility (CSR) policies. In some EPR systems, responsibility for collection and/or recycling is delegated to so-called Producer Responsibility Organizations (PROs). These act as specialized compliance service providers which organize e-waste management on behalf of producers in line with legal targets. However, in order to meet these targets, they must have access to sufficient quantities of e-waste. Since the informal sector is often much more efficient in the collection of e-waste than formal actors, a partnership offers a number of advantages.

For one, producers and PROs can use existing informal structures to achieve their collection/ recycling targets and at the same time achieve CSR goals by offering better working conditions to informal workers and reducing environmental impacts. In addition, more and more consumers are starting to demand certified, sustainable products. Developing a sustainable and inclusive waste management model offers the possibility of positive public relations for producers striving for CSR. Knowing where e-waste is recycled and by whom is increasingly important for transparency in international supply chains. Knowing the origin of secondary raw materials and securing access to these represents one way to reduce future business risks, which can add additional value to a PRO's operation. Lastly, some producers have expanded their traditional sales-centered business models by engaging in refurbishment activities in order to gain access to new consumer segments through re-sale of secondhand goods. Due to their local experience and knowledge, informal stakeholders can assist in the identification of relevant waste streams and increase collection rates.

Formal Recyclers

Formal recyclers typically have established supply channels for sourcing different e-waste fractions. Larger quantities are usually obtained via business-to-business (B2B) channels (e.g. corporate bulk disposers or public institutions) which are legally required to cooperate with authorized recyclers only. However, e-waste from these sources represents only a fraction of materials available on the market and remains a niche in comparison

to quantities available from business-to-consumer (B2C) channels. Tapping into e-waste flows from B2C sources represents a major challenge for formal recyclers due to their dispersed nature. These streams are mainly managed by informal workers, which are embedded in local communities and are able to mobilize a large work force, which can perform labour-intensive door-to-door collection. Hence, partnering with informal actors can give formal recyclers reliable access to larger amounts of e-waste.

In addition, informal workers usually possess in-depth knowledge about the economic value of different e-waste components, including their most valuable fractions. Therefore, they under-stand in which conditions an item needs to be in and the market value of the product. Entering long-term partnerships with informal collectors can, therefore, help avoid the practice of cherry-picking where recyclers receive only scavenged products of minimal economic value and they keep the valuable fractions. However, it should be high-lighted that producers and PROs should not see this as an opportunity to cherry-pick valuable fractions themselves. They should be legally required to take care of all fractions, regardless of their economic value.

Furthermore, recyclers can focus on their strengths of recycling in an environmentally sound and legally compliant way. Higher and more reliable input material flows enable recyclers to invest in appropriate treatment technologies. By aggregating larger quantities of e-waste, the bargaining power towards material buyers on the international secondary raw-material markets increase, while reliable flows of materials improve the cash flow situation for recyclers.

Public authorities

By promoting partnerships between informal and formal stakeholders active in the collection, repair, dismantling and recycling of e-waste, public authorities can bring all stakeholders under the ambit of existing legal frameworks. This may help to close existing routes through which e-waste is leaking to uncontrolled recycling facilities with crude practices creating environmental and health hazards, and strengthen the position of environmentally and socially viable alternatives. Furthermore, integrating informal sector actors will increase the acceptance for the recycling system and thus decrease the social risks for authorities (i.e. from closing large informal work operations). Promoting these partnerships is therefore in the interests of national and local authorities. In many cases, workers from the informal sector operate in well-established networks for the collection of e-waste. Hence, promoting informal-formal partnerships allows public authorities to capitalize on the existing informal collection infrastructure and offers the advantage to scrutinize, monitor and ultimately formalize the sector. By integrating informal stakeholders into formal e-waste management systems, public authorities increase the chance of legislations being successful as they avoid the creation of parallel systems and reduce the competitive pressure on formal actors. Moreover, national and local authorities can realize important co-benefits, such as achieving national objectives to increase employment levels and inclusive development and, at the same time, prevent the forced displacement of informal workers as well as potential unrest of marginalized populations.

As for the economic benefits, public authorities can reduce administrative efforts, which would be needed in an approach with a singular focus on enforcement as opposed to dialogue, incentives and partnerships. Ultimately, formalization of the informal workforce will also increase tax revenues and promote the establishment of local value chains and local income from e-waste collection and processing. With regards to environmental impacts, promoting partnerships between formal and informal stakeholders helps to ensure that e.g. pollution control standards or targets for collection and recycling of e-waste and other waste fractions specified in national policies or laws or in international conventions are achieved. Paired with increasing efforts for monitoring and enforcement, the process of formalization can create opportunities for remediating contami-

nated sites and avoid the creation of new contaminated sites within cities created by uncontrolled recycling of e-waste and reduce the associated health risks for local populations.

Informal sector

As public attention on the negative impacts of informal e-waste recycling increases and new regulations are established to deal with the issue, informal collectors and recyclers come under increasing threats from enforcement activities and the police. This may lead to being further marginalization, increased harassment or bribes, and eventually being pushed either further underground or out of the business. Entering into partnerships with formal stakeholders (be it manufacturers, recyclers, aggregators or non-governmental organizations) can prevent marginalization and offers a number of opportunities.

First and foremost, by undergoing a process of formalization in partnership with the stakeholders mentioned above, informal workers can improve their status by being acknowledged as relevant stakeholders. Thus, at least some of their economic activities are protected. Additionally, informal workers can gain access to appropriate equipment and protective gear as well as trainings to avoid health risks arising from daily operations. Several case studies indicate that formalized waste pickers benefit from increased visibility and recognition for work as a licensed collector or dismantler (IIED, 2016). By using official clothing and possessing formal ID cards, informal workers minimize the risk of harassment and may gain access to facilities which were previously inaccessible. This goes hand in hand with increased public awareness for worker's rights, which usually remains neglected in public debate. Furthermore, additional e-waste flows could become incentivized for collection by a PRO. As of now, informal collectors collect predominantly valuable materials and products such as PCBs, cables, computers and mobile phones to mention a few. Given the right support

and training, products such as lighting equipment amongst others could be included in the portfolio of collection for the informal sector and as a result, increase their income.

More direct, tangible benefits of formalization include access to social security or health care, both of which are often lacking in informal economies due to tight profit margins, which are spent on essential items (e.g. food) for self-subsistence. In addition, having a contract with a formal entity also provides the opportunity to generate a stable and reliable income. Depending on the contractual agreements, there may also be a chance to gain managerial skills, extend business activities, and improve the ability to access institutional sources of capital, thus expanding access to formal value chains. This may further increase the bargaining power with industry and governments and provide access to previously inaccessible e-waste supply channels, e.g. via bulk disposers who are legally required to cooperate with formal collectors only. Access to downstream formal markets can also be increased, as many buyers in the industry are subject to strong regulations and follow internal CSR-policies, which prohibit cooperation with informal entities. Lastly, being part of a formal collective also helps to gain political attention and enables these stakeholders to participate in the development process of e-waste legislation.

3. Modes of collaboration

In reality, there are numerous ways in which formal e-waste management systems and activities of informal stakeholders interlink with each other. For certain informal stakeholders formalization or stopping their activities will be the only viable option to make their activities environmentally sustainable - this applies particularly to stakeholders active in primitive methods of hydrometallurgical processing or other recycling activities requiring a high level of process control and reporting. For less dangerous activities such as collection or dismantling of defined categories of e-waste, formalization may include the creation of cooperatives of waste collectors or similar structures. Other forms of integration could be measures for professionalizing informal stakeholders (training and advice on management or technical issues), more or less formalized franchise or business relationships with formal stakeholders in the value chain. Partnerships between formal and informal actors are - or should be - very specifically tailored to the local conditions, reflecting diverse value chain structures in different countries.

Partnerships can only be established successfully when all stakeholders are able to perceive positive impacts and become aware of the mutual benefits of the collaboration. There are several ways of how all parties involved can benefit from the formalization of the e-waste recycling and management sector. For instance, some partnerships may be facilitated through dedicated so-called "interface" or collection agencies who purchase e-waste from informal collectors and channel them to authorized (qualified) recyclers. In doing so, they act as intermediaries in the e-waste value chain. Such intermediaries sometimes are aggregators, cooperatives, unions, or could also be PROs in an EPR system if they maintain direct relationships with informal collectors. Their role is essential for providing a central contact point for authorities, recyclers or producers. The challenge is to establish a clear value-added to such an interface organization in order to maintain financially viable operations. Figure 1 illustrates an example of types of partnerships found in India.
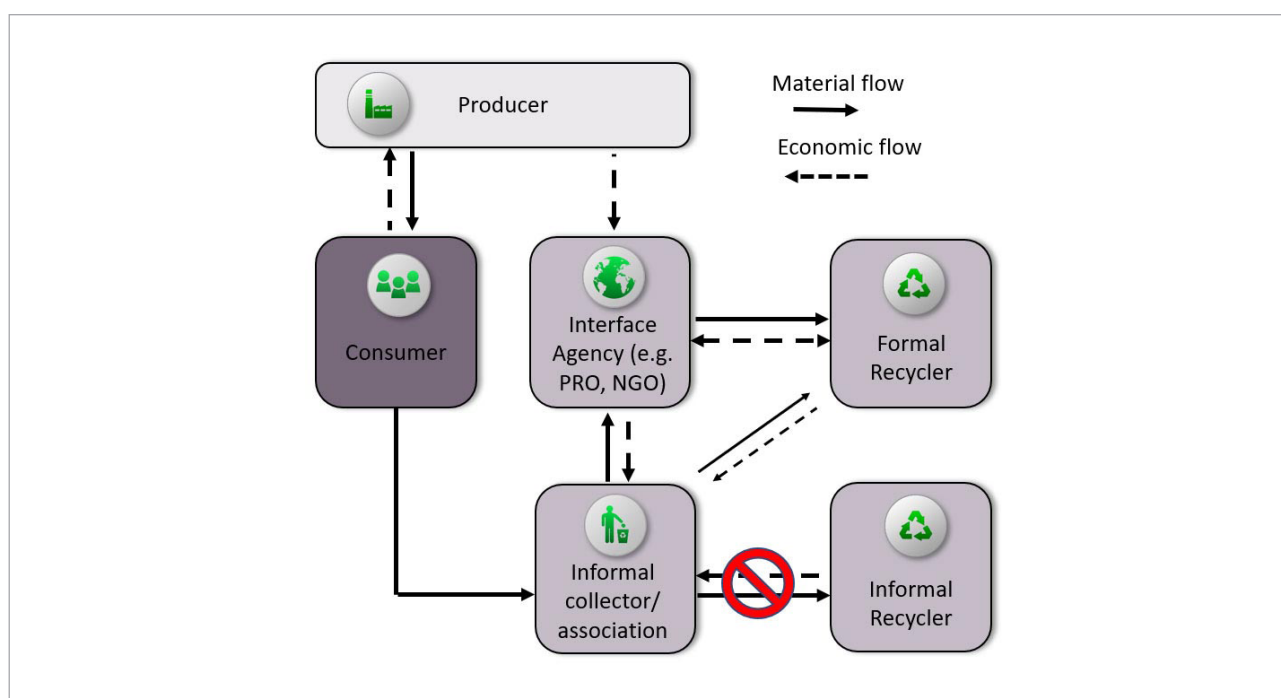

Figure 1: Systematic illustration of informal-formal partnerships in India. Adapted from (Khetriwal et al., 2016).

Another type of collaboration is the direct partnership between formal recyclers and informal collectors. By directly collaborating with informal collectors, recyclers have the advantage that they do not have to deal with interface agencies and can skip costs associated with these. On the other hand, as recyclers are often located in more distant, less populated areas, where waste generation is comparatively low, receiving waste from informal collectors can be difficult. Depending on the size of the organization and the specific organizational set-up, some recyclers may be able to find a workaround solution by organizing collection drives or purchasing a vehicle fleet to purchase e-waste from more distant places.

Although partnerships between formal and informal stakeholders are thriving in some countries, there are a number of challenges that need to be kept mind in order to ensure that they can be developed on a fruitful basis and become sustainable in the long run. For one, partnerships with informal stakeholders can be difficult to set up as formal companies or organizations often lack local acquaintance to approach the informal sector. In this context, trust is one of the most essential preconditions for the development of good working relationships with informal workers which needs to be developed in a step-by-step fashion. Such a process requires investing precious time and resources which producers, PROs or different types of interface agencies are sometimes unwilling to mobilize. Moreover, in the initiation stage of informal-formal partnerships, information asymmetries can pose challenges to establish trustful relationships, e.g. in terms of the reliability of stakeholders, knowledge about market prices and quality of collected goods. Further, when there is a lack of long-term engagement by producers, PROs or public authorities to provide price supports or other auxiliary measures, informal collectors may face existential risks if they have left their previously informal business arrangements in order to enter formal partnerships. Therefore, trust-building measures are required between informal and formal stakeholders, goodwill on behalf of all stakeholders for long-term collaboration, and

mechanisms to ensure stability in relationships. Past pilots in India sponsored by multilateral institutions have demonstrated the price differences between what formal and informal recyclers could offer collectors (IIED, 2016), as shown in figure 2. They also demonstrated that formalization efforts only remained in effect over time if newly formalized e-waste recyclers had sustained market access, otherwise they would likely return to adopting informal practices in their operations (i.e. not running safety equipment, or returning to environmentally substandard processes) to save on costs. Stakeholders that seek to cooperate with informal stakeholders need to pay close attention to these challenges when initiating partnerships. They can be addressed by providing a balanced mix of incentives and designing agreements in an inclusive fashion which reflect the needs of informal stakeholders.

Formal operators have a range of options to develop agreements with informal actors, which may be binding or non-binding, written or oral in nature. If for example, actors start to work on behalf of recyclers then they may need to sign an MoU or contract and follow a code of conduct which outlines minimum standards on environ-ment and work practice. If a formal operator wants to sub-contract an informal entity this may require them to first formalize their practices enough to be able to allow a contractual arrangement to take place. On the other hand, non-binding oral agreements may be enough to offer individual collectors a take-back point at a collection center where they can drop off their e-waste.

Incentives

Compared to formal recycling, informal recycling is more cost-effective, as costs for protecting the environment (e.g. disposal costs for non-valuable or hazardous fractions, investment in appropriate technology for treatment) can be externalized, or health and safety costs or costs of compliance (reporting to governing bodies) and taxation can be avoided by informal workers. Informal collectors often buy e-waste from consumers and sell on to informal recyclers, and as a result,
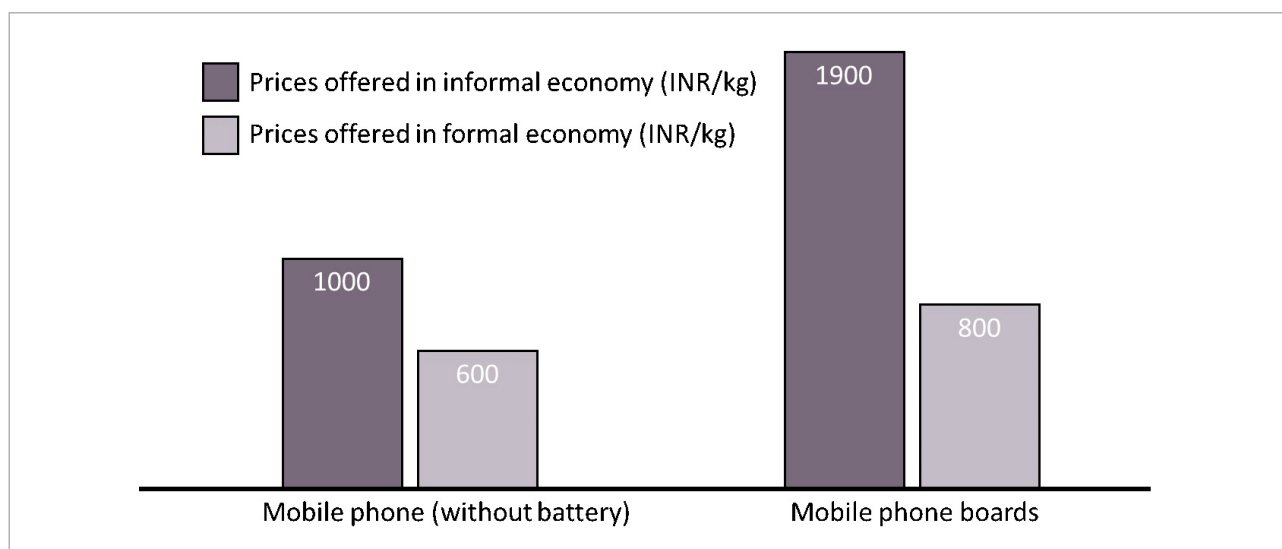
Figure 2: Price gap difference between informal and formal recycling adapted from (Khetriwal et al., 2016).

formal recyclers struggle to get access to e-waste as they cannot offer the same price to collectors, as shown in Figure 2. To offer a viable alternative to existing informal treatment channels, some kind of alternatives must be offered, and financial incentives are in most cases crucial to bridge this price gap.

Finance sources to overcome the price gap may take the form of voluntary producer payments, or more systematically applied subsidies through EPR legislation or eco-levies. A range of different types of monetary incentives may be applied:

» **Financial incentives:** these can be payments made by municipalities, communities or PROs to the collectors or groups of collectors that are adapted to local market prices, market conditions or collection costs; or contributions in the form of territory or a sorting plant
» **Market price payments:** companies buy the sorted material for a price that corresponds to the market value of the recycled components, but offer a safe business relation that guarantees a frequent purchase of fractions.
» **Minimum price guarantees:** companies offer frequent purchase always at the same minimum price; financial losses are possible or can be covered by market prices.

» **Fixed salaries:** payment of fixed salaries per week or month are provided instead of payment per amount of fraction sold; the gained income might be lower but is more reliable than volatile market price payments.

Financial incentives are highly important to bridge the price gap, but these alone may not necessarily be enough to channel waste into formal recycling systems. In some situations and in particular for the higher value fractions, it may not matter how much money is on the table – someone else may still come along and offer more. In Colombia, for example, there was in the past a successful collaboration between a formal buyer of Printed Circuit Boards (PCBs) and informal collectors. The formal buyer would buy the PCBs from the informal recyclers and export them to international smelters. However, in recent years, the drug cartels in Colombia have realized that by buying PCBs from the informal sector and exporting them to smelters in foreign countries, they can develop clean commodity receipts for drug money – in other words, money laundering. Using profits from the drugs trade, they price PROs or other buyers out of the market and offer informal collectors a price 15-30% higher than their competitors. Upon sending to the smelters abroad, they receive the recycling value of the

PCBs as foreign exchange – but most importantly this results in a legal source of income.

Bringing incentives into local e-waste management activities changes local market conditions, and it is vital to support with information and awareness raising campaigns to build trust and avoid misunderstandings or abuse of the system. In Ghana, for example, when incentives were provided for refrigerator collection, rumors started in the informal sector that refrigerators contained gold, making collection more difficult. While one of the challenges in India in 2018 was that informal aggregators manipulated pricing once they learned that they had the e-waste amounts that producers/PROs needed to reach EPR collection targets, increasing the price as the reporting deadline approached. This demonstrates the challenges in getting the pricing right in the marketplace in the face of opportunistic behavior. Once more actors are involved, with more PROs and more aggregators competing with each other, such issues may resolve themselves. Either way, developing trust through existing partnerships before targets come into force is of high importance, as well as ensuring that both informal actors and formal actors be transparent on costs and reporting. This can be assisted through agreeing pricing mechanisms together with the informal sector in workshops, which can then ensure fair prices for both sides. Ultimately it is about paying for collection/dismantling as a service, rather than for the materials themselves. To avoid paying over the odds, incentives should start low and, if necessary, increase over time towards the market value. At the same time, monitoring mechanisms such as mass-flow tracking must be in place to ensure that waste does not re-enter informal recycling practices following collection, or get sold multiple times.

Non-financial incentives and/or support can add value to informal collectors, groups of collectors or associations of scrap workers. They can be an essential part to improve conditions of e-waste management in the informal sector and also build trust, meeting a certain minimum standard. Non-financial incentives or support can be:

» Access to public or private services like health care and education (e.g. trainings in sustainable e-waste management)
» Support to formalize as an individual or a group (forming an association of scrap workers)
» Access to financial services (e.g. opening of a bank account, mobile money accounts, insurances)
» Protective gear or uniforms for collectors or groups of collectors
» ID-Cards
» Advocacy of workers' rights
» Certificates of compliance with the system
» Assistance with their taxes and legal support for their operations
» Access to bulk consumers

Public authorities can support the above by providing additional competitive advantages to actors willing to undergo formalization within such partnerships through non-financial support such as authorizations, provision of certificates, granting access to public tenders or other information (Davis & Garb, 2015).

New opportunities of digital approaches

It is hard to imagine monitoring and reporting across thousands of informal actors without the coordination support of digital reporting applications and databases. Digital applications are providing new opportunities to connect informal collectors to the formal system, as can be seen in the case studies that follow in the next section. In the Indian case, Karo Sambhav leverages mobile apps to improve the outreach, communication and management of a very large network of aggregators, while digital payments have been a key factor in building trust compared to the cash-based economy. Using a mobile app, aggregators are able to report volumes and shipments. This data is centralized and verified along the e-waste chain. As a result, the company is able to ensure accountability, gather data on e-waste flows and spot non-compliance cases. This data will enable the optimization of the service going forward. Tracking the mass-flow of waste through different operators will also improve

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accountability along the e-waste chain, ultimately making it more difficult for formal recyclers to re-sell waste to the informal sector after treatment.

In Ghana, pilots carried out under the e-waste program implemented by GIZ on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ) have also benefited from digital technology to monitor and evaluate transactions at collection centers. The usage of mobile-money payments in exchange for cables in Agbogbloshie led to an almost fully digital data management system greatly enhancing traceability of financial and e-waste flows and facilitating informal-formal sector cooperation. It also reduced the risks of handling large volumes of cash on the scrapyard, and enabled collectors with a migrant background to transfer funds to their families in other regions. In another pilot in Kumasi, in northern Ghana, refrigerators were collected and an incentive was paid based on pre-agreed categorization process (small, medium, large, freezers, with/without compressor, weight). In this case, the local informal sector association refused the use of mobile money payments, however, they were happy to use Whatsapp to document each refrigerator dismantling process

and were able to communicate this directly with GIZ to agree on category and prices to be paid out in cash. Thanks to the remote-verification this allowed, over the course of the implementation the system changed from GIZ refinancing to GIZ reimbursing the association for the collected material.

In general, mapping the transactions across the informal sector can play an important role in determining how to cooperate with informal actors. For instance, Kabadiwallah Connect has built on detailed data mapping of the informal sector value chain for plastics recycling in Chennai, and using this, has taken an app-based approach to link waste generators with local informal waste collection services. Through giving real-time information on the plastic market prices, they are also able to improve the income of plastics aggregators in Chennai – and at the same time provide trainings on how to better segregate plastics to achieve a high quality for recycling at their own recycling facility. This approach not only improves incomes for informal collectors, but also increases recycling rates for plastics, which were otherwise burnt or sent to landfill.

4. Case Studies for informal-formal partnerships

4.1 India: PRO Karo Sambhav engaging with informal e-waste workers

Karo Sambhav, a producer responsibility organization (PRO) in India, has engaged informal workers to increase e-waste collection, aggregation, and dismantling. Following India's 2016 E-Waste Rules, producers must meet collection targets for e-waste proportional to the number of products they bring on the market. The E-Waste Rules do not mention engagement with the informal sector and few producers have attempted this. However, as the informal sector

currently handles over 95% of the e-waste in India, engagement will be important to reach high collection targets.

Building on past pilots and stakeholder experiences in India (IIED 2016, GIZ 2017) as well as their own pilot initiatives, Karo Sambhav has targeted the collection in cooperation with informal e-waste aggregators, waste pickers and repair shops on behalf of several producers in several cities across India. Unlike other past pilots, this initiative is backed up by sufficient financial resources to close the price gap between informal and formal

recyclers due to partnerships with producers that pay financial contributions as part of their obligations stated under the 2016 E-Waste Rules.

To efficiently collect large amounts of material, Karo Sambhav targeted nodes in the informal collection networks, such as lower-level aggregators specialized in only a few e-waste categories. Larger, more powerful players with a steady supply of buyers can charge higher prices, whereas less established aggregators may sometimes be willing to sell material at lower prices. Within the e-waste value chain, aggregators represent a key lynchpin because they amass large amounts of obsolete products before selling them further downstream for processing. Some aggregators may also be dismantlers, specializing in certain materials and components. While it is still necessary to meet the prices set by smaller aggregators, other interventions help to build the trust, solidify trading relationships and build the value for informal workers. As most informal sector transactions are cash-based, traders can easily short-change smaller aggregators, sometimes disappearing before making the final cash payment.

Karo Sambhav was able to win partners through trustworthy financial transactions: Following a few initial small trades, they convinced some workers to transition to digital payments and helped workers to establish bank accounts and register their GST tax information - first steps towards formalization. Some workers began to prefer digital payments once they saw money deposited immediately into their bank accounts, thus alleviating stress over the security risks or bribes when carrying large sums of cash. At the same time, these aggregators benefit from business development support to expand their businesses. Once the aggregators are on board they act as multipliers by word of mouth as it becomes clear that they are benefiting from the partnership.

The e-waste landscape varies considerably across India, therefore a range of collection/partnership strategies must be applied. Most e-waste is sent north of Delhi to Moradabad for end-processing by informal recyclers. Karo Sambhav also reached out to NGOs experienced in improving livelihoods of waste-pickers by organizing them into collectives and 'self-help' groups. In Patna, Bihar's capital city where e-waste volumes are substantially lower and collection is minimal compared to other cities, the absence of a strong aggregator network provides opportunities for waste-pickers to collect e-waste. Starting in October 2017, Karo Sambhav with its NGO partner in Patna, engaged over 1.000 waste-pickers to begin collecting e-waste. The model involves community group initiative, creating self-help groups of 4-5 women who can access credit from banks. The outreach campaign identified 112 slums for weekly collection during fixed time-periods. The NGO also assisted waste pickers with the purchase of an electric rickshaw for e-waste collection from small vendors and repair shops.

Aggregators have to sign a code of conduct, which requires them to meet the standards of Karo Sambhav. Checks and balances ensure accountability in tracking flows of e-waste along the collection chain. Electronic documentation of transactions and flows ensures that material channeled out of the informal sector is not sold back to informal recyclers. Within its first two years of operation, Karo Sambhav has so far managed to engage over 5.000 aggregators and collectors, and collect over 3.000 tons of e-waste. It continues to expand and improve its operations going forward. For more details, see the impact report (Karo Sambhav 2018).
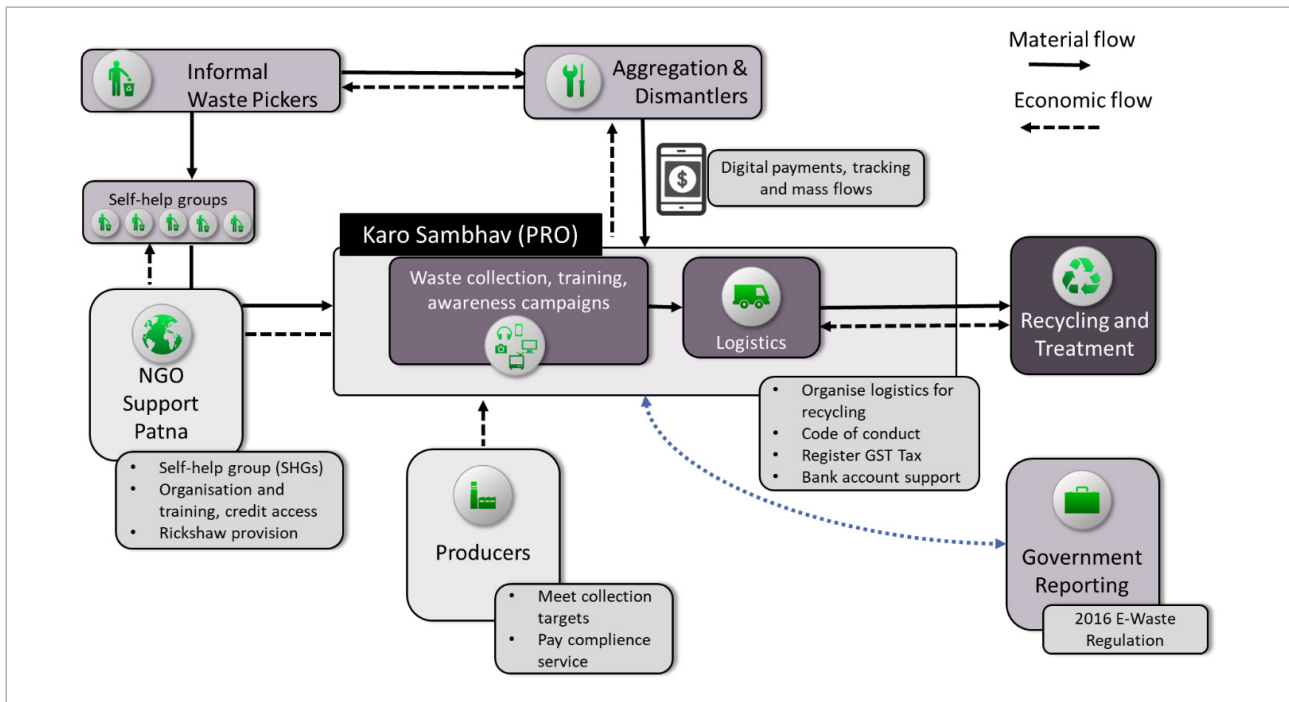
Figure 3: Karo Sambhav's role as a PRO for collaborating with the informal sector in India.

4.2 Peru: a PRO cooperation model between Reverse Logistics Group (RLG) and Traperos de Emaús Trujillo

In 2008, Swiss international cooperation started with the Peruvian government on developing a stakeholder dialogue and legal framework for e-waste management in Peru. This led to an extended producer responsibility (EPR) legislation being passed in 2012[1], which was amended by decree in 2015 to introduce compulsory annual targets for producers on collection and treatment of e-waste as a percentage of products placed on the market, starting with 4% in the first year and rising to 16% by year five[2]. However, the legislation makes no mention of collaborating with the informal sector. In response to the legislation, Reverse Logistics Group (RLG) set up a producer responsibility organization ("RLGA Group Plan Peru") to meet the e-waste obligations of 18 producers and importers in Peru. As collection targets increase year by year, a wider range of collection mechanisms becomes necessary to meet them. In 2016 RLG made an agreement with Traperos de Emaús Trujillo for the collection and transfer of e-waste collected in the north and north-

east of Peru. Traperos de Emaús is a nonprofit and self-financed association of previously informal waste collectors with a strong organizational structure, which associates with the worldwide association of Emaús waste collectors. In Peru, the Emaús are divided into regional sub-groups, dedicated to the collection of all waste types, including e-waste and raw material for recycling. RLG made an agreement with the Traperos de Emaús sub-group operating out of Trujillo, where a group of about 20-30 workers collect e-waste from households and businesses and bring this waste to the Emaús segregation center. RLG pays a collection fee per kg e-waste to the Emaús and takes care of logistics from the segregation center to appropriate treatment facilities as shown in Figure 4. There is no dismantling at the segregation center.

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[1] Reglamento Nacional para la Gestión y Manejo de los Residuos de Aparatos Eléctricos y Electrónicos (DS 001-2012-MINAM)

[2] Disposiciones Complementarias al Reglamento Nacional para la Gestión y Manejo de los RAEE (RM 200-2015-MINAM)
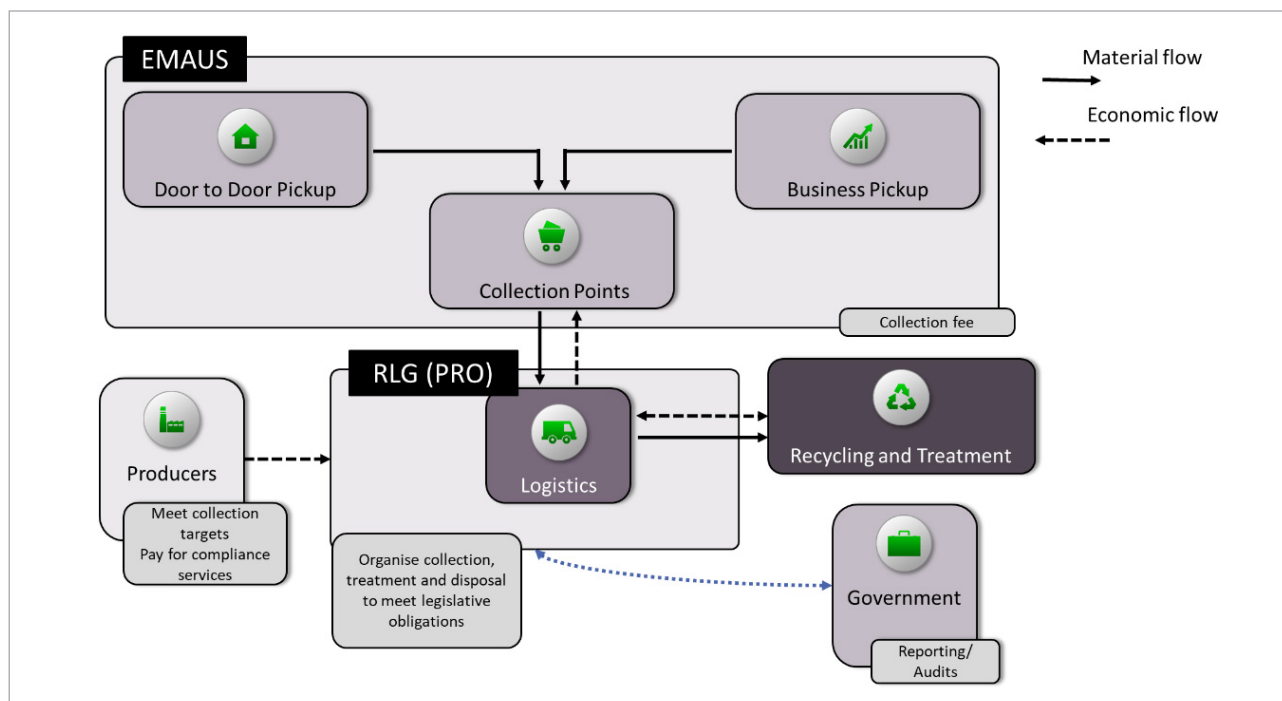
Figure 4 Overview of the alliance between Traperos de Emaús and RLG in Peru.

In the first year of the cooperation from mid-2016 to 2017, RLG was able to collect over 150 tons of e-waste through Traperos Emaús. This represented more than 10% of RLG's collection target constituting an important source of material for them.

An agreement has been signed between RLG and the Emaús in which the Emaús agree to send their e-waste to RLG and RLG guarantees to take all volumes of e-waste that the Emaús collect, regardless of the value and state of the equipment. RLG provides Traperos Emaús with a certificate approved by authorities, which states that they are formally working for them. This certificate provides the Emaús proof that they are working within the law and that their e-waste will be appropriately treated, thereby increasing their legitimacy when collecting from equipment from businesses and households. RLG supports the Emaús to extend their collection services, which also strengthens the standing with municipalities and communities across the region while enabling collection from difficult areas such as those near the jungle. They also strengthen the Emaús as a service provider,

for instance making sure they were a part of the collection system in a three-way collaboration with the municipality of Trujillo in 2018.

This cooperation represents a win-win for both parties: RLG is able to make a significant contribution to its collection targets and improve collection coverage in hard to reach regions, while the Emaús are able to cement their role as a service provider in the local community and receive remuneration for their collection efforts. The willingness to cooperate in this alliance was made possible due to the fact that the regional Emaús group had been involved in the e-waste legislation stakeholder dialogue processes from the start and were aware of the risks of e-waste. Although they receive a lower economic return from the cooperation than they would by selling the material to the informal sector, they are willing to do the right thing. Whilst RLG has reached out to other regional Emaús groups, it has so far proven difficult to set up further alliances. However, if stronger enforcement of the legislation takes place, the incentive to collaborate may increase in the future. The collaboration with informal actors is in

this case facilitated by the formalized structure of the Traperos Emaús, which is important to enable liaison with fixed contact persons and some form of organization with whom RLG can communicate. Nevertheless, the cooperation remains fragile – if Traperos de Emaús want to, they can start selling to others at any time, as the signed agreement has limited legal standing and RLG mainly depends on their goodwill and decision to "do the right thing".

4.3 Nigeria: Hinckley Recycling supports Informal Association Building

In Nigeria, the vast majority of e-waste recycling takes place in the informal sector, with damaging impacts to health and the local environment. Informal workers are very organized and have a very large network nationwide including wholesalers exporting to China, who often export without permits. Nigeria is also subject to major imports of used electronics, often arriving stuffed inside cars and trucks from Europe – in 2016 this was estimated to be ca. 60,000 tons, of which around 19% was e-waste on arrival (Odeyingbo, Nnorom, & Deubzer, 2017). Informal scavengers and dismantlers tend to look for specific materials currently in demand by wholesalers, whilst non-valuable materials such as leaded glass from CRT's, broken LED screens from phones and high volumes of BFR plastics, are dumped. The sector needs development, and collectors could benefit from protection measures such as training, PPE and health insurance. At the same time, informal workers face challenges getting bank accounts; and a fair price from off-takers for their outputs with prices varying by location.

The National Environmental (Electrical Electronic Sector) Regulations S. I. No. 23 of 2011 set out the general provisions for managing e-waste in Nigeria, while operational guidance for imple-mentation of an EPR program was published by the Nigerian environment enforcement agency, NESREA, in 2014. A PRO was established in 2018, however, overall the implementation of the EPR principles in the legislation has so far been held up by delays. Until an agreement for implementation

is reached with producers/importers, funds to appropriately compensate and implement these responsibilities will be lacking. In the guidance document on EPR, informal collectors are required to register with collection centers and work closely with both consumers and operators of the collection centers. Consumers are to be compensated for their e-waste, whilst informal collectors will be compensated by either collection centers or recyclers in the system.

Despite legislative delays, some private sector players have taken a proactive approach. Hinckley Recycling, for example, established a semi-industrial authorized e-waste recycling facility operating to international standards in 2017, built following match grant funding in 2016 from DEG, part of the German Development Bank (KfW). The facility has a large manual dismantling team and aims to embrace the informal sector. Hinckley is attempting to incentivise informal collectors as much as they can by holding informal sector training workshops with medical teams and an awareness raising campaign to reach out, speak with and work with these actors, explaining the consequences of bad practices. What started as training workshops and medical check-ups is evolving into a trade partnership as more and more collectors start looking to work with Hinckley.

In 2018, the recycler assisted the set-up of an association of informal e-waste collectors, consisting of 40 collectors by the end of the year. As a member, these collectors derive the benefit of being invited to trainings on how to safely collect and dismantle e-waste, support on opening bank accounts and access to medical assistance, as well as a fair price for their collected e-waste. In order to avoid cherry picking practices, the collectors are encouraged to bring Hinckley whole units or entire products, (rather than pre-dismantled parts) by providing them with higher prices. Avoiding this dismantling step saves the collectors time and money. It is often the lower value e-waste which is brought to Hinckley by informal collectors, however, the partnership is beneficial to Hinckley as it generates a better return on investment in

the recycling facility by increasing input. So far agreements are loose, with registration of personal or company contact data. Going forward this will be supported with a more formal application process. Within the forthcoming EPR system, Hinckley will function as a recycler and an off-taker for collectors. Both recyclers and collectors are currently required to register with NESREA to participate in the EPR system. Hinckley was the first recycler to register nationwide and it is foreseen that the collectors in the association will be registered with the PRO once the EPR system becomes operational. The advantage for these collectors will be that having worked with Hinckley they will already have received the prerequisites to work within the EPR system; training, bank accounts, personal data.

Throughout their training programs, Hinckley aims to set up a wider collection network and derive a better understanding of the local e-waste mana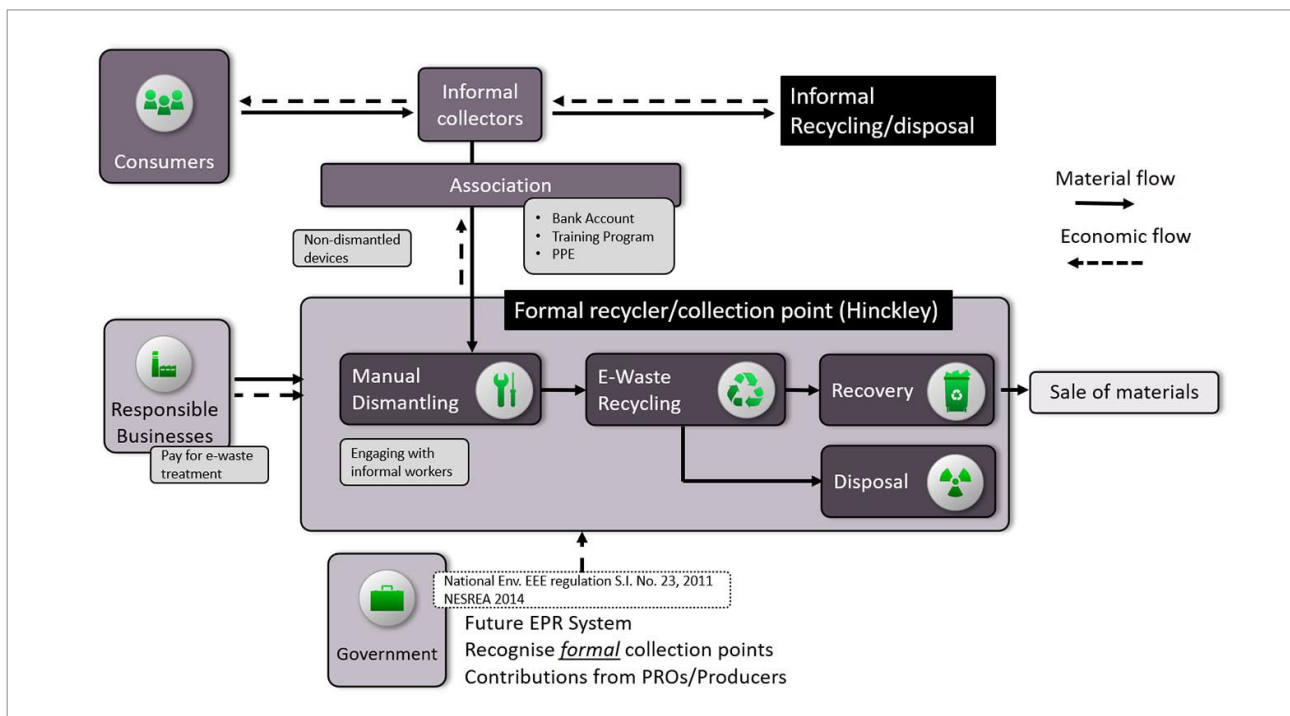gement system. This in turn provides knowledge to fill major data gaps on e-waste recycling and e-waste sources in and around Nigeria - as data is compiled on prices paid in different regions for different devices, a better overview on price differentials is developed which can be used to support the future EPR System. The hope is that this can then be used to move members in the association towards formalization. With no supporting finance from the EPR system, these approaches have so far had mixed results financially. However, Hinckley sees these steps as essential to bringing the EPR System in Nigeria into action and works closely with regulators on enforcement, as well as with other stakeholders in the value chain to bring the dialogue on EPR forwards.

Figure 5: The interaction of Hinckley Recycling with the informal waste sector in Nigeria.

4.4 South Africa: Informal Sector Enterprise Development within Desco Electronics Recyclers

Desco Electronic Recyclers was founded in 1992 in South Africa, originally to recycle obsolete and redundant mainframes and general IT equipment. Over time the company has grown into a diverse e-waste recycling company, with a focus on Printed Circuit Boards (PCBs). This family business also makes an effort to incorporate informal workers into the business model through supporting ex-employees or individual informal/semi-formal waste dismantlers and collectors to become formalized independent business contractors, which then cooperate as a subcontractor with Desco. This gives Desco the advantage that they can outsource dismantling operations, while the workers retain their independence and manage their own businesses. The first of these partnerships began in 2000, as Desco helped establish the autonomous companies of UBISI and Selolo Recycling, which are still loyal subcontractors of Desco. In 2003 the Black Economic Empowerment (BEE) Act came into force, which supported the development of further enterprises within the Desco facility.

At the time of writing, 10 subcontractor businesses are currently working with Desco – five on the premises, and five off-premises. The subcontractors have two income stream options; i) Desco sells pre-processed e-waste to the subcontractor who takes it off-site, adds value through dismantling and sells the fractions back to Desco or ii) Desco hires the subcontractor to provide labour, the material remains on-site and in the ownership of Desco but is dismantled or processed by the subcontractor. In practice the subcontractors may engage with both of these activities, depending on volumes of material to be dismantled on-site at Desco. The e-waste that is outsourced to the subcontractors for dismantling includes: printers without toners, photocopiers, plotters, telephones, cash registers, telex machines, calculators, household appliances like vacuum cleaners, toasters, coffee machines, radios, HiFi, etc. The contractors are also hired when equipment dismantling is required at a client's premises, including the loading of trucks.

Persons eligible to partner as a subcontractor with Desco are:

1) Employees that have been working for Desco (often for a long time), who have learnt the business and how to responsibly handle e-waste. Desco identifies potential in selected employees with a genuine interest in starting their own business and encourages them to do this. Should they choose to accept, Desco provides them with pre-processed stock (containing no hazardous fractions, i.e. printers free of toners) and starting capital (stock or e-waste).

2) Non-employees or suppliers, i.e. existing informal dismantlers and recyclers (counter customers) that already sell their PCBs to Desco. These persons must have supplied Desco with PCBs and other fractions for more than 1 year to establish a trust relationship. Once approved, they must put down a deposit to take stock. When they sell back their dismantled fractions, the deposit is paid back.

The initial capital to start a business is always high. Depending on whether or not the subcontractor already has a suitable working site or is transitioning from being an employee, they will first need to find a suitable working space and rent it. From here, Desco supplies the subcontractor with stock or e-waste to process.

When subcontractors buy material from Desco they are free to sell their purchased material streams (e.g. aluminium) or refurbishable parts to other buyers. However, part of the agreement is that they sell all printed circuit boards from their operations back to Desco.

Subcontractors also sign a contract with Desco, agreeing to follow all environmental, health and safety rules set out by Desco's policy and national legislation, as well as to pay their own employees minimum wage. To ensure the fulfillment of these conditions, all subcontractors in the starting phase work at the Desco site. Once Desco is sure they follow these standards, they may also work off-site but will be visited regularly to ensure standards

are maintained – if a substandard practice is found, the partnership is terminated. Similarly, no material would be sold to the enterprises on credit, as the return of the material might not always be guaranteed. In addition, workers are subjected to body-searches to avoid material leaving the premises at the end of each day.

Desco provides administrative assistance, e.g. when registering their new companies and making them compliant with corporation and tax law so they are a legally formalized business enterprise. Furthermore, Desco assists with: training; equipment such as Personal Protective Equipment (PPE) and dismantling tools; vehicles for transporting heavy equipment to their sites; 0% interest loans, and no charges on the use of tools, vehicles and Desco premises.

The success rate of these partnerships has been about 50%, as several failed due to disagreements between the parties or going separate ways – many are lured into selling to the competition for a few cents/kg more. However, over time Desco has supported the set-up of numerous enterprises in this way, which has contributed to uplifting ex-employees and workers from the informal sector. As an officially registered (BEE) business, the subcontractors have the option to apply for funds to the Department of Trade and Industry, and for government e-waste stock tenders. They can also apply to OEMs for sponsorship to develop into a formalized recycler. Figure 6 provides an overview of the partnerships within Desco.
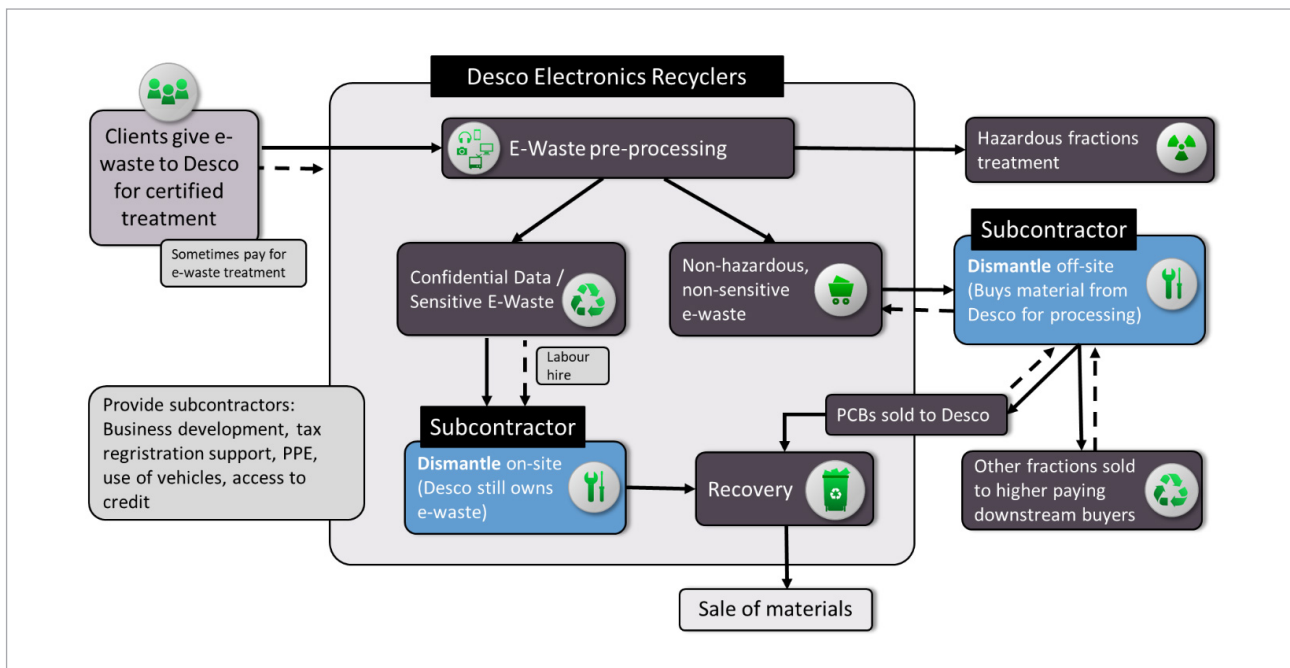

Figure 6: Overview of subcontractor cooperation to dismantle e-waste fractions in Desco's business model.

4.5 Ghana: Technical Guidelines –a pathway for informal-formal partnerships in legislation

In 2016 the government of Ghana adopted the Hazardous and Electronic Waste Control and Management Act 2016 (ACT 917). Amongst other requirements, the Act sets out the framework for collecting an eco-levy on electronics imports, which shall be used to finance sustainable e-waste management. To facilitate its operation, a Legislative Instrument (LI 2250) was adopted, and the Environmental Protection Agency (EPA) of Ghana developed[3] Technical Guidelines on Environmentally Sound E-waste Management for Collectors, Collection Centers, Transporters, Treatment Facilities and Final Disposal' (EPA-SRI, 2018). These technical guidelines take into consideration the needs and challenges of the local e-waste sector. Roughly 95 % of the e-waste in Ghana is collected and later recycled by the informal sector. The guidelines provide a framework to govern the roles and responsibilities along the e-waste recycling chain in Ghana, including for formerly informal actors that are dependent on e-waste management for their livelihoods.

A five tier approach was taken to factor in the needs for the different activities along the value chain. Each tier sets out guiding principles and defines the roles and responsibilities of partnerships between actors, as shown in Figure 7. Collectors (Tier 1) must deliver e-waste (whole equipment or components) to a collection center (Tier 2) permitted by the EPA, where the e-waste is temporarily stored and dismantled before transport (Tier 3) to authorized treatment facilities (Tier 4) or final disposal (Tier 5) according to legislative instrument LI 2250. Collection is predominantly carried out by informal actors at the present time, while the collection center function is carried out by both informal and formal actors.

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[3] The development of the guidelines by EPA was supported through the "Sustainable Recycling Industries" project funded by the Swiss State Secretariat for Economic Affairs (SECO).
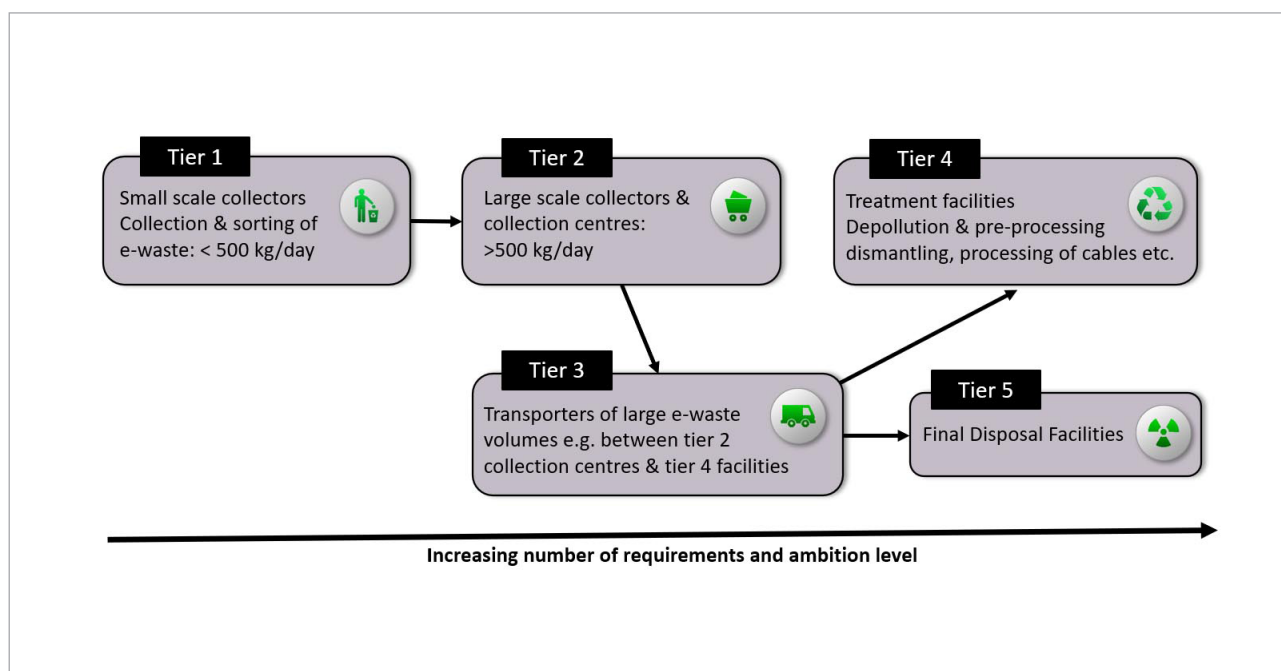

Figure 7: Tiers and relationships set out in the technical guidelines for different actors. Adapted from (Atiemo, 2019).

Collectors are defined as any person that collects, sorts or consolidates e-waste. They must be registered with the EPA and municipalities and activities like disposal or treatment are prohibited. Collection centers must register and keep records of collectors within their catchment areas, and are also prohibited from disposing of materials or treating e-waste, although may practice dismantling with an EPA permit. Tier 3 covers transport from collection centers to recyclers, between collection centers or from a recycler to another recycler. The guidelines provide orientation on prohibited activities, transboundary movements, transport standards and reporting. While Tiers 1 and 2 are specifically targeted at recognising and integrating informal actors into the value chain, actors operating under tiers 4 and 5 must follow more formalized processes and are already fully compliant with national law – for these tiers the guidance is therefore significantly more specific.

By detailing the specific guidelines along the recycling value chain, the technical guidelines provide the framework for partnerships between different actors and define the conditions for the interactions or partnership between formerly informal actors and formal recyclers. The guidelines factor in the different levels of formalization and foresee an incremental approach, with requirements for being registered as a Tier 1 collector being significantly lower than for higher tiers.

First steps towards implementation of informal-formal partnerships are taking shape through pilot activities. With the introduction of the Ghana E-Waste Eco-Levy, it is expected that funds will be available to provide financial incentives to channel cables e.g. from informal collectors of the Old Fadama Scrapyard (better known as Agbogbloshie) to sustainable recycling. Currently, most cables are burnt, however, a pilot payment and incentive system was implemented i by Öko-Institut, GreenAd, Mountain Research Institute, Greater Accra Scrap Dealers Association (GASDA) and City Waste Recycling as an activity of the GIZ E-waste Program in Ghana (Manhart, et al., 2020).

Individual collectors delivered cables to a transfer station where information about the weight, the category of cables, the collector, the source of the cables and a picture of the cable batch on the scale (with the display-figure being visible) were submitted to a database. After completing the registration, a mobile money payment was released to the individual collector. The aggregated cables were delivered to the formal recycling partner. By comparison of the weights of the registered volumes during collection, transport and recycling, a transparent material-flow monitoring was guaranteed. Over time, the informal collectors reduced sending cables to burning and started to bring them to formal channels for recycling, demonstrating that this approach can effectively bridge the gap between the informal and formal sector – provided that a longer-term finance source is in place to enable these payments. Steps are being taken to extend the pilot and add further e-waste categories.

5. Steps towards building partnerships

The case studies have shown that it is possible to develop effective collaboration which provides benefits for both formal and informal actors. In Peru and India, it has been shown that PROs may cooperate successfully with informal actors within the context of existing EPR legislation, even if this legislation does not explicitly define major roles for informal collectors. In Nigeria, EPR legislation has been passed but not implemented, and in South Africa, it an ongoing task, but still not yet approved. Despite this, recyclers have been able to engage with informal actors and develop partnerships which are beneficial for both collection and dismantling. In Ghana, initial steps have been taken in order to recognize and incorporate informal actors along the value chain as seen in the technical guidelines. Their implementation will enable the use of synergies between informal and formal actors and hopefully lead to longer term sustainability in the e-waste management system. The long-term success of these initiatives depends in part on the commitment of different local actors to collaborate.

At a high level, a number of steps have been outlined by Davis and Garb which can help in developing frameworks for cooperation (Davis & Garb, 2015):
» Map and develop a good understanding of the local informal and formal value chains
» Recognize formalization as an incremental and continual process
» Engage relevant stakeholders and design policies co-operatively
» Focus on minimizing key risks, and supporting key strengths of the informal sector
» Create change by incentivizing rather than punishing the informal sector
» Integrate bottom-up and top-down approaches

The level which different actors will be able to cooperate will in part be dependent on the local context and legislative framework (e.g. EPR System in place or not). In order to create attractive conditions for partnerships, the different involved stakeholders may take the following specific measures:

Producers/PROs

» Seek to cooperate with recyclers which engage with the informal sector.
» Understand informal market mechanisms to give the right financial incentives (consider the value of e-waste e.g. in India, consider re-use and re-selling activities). Joint workshops with the informal sector can be useful to get fair prices and agree on a pricing mechanism which is accepted by the informal sector.
» Identify and include local leaders/ key individuals in the workers' community or NGOs for establishing trust and dialogue with informal workers or their representatives, conduct dialogue on feasible organizational forms and agreements for collecting materials and reporting to producer-led take-back systems.
» Establish an inclusive EPR plan including employment creation and training.
» Provide long-term support to informal workers, including:
- Training and organizational support, equipment or similar
- Further non-financial benefits, e.g. social security benefits, ID cards
» Externally monitor proper recycling (minimum requirements for formal recyclers, auditing).[5]

Authorities

» Leave room in regulatory texts for organizational setups allowing formal collection agencies, PROs or recyclers to receive e-waste from informal stakeholders, provide sufficient time to informal stakeholders to adapt to new regulations before starting enforcement.

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[5] For more specific guidance for producers and PROs, see e.g. (GIZ, 2018).

» Provide support for informal stakeholders to enable them to establish partnerships with formal stakeholders or formalize.
» Establish clear procedures/ criteria/ trainings for monitoring reports on quantities placed on the market, quantities recycled and quality of recycling, in order to create a level playing field and prevent leakage back from formal recyclers to informal recyclers.
» Establish clear obligations for private, public institutions and households to channel their e-waste to compliant recyclers, service providers or their intermediaries, and control the implementation of these obligations[6].

Informal sector

» Collectors, sorters and dismantlers need to be prepared to enter minimal forms of organization, and should look for and seek support and partnerships on the most appropriate forms of organization, e.g. associations, cooperatives, agreements with interface agencies/ NGOs or adherence to a franchise system with aggregators or recyclers.
» Comply with minimal forms of reporting and transparency required by informal-formal partnerships or associate with partners who can support in these management tasks. Be transparent in costs and reporting for producers to develop and maintain reliable business relationships.
» Restrict activities to non-problematic practices, e.g. collection, sorting or basic dismantling that does not create negative externalities.
» Informal stakeholders active in recycling should engage in the effort to formalize, explore options for technical upgrading and compliance with environmental standards or specialize in non-problematic activities.
» Diversify activities beyond the mere collection, e.g. combining with the refurbishment of equipment which provides higher financial returns and opens up broader business partnership options[7].

Recyclers

» Set up simple but reliable reporting measures on inputs (also for materials received from informal stakeholders) and outputs.
» Contract informal collectors as far as possible also for own collections/ providing ID cards or franchise systems or collaborations with NGOs.
» Promote the idea of informal-formal business partnerships to producers/ PROs and authorities.
» Integrate as far as possible informal workers from informal recycling areas that are due to be shut down, participate in sensitization of informal workers.

From the global value chain perspective, an ISO Workshop Agreement "Guiding Principles for the Sustainable Management of Secondary Metals" has been developed under the Sustainable Recycling Industries program. The Guiding Principles set out how actors throughout the metals value chain can support e-waste workers in a stepwise approach to improve their practices. Analogue to the Fairtrade standard, this aims to bring traceability to the secondary metals value chain and improve conditions for informal subsistence actors. It provides a framework in which international materials buyers can aim to source recycled materials from ethically and environmentally sound sources, using a stepwise approach to formalization over five years (ISO, 2017).

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[6] For more guidance for authorities on inclusive legislative approaches, such as StEP Legislative Principles (StEP, 2018) and SRI's approach in Colombia (SRI, 2017).

[7] For more guidance on developing the informal sector see: (Swachh Bharat Mission, 2016), (GIZ, 2019).

6. Conclusions

For too long, the informal sector was ignored, simply because any assistance was regarded as a means to keep it alive and was even fought by NGOs. But there is now increasing acceptance across stakeholders that these actors must be included in e-waste management systems if these are to operate successfully in the long term. This work has introduced the concept of informal-formal partnerships as a means to set up inclusive e-waste management systems in low and middle-income countries, where informal actors derive a livelihood from collecting, dismantling, refur-bishing and recycling e-waste. The partnerships concept has been around in theory for several years, and this paper has aimed to collect approaches across the world where it is now being implemented. Through various case studies, it has been shown that collaboration models between informal and formal actors have successfully been set up to utilize synergies from both sides. These must be tailored to local operating and legislative contexts, requiring patience and adaptable approaches, however, they can be advantageous for stakeholders across the value chain.

The informal sector can play an important role in the lower risk stages of e-waste management such as in the collection and sorting of products, but also first pre-processing through e.g. dismantling. Besides maintaining employment, enhanced community health, elevation of the quality of life and sustainable recovery of material fractions using environmentally friendly techniques, these types of partnership could facilitate formalization. However, it is challenging to initiate this type of integration process, given that in most cases, the informal sector has neither adequate facilities, structure nor support from the government or the industry. And it is also likely that a large informal sector will always remain.

It is important to consider that when creating and promoting a social and working structure of this kind it should not be based on a model-based from other countries but rather take into account the local characteristics and context (e.g. region, education, legal framework among others). In this process, the inclusion of the community and involved stakeholders is crucial in the creation and support of partnerships or cooperatives as well as the benefits associated with them. Incentivising rather than punishing informal actors is a constructive way to channel e-waste out of informal recycling and into formal recycling facilities. A mix of financial and non-financial incentives is usually important to enable long term viability of initiatives. This may require financial producer contributions (voluntary, eco-levy fees, or through EPR systems), twinned with training, recognition and awareness-raising programs.

A better understanding of the needs of the informal sector and its overall context can help with the creation of inclusive legislation and policies that contribute to improving working conditions. To make EPR work in low and middle-income countries, and to assist the transition towards more sustainable and inclusive e-waste management, these partnerships can play an important role. Advances in digital applications and mobile money are already facilitating transactions and communications with informal actors and could play a key role in supporting these partnerships and the development of traceable e-waste value chains in the future.

Case Studies and approaches to building partnerships between the informal and the formal sector for sustainable e-waste management

step

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