International Labour Organization

Tackling informality in e-waste management:

The potential of cooperative enterprises

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Tackling informality in e-waste management: The potential of cooperative enterprises

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Foreword

The present paper is the product of a joint effort by the Sectoral Activities Department and the Cooperatives Unit of the International Labour Organization (ILO). This initiative supports the ILO's commitment to promote forms of employment that safeguard the environment, eradicate poverty and promote social justice through sustainable enterprises and decent work, as reinforced by the International Labour Conference (ILC), at its 102nd session in June 2013.

Electrical and electronic waste (e-waste) is currently the fastest growing waste stream, and it is hazardous, complex and costly to treat. Adequate e-waste recycling can contribute to an environmentally sustainable economy, but that requires immediate improvements in job quality and incomes. Most of the world's e-waste ends up in developing countries to be treated by informal workers. These workers are vulnerable to the health and environmental risks of e-waste, have little power to negotiate their working conditions and end up recovering a fraction of the recyclable material while contaminating themselves and the poor communities where informal e-waste recycling takes place. Therefore, improving occupational safety and health, upgrading skills, increasing workers' incomes to fair and decent levels, and promoting the formalization of informal workers in this sector – along with other decent work strategies – is needed to promote sustainable development and better jobs in this growing sector. As a follow up to the working paper *The global impact of e-waste: Addressing the challenge*,[1] this paper provides further insight on the e-waste sector, focusing on labour challenges and opportunities to leverage working conditions through the promotion of cooperatives and other social and solidarity economy organizations.

The paper was drafted by Andrea Betancourt, and includes case studies compiled by Marina Ilic, in Serbia, and Marisol Rodriguez, in Bolivia. This work benefitted from valuable inputs, comments and guidance from a larger group of colleagues, among which special thanks goes to David Seligson, Waltteri Katajamäki, Guy Tchami and Simel Esim. The field research studies were facilitated by Jovan Protić in Serbia and Rodrigo Mogrovejo in Bolivia.

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1. *The global impact of e-waste: Addressing the challenge*, Karin Lundgren; International Labour Office, Programme on Safety and Health at Work and the Environment (SafeWork), Sectoral Activities Department (SECTOR). – Geneva: ILO, 2012

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Abbreviations

ARALPAZ	Asociación de Recicladores y Acopiadores de La Paz (Association of Recycling Collectors and Sorters of La Paz)
CPU	central processing unit (computer)
CRT	cathode ray tubes
e-waste	electrical and electronic waste
EEE	electrical and electronic equipment
EMPA	Eidgenössische Materialprüfungs- und Forschungsanstalt (The Swiss Federal Laboratories for Materials Science and Technology)
EPR	extended producer responsibility
EU	European Union
ICA	International Co-operative Alliance
ICT	Information and Communication Technology
ILO	International Labour Organization
NGO	non-governmental organization
OSH	occupational safety and health
SMEs	small and medium-sized enterprises
SWaCH	Solid Waste Collection and Handling
SSE	social and solidarity economy
UNEP	United Nations Environment Programme
WEEE	waste electrical and electronic equipment
WIEGO	Women in Informal Employment: Globalizing and Organizing

Introduction

1

In many countries around the world, e-waste is quickly becoming the fastest growing waste stream. The abundant production of electrical and electronic devices, the increasing capacity of inhabitants of both the industrialized and developing countries to access and purchase those goods, and the flexibility with which old devices are quickly replaced with newer ones, have allowed for the production of more and more electrical and electronic waste (e-waste). Most developing countries have not yet established the appropriate infrastructure and relevant legal frameworks to handle this type of waste in an efficient, safe and environmentally sound manner.

Activities associated with the collection and recycling of e-waste often take place in spaces of informality and illegality; they also take place in formal and controlled environments, but to a lesser extent. There is an attractive demand for metals – and other materials found in e-waste – and thus individuals or groups of collectors recover e-waste to extract the valuable substances and components, and sell them to the recycling industry. What is concerning is that the treatment process of e-waste is dangerous to human health and the environment. Moreover, those who manage e-waste informally are usually neither well aware of nor trained in environmentally sound management of e-waste, occupational safety and health (OSH), and other decent work standards applicable to this field.

Various publications have reported on the several diseases and intoxication levels of e-waste substances that workers involved in e-waste recycling develop over time. At the same time, the performance of informal workers has been relevant to maintaining the current recycling rates of e-waste and contributing to the economies of many cities and countries, particularly in developing and transition economies. Despite their roles in e-waste management value chains in developing countries, there is little documented information on how and where informal workers contribute to e-waste recycling. Few government initiatives on e-waste management systems focus on the informal economy, and public discussions on e-waste tend to place less emphasis on the working conditions of formal and informal workers.

Over some time, the International Labour Organization (ILO) has developed an interest in addressing the issue of informality in the e-waste management value chain and exploring ways of improving working conditions through the organization of workers. This paper seeks to produce better understanding of the potential role of informal workers in e-waste recycling chains in developing countries, and to shed light on the role and prospective of cooperatives and other types of social and solidarity economy (SSE) organizations in providing services, improving working conditions and improving the performance of e-waste management value chains. It provides a broad picture of how e-waste recycling chains, and the increasing bargaining power of and returns to waste pickers and other workers in the chain, perform in developing countries, and identifies stakeholders, in particular those who take part in the informal economy. A key interest of the ILO is to find out whether and in what ways informal e-waste workers operate in cooperatives and other SSE organizations, and if their incomes, bargaining power and working conditions have improved through such business and organizational processes.

Research for this paper involved the examination of several value chains through both secondary sources and field research. The first section provides a general overview of the e-waste recycling value chain in developing countries and identifies the different stakeholders involved in this trade. Despite the limited availability of published data, information on e-waste management value chains in Brazil and India, and initiatives in those countries to formalize and organize informal workers, exemplified some of the trends of e-waste management in those countries. These are discussed in section 4.

Two field studies, conducted in Serbia and Bolivia, are presented in sections 5 and 6. For both Serbian and Bolivian cases most of the information related to e-waste management came from primary sources. Both countries have a relatively small e-waste recycling market and significant informal economy which plays a decisive role in managing e-waste.

The final section of this paper compares the findings to provide some insights and reflections. It focuses on the performance and composition of the e-waste recycling chains, the role of informal actors, the presence and role of cooperatives and other SSE organizations, and the crosscutting issues between them. Moreover, it identifies some lessons and provides suggestions to ensure the responsible management of e-waste, and calls for the use of the social economy and organizational structures to improve e-waste management systems and mitigate their human and environmental risks and impacts.

Overview of the e-waste management value chain 2

Understanding e-waste

The concept of waste electrical and electronic equipment (WEEE) or e-waste covers a broad spectrum of electrical and electronic products that have reached their end of life. These products contain valuable substances (non-precious metals, including iron, steel, copper, aluminium; and precious metals, such as gold, silver, palladium and platinum) and hazardous elements (e.g. lead-containing glass, mercury, cadmium, batteries, flame retardants, chlorofluorocarbons, etc.) that can have detrimental effects on human health and the environment, if not handled properly (Wang et al., 2012). Some devices are refurbished for reuse and others are dismantled to recover the valuable materials for recycling.

There is no standard definition of e-waste, but the European Commission's WEEE Directive (European Commission, 2012) and the Basel Convention[1] provide frameworks for identifying and quantifying e-waste. Several countries are in the process of formulating their own definition and regulations, as the stream of e-waste rapidly increases, turning into the fastest growing waste stream in the world (UNEP, 2007). E-waste is generally categorized as special or hazardous waste due to its hazardous composition. E-waste management and recycling must be guided by specialized rules and regulations issued at the local, national and international levels.

A generic e-waste management value chain in developing countries involves both informal and formal stakeholders. Informal stakeholders are generally involved from the e-waste generation phase up to the production and manufacturing of new products. They are prevalent in the stages of collection, dismantling, pre-processing, processing, and, to a lesser degree, in the production of secondary raw materials. In most developing countries – which do not have formal e-waste recycling systems in place – informal recyclers (or collectors) act as the main e-waste suppliers to the recycling industry. In industrialized countries, most, if not all, value chain stakeholders operate in the formal economy. For this reason, it is important to understand the role of the informal economy and its interactions with other stakeholders in developing countries before designing policies and importing e-waste management models from industrialized countries. Implementing a high-tech, capital-intensive recycling process will not be appropriate in every country or region. An innovative approach to e-waste management will have to go beyond the technology aspect and will have to include an effective combination of processes in a recycling chain (Schluep et al., 2009; Wang et al., 2012).

A generic e-waste management value chain in a developing country, based on the e-waste material flow within a defined boundary, is represented in Figure 1. This shows the entire value chain, starting with the generation and production of electrical and electronic equipment, and proceeding through to its consumption by businesses, government entities and

1. The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal was adopted in 1989 and entered into force in 1992. It has been ratified by 180 United Nations member countries. The main objective of the Convention is to protect human health and environment against the adverse effects of hazardous wastes. To learn more about the Convention, see: www.basel.int.

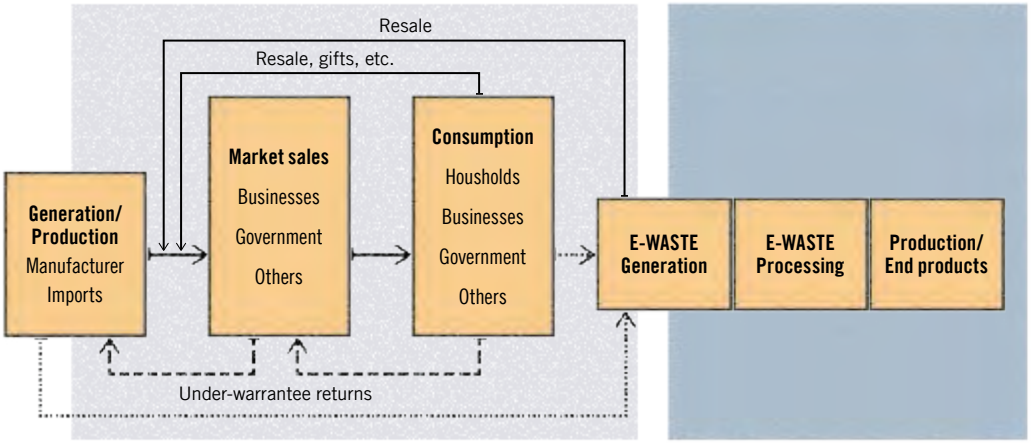

Figure 1. Generic flow of e-waste material
Source: Schluep et al., 2009, p. 41.

private households. Once this equipment becomes obsolete, it is transformed into e-waste and is collected, processed and converted into secondary raw materials, to be sold back to the electronics manufacturing industry. The major stakeholders can be identified and described through the different stages of the depicted value chain.

Drivers of the informal economy of e-waste recycling

As is the presence of informal workers in municipal waste management, informal recycling is the prevalent e-waste recycling practice in many developing countries (Chi, Streicher-Porte, Wang and Reuter, 2011; Schluep, 2010). The reasons that drive low-end management of e-waste and the existence of informal recycling workers in these countries are related to various social and economic factors. For one, consumers in developing countries are unfamiliar with the concept of returning end-of-life EEE and paying for its disposal, particularly given that many of these countries do not have effective take-back programmes for WEEE. Second, many developing countries receive uncoordinated (legal and illegal) imports of large quantities of e-waste brought in as second-hand devices; at the same time, low funding and investment in e-waste recycling systems at the local level results in deficient infrastructure for e-waste management and recycling. Third, the lax implementation of e-waste regulations in multiple countries has enabled the informal economy to expand in the recovery and trade of valuable secondary raw materials extracted from WEEE (Chi, Streicher-Porte, Wang and Reuter, 2011).

The incentives for informal workers to enter the e-waste recycling sector are related to the high profits in commercializing devices or components for reuse and recycling, combined with the low level of investment needed to participate in this trade. In China, for example, where the disparity between the urban and rural populations is high, there is a large market for second-hand devices in rural areas. When these devices later enter the waste stream, they are retrieved and disassembled to extract components of economic value – mainly iron and steel; non-ferrous metals such as gold, silver, platinum and palladium; and plastics. These are subsequently sold back to the manufacturing industry. Overall, the markets for second-hand electrical devices and secondary raw materials deriving from these devices are significantly more profitable than the conventional recyclables from solid waste. At the same time, this trade has low entry barriers and is accessible to non-skilled workers.

Similarly to the distribution of profits in municipal waste recycling, income is not equal among all stakeholders in the sector. The bulk of the workforce operates at the bottom of the value chain. They operate outside labour or environmental regulations, and thus are exposed to the hazards of e-waste. Their incomes are low despite the high risks they are exposed to. Labour costs for e-waste recycling are significantly lower in developing countries and constitute one of the main drivers of informal recycling (Lundgren, 2012).

For industrialized countries, there are clear economic incentives to export e-waste to developing countries. The costs of treating e-waste in industrialized countries, amidst strict environmental control and OSH regulations, are significantly higher than shipping bulk e-waste to developing countries, where laws and regulations – or their enforcement – are lax or non-existent. As noted by Lundgren (2012), the United States Environmental Protection Agency (EPA) calculated that it was ten times cheaper to export e-waste to Asia than it was to process the same

quantity in the United States under strict government control and regulations.

Given the increasing growth of e-waste around the world, the informal economy will continue to exist and expand as long as sound, responsible and accessible e-waste recycling systems remain absent. In the meantime, a large network of informal recyclers is becoming stronger in many developing countries – in particular those with significant volumes of e-waste. Research and institutions with expertise in the field have advised governments to integrate the informal economy in policy design (Chi, Streicher-Porte, Wang and Reuter, 2011; Schluep, 2010). Nonetheless, this has seldom been put into practice.

Sources of e-waste in developing countries and transition economies

E-waste is the smallest, yet the fastest growing, waste stream in the world. In industrialized countries, e-waste accounts for an average 1 per cent of all solid waste (Schluep et al., 2009). In the European Union (EU), it increases by 16–28 per cent every five years, three times faster than the average annual generation of municipal waste (Schluep et al., 2009).

In general, the growing volumes of e-waste come from three sources: i) from increasing imports of new and second-hand electrical and electronic devices for internal consumption; ii) illegal imports of secondary and e-waste products; and iii) to a lesser extent, from domestic manufacturing of electronics. There is a massive and complex trade of secondary and e-waste products that flows from industrialized to developing countries, between developing countries and within their domestic markets (Lundgren, 2012). The main global sources of e-waste are the United States, the EU, Australia, Japan and the Republic of Korea, and the main recipients of e-waste are China and India, followed by Mexico, Brazil, the Eastern European countries, and African countries, including Egypt, Ghana and Nigeria, among others (Lundgren, 2012).

China has been estimated to process at least 70 per cent of global e-waste and is thus considered to be the largest dumping site of e-waste in the world (Chi, Streicher-Porte, Wang and Reuter, 2011; UNEP, 2007). Despite the formal ban on e-waste imports in China in 2000, unaccounted flows of e-waste from the United States, Japan and the Republic of Korea continue to find their way into the country to meet the demand for cheap second-hand products and raw materials for remanufacturing. In the meantime, domestic generation of e-waste has risen due the country's technological and economic development. In addition, the Chinese electronics industry – being a major economic driver and one of the fastest growing sectors in the country – adds scrap generated during electronics manufacturing to the total volume of e-waste.

India, Mexico and Brazil have similar sources of e-waste. Research has established that, in these countries, where e-waste volumes are large, there is a well-organized and established informal economy (Schluep, 2010). In other developing countries with smaller electronics markets, e-waste is generated mainly through the increasing consumption of imports of new and second-hand electronic devices, and from illegal shipments of e-waste. Research has revealed that estimates of the illegal waste trade into developing countries are limited; however, there are methods to estimate the domestic future generation of e-waste based on the accounting of EEE stocks. In some African and Latin American countries imports of second-hand electronics, including donations, are greater than imports of new devices. An estimate of EEE stocks in Ghana exposed that, of the 171,000 tons imported in 2005, 149,000 tons were second-hand devices and approximately 30 per cent of that volume was not eligible for sale (Schluep, 2010). Aside from the illegal trade of e-waste, the domestic generation of e-waste is rapidly increasing in developing countries and posing a challenge to local and national authorities, as well as opening up job opportunities for unskilled workers.

The stakeholders in e-waste recycling chains

The e-waste recycling chain is made up of several stakeholders who operate in both formal and informal economies (see Section II). While there is a generic e-waste material flow, as shown in Figure 1, scenarios on e-waste management vary from one chain to another. In some countries, the stakeholders involved may be more closely linked to the informal economy than are stakeholders elsewhere. Likewise, the borders between formal and informal economies within these chains are unclear as formal stakeholders (e.g. recycling enterprises and companies) may sometimes operate informally, given lax regulatory environments.[2]

How does the e-waste recycling chain work and where do informal workers operate?

The e-waste recycling chain is made of a generic sequence of operational stages, as depicted in Figure 2, which are facilitated by a variety of actors (Figure 3).

2. Note that the stakeholders referred to in the following section are those who participate in the production and treatment of e-waste rather than the production of EEE.

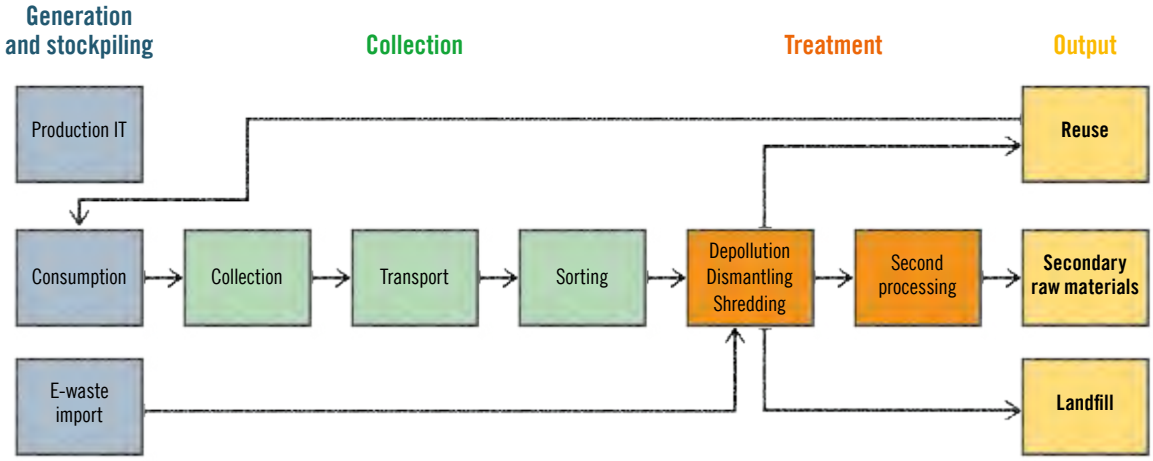

Figure 2. Generic e-waste recycling value chain
Source: Adapted from Pena, 2012, p. 5.

Generation

Stage 0: This stage refers to the generation of e-waste, which comes from the domestic consumption of EEE and legal and illegal imports of e-waste.

Collection

Stage 1: In short, e-waste is collected from households, businesses and public and private offices, aggregated and then transported to treatment facilities. Collection is carried out by formal public or private collectors and by informal waste pickers. Consumers have an important role at this stage, as it is their task and responsibility to return obsolete EEE to recycling points. Collectors, mainly informal, are also important at this phase, as they provide a pick-up service and collect e-waste that could otherwise remain stored or be disposed of inappropriately.

Stage 2: At this stage, e-waste is sorted to separate the components for refurbishment (or reuse) from those for recycling. Reusable equipment or valuable components are separated by social enterprises and small and medium-sized enterprises (SMEs) that focus on manual dismantling. Equipment or components with substantial value are sold for reuse, and the remaining components are prepared for material recovery.

Stages 1 and 2 are often classified as the collection step and require less investment and technological innovation to be performed with OSH and environmental standards.

Removal (Depollution, dismantling, shredding)

Stage 3: This is the stage where pre-processing and dismantling is performed to liberate and recover the valuable components (e.g. circuit boards with high precious metals content). The liberation and removal of hazardous components (de-pollution), following environmental standards and regulations, is a key step in this stage. In the informal economy, however, disassembling units carry out this step following neither OSH nor environmental guidelines. Unwanted components are also removed and disposed of in landfills at this stage. Some of the pre-processing activities are carried out mechanically and others manually. Manual dismantling achieves higher liberation rates without breaking the original components and materials, making it easier to sort them and improving their reusability. The combination of selective manual dismantling and mechanical separation is optimal and cost effective (Jain and Sareen, 2006). Actors in the informal economy are strongly involved in manual dismantling.

Treatment (Second processing)

Stage 4: End-processing is the final stage, to refine and detoxify various materials previously liberated. Chemical, thermal and metallurgical processes are used to upgrade materials and reduce impurities. The different materials that are present in e-waste require various and separate treatments as well as sophisticated technologies (especially for metallurgical recovery) in order to reach high recovery rates and low environmental impacts. In addition, these technologies require large volumes of material for their operation.

Stages 3 and 4 together make up the treatment phase.

The e-waste recycling cycle ends when the output – secondary raw materials – is produced in the treatment process (the end-processing stage) and is sold back to the manufacturing industry. The components that were returned for reuse in stage 2, and the materials that make it to landfill, are also considered outputs (Pena, 2012).

Who are the main stakeholders involved in the e-waste recycling chain?

Manufacturers and retailers

Manufacturers and retailers supply the domestic e-waste market with used and obsolete devices and equipment made of defective integrated circuit (IC) chips, motherboards, cathode ray tubes (CRTs) and other left-over items produced during the manufacturing process. They also deliver defective computers under warranty that fail tests and are returned by consumers.

Importers of second-hand EEE and e-waste

Importers bring in huge quantities of e-waste including used and obsolete monitors, printers, keyboards, central processing units (CPUs), typewriters, projectors, mobile phones, polyvinyl chloride (PVC) wires, etc. These items exist in all ranges, models and sizes, and are functional as well as unsellable and non-reusable materials.

Importers bring in bulk e-waste both legally and illegally. Often, illegal shipments of e-waste are labelled as donations or imports of second-hand EEE, to cross borders as a legal trade transaction. These illegal transactions are difficult to track as they are both hidden and controlled by criminal groups that profit from informal e-waste recycling practices. Illegal e-waste is often imported to developing countries to be disassembled and stripped of valuable metals (and other secondary raw materials) using a cheap and informal labour force and without following health, safety and environmental standards.

Households

Most households do not always sell e-waste directly into the scrap market. Preferred practices are to exchange it at a retailer (while purchasing a new computer), pass it on to relatives or friends, or store it in the house. In the first, the responsibility to dispose of the EEE is passed back to the retailer. The way households behave in relation to their e-waste varies from country to country. In China, for example, households tend to sell their end-of-life EEE to informal e-waste collectors (Chi, Streicher-Porte, Wang and Reuter, 2011). In Latin American countries, households are unaware of the possibilities of recycling e-waste and tend to store their end-of-life EEE at home for several years or sell it to refurbishing workshops (Silva, 2009).

Business/government sector

The business sector (government departments, public or private sector enterprises, multinational corporations, etc.) was the earliest to use information and communication technology (ICT). Today, this sector accounts for a sizeable amount of installed ICT equipment and is a high-profile generator of e-waste.

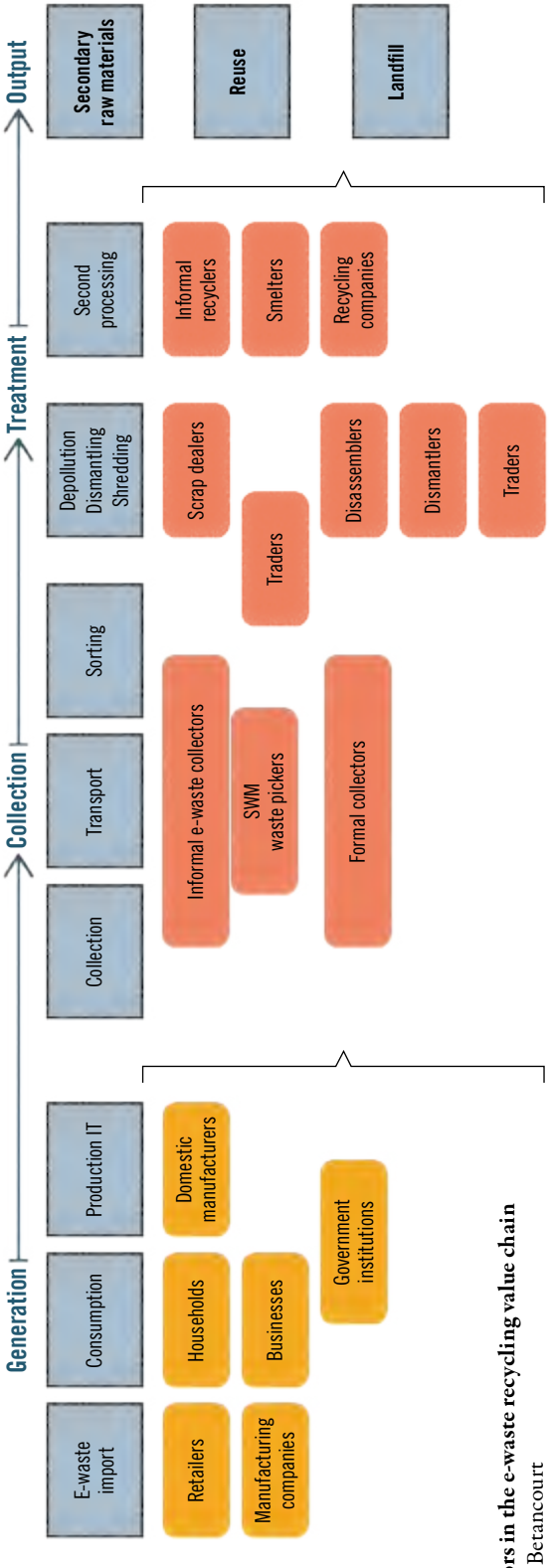

Figure 3. Actors in the e-waste recycling value chain
Source: Andrea Betancourt

The incompatibility of old systems with present needs and requirements prompts business sector entities to pass obsolete EEE in large amounts to dismantlers/recyclers, who sometimes pick up these items at auction or through other standard business practices. Ties between the informal and social economy sectors and the business and government sectors are usually weak. Therefore, partnerships between these two stakeholders are advisable to integrate the informal economy into formal e-waste management and recycling systems.

Collectors, traders, scrap dealers, disassemblers and dismantlers

Value chains are not straightforward; the majority of stakeholders at the e-waste generation (and pre-processing) stage are, for the most part, informal and unorganized. It is not possible to make clear distinctions among the actors involved in each one of these activities in developing countries. Collectors collect e-waste from households, public and private offices, and other institutions. They may work independently or be part of a formal or informal enterprise, and they may also trade, disassemble or dismantle e-waste. They rely on other mediators (traders) to sell their e-waste; there is, in fact, a spectrum of middlemen (or women) involved in collecting small, medium and large quantities of e-waste. These, in turn, can be formal or informal, and may provide services and contribute to the logistics of the value chain (Tuori, 2012). These actors need to be carefully assessed in order to better understand their role, distribution and profits, and the skills and capacities required by waste pickers at the bottom in order to move higher in the value chain.

Furthermore, once they secure e-waste from various sources, scrap dealers decide which items need to be dismantled and which will be retained for resale as second-hand merchandise. The e-waste items and components that can no longer be resold find their way to the dismantling workshops.

Recyclers/smelters

These stakeholders, who operate in the e-waste processing stage, are not concentrated in a single place, but are spread across different areas of a city, each handling a different part of recycling. For the most part, they operate in the informal economy and are not organized. The common methods used to recover different metals are unsafe and suboptimal; they include roasting, smelting and using an acid bath.

A study published by the United Nations Environment Programme (UNEP) (Schluep et al., 2009) identified some general features of the informal economy of the e-waste recycling sector in developing countries. It found that, in countries with a functioning e-waste recycling market, such as India and China, there were well-established formal and informal economies that interacted with each other. The formal economy operated mostly in the processing stage of the value chain, and could hardly compete with the informal economy in the stages of collection, dismantling and pre-processing. Moreover, it found that the informal economy was more organized than was commonly perceived, and was gradually moving towards formalization. In some middle-income countries, such as South Africa, Morocco, Brazil and Colombia, a formal sector was in the process of being developed, while informal activities related to collection and dismantling remained at the individual level or on a small or medium scale. The study also identified that in West African countries with larger economies (e.g. Côte d'Ivoire, Ghana and Nigeria) an informal recycling sector, operating at the collection and dismantling stages, was being established, while formal activities remained small scale. In other African countries (e.g. Benin, Liberia and Tanzania, among others) where e-waste volumes were small, the formal and informal activities were small in scale and not organized, if existing at all.

Decent work deficits in e-waste management

The workers who are mostly embedded in the informal economy and who are the most vulnerable to hazardous working conditions are those involved in collection, trading, dismantling and metal extraction. As outlined above, the bulk of e-waste recycling is carried out in the informal economy and its workers are generally involved in labour-intensive activities that involve low earnings, long working hours and exposure to hazardous substances, leading to a serious of decent work deficits. The potential mismanagement of e-waste by informal workers can have damaging consequences on entire communities, including children.

Employment: Informality, uneven remuneration and suboptimal conditions of work

The number of jobs, levels of remuneration and conditions of employment in e-waste management are largely unknown. In developing countries, such assessments are challenging to undertake, particularly because jobs take place in the informal economy and are not officially registered. The available information

indicates that most e-waste workers (especially collectors) operate informally. The level of organization among workers varies between countries. In several countries, these workers operate in a legal grey area, where legislation bans e-waste business activities, but authorities tolerate their presence, acknowledging that they contribute to the local economy (Nordbrand, 2009).

While the e-waste recycling chain is based on a network existing among collectors, traders and recyclers, each adding value and creating jobs, working conditions and incomes can vary considerably among workers and enterprises, whether formal or informal. Informal collectors, who are at the bottom, or foundation, of the value chain, tend to come from marginalized backgrounds and live on survival incomes. The incomes of traders, scrap dealers and dismantlers can vary greatly depending on how low or high they are in the value chain. Nonetheless, profits in this sector are high and growing, and developing countries view e-waste as an opportunity for business ventures and income generation. The regulation and formalization of the sector will be required to tackle negative employment indicators and improve working conditions.

Independent of remuneration, another highly concerning issue is that workers in the informal economy of e-waste are exposed to hazardous substances and dangerous working methods. Informal workers collectors, traders and dismantlers do not often use appropriate technology and do not follow health and safety guidelines (Lundgren, 2012). In the recovery phase of the e-waste recycling chain, workers extract metals under highly hazardous circumstances, using acids and bare hands (Sinha-Khetriwal, Kraeuchi and Schwaninger, 2005). Poor e-waste recycling carried out in the informal economy emits large amounts of deadly toxins, lead and acid fumes into the environment. Due to their exposure to heavy metals and toxic chemicals, workers throughout the electronics industry have suffered from severe illnesses. Health issues specific to e-waste recycling as a whole have been reported, including diseases and problems related to the skin, stomach, respiratory tract and other organs. Recent reports mention explosions and exposure to n-hexane at the workplaces of secondary raw material suppliers. In addition, there have been several country and global reports referring to diseases such as malignant cancer among e-waste workers (Chaturvedi and Bhardwak, 2013; Kuehr and Magalini, 2013; Nordbrand, 2009).

The use of protective equipment among informal workers is rare, even though basic safeguards – such as inhalation protection masks against dust – could mitigate some of the respiratory problems.

Social security: Limited access to social protection schemes

Given that most workers involved in e-waste management are embedded in the informal economy, access to national social security systems is limited. In many countries, "waste picker" or "informal collector" is not recognized as a formal occupation, inhibiting those in this form of work from accessing any type of social protection. Workers involved in this trade, who are exposed to high risks, precarious working relationships and global price fluctuations of (secondary) resources would benefit most from employment injury protection, unemployment protection, disability benefits, maternity benefits and access to healthcare systems for themselves and their families. Governments must develop arrangements to meet the basic needs of vulnerable groups and protect the workers of e-waste management against risk (ILO, 2014).

Rights at work: Child labour and marginalization

Among the most concerning issues in e-waste management is the presence of child labour. E-waste management is a sector that highly endangers children's health and safety, which should be prohibited and eliminated as a "matter of urgency", as stipulated in the Worst Forms of Child Labour Convention, 1999 (No. 182).

General research on e-waste has identified the presence of child workers in its collection and dismantling (ASSOCHAM, 2014; Kuehr and Magalini, 2013; WHO, n.d.). Recent research in India, for instance, reveals that in recycling workshops there are about 450,000 child workers in the 10–14 age group engaged in e-waste activities, without adequate protection and safeguards, in recycling workshops (ASSOCHAM, 2014). The low incomes of parents engaged in waste picking and scrap yards often do not cover basic needs, and therefore children are encouraged to work with their parents. Children are especially vulnerable to the health risks that may result from exposure to e-waste and, therefore, need more specific protection. In a recent survey on e-waste and its health impacts on children, the World Health Organization (WHO) and the United Nations University identified some of the most salient outcomes of children's exposure to e-waste recycling/processing/dismantling, which included respiratory diseases from inhalation of dust or other substances, skin diseases, growth retardation, neurodevelopmental effects, cancer and immune deficiencies (Kuehr and Magalini, 2013). During the last few years, various

international calls for action[3] have highlighted the need to raise awareness and intervene in this issue (WHO, n.d.).

Many informal collectors and recyclers come from vulnerable and marginalized populations that include the poor, ethnic or religious minorities, rural migrants and immigrants. As is the case in solid waste management, they enter this type of work because of economic necessity and the low skills and investments required (Gunsilius, Chaturvedi and Scheinberg, 2011; Nordbrand, 2009). The informality and lax regulatory context of this sector in many developing countries sets an enabling environment for these populations to absorb the negative externalities of the global electronics industry, suffer severe health impacts and become further marginalized.

Social dialogue: Inaccessibility in the absence of collective bargaining

Linked to the informal nature of e-waste work and the authorities' non-recognition of e-waste workers is the inability of those workers to participate in social dialogue. There is limited social dialogue in this sector, which often prevents workers from gaining full awareness of the sectoral dynamics (as well as the risks involved in their occupation) and from forming organizations and securing representation in sectoral dialogues with other stakeholders in the value chain. Organization of e-waste workers is key to attaining their recognition, raising awareness of their collective concerns, needs and challenges among other industry players and public authorities, and improving their working conditions, including skills development and better income.

Formal and informal economies in the e-waste recycling chain

Current e-waste recycling chains in developing countries are made up of formal and informal stakeholders. In some countries, these are interlinked and depend on each other's activities, while in others, only informal actors are present. Several studies on e-waste recycling chains suggest that any approach to creating innovative and sustainable e-waste recycling systems will have to take into account the role and integration of informal actors (Chaturvedi and Bhardwak, 2013; Chi, Streicher-Porte, Wang and Reuter, 2011; Lundgren, 2012; Raghupathy et al., 2010; Wang et al., 2012). These studies point at the need to introduce technological innovation, through technology transfer, while also keeping a balance among efficiency, social compliance (including job creation) and economic viability. Several studies have identified the presence of informal workers in e-waste recycling, but only a few have carried out a close analysis and mapping of the internal dynamics of the informal economy.

Research by UNEP in 11 countries has assisted understanding of the role and contributions of the informal economy in the e-waste recycling chain (Schluep et al., 2009). Other studies that have looked at the role of the informal economy in e-waste recycling have focused mainly on China, India and, to some extent, Brazil. These studies showed that the work of informal actors has certain competitive advantages in specific stages of the e-waste recycling chain, namely collection, dismantling and parts of the pre-processing phase. These activities often benefit from manual labour, require less financial investment and pose fewer and controllable risks to human health, occupational safety and the environment (Schluep et al., 2009; Wang et al., 2012).

Collection is one of the main areas in which the informal economy is a significant driver. In many developing countries, informal collectors feed the entire e-waste recycling chain. They provide house-to-house collection and reach areas of a city that formal companies are unable to access; they act as a facilitating mediator between households and recycling centres and, in some cases, compensate households for the e-waste that they take. In China, for instance, households prefer to sell obsolete EEE to individual collectors, and 60 per cent of Chinese e-waste makes its way to informal recycling processes (Chi, Streicher-Porte, Wang and Reuter, 2011; Wang, Kuehr, Ahlquist and Li, 2013).

Informal collectors are generally flexible regarding working hours and location; they provide the transportation service and offer reasonable prices for e-waste. In India, there is an informal yet entrepreneurial SME-based organization that collects and recycles 95 per cent of the e-waste that is recycled inside the country. This sector is made up of a widespread and active network of workers with considerable manual skills (Raghupathy et al., 2010).

Workers in the informal economy are actively involved in manual dismantling and pre-processing (to a lesser degree) to separate and liberate materials, and direct them to an adequate treatment process. The separation phase separates toxic and hazardous

3. These include the Libreville Declaration emanating from the first Inter-Ministerial Conference on Health and Environment in Africa 2008, the Busan Pledge for Action on Children's Environmental Health 2009, and the Strategic Approach to Integrated Chemical Management's expanded Global Plan of Action issued at the International Conference on Chemical Management ICCM3 in 2012.

Box 1. The coexistence of the formal and informal economies of recycling in China

In China, formal and informal economies coexist, despite government efforts to support formal recycling companies. There are currently 130 registered e-waste enterprises and 53 e-waste processing enterprises that have received the necessary treatment licences after a three-year monitoring of technical and environmental standards (Wang, Kuehr, Ahlquist and Li, 2013). Most of these enterprises have settled in regions of intensive manufacturing of EEE. Simultaneously, since 2004, the government has carried out pilot projects to increase collection and e-waste supply for authorized recycling plants. One is the Old for New Programme (2009–2011), in which consumers received subsidies for returning their old appliances when they bought new ones. The old appliances were then sold to official collectors, dismantlers and recyclers (Wang, Kuehr, Ahlquist and Li, 2013). The goal to increase collection and recycling rates in formal establishments was not attained, and raised questions about the financial viability of those projects as well as the sustainability of the formal recycling system (Chi, Streicher-Porte, Wang and Reuter, 2011).

Formal recycling plants rely on the e-waste supply of informal networks. Since official recycling enterprises bear the processing costs on their own and must practise sound treatment, through modern technology, they are unable to compete with the prices that informal collectors pay for obsolete EEE. In addition, they have neither the capacity nor financial viability to set up an extensive door-to-door collection system comparable to those established by the informal network of collectors (Wang and Huisman, 2010). The informal recycling chain overall is more competitive and profitable than the formal one. It gathers sufficient amounts of e-waste – through domestic household collection and illegal imports – and can maintain low operating costs by employing rudimentary processing operations. E-waste in the informal stream is manually dismantled and components are separated for reuse or recycling. Subsequently, processes to recover specific materials are applied without safety and environmental criteria. It must be noted, however, that while formal recyclers make use of recycling technologies, in the actual recycling chain, formal and informal actors are not always different from one another, and they tend to overlap in certain phases, particularly as recycling operations are often not supervised (Chi, Streicher-Porte, Wang and Reuter, 2011).

The informal economy of recycling in China is efficient, well organized and comprehensive. For example, products and components from informal recycling sites in Guiyu are usually sold to neighbouring cities such as Schenzhen. Metal fractions are sent to metal refineries, through intermediaries, and shredded plastics are locally recycled and sold to toy manufacturers in Shantou city at one third of the price of original plastics (Chi, Streicher-Porte, Wang and Reuter, 2011). At the same time, China's recycling areas, such as Guiyu, show among the highest concentrations of toxicity in workers' and childrens' blood, as well as in rivers, surface water and soil. There is an urgent need for government authorities to intervene and incentivize the formalization and good practices of this sector. Besides supporting formal companies and banning informality, engaging informal actors and encouraging them to adopt safety and environmental guidelines – by forming small enterprises and partnering with official recycling companies, for instance – would be a more effective way of controlling and reducing the detrimental effects of e-waste on workers, communities and the environment.

Table 1. Comparison between formal and informal recyclers in China

	Formal recycling	Informal recycling
Economic	Large-scale investment in infrastructure; High operation cost and overheads; Internalized environmental cost; Subsidized by the government.	Low investment in facility and equipment; Low operation cost and fixed cost; Externalized environmental cost; High revenue from critical materials and reuse.
Technical	Combination of manual disassembly and shredding; Incineration and refinery to upgrade materials; Limited reuse.	Labor-intensive manual disassembly; Primitive and hazardous processes to recover materials; Component or complete set reuse.
Environmental	Controlled detoxification and disposal; Environmental, health and safety system.	No measures for detoxification and waste disposal; No health or safety protection.
Social	Machinery replaces labour.	Numerous migrant workers involved.
Legislative	Authorized by Ministry of Environmental Protection.	Banned by Ministry of Environmental Protection.
Market	Lack of e-waste feed from formal collection channels.	Deeply coupled with illegal import, informal collectors and trading market to obtain e-waste.

Source: Wang and Huisman, 2010.

materials from high value materials, including reusable components and recyclables (both are found in mercury backlights, printed circuit boards, capacitors and batteries, for example). Subsequently, this stage dismantles the recyclable components to liberate materials and sort them into clean plastics, CRT glass, ferrous metals, non-ferrous metals and other materials. This phase can include manual and semi-manual technologies for more efficient results. Some of the manual procedures used for certain materials require basic tools and are safe and efficient, provided that workers have a knowledge base on how to operate safely. The pre-processing phase benefits from having a mix of manual labour, skills and technological tools, depending on the electrical or electronic component being treated (Wang et al., 2012).

A balanced combination of manual, semi-manual and mechanical dismantling and pre-processing, appropriate to the different types of e-waste, can bring economic, environmental and social benefits, including employment creation (Schluep et al., 2009). Similarly to the collection phase, this phase does not necessarily require large amounts of investment. This part of the recycling chain can continue to be carried out by the current actors in the informal economy – under improved working conditions, OSH, adequate technology, where necessary, and awareness of the nature and potential impacts of hazardous substances – with the vision of formalizing the sector.

The end-processing phase (for metal recovery) does require large investments, infrastructure, innovative technology and a relatively skilled workforce, and must comply with strict controls and the licensing of formal businesses. This phase aims at final metal recovery, which is carried out by smelter and refinery plants. Currently, this process is also being widely practised by actors of the informal economy in developing countries, but through primitive processes that include open burning and acid baths to recover metals, and that are performed without adequate protection gear. Heavy contamination from these forms of recycling, leading to risks to workers' health and the environment, have been reported in India and China (Wang et al., 2012).

The idea that actors (workers) in the informal economy could continue to play a role in recycling systems has been proposed by several studies and field experts. In a joint proposal of the United Nations University, Delft University of Technology, Umicore Precious Metals Refining and The Swiss Federal Laboratories for Materials Science and Technology (EMPA), the authors developed the Best-of-2-Worlds philosophy, an innovative approach for e-waste treatment in developing countries (Wang et al., 2012). This approach is based on the creation of a technical and logistic integration of suitable and available technologies in different treatment phases to form a complete recycling chain for all materials. It supports the possibility of combining treatment processes that are competitive in developing countries (pre-processing phase, manual dismantling) with treatment processes that are more competitive in industrialized countries (end-processing phase). The resulting recycling chain would have manual pre-processing, with environmental and OSH standards, performed at the local scale, and the high-technology end-processing performed at the global scale (i.e. shipped to industrialized countries).

Whether the recycling chain is shared among countries with competitive capacities, or carried out mostly within a single country, governments will need to focus on formalizing the workers in the informal economy. Informal workers would benefit from the formalizing of enterprises, following decent work and environmental guidelines, and interacting directly with recycling companies. Access to markets could be improved and incomes could increase, allowing them to remain competitive in a sector that may become stricter and better regulated in the future. By having a formalized sector, public authorities may also establish clear recycling targets and mitigate the e-waste problem, reducing the public health and environmental risks. In order to formalize the sector, public authorities may consider setting up facilitating policies to encourage informal collectors, traders and recyclers to organize and form cooperatives and other SSE enterprises. This is an accessible means of formalization that opens up opportunities to address decent work deficits, improve business operations and incomes, provide services for members and increase the negotiation power of workers at the lower end of the e-waste chain, while also addressing unemployment in both cities and countries.

Organizing informal workers in the solid waste management sector

3

The role of the informal economy in waste management

Waste management and recycling is currently a growing economic sector that generates millions of formal and informal jobs worldwide. However, the informal economy of the waste management sector appears to be widespread, and more extensive than that of the formal sector. Researchers estimate that, of the 24 million people who work in recycling activities, about 80 per cent perform in the informal economy (WIEGO, 2013). For instance, in China – the largest producer of solid waste – 2.5 million people worked in the informal waste management sector, while 1.5 million people were employed in the formal sector (Medina, 2007). Most of the workers involved in the informal sector are poor, unskilled, live in slum areas, and have scarce opportunities to be formally employed elsewhere. A significant proportion of the informal waste workers tend to be rural migrants, disabled people who are unable to find other occupations, or elderly people whose pensions are non-existent or insufficient (Gunsilius, Chaturvedi and Scheinberg, 2011; Gunsilius et al., 2011; Medina, 2000). These same workers are now also retrieving e-waste as an additional material of the recyclables that they collect, or as an exclusive material for the specific e-waste market.

The coexistence of formal and informal economies in solid waste management systems in low- and middle-income countries has been widely identified and studied (Gunsilius et al., 2011; Wilson, Velis and Cheeseman, 2006). The research literature prominently characterizes the informal economy in solid waste management as small scale, labour intensive, largely unregulated and unregistered (often without trading licences). It is often associated with evasion of taxes and low-technology processing in the provision of services, such as primary collection (Wilson, Velis and Cheeseman, 2006). Informal activities in solid waste management (i.e. municipal waste) are generally associated with recycling and include collection, recovery of recyclables, sorting, grading, cleaning, bailing and waste compacting (WIEGO, 2013). The waste that is being recovered includes paper, plastic, glass and aluminium. More recently, informal collectors have also found market value in recovering e-waste.

Informal collectors and recyclers of waste (also referred to as waste pickers) carry out these activities because there is high demand for secondary raw materials (recyclables), a shortage in the provision of these public services and an opportunity to earn income (i.e. survival income). Their work is characterized by low entry barriers, low organization levels, low bargaining power and low incomes for most workers at the bottom of the value chain. A great proportion of the informal workers in the waste management sector work independently and are not part of any form of formal organization (e.g. union, cooperative, association, small enterprise). They often collect and sort recyclable waste, which are phases situated at the lower end of the chain (Wilson, Velis and Cheeseman, 2006). The stages that add value to recycling are the gathering of larger volumes of recyclables and small-scale manufacturing of secondary raw materials. These, however, require infrastructure and capital, and are more accessible to formal enterprises,

such as cooperatives, which have the ability to negotiate collectively or pool resources among members to achieve economies of scale. Informal waste collectors (or waste pickers) often retrieve recyclables in small quantities and sell them to middlemen (traders and recycling repositories), but do not negotiate with the recycling industry. These workers are far removed from the final consumers of secondary raw materials; they highly depend on middlemen, and thus tend to have little bargaining power in the negotiation of prices. Additionally, these workers generally suffer from poor working conditions, exposure to health risks, the presence of child labour and absence of social protection schemes (Gunsilius et al., 2011; Medina, 2000; Wilson, Velis and Cheeseman, 2006). Nonetheless, informal collectors (or waste pickers) in certain countries and regions have been historically involved in municipal waste management collection and have gained experience in organizing workers into membership-based cooperative enterprises and business associations, as well as national, regional and international networks, such as the Global Alliance of Waste Pickers.

One of the main concerns regarding the informal economy of solid waste management is related to the impact of waste management activities on the occupational safety and health of workers. The physical demands of walking, collecting and carrying materials, without protective equipment and adequate technology, as well as the presence of sharp, dangerous and unsanitary elements, can cause diseases, extreme fatigue, back pain and physical injuries (Chintan Environmental Research and Action Group, n.d.). Moreover, workers who deal with e-waste tend to be exposed to toxic chemicals and heavy metals, which can have even more harmful impacts on human health and the environment.

Another key issue of concern in waste management in developing countries is the presence of child labour. A global study by the ILO found that children are frequently involved in waste-picking activities in developing countries and that, in some countries, such as Tanzania, children dominated the sector, comprising 88 per cent of waste pickers (ILO, 2004). Children who work with waste are not only deprived from attending school but also exposed to unsanitary environments and toxic substances, which cause more damage to children than to adults (Leung, Duzgoren-Aydin, Cheung and Wong, 2008). In many cities, women dominate the informal economy of solid waste management out of extreme necessity, and due to social and cultural barriers that inhibit women from finding opportunities in skilled sectors and formal economies (Gunsilius, Chaturvedi and Scheinberg, 2011).

Informal waste workers play an important role in the waste management systems of developing countries (Gunsilius, Chaturvedi and Scheinberg, 2011; Medina, 2007; Vyrenhoek, 2012). They carry out primary collection in the areas of cities which municipal services do not reach, particularly the urban slums (Medina, 2000). In developing countries, waste pickers recover 15–35 per cent of recyclables in the cities of developing countries, and supply at least 40 per cent of raw materials to the recycling industry (Medina, 2008; Scheinberg, Wilson and Rodic, 2010). In the case of e-waste, informal collectors and manual dismantlers are almost entirely responsible for collecting old EEE from households. Despite their work and contributions to the environmental sustainability of cities, informal waste workers are seldom recognized or financially compensated for their services.

In recent years, waste management workers have faced threats of displacement and the loss of jobs and livelihoods. Many cities in developing countries are modernizing their waste management systems. They are shutting down informal waste sites, contracting multinational companies and adopting other, less labour-intensive technologies, without implementing strategies to compensate for the job losses. Consequently, many informal waste workers are being left without a job and income, and those who remain in business are left to compete with large-scale and experienced national and multinational companies (Vyrenhoek, 2012). These trends are having severe impacts on the livelihoods of informal waste workers. Increased knowledge and entrepreneurial capacities would help their activities turn into efficient, competitive and environmental enterprises with the ability to address the waste challenges of modern societies while providing green and decent jobs. Experience has revealed that organizing these workers is a first and essential step toward formalizing the sector, while making it more competitive and allowing informal waste workers to preserve their jobs (Chaturvedi et al., 2005; International Labour Foundation for Sustainable Development, 2014; Medina, n.d.).

Most, if not all, waste pickers suffer from various forms of marginalization, including in relation to local authorities. This marginalization contributes to the lack of recognition of their work by both the general population and governments. In addition, their lack of organization and representation prevents waste pickers from obtaining contracts with municipalities for waste collection, sorting and/or processing.

Some organizations, such as the ILO, have pointed out the waste management sector's potential to generate green jobs for local communities, while simultaneously bringing voice and representation to

the workers as well as health and environmental contributions to cities and countries (ILO, 2012). Hence the importance of promoting decent work and green jobs[1] to improve the working conditions, environmental performance and income of informal waste pickers and recyclers. Cooperatives and other SSE enterprises are the preferred forms of economic organizing among many groups of workers in the informal economy. There is a growing number of cooperatives and SSE enterprises of waste pickers and recyclers, particularly in Asia and Latin America. The membership-based cooperative business model also carries potential for waste pickers and recyclers elsewhere, as well as in the e-waste management value chain.

Cooperatives and other social and solidarity economy organizations

The social and solidarity economy (SSE)[2] is a broad term generally used in reference to that part of the economy that embraces organizations, enterprises and activities whose main objective is to achieve social wellbeing, not profit. Historically, the SSE was used as a concept to create alternative communitarian responses to the mainstream capitalist economy. SSE enterprises and organizations can be cooperative enterprises, mutual benefit societies, associations, community-based organizations, social enterprises or foundations. They are a dynamic and evolving group of entities which promote and run people-centred economic organizations (Fonteneau et al., 2010).

While there is no fixed definition of the SSE, the ILO defines it as "a concept designating organizations, in particular cooperatives, mutual benefit societies, associations, foundations and social enterprises, which have the specific feature of producing goods, services and knowledge while pursuing both economic and social aims and fostering solidarity" (ILO, 2009). SSE organizations, including enterprises, are perceived as strong promoters of ILO principles, including workers' rights, employment creation, social protection and social dialogue, as well as environmental sustainability (ICA, n.d.).

Among the different SSE organizations, the cooperative model has proven to be successful in organizing waste pickers, and in improving their working conditions. The International Co-operative Alliance (ICA), a non-governmental umbrella organization for cooperatives worldwide, defines a cooperative as an "autonomous association of persons united voluntarily to meet their common economic, social and cultural needs and aspirations through a jointly owned and democratically controlled enterprise". This same definition has been adopted by the ILO in its Promotion of Cooperatives Recommendation, 2002 (No. 193) (ILO, 2002).

The purpose of a cooperative model – individuals or corporate bodies who have joined together to form a business by sharing their resources – is to benefit from economies of scale, reduce costs, and achieve a common goal that would otherwise be unreachable individually. The members of a cooperative are both its owners and users (customers, suppliers or workers) and they cooperate to solve the problems they share, such as low incomes, lack of negotiating power and vulnerable working conditions (Tchami, 2007). This is particularly relevant when certain groups of workers face difficult and/or unjust social and economic conditions, and are therefore relegated to the informal economies. Informal workers tend to transition toward the formal economy by coming together and organizing themselves into cooperatives or other types of SSE organizations, which remains an accessible process for poor informal workers – provided they receive the basic knowledge and capacities needed to operate them successfully.

Cooperative enterprises are important sources of employment: the ICA estimates that they have around 1 billion members and employ more than 100 million people around the world (ICA n.d.). Moreover, cooperative enterprises are significant players not only in terms of jobs and gross domestic product (GDP) but also in providing other social and societal benefits. Given their nature, cooperatives and other SSE organizations often address the principles

Box 2. Cooperative principles

- Voluntary and open membership
- Democratic member control
- Member economic participation
- Autonomy and independence
- Education, training and information
- Cooperation among cooperatives
- Concern for community

Source: ICA (http://ica.coop/en/whats-co-op/co-operative-identity-values-principles).

1. According to UNEP, green jobs comprise work in agricultural, manufacturing, research and development (R&D), administrative and service activities that contribute substantially to preserving or restoring environmental quality. Specifically, but not exclusively, this includes jobs that help to protect ecosystems and biodiversity, reduce energy, materials and water consumption through high-efficiency strategies, decarbonize the economy, and minimize or altogether avoid generation of all forms of waste and pollution (Renner, Sweeney and Kubit, 2008).

2. Other common terminologies used for this concept include: solidarity economy, popular economy, non-profit organizations, third sector and social economy (see Fonteneau et al., 2010).

of decent work by attempting to provide their workers with stable local jobs, increase their incomes, improve their working conditions and facilitate access to social protection. They also provide voice and representation to their members. Therefore, they are essential players in allowing poor and vulnerable groups or communities, who often operate in the informal economies, to gradually formalize their economic activities. The ILO has embraced support for cooperatives in its Promotion of Cooperatives Recommendation, 2002 (No. 193), by recognizing that cooperatives create jobs, mobilize resources, and allow all people to contribute to and benefit from economic and social development (ILO, 2002).

According to various studies, most workers in the informal economy of solid waste management operate independently or in families – a condition that makes them more vulnerable and prone to abuse and exploitation (Medina, 2007; Scheinberg, Wilson and Rodic, 2010). However, in the past two decades, groups of informal workers, particularly in certain cities in Latin America and Asia, have come together to form cooperative enterprises to access much-needed services and improve their labour conditions and bargaining power. Such cooperative enterprise initiatives have been shown to be effective ways of initiating a formalization process that can help informal workers not only to access services and resources, but to gain recognition and representation and a stronger negotiation stance on prices, access social protection schemes, create new partnerships with other stakeholders and reach out to authorities. Likewise, cooperative enterprises can also carry an organizational function, allowing members to instil awareness of their occupation, advocate for policies that are favourable to them, participate in social dialogue and promote social inclusion in solid waste management systems. In the waste management and recycling sector, most cooperatives continue to originate among workers in the informal economy, and need an enabling environment and support services that would facilitate their transition to formality (Gunsilius et al., 2011).

Organizing the informal economy: Insights from the solid waste management sector

There is solid experience and a body of literature on the organization of waste pickers, particularly in Latin America and Asia. Researchers, waste workers' organizations and non-governmental organizations with expertise in the field argue that the organization of waste workers in cooperatives increases their income, improves their working and living conditions, and promotes their civic activism and transition to the formal economy (Chaturvedi and Bhardwak, 2013; Medina, 2000; WIEGO, 2013). Because of the relatively recent focus on informal e-waste recycling, research has not yet documented many processes or cases on the organization of informal e-waste workers. However, information on the organization of informal solid waste workers provides valuable and relevant insights for any potential process of organization and formalization in the e-waste recycling sector.

Generally speaking, independent collectors of solid waste gather recyclables (often including e-waste) through their door-to-door collection services, or by waste picking in landfills, open dumpsites, transfer zones, community deposits, streets or any other public space where residents deposit waste (before the municipal collection routine) (Medina, 2000). Individual collectors, who often lack the appropriate tools, technologies and space to do so, are habitually unable to retrieve the minimum quantities, volume and quality of recyclables demanded by industry. Therefore, they depend on one or several middlemen to sell the recyclable waste to industries (Medina, 2000).

In contrast, when informal workers in solid waste management join together to form a cooperative, as a collective entity they can gather recyclables in quantities large enough to allow them to approach industries directly and negotiate better prices. The possibility of receiving higher prices, and consequently higher income, is a defining advantage with further implications for the labour conditions of informal workers. With higher profits, cooperatives can create a common capital fund and invest it in the purchase of technological and protective equipment, including transportation vehicles, pre-processing machines, uniforms and protective equipment. Cooperatives can also support their members in accessing financial services, or create their own financial cooperatives. In addition, collectors and recyclers organized as a collective can arrange limited working hours and share the collection, segregation, cleaning, sorting and crushing duties, while also reducing the labour intensity and physical burden of their work. As cooperatives mature and expand, they have the capacity to improve and diversify their services, increasing their opportunities to move up the value chain and collect fees for the provision of their services. It is equally important to note that waste management cooperatives tend to increase their members' awareness of workers' rights and OSH, which becomes particularly important when dealing with hazardous substances. They can also support their members through provision of other services, such as childcare or financial services.

Box 3. SWaCH: How a cooperative improved waster pickers' working conditions

The SWaCH (Solid Waste Collection and Handling) cooperative, based in Pune, India, was formed by members of the waste pickers' union Kagad Kach Patra Kashtakari Panchayat (KKPKP). Its services include door-to-door collection of waste, selection of recyclables and disposal of remaining litter in municipal collection points. Ever since its members started operating as a cooperative, they demanded recognition from local authorities and city permits to operate formally. The 2,300 members of this cooperative now provide services to 400,000 homes in the city of Pune. Residents pay a fee for the collection service, while the government contributes equipment and administrative expenses. After some time, SWaCH purchased a storage area for recyclables to avoid dependence on middlemen. It also became increasingly committed to building the capacity of its members and improving their working conditions; it provided uniforms, basic protective equipment and eight-hour working day schedules. As SWaCH is a partner of the municipality of Pune, its members secured access to public health care for their children. Since 2008, the incomes of SWaCH members have doubled. Moreover, the successful expansion of the cooperative has led SWaCH to diversify its services to other areas of waste management, such as composting and collection of batteries. Despite the obstacles that cooperatives are currently facing in Pune (e.g. competition and displacement by transnational waste management companies), SWaCH's members claim to have benefited from higher income, more decent working conditions, a sense of empowerment and more opportunities for capacity building. It is worth noting that KKPKP was instrumental in setting up the SWaCH cooperative, thus helping waste pickers achieve wider job security, recognition and rights.

Source: http://swachcoop.com/about-swachpune.html.

Another valuable advantage of organizing workers into cooperatives or other SSE organizations is that it gives them a common voice to jointly advocate for the recognition of their work and rights to access services and generate employment with decent work standards. Furthermore, organizations with clear roles and objectives can join together to create networks and advocate for the inclusion of informal workers and enterprises in waste management systems. In the solid waste management sector, cooperatives in Latin America and India have combined to create national associations and regional/international networks. In Colombia, the ANR (Asociación Nacional de Recicladores – National Association of Recyclers) struggled for years to get recognition as public service providers. In 2009, the Constitutional Court ruled in favour of the Association by granting its members customary rights to access, sort and recycle waste, and, in 2013, the office of the Mayor of Bogota launched a remuneration system for waste pickers registered in the city's system. In Brazil, the MNCR (Movimento Nacional dos Catadores de Materiais Recicláveis – National Movement of Recyclers) hosts 600 cooperative members and provides jobs to more than 80,000 recyclers who collect 90 per cent of the country's recyclables. As a result of MNCR's political advocacy, informal organizations were included in the National Solid Waste Policy (2010), in which the government recognizes waste picking cooperatives as service providers and encourages municipalities to integrate them into solid waste management systems.

These local and national organizations, and other supporting allies, have also created transnational networks to support each other's advocacy to integrate informal workers into formal waste management systems, and share good strategies, practices and leadership. The Global Alliance of Waste Pickers, for instance, supports many waste picker organizations around the world and advocates for fair and just solutions to waste management issues, within the framework of climate change and environmental discussions at the international level. The Alliance advocates for national and international decision-makers to consider the work and livelihoods of informal waste workers (the social dimension) in their discussions on the environmental impact of waste management (Global Alliance of Waste Pickers, n.d.).

The history and experience of solid waste organizations, cooperatives and other SSE organizations, including networks, is useful and relevant for the actors involved in the informal economy of e-waste. This history and experience sets a rich legacy for: i) the integration of informal e-waste workers in the formal economy; and ii) the advocacy of cooperatives and other SSE organizations in e-waste recycling.

Formalization initiatives in the e-waste sector

4

Sections IV and V present four case studies that tell stories on the intervention of organized informal workers in the e-waste recycling chain in different countries. They exemplify the variety of problems encountered in the labour dimension of e-waste recycling and approaches that can be used to encourage formalization of workers. The cases of section IV – Brazil and India – illustrate government and NGO-led initiatives, respectively, to support the organization of informal e-waste workers as well as the participation of organized workers in e-waste recycling chains. They provide insights on steps that can be taken to create links between formalized workforces and improved working conditions, service provision and broader economic outcomes. The information for both cases was gathered through a desk review of available literature.

The cases presented in section V – Serbia and Bolivia – look into the role that informal and organized workers play in e-waste recycling. The fact that the e-waste recycling markets in these countries are not as large as Brazil and India's, offers an opportunity to reflect on the possibilities, and obstacles, of improving working conditions and formalizing the sector by promoting the organization of workers, following SSE models (e.g., cooperatives). They demonstrate (albeit on a more limited basis than is the case in Brazil and India) the social and economic advances that such forms of organization can and might effect in the face of various constraints. These cases were developed through field research, including on-site interviews and focal groups.

The case of Brazil: The role of cooperatives and small enterprises

Although Brazil has a dynamic e-waste recycling value chain, there is scarce and isolated information on its internal dynamics, in particular regarding the informal economy. In the past decade, cooperative members have advocated loudly for the integration and formalization of the informal economy of waste management, in the framework of the National Solid Waste Policy 2010 (Fonseca and de Carvalho Matielo, 2009). Likewise, the government has set up initiatives to address the informal economy. Early research works carried out by international institutions (e.g. EMPA) and the government identified the presence of an informal economy made up of small-scale cooperative recycling businesses. In addition, in 2010, Brazil introduced new waste management regulations and extended producer responsibility (EPR) schemes. Both of these drivers now favour the role and contribution of cooperatives and small enterprises in the waste management sector.

Recent studies have suggested that most of Brazil's e-waste is disposed of as conventional solid waste by consumers, ending up, for the most part, in sanitary landfills. In 2007, a field study in Minais Gerais (one of the main states for e-waste production) found that the largest generators of e-waste – households and private companies – dispose of their EEE through solid waste management chains (Rocha et al., 2009). Once the EEE reaches its end of life, it is delivered to public waste collection services,

collectors of recyclable waste or private transportation services.[1] When necessary, the equipment is sent to refurbishing centres, where some parts can be processed for reuse. Public waste collection services and private transportation services deliver all of their waste directly to landfills or garbage dumps.

Collectors of recyclable waste, who are often organized and belong to solid waste management cooperatives, carry out functions in two different phases of the e-waste cycle: the collection and recovery of the recyclable material. They collect materials coming from households and private companies, as well as refurbishing centres, and receive equipment from the technical assistance centres. They contribute to the recovery of recyclable materials by dismantling all of the equipment received, and by selling parts to scrap metal collectors as well as recovery and recycling companies, which have grown in number in recent years. The study suggests that the quantity of EEE received by collectors varies considerably, since most of it is obtained from company donations, door-to-door collection, municipal waste sorting, and private donations made directly to cooperatives. After receiving the material, the collectors verify whether the equipment and its components are functional. Functional devices are sent to refurbishing cooperatives, and those which are not functional are dismantled into fractions of different materials to be sold. Collectors are largely responsible for the recycling of e-waste in Brazil (Rocha et al., 2009).

Despite the role played by collectors in salvaging recyclables, most of the e-waste ends up in landfills and dump sites. The study in Minas Gerais also found that consumers in Brazil are often unaware of dangerous substances contained in EEE, or their health and environmental impacts, and most private companies do not know of the final destination of the waste generated within their installations (Rocha et al., 2009).

The National Solid Waste Management Policy 2010 introduces the concept of "reverse logistical responsibility" and demands that all the actors involved in the entire producer chain (manufacturing companies, distributors, importers and retailers) take responsibility for organizing points of collection for the e-waste generated by their products (Pena, 2012). Moreover, the law encourages the different sectors and municipalities to involve cooperatives and other organizations of collectors of recyclable or reusable materials in their e-waste management plans.

After approving the waste management law (National Solid Waste Policy [PNRS], Federal Law 12.305/2010), the Ministry of Environment and the Agency for the Support of Individual and Small Enterprises (SEBRAE) signed an agreement to develop projects and programmes to promote environmental sustainability and build technical and management capacity in e-waste management SMEs, in the context of the new rules. For this purpose, the government launched the project Eco-Electro, which provides training to solid waste management cooperatives on the separation and dismantling of e-waste. Cooperatives also receive guidance on how to sell the different fractions of recyclable electronics to ensure that they are delivered to certified buyers who can adequately treat e-waste. Thus far, 119 waste collectors from 53 cooperatives have been trained and certified (Gandhinagar, 2012). The government has also supported the creation of centres for the refurbishing of computers (CRCs), which will provide refurbishing and reparation services, and will train and employ vulnerable young people from disadvantaged backgrounds. These young workers will learn to refurbish computers, following safety and health guidelines, and the refurbished computers will be donated by the CRC to educational centres in impoverished communities. As part of this initiative, the Oxigênio company and the Sao Paulo Federal Unit have partnered to create a CRC that is currently receiving and treating e-waste from all levels of government. At this centre, Oxigênio has been training 983 youngsters in rebuilding computers, monitors, mouses, printers and other computing equipment (Oxigênio, 2010; Pena, 2012).

Prior to the National Solid Waste Policy, there were numerous and older cooperatives with various levels of experience and capacities, which already collected and separated e-waste (along with solid waste). These groups had started, and continue, to advocate for their inclusion in waste management systems in their respective municipalities. While these organizations have gained considerable skills and experience in solid waste management, concerns remain about whether the handling of e-waste, specifically, is being performed in an economically viable and environmentally sound way (Pena, 2012). Simultaneously, there are other cooperatives that are specialized in the full cycle of e-waste recycling, hold international environment certifications (e.g. ISO 9001:2008, ISO 14001:2004) and support the principles of social inclusion. Coopermiti, for example, is a fully certified e-waste recycling cooperative that receives e-waste from voluntary donations and benefits from partnerships with retail stores and businesses (see www.coopermiti.com.br).

It must be noted that several business initiatives, led by transnational or national companies, have also emerged to set up e-waste recycling businesses in the wake of new legislation (e.g. Philips Brasil, Carrefour,

1. Private transport is used only for collecting large amounts of bulk solid waste from private companies and disposing of it.

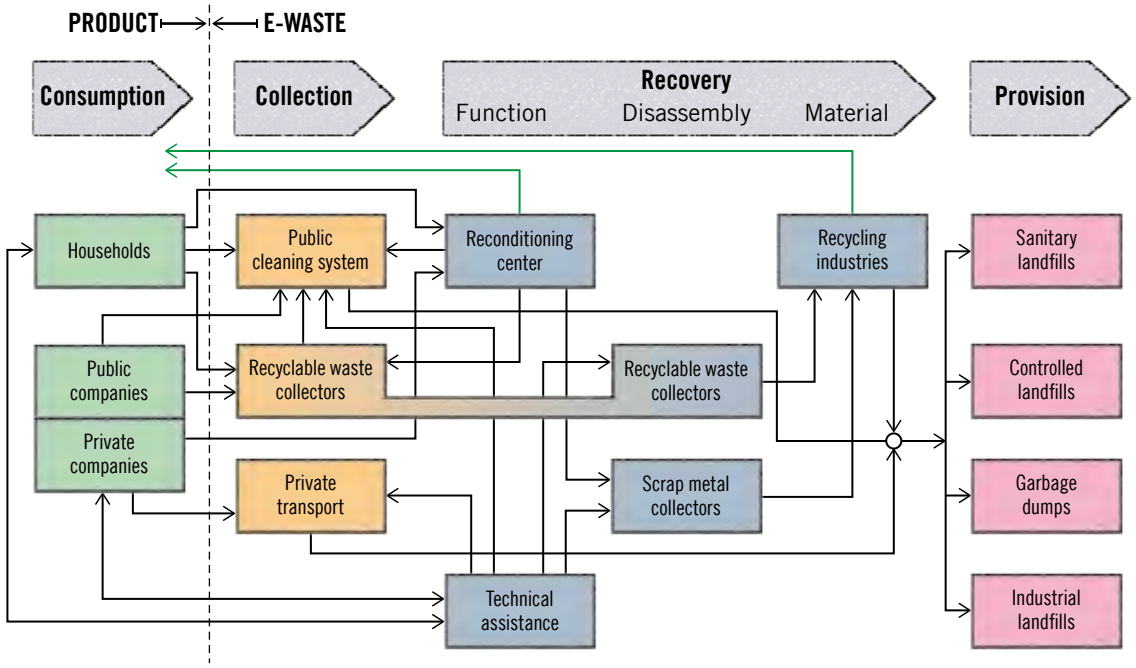

Figure 4. E-waste recycling chain in Brazil
Source: Rocha et al., 2009, p. 53.

Oxil). However, according to Pena (2012), these large manufacturers have not yet been able to generate e-waste profit due mainly to high transportation costs. Transportation represents the major e-waste processing costs, at about 50% of total process cost in the country. As in China, in Brazil, the main actors in charge of collecting, dismantling and separating e-waste fractions are currently collectors (cooperatives, small businesses and individuals), as consumers are not yet aware of the importance of separating e-waste. As the National Solid Waste Policy is progressively implemented through systems of reverse logistics, cooperatives and small businesses will have the opportunity to play a substantial role and partner with formal (and certified) recycling plants within a formal e-waste recycling system. This leaves room for cooperative enterprises to engage in collection and to establish agreements with large manufacturers, distributors and retailers to increase the volume of e-waste and reduce the costs of transportation. The involvement of these actors will be urgent and essential in the face of current and future e-waste generation rates, particularly as the government hopes to eventually close all the sanitary landfills.

As an emerging economy, and with a relatively well-developed legal framework on e-waste, Brazil could take advantage of the opportunity to collect and potentially import e-waste and develop the processes and facilities to extract valuable materials from it. If successful, this could create a significant number of high-quality jobs in Brazil (Pena, 2012) for organized and trained collectors and dismantlers.

The case of India: Formalizing through the organization of workers

India produces nearly 1,250,000 metric tons of e-waste every year, of which only 4 per cent is recycled, due to poor infrastructure, inadequate legislation and lax regulatory frameworks. Of this meagre amount, 95 per cent is managed by the unorganized e-waste sector and scrap dealers. The main generators of e-waste are the government, and public and private industries – which together contribute more than 70 per cent – while household waste accounts for 15 per cent. Among the issues of greatest concern in India is the presence of more than 450,000 child workers in the sector (ASSOCHAM, 2014).

India's e-waste (Management and Handling) Rules, 2011 support EPR schemes, including financial responsibility, in order to set up effective collection systems for the proper management and handling of e-waste. In addition, the rules include all stakeholders in the scope of e-waste responsibilities, including informal actors, who can now legally participate in collection centres and dismantling units once they have become formalized. India has very few formal e-waste treatment centres and, while technology and facilities do exist, there is a greater need to develop more trained businesses to handle the large volumes of e-waste. It is also important to note that India's rules have banned the import of used EEE for charity purposes (Pena, 2012).

Even though India's regulations offer no incentives to informal businesses to formalize, successful initiatives

Box 4. Chintan's organization process unfolded in six steps

1. Finding the right partners: Chintan sought partners who could provide deeper knowledge of e-waste value chains. Partnerships with the Silicon Valley Toxics Coalition and GTZ (German Technical Co-operation Agency) allowed Chintan to better understand the strengths and challenges of the informal economy of e-waste, and to design strategies of formalization.
2. Getting the right data: Chintan carried out an exhaustive study to meet the stakeholders and understand the dynamics of the process in detail. It learned that actors in the informal economy were highly skilled due to their experience in waste picking; the equipment they used was rudimentary; they did not want their families to follow the same line of work; they recognized the value of building associations and networks; they believed that their income gave worth to their occupation; they admitted to having encountered health issues, such as hand blisters and breathing problems; dismantling units had three workers on average and could not compete with larger companies; and many of their workers and owners had received training in mechanical reparation, as well as in basic engineering principles.
3. Organizing the informal economy: Chintan organized capacity-building workshops on relevant topics such as the city's waste management plan, workers' rights, OSH, and leadership and organization skills. As a result of these workshops, the 4R association was formed and the Safai Sena association was officially registered. The former went further to develop a business plan for setting up a dismantling unit and obtained authorization to operate as a collection centre, after having trained its members to collect and separate e-waste. It relied on donated e-waste, which made it less competitive and financially unsustainable.
4. Advocating for inclusive legislation: Chintan participated actively in the public discussions on India's e-waste legislation. It advocated for rules that would not only disenfranchise the informal economy but would include and encourage formalization. The current rules allow for local collectors to establish a collection centre, either individually or collectively, as long as it is registered through an association or company and receives consent from the corresponding authorities.
5. Seeking new partners: Chintan partnered with Nokia for one year, to channel the household e-waste stream to formal recyclers through the informal waste buyers and collectors. This initiative allowed consumers and collectors to gain more awareness about safe e-waste collection, and helped legitimize the work of informal collectors.
6. Re-thinking EPR: The Chintan–Nokia partnership was built in the context of an EPR plan. Nokia paid Chintan to train informal collectors to retrieve end-of-life cellphones and supply them to an authorized recycler. However, authorized recyclers paid less for e-waste than did unauthorized traders, making the project less attractive for informal collectors.

Source: Chaturvedi and Bhardwak, 2013.

have taken place to integrate actors in the informal economy, who are responsible for 95 per cent of e-waste recycling in India, into the formal economy. In New Delhi, for example, the NGO Chintan Environmental Research and Action Group engaged in an initiative to help e-waste workers formalize. Chintan is one of the few organizations – if not the only one – to have documented the process of formalization of e-waste workers, pointing out the lessons learned, benefits and challenges (Chaturvedi and Bhardwak, 2013).

As in Brazil, the e-waste problem in India arises not only from imports, but, more importantly, from the domestic production of e-waste. Indian production of e-waste has grown by a factor of eight in the past seven years (Chaturvedi and Bhardwak, 2013). The environmental and health costs of higher EEE consumption have been internalized by the informal recycling sector, which extracts metals under highly hazardous conditions. In the city of New Delhi alone, there are 25,000 people earning a living from e-waste management, collection, dismantling and metal extraction (Chaturvedi and Bhardwak, 2013). Most of these workers come from marginalized backgrounds and have limited skills whch would enable them to move to another sector.

Given this situation, Chintan became involved in helping two groups of e-waste workers to organize: Safai Sena, an active organization of 12,000 members which has worked on the collection of recyclables for more than a decade; and 4R, the Association of Electronic Waste Recyclers. In Chintan's experience, organizing e-waste workers can allow them to strengthen their trade and remain in business. In addition, organized workers can better advocate jointly for the integration and formalization of informal actors in the formal economy, and demonstrate to government authorities that supporting an organized network of collectors and dismantlers could be socially, economically and environmentally more beneficial than shutting down their operations.

The informal economy in India is involved in most aspects of the collection, dismantling and metal extraction of e-waste. Individual buyers purchase e-waste from households and small businesses, while specialized e-waste collectors obtain it from companies and other major e-waste producers. Collection

is based on a door-to-door service, which is critical in a society in which consumers and formal discarders are unfamiliar with responsible methods of discarding e-waste. Chintan's support in the process of organizing e-waste workers allowed it to contribute to the e-waste recycling chain in a formal manner, while creating jobs for waste pickers and reducing environmental damage.

Chintan's experience of organizing the informal economy of e-waste recycling in India highlights some of the issues that are also present in China and Brazil. Informal actors in the e-waste recycling sector are involved in most areas of the value chain, and particularly in the stages of collection and disassembly. Informal workers and entrepreneurs entering the e-waste market either come with a background in (solid) waste picking and recycling, or come from other backgrounds and are attracted to this sector due to the relatively recent growth in demand for secondary raw materials. Historically, the actors in the informal economy (most of them known as waste pickers) have participated in waste management and recycling; they have long-established, widespread and active networks and solid manual skills in the collection, segregation and dismantling of solid waste. These groups are now entering the e-waste market. SWaCH (see Box 3), is an example of a cooperative that engaged in e-waste to diversify and expand its business activities, as well as increase income of its members.

Still, many waste pickers remain unaware of the many materials and products that could also be retrieved and recycled (Raghupathy et al., 2010). Others are creating small enterprises for dismantling which operate following no health and environmental criteria but face challenges when competing with large formal companies. Meanwhile, authorized recyclers have difficulty accessing e-waste supply. India's case shows a clear need to reach out for the mutual gains to be had in bridging the formal and informal economies: the informal economy could retain its jobs and income, and the formal sector could access higher volumes of e-waste. In addition, bridging the two sectors could achieve social welfare objectives by generating less pollution, reducing health hazards, improving resource management and creating green jobs (Raghupathy et al., 2010).

A number of e-waste field experts in India agree with the Best-of-2-Worlds philosophy (Wang et al., 2012) and support the creation of a multi-stakeholder system of e-waste recycling. Nonetheless, worker organization, and the creation of associations and representative bodies of both formal and informal recyclers, are essential in order to voice the concerns and interests of all stakeholders at the decision-making level (Raghupathy et al., 2010). Furthermore, organizing the informal economy is not an easy process; it requires knowing the actors, gaining their trust and acquiring good understanding of the entire recycling chain. Chintan's experience provides insights that might usefully be taken into consideration and/or applied when organizing the informal economy of e-waste recycling elsewhere.

General insights

There are some essential requirements for organizing e-waste workers. An NGO, such as Chintan, must have a solid understanding of the dynamics of the sector and the level of skills of the workers involved and be able to gain their trust in the organizing process. One of the main steps towards organization is identifying leadership; someone among the workers must take over this role and encourage others to join the organization, as well as to lead its future management and decision-making processes. Any business plan accompanying the formation of an organization must be well grounded in the current context (legislation, rules, value chain, prices, etc.) and must envision future changes and trends in the dynamics of the value chain in order to remain competitive to new market entrants. Moreover, e-waste recycling is a sector with high private sector involvement, and organizations of collectors and dismantlers will benefit from key partnerships with companies practising EPR. Partnerships with bulk producers, in particular, are key to accessing large amounts of e-waste and ensuring secure income.

Organizations of collectors need to promote their role in the two phases of collection and transportation between e-waste producers and formal recyclers. Likewise, legislation must encourage and incentivize informal recyclers to adopt environmentally responsible practices. Alternatively, legislation could require EEE manufacturing and distribution companies to fund the e-waste price gap between formal and informal sources, as part of the country's EPR scheme. Another solution proposed by Chintan is the establishment of an industrial park for e-waste trading and dismantling, with the state providing the land and the producer and retail companies financing infrastructure, transportation, technological innovation and training. Furthermore, groups of workers in the process of organizing and establishing organizations must advocate on an ongoing basis for their inclusion in formal e-waste recycling systems, especially in countries where e-waste laws and regulations are being discussed. Their widespread networks could also support the process of raising awareness in civil society of the dangers of e-waste and the importance of recycling EEE.

E-waste management in Serbia and the presence of cooperatives

5

Overview of e-waste in Serbia[1]

Serbia has improved its waste management services and infrastructure in the past few years, including the development of sanitary landfills and waste management policy frameworks. Nonetheless, waste management continues to pose environmental, economic and social challenges. Waste generation has increased over the years with the growth of the economy, reflecting changes in the production and consumption patterns of society. The Government of Serbia has taken steps to reduce waste and increase recycling rates; in 2009, it adopted the Law on Waste Management, among other regulatory frameworks, and committed to increasing e-waste collection to 2 kilograms per capita by 2015 and 4 kilograms per capita by 2019 (following EU regulations)[2].

In Serbia, as in many other countries, e-waste is one of the fastest growing waste streams. Imports of EEE to Serbia increased from 58,943 tons in 2010 to at least 63,423 tons in 2011. An average of 60,000 tons of EEE per year is introduced into the domestic market, and another 10,000 tons per year is commercialized in the informal economy. The average lifetime of most electrical and electronic household appliances is 10 years, approximately. Once these devices reach their end of life they need to be properly treated, recycled and disposed of.

Serbia references the European Waste Catalogue to classify its EEE. Forty per cent of the e-waste produced in the country is made up of household appliances (e.g. ovens, refrigerators, washing machines); other large volumes comprise IT equipment (mainly computers), TVs, small household appliances (e.g. kettles and hair dryers) and mobile phones, among other equipment.

According to the Serbian Environmental Protection Agency, licensed companies (operators) are allowed to collect and treat hazardous and non-hazardous waste. In 2012, eight operators received permits for the treatment of hazardous and non-hazardous e-waste, and 12 had a licence to treat non-hazardous waste.

In 2013, it was estimated that approximately 14,000–18,000 tons of e-waste would be recycled in Serbia by the end of that year.[3] There are almost 1,500 formal employees working in the e-waste collection and recycling chain. The overall amount of e-waste collected in 2017 will reach between 15,000 and 22,500 tons (2–3 kilograms) per capita (Twinning, 2012; Eurostat, 2011) and by 2019 it could reach 28,800 tons (4 kilograms) per capita) (Ilic, 2013d). This will require new employees, and approximately 2,000 new green jobs could be created by 2020. In general, e-waste, and its valuable elements, is largely

1. This case study was carried out in Belgrade between September and November 2013. Information was collected through on-site interviews, mainly with representatives of e-waste recycling companies and cooperatives.

2. At the time of the adoption of the Law on Waste Management (2009), Serbia did not quantify nor document e-waste collection. The mentioned law established future targets for e-waste collection, using EU policies and regulations on e-waste as a reference, but had no baseline numbers available (BEWMAN, n.d.; Twinning, 2012)

3. Based on data received from the largest operators in Serbia: Božić i Sinovi, Yugo-Impex E.R.R. and S.E.Trade.

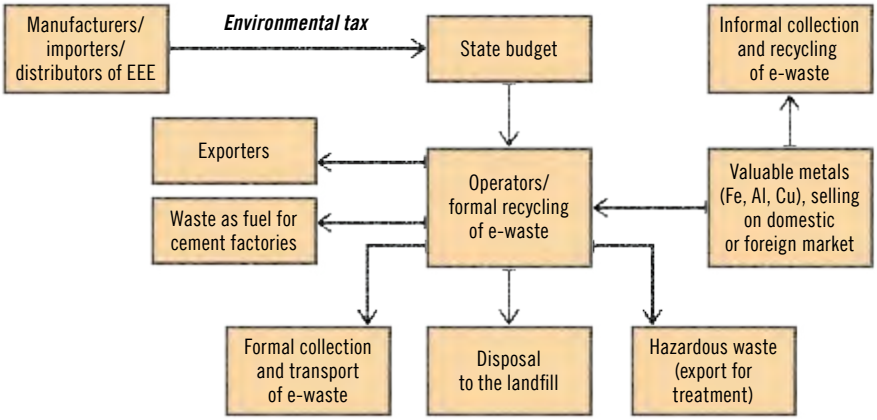

Figure 5. Environmental tax and its impacts in Serbia
Source: Marina Ilic

collected through informal activities and, to a lesser degree, through formal waste management paths.

The formal operations of e-waste management are financed through the environmental tax, which is collected from manufacturers and importers of EEE. The tax is transferred to the state budget (Figure 5) and then delivered to operators in the form of subsidies for e-waste management. By receiving those subsidies, operators can pay collectors, export hazardous components, and dispose of some of the non-hazardous and non-reusable waste in landfills. In addition, operators profit from selling ferrous metals, aluminium and copper in the market of secondary raw materials.

Regulatory framework on e-waste

Serbia has a comprehensive range of national policies, strategies and regulations which are harmonized with EU directives to implement integrated waste management and address related environmental impacts. Policies related to e-waste are embedded in several environmental policies, including the Environmental Approximation Strategy (Republic of Serbia, 2011) and the National Environmental Protection Programme (Republic of Serbia, 2010a), which harmonize Serbian regulations with EU regulations and, thus, set targets for waste management and recycling. In addition, the National Waste Management Strategy 2010–2019 (Republic of Serbia, 2010b) identifies the gaps in current waste management and recycling systems and defines strategic policy objectives, including policies for e-waste.

With regard to e-waste, a policy was issued in 2006 to ban the import of WEEE (with the exception of equipment for personal needs). Moreover, a set of waste management-related legislation (Law on Waste Management, 2009), in line with EU standards, was adopted over the past four years. This law was strengthened by applying the extended producer/importer responsibility principle, and by enforcing a separate collection and recycling stream for e-waste. The main challenge is the implementation and enforcement of the regulation. A draft national waste management plan for EEE and WEEE, which seeks to define an effective and environmentally sound management system for all types of WEEE in Serbia, was in preparation at the time of writing.

Underpinning this body of policy and law is the Law on Waste Management (Republic of Serbia, 2009), which lays out guidelines, actors and their responsibilities, and financing tools for the management of waste, including special waste and e-waste. This law promotes e-waste collection, reuse and recycling, and advocates for improved compliance with standards on behalf of producers, importers, distributors, sellers and final benefactors during a product's life cycle. EPR fees, paid by producers and targeted to finance treatment facilities for special waste, are delivered to the state budget. Under this law, treatment facilities are obliged to reuse old EEE before recycling it.

The e-waste management value chain

The recycling chain for e-waste in Serbia is presented in Figure 6. About 70 per cent of the collection of e-waste is carried out in the informal economy. Thus, there is a need to provide linkages between the formal and informal sectors (Jovanic, Tosic and Rochat, 2011). A system for organized collection channels is needed, as is stakeholders' participation. The recycling chain for e-waste consists of three main steps: collection, pre-processing and end-processing.

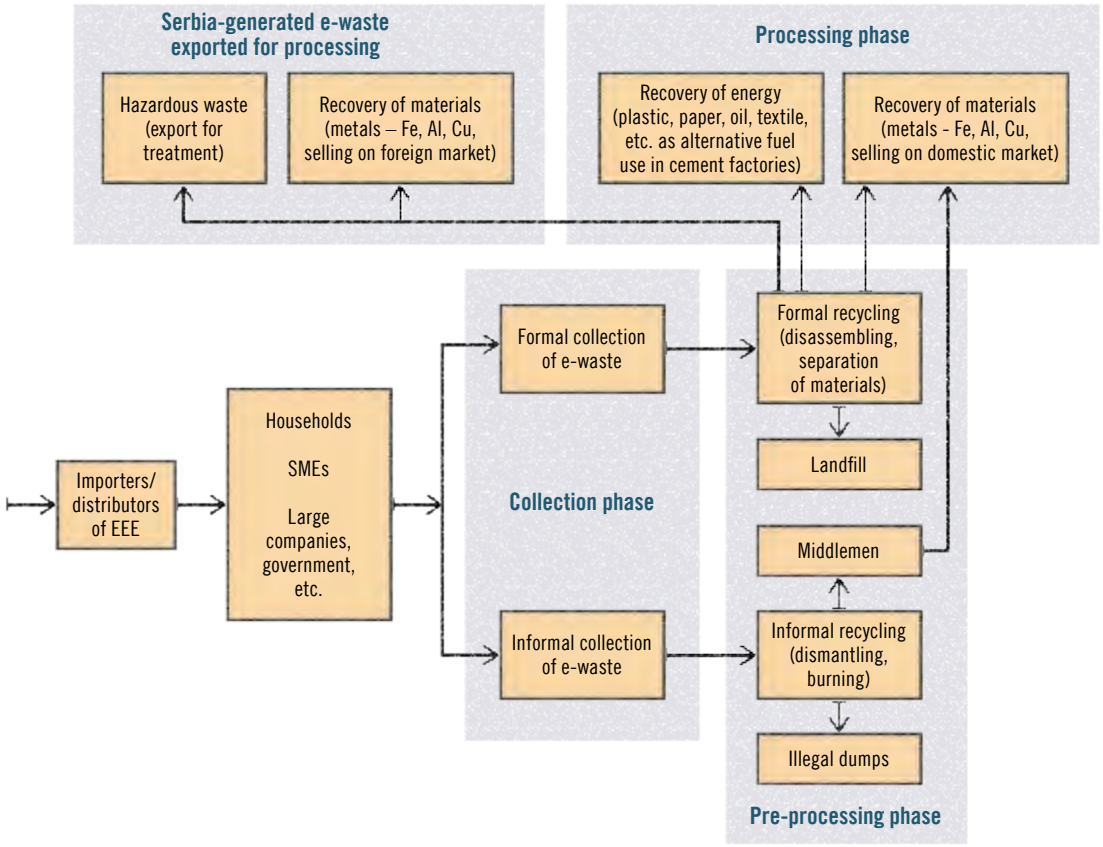

Figure 6. E-waste management value chain in Serbia
Source: Marina Ilic

Working conditions in different parts of the value chain vary significantly. Informal collectors operate in very poor working conditions, using no OSH equipment and having no access to OSH training. Moreover, a vast majority of them are not part of any social security system and thus depend entirely on the revenue that comes from their informal engagements. At the same time, employees of formal recycling companies work in conditions similar to those in any other modern manufacturing industry; they enjoy full social security coverage – with the exception of seasonal workers. However, like most of the labour force in the Serbian private sector, these workers are not unionized.

Collection

The first step in the recycling or e-waste management value chain is collection. The aim of this phase is to ensure that generated waste can actually supply the recycling chain, by being either reused or recycled. There are some basic problems in the collection and selection systems in Serbia. First, there is little documentation on the amount and types of e-waste that are produced and collected. In addition, there is no information on the hazards of inadequate disposal of electronic equipment in landfills. Moreover, there is a limited number of companies dealing with e-waste recycling and those companies face complicated procedures when exporting selected e-waste types which cannot be recycled in Serbia (BEWMAN, n.d.).

There is a significant informal e-waste collection network in Serbia. One authorized operator recently estimated that there are between 5,000 and 8,000 informal collectors of e-waste (Ilic, 2013a). For all types of waste, there are between 35,000 and 50,000 collectors (waste pickers) – mainly members of the Roma population – working in the informal economy (Ilic, 2013d). These figures are not represented in official statistics. Informal collectors engaged with e-waste are mainly interested in recovering any type of metal-containing waste (Jovanic, Tosic and Rochat, 2011). Therefore, some e-waste is sold in existing scrap metal markets, which often operate informally. In addition, collectors often supply local repair and second-hand shops with spare parts extracted from WEEE.

Formal collectors are generally characterized by working in a formal, tax-paying business entity and delivering the collected e-waste to legitimate, permit-holding recycling facilities. In 2010, licensed companies recovered nearly 30 per cent of obsolete computers, which represented approximately 2,500 tons of e-waste (Jovanic, Tosic and Rochat, 2011). Organized e-waste collection is based on

collection contracts issued between public agencies and private collectors. Companies occasionally collect from schools, universities and municipalities. Furthermore, education campaigns on recycling are sometimes organized through private companies with the purpose of raising public awareness of the risks of e-waste and the benefits of recycling.

Households and institutions usually store old electrical and electronic appliances. Consumers in urban areas are incentivized to sell their old electronic devices to collectors and receive some money in exchange for obsolete household items (there is an ongoing initiative on this by the recycling company, S.E.Trade). In rural areas, there is no formal waste collection collection system, leading to the uncontrolled disposal of old TVs and batteries.

Pre-processing

The pre-processing phase of e-waste management takes place mostly in the informal economy and is, for the most part, performed inefficiently. Informal dismantlers focus on the recovery of "easy-to-sell" material fractions, while dumping the rest on abandoned land or incinerating it in open fires (Jovanic, Tosic and Rochat, 2011). It is assumed that other e-waste types, in particular large household appliances, are also collected in relevant amounts by informal workers, from which only metals are recovered (Jovanic, Tosic and Rochat, 2011).

Companies can be certified by the Ministry of Energy, Development and Environmental Protection to collect, transport and store hazardous and non-hazardous e-waste, and to dismantle and sort e-waste fractions. The resulting material fractions are either sold to companies in Serbia or exported as hazardous waste for further processing in other countries. Formal recycling companies usually treat e-waste from households and businesses.

End-processing

In the end-processing phase, WEEE is treated or disposed of. Some of the capacities required for this phase are available in Serbia:

- **Steel, aluminium, copper and printed circuit boards**: An aluminium and a copper mill operate in Serbia (in Bor and Sevojno, respectively). The steel mill in Smederevo is not currently in operation. No end-processing facilities for printed circuit boards presently exist in Serbia; they are exported for treatment.
- **Plastics:** There are several plastic recycling companies in Serbia, which recycle various types of plastics, such as polyethylene (PE) and polypropylene (PP), from local sources.
- **Final disposal:** There are no hazardous-waste-disposal sites or hazardous-waste incinerators in Serbia. Cement kilns represent the only potentially feasible and locally available hazardous-waste-treatment facility. As the kiln stage requires very high operating temperatures (over 1,400 oC), the process could theoretically be used to destroy certain types of organic pollutants contained in some of the e-waste fractions (e.g. flame retardant plastics). In this process, this material can be used as a fuel substitute. Some kinds of plastic waste are also sent to cement factories.

There is currently an unknown number of plants licensed by local municipalities to treat non-hazardous e-waste; it is assumed they also process hazardous e-waste.

The main stakeholders

One of the main stakeholders in the e-waste management value chain is informal waste pickers, who contribute to waste management by collecting, sorting and trading e-waste. These activities also provide income to a significant population who would otherwise be unemployed. Waste pickers come from vulnerable groups: Roma, immigrants, the unemployed, the disabled, women, children and the elderly. They live in hostile social environments, and are often socially and economically marginalized. Informal collectors collect waste from residential homes, the streets and public waste containers, dumpsites and landfills, and are in constant contact with different kinds of waste, including hazardous and medical waste, putting their health and safety at risk. Children who accompany their parents or work with e-waste are especially vulnerable to these risks.

In addition to informal workers, there is a growing formal sector of recycling companies (at the processing phase) in Serbia. These companies provide collection services to households as well as businesses. There are four main companies in Serbia that are licensed to collect, transport, store and treat all ten categories of WEEE. Their capacity for e-waste treatment is over 80,000 tons per year, which is sufficient, potentially, to handle the increasing quantities of e-waste until 2020 (Ilic, 2013d).

All Serbian companies have stated that they are limited on the supply side. The major challenge in running a sustainable pre-processing and processing business lies in the area of collection, namely in securing sufficient amounts of e-waste for treatment. For this reason, some of these companies rely on e-waste supplied by informal collectors. It is therefore particularly

Table 2. Main Serbian companies involved in the treatment of e-waste

Company	Capacity of facilities (tons/year)	Amount recycled in 2010 (tons)	Number of employees
Jugo-Impex E.E.R., Nis	25 000	2 200	145–200
S.E.Trade, Belgrade	15 000	2 100	40
Eko-Metal, Vrdnik	12 000	1 200	30
Božić i Sinovi, Pancevo	25 000	1 184	40

Source: Marina Ilic

important to strengthen formal transportation and collection services in the country (Jovanic, Tosic and Rochat, 2011).

One of the major institutional issues in the Serbian waste sector is the relationship between the formal and informal economies. As reflected in interviews with the main recycling companies in Serbia, the recycling industry depends on supply from the informal economy. This relationship could be strengthened to improve efficiency and profitability, and to create more and better jobs in recycling. Incentivizing formal recycling activities, providing microfinance and facilitating access to markets could help shift informal workers to the formal economy. In the meantime, e-waste recycling facilities work with registered collectors and middlemen.

The role of EEE consumers (households) has thus far been marginal, as the lack of awareness of the negative environmental impacts of waste is widespread (in particular, the disposal of batteries and other kinds of e-waste that contain hazardous substances). The companies that place EEE on the market have a very ambiguous role (Ilic 2013a; Ilic, 2013b; Ilic, 2013c), as they focus mostly on abolishing, avoiding or reducing the environmental tax, rather than supporting or abiding by e-waste collection and treatment regulations.

E-waste cooperatives

Serbia has made significant progress toward adopting a democratic system and participating in a market economy. Unfortunately, the global economic crisis has brought stagnation and intensified public and private debt. Among the main concerns are employment and the need for improved access to finance, including microfinance, to support entrepreneurship and job creation. The unemployment rate in April 2013 was 24.1 per cent (Republic of Serbia, Statistical Office, 2013). A variety of population groups face social exclusion (including Roma, the disabled, refugees and internally displaced people), and there are also considerable regional disparities in employment. At the same time, there is a sizeable informal economy which includes a large number of non-registered enterprises, as well as an even higher number of informal workers in formal companies (Krstić et al. 2013). One of the reasons for such an increase in informal employment is related to labour market rigidities, high labour taxation and social security contribution levels, and non-conducive business environments (e.g. slow administration, numerous and complicated procedures, etc.). Under these conditions, establishing cooperatives or other SSE organizations may help introduce vulnerable groups into the labour market, while also providing them with access to decent working conditions (e.g. social security, healthcare, regular income), rather than relying solely on the "standards" of formal employers in the traditional labour market (e.g. companies, public institutions).

Cooperatives in Serbia are an important resource for agricultural development, as well as in other sectors (youth employment, housing, etc.). Often, cooperatives have been the only source of services in rural (agricultural) areas. Of the 2,140 cooperatives that submitted their business reports in 2009, 60 per cent worked in agriculture (Republic of Serbia, Statistical Office, 2011).

Cooperatives have been active in the Balkans for a long time. However, relevant legislation remains stagnant. In Serbia, the Law on Cooperatives (1996) is in force, but the cooperative system is not favourable to interested parties; there are no tax exemptions,[4] or any form of incentives, and the issue of social property[5] (Article 49a of Law on Cooperatives) remains

4. Cooperatives abide by the same tax regime as associations (10 per cent corporation tax) and private businesses.

5. In the Serbian context, social property refers to the "socially owned" land that was given to agricultural cooperatives during the communist regime. There are currently unresolved discussions on the ownership of those lands. Given that most cooperatives in Serbia are agricultural, the definition of "social property" has a strong place in the legislative framework of cooperatives.

Box 5. Company profiles of the main recycling facilities in Serbia

Jugo-Impex E.E.R., Nis

Jugo-Impex E.E.R. has an integrated permit for e-waste management. It was Serbia's first plant for the processing of refrigerators and electronic waste. Nowadays, it is contracted by public and private companies to collect and treat WEEE. It carries out manual dismantling of unspecified e-waste using pneumatic devices, installation of drainage in cooling and freezing appliances, and installation for the treatment of insulation foam. The company has two compact plants for cable treatment and recycling. In 2013, it recycled nearly 10,000 tons of all kinds of e-waste (mostly refrigerators), up to 60 per cent of the total registered e-waste recycled in the country. It receives WEEE from dumpsites, collection companies, households and old-for-new programmes.

Several of the components extracted from WEEE are formally exported (Ilic, 2013c). Steel, aluminium and copper are exported for end-processing. Plastic waste goes to China, polyurethane foam is sent to Germany and chlorofluorocarbons (CFCs) go to the Netherlands for final treatment. Approximately 80 tons of electronic waste are recycled in the company's newest installations.

Currently, the company has 145 employees in its main facility and contracts 15 small subsidiaries. The company plans to have around 200 employees by 2015. In addition, the company has 192 externally contracted collectors who receive payments through their bank accounts and declare income for tax purposes. While 20 per cent of the external collectors are simultaneously working with other companies, more than 100 work exclusively for Jugo-Impex E.E.R. Women – mostly working together with their husbands – represent up to 30 per cent of the company's collectors, and are viewed as highly reliable and committed. The company remains focused on extending their collectors' network. A key concern of the company, regarding legal and institutional arrangements, is that storage facilities for hazardous e-waste are very difficult to regularize. All the subsidiary companies working for Jugo-Impex E.E.R. hold at least one of the waste management permits (collection, storage, transportation and recycling), but only one of them holds a permit for storing e-waste.

S.E.Trade (SETrade), Belgrade

SETrade is a licensed company for the collection, transportation, storage and pre-treatment of e-waste. It has 40 employees and operates with a zero waste policy. The company's pre-processing operations result in various valuable fractions of metals, pure plastics (acrylonitrile butadiene styrene [ABS], polystyrene, polypropylene), and plastics/metal mixtures from WEEE. It disassembles and extracts plastic, rubber and valuable metals for sale on the domestic market. Printed circuit boards, contacts for the transmission of digital data (e.g. plugs, sockets), batteries, capacitors, leaded glass and freon contain a broad variety of materials, including copper, precious metals and hazardous substances. These fractions, which represent 10 per cent of total e-waste in Serbia, are exported to Germany and China for further treatment. Oiled materials and polyurethane foam are sent to a cement factory for incineration. Non-hazardous glass from CRTs is disposed of in landfill.

For SETrade, the main problems identified in the organization of the e-waste recycling sector include: i) no agreements between e-waste recycling operators to coordinate collection efficiently throughout the city and optimize transport costs and investment in other parts of the chain; and ii) delay in disbursement of government incentives.

Božić i Sinovi, Pancevo

Božić i Sinovi (BiS), comprising a recycling centre in Pancevo and a mobile facility, has been licensed to process e-waste and fluorescent tubes since May 2010.

BiS operates in a 3000 m² facility located in Omoljica. It has two core businesses: IT recycling and software development. It recycles all types of WEEE, in addition to magnetic tape and fluorescent bulbs. E-waste pre-treatment (disassembling and separation) is performed manually. Likewise, the company provides services to destroy CDs and DVDs collected from public offices. BiS has 40 registered employees, and works with another 20 external independent collectors (Ilic, 2013b). It retrieves between one and four cargo trucks of e-waste per week from its suppliers (external collectors), often picking up the loads of e-waste from the suppliers as the lattter do not often have appropriate vehicles for e-waste transportation. Some 30 per cent of BiS' e-waste comes from direct collection services provided to private companies, and nearly 70 per cent comes from households through informal collectors. BiS states that, if the state administration would pay the corresponding subsidies regularly, it could hire its external collectors as permanent staff.

Formal recycling companies such as BiS face other challenges when trading secondary raw materials. For one, the extent of enforcement of the environmental tax is unclear and uncontrolled; also unclear is the percentage of companies (importers of EEE) that pay this tax to support e-waste management activities. Second, there is a detrimental trend in the trade of hazardous e-waste in Serbia. Competition from the informal economy has encouraged state-owned enterprises to organize public biddings to sell their own e-waste. At these bidding events, private entrepreneurs and companies without e-waste management-related permits represent illegal competition to licensed recyclers. At the same time, prices of raw materials in Serbia are at a similar level to, or higher than, prices elsewhere in the region, due to a sizeable volume of informal export, which decreases supply within the domestic market.

BiS exports hazardous e-waste to Bulgaria, and some minor quantities to Germany and France through intermediate companies (Ilic, 2013b). The company noted that applying for an export permit is a lengthy and complicated process, which may encourage others players to export illegally.

unresolved, preventing cooperatives from accessing credit and reinvesting. A draft Law on Cooperatives to help develop social cooperatives was prepared in 2010 and discussed publicly. The absence of solutions to problems associated with the restitution of socially owned assets to members, cooperatives or the state blocked the acceptance of the proposed law.

Currently, ten people are required in order to form a cooperative, but this number would be reduced to five if the proposed legislation were approved. Moreover, the proposed law (Article 11) addresses social cooperatives by specifying that there should be a proportion of profits to be used for social purposes, but it does not specify that proportion.

Supportive regulations for cooperatives and access to financial services, including credit, are among the key things needed to support the creation of cooperatives. There are a handful of other problems that burden existing cooperatives, due to an outdated current legal framework. For example, most institutions related to entrepreneurial development lack the capacities to support cooperatives, and financial support (grants and microfinancial instruments) are absent. Cooperative members in Serbia must be relatively wealthy to be able to contribute with initial capital and pay taxes and membership fees. The development of microfinancial institutions in Serbia has been effectively blocked since 2009, forcing all private actors to refer to banks. At the same time, given the unresolved understanding of "social" property (property belonging "to the society"), many cooperatives cannot use this resource as collateral for mortgages or loans. Furthermore, cooperatives also lack access to non-financial support. In addition, cooperatives also need to have access to information and markets for their products and services. Professional support services for cooperatives (e.g. training of managers and cooperative members, business planning and counselling, legal counselling, etc.) are almost non-existent.

Cooperatives in the recycling sector

Cooperative enterprises involved in waste management have mostly abstained from recovering e-waste and have remained in the business of paper and plastics. This is due to the complex operational requirements in the e-waste collection and recycling sector, in particular regarding the presence of hazardous components in e-waste.

Cooperatives are important players for Roma populations in Serbia, who have traditionally been for decades the key (albeit informal) labour force in the country's waste management sector. At times, the entire waste management and recycling industry has relied on the Roma waste pickers. Incorporating them into waste management and recycling programmes can, in many cases, be socially desirable, economically viable and environmentally sound.

Waste pickers work at the foundation of the value chain. Recycling industries purchase large amounts of secondary raw material directly from middlemen rather than individual waste pickers. In these circumstances, middlemen tend to earn much larger profits than do waste pickers (Medina, 2008). Through the creation of cooperatives, waste pickers could strengthen their businesses, by putting together competitive amounts of raw materials, and increasing their bargaining power. This could help them move up the value chain and improve their working conditions and income.

In Serbia, waste picking (secondary raw materials collecting) is now recognized as an occupation; organized waste pickers are perceived as legitimate stakeholders at the local, state and national levels. Serbia has followed Brazilian examples by using labour organizing methods to support waste pickers in gaining status and recognition as economic actors. Key efforts in labour organizing have focused on achieving occupational recognition, that is, the inclusion of "recycler" or "collector of secondary materials" in the national registry of official occupations. In 2011, the National Employment Service registered and codified the position of "individual collector of secondary raw materials" (9612) as a legitimate occupation in its Registry of Occupations, published by the Statistical Office of Serbia.

Examples of of waste collectors' cooperatives in Serbia

Union of Collectors of Secondary Raw Material

This initiative was born through the support of the YUROM Center, an association created and run by Roma people which works on behalf of Roma citizens to improve their quality of life and end discrimination against them (YUROM Center, n.d.). It trained Roma activists in ten municipalities in effective advocacy skills to press for their integration into waste management plans, and built their capacity to organize, manage their micro-businesses, and influence local and national policy-making and job creation.

Out of these efforts came the Union for Collectors of Secondary Raw Materials, formed in 2011 by 350 members. This was the first organization of its kind in Serbia and the wider region. It does not have the structure and orientation of a trade union, but focuses

on solidarity and mutual assistance among collectors, improvement of their legal and social status, and their inclusion in social dialogue at the local and national levels. It has a wide range of objectives, including advocating for the introduction of export limits for secondary raw materials, encouraging the participation of collectors in local waste management plans and policy-making, and enhancing the development of cooperatives in the area of waste collection and recycling. Within one year of its existence, it was the Union's lobbying of the National Employment Service that resulted in the registration and codifying of the position of "individual collector of secondary raw materials" within the official Registry of Occupations (Institute for Sustainable Communities, 2012).. These workers can now officially register their businesses. In 2012, there were plans in place to secure health and disability insurance and pension plans for them, but this has not yet been realized.

The Union has established affiliate offices across Serbia. Its membership currently includes 1,500 individual informal collectors. Even though the objective to fully formalize waste pickers in Serbia has not yet been fully achieved, the existence of the Union has helped informal collectors overcome some of the many challenges they face in their daily work. For example, a waste picker testified that, "In Nis, the union has helped us to fight police citations. If we had storage facilities, we wouldn't have to pass through the centre of town with our horses" (Institute for Sustainable Communities, 2012). Moreover, having achieved recognition of this occupation at the institutional level provides a solid foundation on which to exert pressure for the delivery of social protection floors and other decent work rights to this group of workers.

Eko servis

Eko servis was established in 2004. It was the first cooperative of collectors of secondary material in Europe. The founders were part of the Democratic Association of Roma people and had long-standing experience in projects related to sustainable development and support for the Roma population. At the peak of its activities, Eko servis involved more than 300 collectors in Belgrade. However, in 2009, it ceased to exist due to having insufficient financial resources to comply with the new environmental legislation. Subsequently, the management team of the former cooperative created a centre for the development of social entrepreneurship in Belgrade, which supports the development of social entrepreneurship in recycling. Its mission is to create innovative means of self-employment and employment of vulnerable groups, enhance social cohesion and raise environmental awareness.

SWIFT

In August 2010, a United Nations Country Team Joint Programme by the World Health Organization (WHO) (the lead agency), International Organization for Migration (IOM) and United Nations Office for Project Services (UNOPS), in partnership with the Zvezdara municipality in Belgrade, and with financial support from the Government of Norway, formed the Sustainable Waste Management Initiative For a Healthier Tomorrow Cooperative (SWIFT) (WHO Project Office Serbia, 2012).

SWIFT was based on three pillars: employment and job creation, social mobilization and empowerment, and health and environment. The objective of the programme was that the cooperative would be managed by Roma employees, who would, in time, become its owners. As of December 2011, the cooperative was expected to generate sufficient revenues to be self-sustainable. However, due to its failure to achieve real income generation and decent employment of its target group, the SWIFT project ceased its operations and dissolved in 2013.

Improving Human Security in Southwest Serbia

This project was launched in 2012 (Republic of Serbia, Office for Sustainable Development of Underdeveloped Areas, 2012). The initiative included a roundtable on human security in Novi Pazar. The United Nations Trust Fund for Human Security donated US$2.8 million (the total project value) for this project, which involved the construction of a recycling centre that would provide civil rights services and inter-ethnic dialogue through the arts, sports, culture and education. The project reached out to over 60,000 beneficiaries from various vulnerable groups in six municipalities of Southwest Serbia. The objective was to establish a formal recycling and collection centre (which was built in 2014), run by a cooperative of 30 members (employees). The cooperative would be contracted as a public utility company. According to the Office for Sustainable Development of Underdeveloped Areas of Serbia, this initiative is innovative and scalable, and will be able to provide legal and formal employment to individuals from vulnerable populations, including refugees, internally displaced persons and migrants, among other disenfranchised populations. Currently, there are further plans to expand the project to Sjenica and Tutin with financial support from those municipalities (Republic of Serbia, 2014).

Advances and good practices

Among the lessons learned in Serbia is that cooperatives seek to play an important role in the labour market, the integration of disadvantaged workers and the process of economic recovery. However, the following issues must be addressed in order to establish dynamic cooperatives: overall strengthening of the organizational and legal concept of cooperatives; improvement of related national legislation; and possibilities for financial support, training and certification.

The legal concept of cooperatives has been extensively discussed in recent years, but there has never been a political consensus on approval of the new Law on Cooperatives. Too much emphasis was put on the potential benefits (such as tax breaks) that cooperatives should be entitled to, provoking resistance on behalf of the Ministry of Finance and other policymakers. Most cooperatives in the recycling sector have ended their activities because they had insufficient financial and non-financial resources and capacities to create sustainable businesses and comply with policies and regulations (e.g. SWIFT and Eko servis). More market-based approaches in the operations of cooperatives, as well as financial guidance and assistance, are needed to create a sustainable presence of cooperatives. The absence of microcredit resources in Serbia restricts the development of successful cooperatives in the waste collection and recycling sector. Cooperative managers and founders need a broader and more businesslike vision of the objectives and operation models of cooperatives. Employees of cooperatives will also need structured and comprehensive training opportunities on OSH, waste management policies and business operations.

The Eko servis cooperative, which was supported by international organizations and NGOs (Care International, International Finance Corporation / World Bank, ReCan Fund, USAID, etc.) followed some good practices, which are worth learning from. These included:

- training and education in various fields (OSH, sorting of secondary material, etc.) for more than 1,200 collectors;
- supply of working equipment (small waste-transport vehicles, protective suits, gloves);
- a programme of social support to members and associates (provision of personal documents, assistance in achieving social rights, information on job openings, etc.)

All the cooperatives discussed above have been primarily involved in the recycling value chain as suppliers of raw or pre-processed material to the recycling industry in Serbia. There was an attempt to coordinate these cooperatives through the National Platform for Recycling (hosted by the Standing Conference of Cities and Municipalities of Serbia). Nonetheless, most of these cooperatives that lacked appropriate organization (e.g. management, accounting, planning) to operate sustainably, became efficient partners of private recycling companies and remain active in the recycling value chain.

Through the social cooperatives model, informal collectors would be able to register at the National Employment Service, and formalize their working situations (by obtaining personal documents, as well as social and health insurance). They would also be able to improve their working activities and business operations by participating in business and training programmes, and learning more about sound and efficient e-waste collection, prices and the market, and the possibilities of partnership with local recycling businesses. In addition, they could potentially be certified to operate a collection and recycling facility, which would help prevent illegal practices and, instead, encourage OSH and other decent work principles.

Conclusions and recommendations

Through the analysis of Serbia, it can be concluded that the recycling rate of EEE there is rather low. Provision of strong and coordinated support through information, inspection and monitoring to increase the competitiveness of the recycling industry will be necessary. One of the major institutional issues in the waste management sector in Serbia is the relationship between the formal and informal economies. Partnerships between the network of registered companies and informal collectors could be developed by demanding a cooperation model, in which collectors can ensure regular supply of e-waste to recycling companies, without the intervention of middlemen, and companies can ensure regular (and higher) incomes for collectors.

The SSE could make an important contribution to this area, as it has in many other countries in Europe, through work integration for employment and social inclusion, and cohesive welfare services, and by building trust and social capital. So far, the opportunities for cooperatives and other SSE organizations in Serbia have been limited. There have been a few integration initiatives and some welfare service provision, within a framework of restricted access to public procurement markets. Moreover, the potential of cooperatives in Serbia needs to develop further, and the skills of workers must improve.

All the Serbian recycling-related cooperatives discussed above began as a form of SSE organization based on the principle of social inclusion and attention to Roma collectors. One of the reasons for their short existence is precisely the lack of involvement of a medium- to high-skilled workforce. National legislation is an important factor in levelling the playing field for cooperatives compared with other competitors. Nonetheless, cooperatives are now facing a stricter regulatory environment in Serbia. Access to microfinance has been limited. The draft Law on Microcredit Organizations (2003) was intended to regulate the introduction of non-financial institutions that would provide microloans to young enterprises, but the national bank was not ready to supervise such institutions and has thus blocked its adoption. Microfinance is a topic of interest to the non-governmental sector. Some banks provide microloans, but the relatively high interest rates constrain the positive impact that such loans could have on the development of cooperatives.

Management training (managers and founders of cooperatives need professional training with a clear vision of the cooperative's objectives and modes of operation) and technical training and support for employees is one of the most important factors that would allow cooperatives to develop, perform effectively and contribute to society. A range of educational and training programmes, seminars and courses would enhance understanding of business cooperatives and mutual societies for social services.

Support for cooperatives has to start with the building of an organizational and legal concept that can help to make them powerful actors, especially in relation to poverty, marginalization and unemployment. Cooperatives and other SSE organizations must be considered not only as a means to fight unemployment but as a way to enable local actors to engage with social and other types of services, such as environmental services.

E-waste management in Bolivia and the potential role of social and solidarity economy organizations

6

Overview of e-waste in Bolivia

Bolivia is no stranger to the problem of e-waste generation. A survey of electronic waste in Bolivia found that 20,000 tons of electronic residues are produced in the country every year, with each person producing, on average, 0.004 tons (4 kilograms) of electronic waste. The amount of e-waste is projected to double to 40,000 tons a year in 2015. In urban areas, 33 per cent of e-waste consists of information and communication technology (ICT) equipment (mobile phones, CPUs and keyboards, telephones, etc.) and 30.5 per cent consists of domestic electrical appliances (refrigerators, television sets, etc.); the remainder is of other categories. In rural areas more utensils, batteries and toys are discarded into the waste stream (Delfin, Guzman, Garay, Yañez, and Delfin, 2009).

The electrical and electronic items most frequently purchased by Bolivian households include refrigerators, washing machines, electric power tools, CPUs, electric irons, microwaves, mobile phones, television sets and memory cards.[1] According to preliminary data from the 2012 census, 67 per cent of households in Bolivia have a television set, 75 per cent have a radio and 24 per cent have at least one computer (Andre, 2013). The telecommunications and transport authority (ATT) has reported that in Bolivia there are 13.8 million registered mobile phones, of which 9.4 million have active connections. This means that 4.3 million mobile phones are unregistered or inactive (Rojas Jordan, 2013).

Bolivia has experienced an increase in formal imports of electrical and electronic goods over the years, and especially of goods related to telecommunications and informatics. The volume of imports of electrical and electronic appliances fluctuated between 2006 and 2010, but increased by 190 per cent in 2011 and 78 per cent in 2012. Value of imports of the 16 most-purchased EEE items were worth US$8 million in 2004 and reached to US$61 million in 2012- an increase of 780 per cent.[2] The growth trend in import volumes of ICT equipment is exponential, and the standard duration of use of such devices is continually declining, either because of upgrading or from necessity (RedTicBolivia, 2011).

In addition to household accumulation of electrical and electronic appliances, the Bolivian education programme Educación con Revolución Tecnológica (Education with Technological Revolution), and specifically its project A Computer for Every Teacher, has supplied approximately 110,000 computers to the country's teachers (RedTicBolivia, 2013). The government and civil society organizations promote access to digital technology, as part of the country's educational policies and initiatives.

At present, Bolivia has no national policies on environmental responsibility or the management of e-waste. Scrap or residue material, or any kind of artifact that is no longer useful, is kept by consumers to be repaired later on, or to be reused in some other way (Delfin, Guzman, Garay, Yañez and Delfin, 2009). As noted above, significant volumes are discarded.

1. Bolivia, National Statistics Institute, personal communication, 2013.

2. Bolivia, National Statistics Institute, personal communication, 2013.

Only a few collection companies retrieve e-waste from households and businesses. These companies offer to handle this type of waste responsibly, and to destroy computer memories professionally. An e-waste management company must be able to offer both these services simultaneously to businesses. The company makes an inventory of a business's old EEE and issues certification that guarantees the proper management of the e-waste and the discarding of digital information on the business. According to the Recycling Foundation (FUNDARE), this process certifies that the e-waste produced by a business will not damage the environment (Delfin, Guzman, Garay, Yañez and Delfin, 2009).

A variety of initiatives to address the problem of e-waste have emerged in the past few years. Local authorities, international organizations, NGOs and students have conducted awareness-raising campaigns on e-waste.

For this present study, interviews and focal groups were conducted to gather information about the social economy organizations, including cooperatives or other forms of informal self-help groups, engaged in managing e-waste, and their role in the e-waste management value chain. The existing regulatory framework on e-waste was also reviewed, to gain better understanding of the value chain and the role of its stakeholders.

Regulatory framework on e-waste

Bolivia has signed the Basel Convention on Control of Transboundary Movements of Hazardous Wastes and their Disposal, 1989, along with other international agreements supportive of environmental sustainability. At the national level, the recycling of e-waste is governed by general laws that refer to electronic waste.

The draft Law on the Integrated Management of Solid Waste, which is awaiting approval by the national assembly, includes guidelines on managing e-waste. The main aim of the draft law is to prevent pollution and promote reuse and recycling. It refers to EPR, a concept that calls for responsibility throughout a product's lifecycle and takes into account its long-term impacts. Moreover, the draft law places prime responsibility for the management of waste on producers, who must be responsible for the products they sell, and complementary responsibility on consumers as well as government and municipal authorities. It also refers to the need for infrastructure for waste storage, and for environmentally sound solutions for waste disposal, reuse, recycling or export, when appropriate.

Bolivia does not have an official classification of electronic waste. For import purposes, the National Customs Service and the National Statistics Institute (INE) use an unofficial coding that lists the characteristics of EEE. The Bolivian Institute for Standardization and Quality (IBNORCA) – a private non-profit institution that promotes quality control, through technical standardization, training, and the certification of products and/or management systems – defines e-waste as "electrical and electronic devices that combine electrical and/or electronic components, organized in circuits which require electrical energy or electromagnetic fields to function and which have completed their useful lifecycle".[3] The 2009 survey of e-waste in Bolivia (Delfin, Guzman, Garay, Yañez and Delfin, 2009) refers to the EU's categories, and the REDES Foundation proposes a different classification (see Rojas, 2010b).

To supplement the existing national regulations on solid waste, IBNORCA developed a set of norms for the management of e-waste. It laid down a procedure for e-waste generated in companies, which involves collecting it internally for temporary storage and thereafter delivering it to a collection or dismantling point, where a primary classification is made. The non-reusable parts are returned to the company to be further taken care of. In a second evaluation, the e-waste goes through a process of refurbishment, dismantling, recycling and sale.[4] This procedure would help businesses to achieve maximum quality standards, access international markets and improve their relationships with providers. However, it has not become compulsory because there are no supporting rules.

Gaps remain in the EPR regime, which is not clearly defined in the draft legislation. The legislation and surveys on residues do not discuss e-waste specifically, and there are no policies or programmes that assign responsibilities or institutional competencies for handling e-waste. In spite of these limitations, however, e-waste collection initiatives have been carried out in several cities, including La Paz, Santa Cruz, Cochabamba and Oruro (Rojas, 2010a).

3. NB 69018:2012 Solid residues of electrical and/or electronic apparatus – The handling of residues of electrical and/or electronic apparatus, in IBNORCA, 2012.

4. NB 69019:2012 Solid residues of electrical and/orelectronic apparatus – The handling of residues of electrical and/or electronic apparatus, in IBNORCA, 2012.

How e-waste is managed

Most EEE is brought into Bolivia through legal imports, smuggling or donations. While import volumes are rising, unknown quantities are smuggled into or assembled in the country, making it harder to place e-waste management responsibility on manufacturing companies (Delfin, Guzman, Garay, Yañez, and Delfin, 2009).

When EEE reaches the end of its useful life it becomes a problem for the owner (consumer), because it takes up space and can no longer be used. Most often, people give obsolete computers away or sell them to second-hand dealers. Other old EEE, for which no solution is found, is kept in people's homes and often forgotten. The e-waste management company RAEE Recicla notes that there has been some progress made on EPR systems in Bolivia; Sony, for example, takes back old devices free of charge (Rodriguez, 2013a).

Collected e-waste is managed in a rudimentary manner. Dismantling is done manually (and sometimes mechanically), enabling plastics and metals to be recovered. Some of these materials are sold in the local market. As for the remainder, the most viable option Bolivia has is to export it through intermediate markets.

Recovering and selling computer components can be profitable – depending on the quantities being sold (UMSA and Swisscontact, 2010). Precious metals (e.g. gold, silver, palladium), semi-precious metals (e.g. copper) and rare metals (e.g. indium, telurium, selenium) make up most of the value of EEE. These metals can be recovered from WEEE and reused in the manufacturing of new EEE.

Bolivian companies send printed circuit boards and monitors to be recycled in neighbouring countries, such as Colombia, Chile and Peru, which have appropriate technology to treat these components safely. Most revenues come from printed circuit boards, as they contain significant amounts of precious metals (Rodriguez, 2013a). It is estimated that, for every 1000 kilograms of discarded circuit boards, extracted metals can sell for as much as US$114,000 (UMSA and Swisscontact, n.d.).

According to an e-waste report, recyclers preference in WEEE is copper and aluminum; the latter comes from a variety of sources, but in low quantities. However, the prices per kilogram are higher than for other kinds of scrap, which means greater economic gains (Delfin, Guzman, Garay, Yañez, and Delfin, 2009). Collectors of e-waste confirm their preference for materials in which they can find aluminium and copper, which are easy to sell (Rodriguez, 2013b; Rodriguez, 2013c).

The process of managing e-waste may take place in the informal economy, through informal collectors, or the formal economy, through formal and experienced companies. For example, the city of La Paz has 90 collection points for recyclables from solid waste; 81 of those are operated by informal workers, and nine by formal enterprises (Delfin, Guzman, Garay, Yañez, and Delfin, 2009).

The main stakeholders

There are various stakeholders in the value chain of e-waste management in Bolivia. They include e-waste generators (consumers, households, businesses and government), government agencies in charge of regulating e-waste management, and a complex network of formal and informal actors who work on e-waste management from its source to its refurbishment, recycling, and/or disposal to landfill.

At the executive level, the highest authority concerned is the Ministry for the Environment and Water and Vice-Ministry for Biodiversity, Forestry Resources and the Environment (MMAyA), which has monitoring functions at the national level and defines general policies on the management of solid waste, in collaboration with sectoral bodies and local and municipal government authorities. Departmental authorities, through their respective Environment Office, coordinate with municipal authorities and sectoral bodies on the management of solid waste and pollution.

Municipal authorities, through the relevant Environment Office and the System for Municipal Regulation and Supervision (SIREMU), are responsible for urban sanitation. Providers of urban sanitation services, contracted by municipalities, do not accept e-waste. When e-waste is discarded with ordinary waste, collectors extract it and sell it as scrap. SABENPE, the contractor responsible for collecting domestic waste collection in households and public spaces, collects 95 per cent of the waste produced by citizens. The remaining 5 per cent is deposited by the public in brooks and rivers. The company does not classify the waste it collects in any way.

Formal actors are generally private companies or NGOs which provide e-waste management services that comply with economic, environmental, social and labour regulations. At the institutional level, FUNDARE has established the Industrial National Chamber, in cooperation with the Swiss Technical Cooperation Fund (Swisscontact) and local partners, to encourage sustainable development. The national Chamber for Informatics, Computing and Technology (CAINTEC) also seeks to promote a

responsible environmental culture in the handling of electronic equipment and its residues.

Informal actors are either individual or organized waste workers who carry out e-waste management activities in the informal economy. As a consequence, they operate in precarious circumstances. They have neither safe and healthy working conditions nor access to healthcare or social insurance, despite being constantly exposed to the dangerous elements found in waste. In Bolivia, informal workers have been found to be prevalent in the collection phase of the solid waste management chain. While information on collectors of e-waste is scarce, research undertaken for this paper identified an organized group of solid waste pickers in La Paz (the Association of Recycling Collectors and Sorters of La Paz, ARALPAZ) which is slowly entering the e-waste market.

Depending on demand on the Bolivian market, both the independent collectors and formal companies engaged in collecting e-waste sell recyclable material to enterprises that refine or recycle the materials found in e-waste. Some of these are engaged in the recycling of plastics, especially PET (polyethylene terephthalate) bottles, which are compressed and sent to Chile or Peru for recycling. There is only one industrial glass recycling plant in Bolivia, Vidriolux S.A. These companies are usually legally constituted, have modern equipment and meet standards of a decent workplace and working conditions, including provision of social security and health protection measures as required by the Ministry of Labour. On the other hand, the city of El Alto has a number of informal metal smelters which operate in substandard conditions (*La Razón*, 2012). Significant volumes of e-waste are exported, primarily to Peru and Brazil, without undergoing any form of processing.

Informal management of e-waste

Within the e-waste management value chain, informal collectors work either individually or through groups which collect recyclables to sell to recyclers as raw material. ARALPAZ has operated formally since 2006 and has 40 members. It is a legal, non-profit, SSE organization. Its objective is to generate income through the recovery of recyclables, standardize recycling market prices and contribute to the protection of the environment.

According to collectors (Rodriguez, 2013b; Rodriguez, 2013c), in La Paz there are approximately 330 people working independently, either as individuals or in family groups; 10 per cent of them are engaged in collecting e-waste. The informal collection points belong to ARALPAZ, but it has no municipal registration or operating licence. Generally, its members/workers include migrants from the countryside, the unemployed, the disabled, widows, children and older people. Sixty-seven per cent are women and 95 per cent are from the indigenous Aymara and Quechua communities and live in precarious socio-economic circumstances in peri-urban areas. Often, ARALPAZ members do not use appropriate clothing or equipment and they have no access to health insurance. Their monthly incomes from sales of all kinds of recyclable waste fluctuate between 1,000 and 1,500 bolivianos (US$143 and US$215).

ARALPAZ currently recycles about 194 tons of solid waste on a daily basis. The most common materials it handles are PET bottles, nylon, plastics, cardboard, copper, lead, aluminium, used clothing, scrap, glass and, occasionally, e-waste. Its collectors work with various enterprises, depending on the types of materials to be recycled. The bulk of the material is purchased by the companies Empacar (a manufacturer of packaging material made of paper and cardboard) and Embol (which is engaged in the production and bottling of drinks). E-waste is occasionally sold at an informal weekday market in the city of El Alto. Given its ability to work collectively and accumulate large volumes of recyclables, ARALPAZ could potentially supply materials to e-waste recycling companies.

According to ARALPAZ, collectors of e-waste collect it as a sideline to more common types of waste (e.g. scrap, glass or metal). The specialization required for collecting and disassembling e-waste, and the high cost of refurbishing or recycling WEEE, does not motivate collectors to focus on e-waste collection alone. In the case of large domestic electrical appliances, collectors buy e-waste components (spare parts) and pay up to 20 bolivianos (US$2.87) per unit, depending on its condition; for small domestic electrical appliances and computer equipment they pay 50 cents (US$0.072) per kilogram. All of these materials are stored in the collector's home until they are sold (Rodriguez, 2013b; Rodriguez, 2013c).

Informal collectors collect, transport, disassemble and market the e-waste manually, in many instances generating high environmental impacts and damaging their health, due to the presence of highly contaminating substances or sharp objects. Among the most-recovered materials are metals, plastics, glass and rubber, which they sell to companies that re-use or recycle them and convert them into secondary raw materials for new production. Collectors may sell spare parts to EEE-refurbishing workshops, or directly to the public at low prices, for re-use. There is a system of mutual dependency between collectors and the companies that buy these materials in large quantities (Rodriguez, 2013b; Rodriguez, 2013c).

At present, there are no registered cooperatives of waste pickers or collectors in Bolivia. However, associations like ARALPAZ are the organizational option best suited to Bolivian conditions, as they require very little start-up capital, comply with social economy principles and operate similarly to the co-operative model. In contrast to the situation in the other countries described above, Bolivia does not yet have a large network of informal collectors of e-waste. This presents an opportunity for Bolivian authorities to design appropriate and inclusive systems of e-waste management. Within such systems, organized waste collectors (in the form of SSE organizations like ARALPAZ) can become more aware of the opportunities and risks presented by e-waste, and contribute by providing collection services under formal contractual relationships with private companies or public entities (e.g. local governments).

Formal management of e-waste

In the city of La Paz, three small companies have identified business opportunities in the environmentally sound management of e-waste: RAEE Reclica, a limited liability company supported by Swisscontact; Tecminal, a sole proprietorship operating in the mining and industrial fields, that has recently extended its activities to e-waste recycling; and Recybel SRL, another limited liability company. They all offer services in e-waste collection, separation (according to the components and their degree of hazard), valuation, transportation to recycling workshops, international sale or disposal, and recycling.

These companies offer e-waste disposal services, which are still rare in Bolivia. To encourage e-waste recycling, they frequently organize public awareness-raising and publicity campaigns, seminars and information events. They retrieve e-waste through their collection services – at the request of their clients (public institutions or private companies) – and from individuals who drop off their e-waste at the companies' plants (Rodriguez, 2013a; Rodriguez, 2013d; Rodriguez, 2013e). Prices for the service range from 1.20 to 1.80 bolivianos per kilogram (US$0.17 to US$0.25), and may vary according to the types of materials and their degree of toxicity. These fees cover e-waste transportation and handling costs. On handing over their unwanted equipment, the clients (e-waste producers) receive a certificate from FUNDARE attesting that their WEEE will be recycled and their digital information disposed of in a safe and secure manner.

Every month, an average of 1.5 tons of WEEE is processed by each of these three companies (Rodriguez, 2013a; Rodriguez, 2013d; Rodriguez, 2013e). Each enterprise has a plant and/or workshop located in La Paz or El Alto, and four regular workers, on average, who dismantle e-waste. Depending on need, each company may hire 15 to 20 more temporary workers. The workers collect and disassemble WEEE through manual and mechanical processes, using appropriate equipment. Certain precautions must be taken during the disassembly process, depending on the item concerned. When disassembling computers, for example, CPUs do not require particularly careful measures, since the task is neither dangerous nor polluting and the volume is manageable – it can be done by one person, with the help of conventional tools. Monitors and screens, however, contain contaminants, so operators use protective goggles, gloves, special clothing and gas masks when disassembling them.

Although the recycling of e-waste creates jobs, the general concern among those companies and NGOs promoting responsible management of e-waste is the absence of legislation or a body of rules to enable the work to be done in better conditions and under clear rules (Rodriguez, 2013a; Rodriguez, 2013d; Rodriguez, 2013e). In addition, the state's lack of attention to the increasing presence of e-waste may have serious environmental consequences in the short and long terms.

Initiatives for the management of e-waste

In light of the growing production of e-waste, national and local authorities, international organizations, NGOs and students have all conducted awareness-raising campaigns to address the issue. In 2012, for example, RAEE Recicla organized an e-waste collection campaign called "Reforesting through electronic recycling" in which plants were given away in exchange for e-waste. And in the city of Cochabamba, a group of young people have set up a centre for testing and dismantling e-waste. Among large scale initiatives to improve understanding of e-waste production and management, the survey of electronic waste in Bolivia (Delfin, Guzman, Garay, Yañez, and Delfin, 2009) now serves as a reference base from which to promote e-waste recycling.

The private-sector Industrial National Chamber finances and provides technical cooperation for projects under the Environmental Neighbourhoods initiative, which focus on the collection of solid waste at the neighbourhood level. It also provides environmental services and regular interventions in urban areas, in particular slum areas, with the purpose of creating income and green jobs. Along the same

lines, the Bolivian Society for Environmental Management, through its Focal Cities Project, conducted a national symposium in 2012 on Management of Electrical and Electronic Residues and Used Batteries, which was attended by various stakeholders, including representatives of local governments, waste and sanitation companies, NGOs, professionals and academics.

There have also been legislative and regulatory proposals to improve e-waste management. The draft Law on the Integrated Management of Solid Waste proposes measures to handle and treat all solid waste, from its generation to its final disposal, and introduces the idea of extending the responsibility for e-waste management to producers, consumers and the state (central government and municipal authorities). It also signals the need to set up appropriate infrastructure for depositing this waste and, subsequently, identifying responsible solutions for reusing, recycling, exporting or discarding e-waste.

Informal collectors have been included in the draft law, with a view to formalizing their economic activities and enabling them to exercise their working rights. There are also initiatives being designed by several organizations to improve the living and working conditions of these (mostly) economically marginalized populations. RAEE Reclica, for example, has an education and training programme, Red Habitat, to improve the capacities of ARALPAZ collectors (Rodriguez, 2013a).

In December 2011, during the Green Business Forum organized by the Chamber for Industry, Trade, Services and Tourism (CAINCO) in the Bolivian city of Santa Cruz, the possibility of building strategic alliances between Bolivia and Peru for recycling e-waste was discussed, with a view to engaging some of the main stakeholders: the public sector, which establishes rules and clear procedures; distributors, through EPR; consumers, households, businesses and government, as generators of waste; and recyclers, who process e-waste (Muriel, 2011). This initiative could bring considerable benefits, as the sector has great potential to create decent and green jobs. The environmental benefits would also be significant, as the environmental impacts of discarding e-waste could be significantly reduced. Furthermore, this project would raise awareness among the general public. Even so, it will also require clear guidelines and regulatory frameworks to facilitate trade and ensure the responsible management of e-waste.

In 2012, the Office for Organizational Development and Information Technology (DDOTI) of the municipal government of La Paz implemented the Technological and Environmental Awareness (GIRAEE) project. This aimed to reach out to public and private actors involved directly or indirectly in the processing of e-waste and raise awareness of integrated e-waste management. It set up a municipal enterprise and a centre for computer refurbishing, to train and equip some SMEs to provide integrated e-waste management with a local development and job creation perspective. GIRAEE was also aimed at promoting inter-institutional agreements.

However, the absence of real inter-institutional coordination affects the formulation and adoption of e-waste policies in Bolivia. For now, MMAyA runs the Plurinational Programme for the Integral Management of Solid Waste, 2011–2015, which, in theory, includes coordination with municipal authorities, as operating entities. Unfortunately, there has been no real interaction between the national and municipal levels on these programmes.

Advances and good practices

Given the scarcity of recycling plants and technology in Latin America, reusing and refurbishing WEEE has become the most common option for managing it throughout the region. People who work informally in the collection and recovery of solid waste are increasingly extending their interest to the recovery of e-waste (mainly from households), and an amateur recycling industry for high-value metals has been slowly emerging.

Bolivia's experience of e-waste management has been very limited. The businesses engaged in the management of e-waste usually comply with environmental and health protection guidelines and decent working conditions principles. Some companies operating in the sector run corporate social responsibility programmes involving inter-institutional work with key actors in the life cycle of electronic products. These aim to reduce the negative impacts of those products on the environment, health and job creation, and increase the recovery of secondary resources by managing e-waste in a sustainable manner (Rojas, 2010a).

Among the main problems that the country faces is the lack of regulatory and legislative frameworks for the management of e-waste. Nonetheless, some progress is being made in Bolivia, in particular in the legislative arena. The draft law on the Integrated Management of Solid Waste represents a step forward.

It is imperative that the demand for electronic appliances and the supply of e-waste, and the various services relating to their management, follow a consistent and safe management plan, with a logistical scheme for the collection, processing and trade of

WEEE. Furthermore, development of the strategies, systems, technologies and equipment needed for the integrated management of e-waste will serve no purpose unless accompanied by information and education campaigns on the dangers of treating and disposing of e-waste inappropriately.

The main challenge lies in how best to support the network of collectors, particularly in the informal economy. This group is made up of highly vulnerable populations and is, by and large, not organized. ARALPAZ provides one model for future development. By becoming members of ARALPAZ, some collectors in Bolivia are part of an entity that oversees the trade of recyclable materials and have achieved a degree of visibility that they did not previously have.

Conclusions and recommendations

E-waste in Bolivia has become a topic of concern, due to its rapid growth in recent years; increasing volumes of imported EEE will generate even more e-waste in the future. Currently, public and private institutions, as well as households, store most of their old EEE. There is a need to develop alternative means of managing this waste, along with relevant information. This situation calls for commitment, partnerships, standards, social responsibility, legislation and regulation to avoid the negative impacts of e-waste and take advantage of the economic and social opportunities presented by managing e-waste responsibly.

Bolivia's draft Law on the Integrated Management of Solid Waste proposes rules for the responsible management of e-waste, extending this responsibility to the producers and/or generators of waste. In pursuit of this objective, the government must decide on the legal sanctions to be applied to offenders, that is, it must establish the degree of penalty in proportion to the degree of fault and/or damage or threat which has been caused. The law's inclusion of EPR principles will provide the foundation for EPR schemes, which will help incorporate the costs of managing e-waste into the retail price of EEE products.

E-waste companies, like any other, need to maintain a level of profitability in order to remain in business. In order to export, they need to handle large volumes of e-waste. Achieving the necessary quotas to negotiate with companies in Colombia, Chile and Peru, for instance, can take at least eight months. For this reason, Bolivian companies rely on raising people's awareness of e-waste and encouraging them to bring their e-waste to companies' collection points. If local and national authorities were to assist in raising awareness among EEE consumers, companies would be further encouraged to stay in business. Yet Bolivian companies reiterate their concerns about the level of bureaucracy required at the municipal level to organize public awareness-raising campaigns for the collection of e-waste.

Even though e-waste represents an environmental risk, it also offers economic opportunity to those who collect and process it. For this reason, sound and progressive legislation will not focus solely on the operational aspect of e-waste management, but will also facilitate and support sustainable economies by formalizing e-waste collection and processing, and open up opportunities for job creation. A starting point might be government recognition of waste picking as a legitimate occupation. Another would be supporting these workers to organize themselves into cooperatives, a type of enterprise that can help informal workers formalize their activities gradually, regularize their incomes and distribute profits among members, thus raising living standards. As cooperatives are member-owned and controlled enterprises with an educational role, a cooperative model could offer opportunities for technical training to improve working conditions and access to markets for WEEE.

There is a need, therefore, for public policies which simplify bureaucratic procedures, establish incentives for those engaged in the management of e-waste, and support research to find workable solutions for the future management of e-waste. These are essential steps in supporting formal enterprises and facilitating the formalization of informal stakeholders in the e-waste value chain.

In the Bolivian scenario, recycling companies, NGOs and local governments are making efforts to address the problem of e-waste by raising awareness of its dangers and providing e-waste management services to households and businesses. These initiatives are shaping a potential green economy sector. In contrast to the situation in the countries discussed above, informal collectors and recyclers of e-waste in Bolivia are not more dominant than formal recycling companies and non-governmental enterprises. This scenario provides the opportunity to build a system of e-waste management and include organized collectors, such as ARALPAZ members, in the formal economy. Such worker organizations can offer a competitive advantage in reaching households and collecting e-waste, but this will require training and awareness-raising on responsible e-waste management.

Given that the introduction of a recycling scheme involves high investment costs, short-term alternatives must also be considered. One such initiative might be the construction of a public–private

recycling centre operated by a cooperative of e-waste collectors, with initial financial support from EEE producers and importers and the state, until such time as the business becomes self-sustainable. Interesting collaborative partnerships can emerge in the Bolivian context and assist the establishment of an e-waste management system that operates on the basis of formal practices and decent working conditions, and that is able to mitigate the negative impacts of the growing volume of e-waste.

Finally, there is a need to govern more strictly the transfer and donation of computers under foreign trade policies and international treaties, in order that Bolivia and certain other countries do not turn into dangerous and unsustainable electronic dumping grounds.

Conclusions

7

Performance and composition of the e-waste recycling chain

E-waste recycling chains share similar characteristics across countries. As the cases above illustrate, the chain begins with the generation phase, where e-waste is generated in two principal ways: i) as domestic electronics become old, unused or reach their end of life; and ii) through legal and illegal importation of second-hand electronic equipment and electronic waste. At this stage, informal collectors are the main collection agents of e-waste, as in all the cases presented in this paper.[1] In most developing countries there are no formal, or widespread, e-waste collection mechanisms in place, and civil society is unaware of both the importance of recycling e-waste and any private and public initiatives to collect and recycle it. Therefore, households tend to keep their old electronic devices, and either sell them to collectors who purchase e-waste on a door-to-door basis or deliver them to refurbishing workshops to have them repaired. In Brazil and India, there are large networks of informal collectors who provide a door-to-door service to recover old electrical and electronic devices. Also in Brazil and India, informal collectors (and traders/middlemen) operate in large competitive networks, acting as the main suppliers of e-waste to the recycling industry.

In Serbia and Bolivia, demand for e-waste is not as strong, and there are only a few groups that collect e-waste. The general population tends to keep their old electronic equipment at home in the hope of fixing it for reuse or to sell as second-hand devices. In Serbia, the government has launched initiatives to certify and compensate collectors through the Environmental Fund, in order to reach higher recycling targets. However, the collection and recycling of e-waste in Serbia has not increased substantially as people were unaware of government initiatives on e-waste recycling and payments (subsidies) to collectors and recyclers were often delayed. In this context, the collection of e-waste is carried out outside the formal system, by groups of waste pickers (often through middlemen) who supply to the manufacturing industry informally.

In Bolivia the situation is similar. Bolivians are not well aware of the value of e-waste and the importance of recycling; the demand for e-waste is low, and there are no government programmes yet in place to regulate and manage e-waste (policies and regulations are currently being discussed). The limited collection of e-waste in Bolivia is mainly attributable to: i) traditional waste pickers who have found market value in e-waste; and ii) non-governmental initiatives established at the local level to raise awareness of the health and environmental dangers of e-waste and provide citizens with neighbourhood collection centres where they can deposit old electronic equipment.

In all cases presented, collectors largely operate in the informal economy. They collect, transport and sort e-waste, and generally sell in small or large quantities to informal middlemen. In Brazil, organized

1. Private and public companies have their own internal systems through which they sell or donate their old electronic equipment to refurbishing centres, or deliver their e-waste directly to recycling companies.

collectors stock their e-waste in large quantities and can potentially sell at profitable prices, while in Bolivia and Serbia informal collectors tend to sell their e-waste at low, survival prices.

Following the collection phase, e-waste enters a disassembling and pre-processing phase. The case studies above illustrate how much of the pre-processing in developing countries continues to take place in the informal economy. Workers tend to clean, disassemble and liberate valuable materials from old electronics in informal contexts. Performing this step and selling smaller components or extracted metals probably allows workers (or the collectors themselves) to increase the value of their merchandise. However, the extent to which the value increases at the pre-processing stage is unknown. It is crucial to implement OSH and environmental guidelines at this stage to prevent workers from being exposed to hazardous substances, as well as to avoid smaller unwanted and hazardous waste being disposed of in regular landfills.

The valuable components of e-waste undergo a secondary processing (end-processing) phase to purify and detoxify the materials previously liberated. The product of this stage is referred to as secondary raw material, which is later sold to manufacturing industries. The case studies of Brazil and India show that this phase is also carried out predominantly within the informal economy. It is uncertain whether workers in Serbia and Bolivia perform the end-processing stage, or sell the components to recycling companies, whether inside or outside the country. These case studies suggest that the workers in the informal economy who carry out collection, pre-processing and processing activities are unaware of the dangers of e-waste and operate without adequate environmental, safety or health measures. This situation puts workers, along with their families and surrounding communities, at high risk. Moreover, these practices generate detrimental impacts on air, soil, water sources and other environmental elements.

In all the cases reviewed here, value chains prove to be complex and lack clear boundaries between the formal and informal economies. At the same time, the studies suggest that informal actors are present at all stages of the e-waste recycling chain and thus it is necessary for them to be addressed as workers and service providers. They must be involved in policy discussions, considered in regulations and engaged in initiatives to implement OSH guidelines in recycling, as a way of addressing and mitigating the negative impacts of e-waste.

The role of informal actors in e-waste recycling

Informal actors dominate e-waste recycling activity across the developing countries. To a large extent, informal actors are heavily involved in the collection phase of the e-waste recycling chain. In Brazil and India, informal collectors operate in networks and reach households across entire cities to purchase old electronic devices that would otherwise remain in the household or be disposed of in landfills. They also recover end-of-life electronics from landfills. In Brazil, India, Serbia and Bolivia, many of the current collectors of e-waste collect, or have been collecting, more "traditional" non-hazardous solid waste. This experience has trained collectors to reach out to a large numbers of households and to work in structured networks.

All of the cases reviewed here suggest that the informal sector is more competitive than the formal sector in e-waste collection. In Serbia, for instance, government initiatives and private recycling companies have admitted to falling short on e-waste supply, making it difficult for them to operate at their full capacity. The prices that informal collectors and middlemen offer for e-waste is higher than the prices offered by private companies, making it harder for the latter to compete and access sufficient supply of e-waste. Informal collectors and middlemen are generally able to offer higher bids for e-waste because some of the costs of treating e-waste are absorbed by informal workers on low wages, in the absence of health or environmental compliance and appropriate technology. Other workers, such as disassemblers and recyclers, also carry out their activities in the informal economy without following OSH and environmental standards. In fact, small and larger recycling businesses currently profit from low wages and the absence or lax implementation of regulatory frameworks that promote public health and environmental safety Pucket, 2006). The most visible issues that arise in this scenario are interdependent: on the one hand, workers who collect, disassemble, treat and extract valuable materials from e-waste are often not aware of the toxicity of the substances they are dealing with; on the other hand, the low cost of processing e-waste without following strict guidelines and regulations is a significant factor in maintaining low recycling costs overall (Schluep, 2010).

Another feature of concern, in regards to e-waste workers in the informal economy, is that their operations may be causing detrimental and irreversible impacts on the environment and on human health (Pucket, 2006) – particularly in developing countries with large e-waste recycling industries.

The most dangerous recycling activities take place at the treatment (processing) phase. E-waste treatment or processing is based on thermodynamics, and requires advanced knowledge of the hazard levels of the different substances that recyclers deal with, as well as access to sophisticated technology to extract and purify metals in a safe and environmental manner (Wang et al., 2012). Much of the current literature on e-waste in developing countries reveals that workers and communities in the hotspots of e-waste recycling suffer diseases and physical problems (e.g. headaches, lung cancer, blood toxification) related to unprotected exposure to hazardous e-waste substances (*China Labor Bulletin*, 2005; Kuehr and Magalini, 2013). Therefore, it is in the common interest of all stakeholders and civil society to improve the working conditions and practices of informal workers, and to demand that they follow environmental standards. In Bolivia and Serbia there seems to be less informal activity in the processing phase. However, it is timely for these countries to guide, regulate and encourage safe and responsible practices of e-waste recycling, to avoid health and environmental disasters in the future.

The precise number of workers involved in the collection and treatment phases of e-waste is not known because informal workers are usually not registered. However, estimates have been made for the countries discussed above. In Serbia, for instance, assessments indicate there are approximately 5,000 informal collectors of e-waste. It has not been possible to predict the number of e-waste workers in Bolivia, but the focal group interviews with ARALPAZ suggested that 10 per cent of its members were now engaging with e-waste. These numbers suggest that countries such as Bolivia have a significant population living off this activity.

The case studies also reveal that informal e-waste management is often carried out by vulnerable social groups, who have migrated from rural areas and/or are from marginalized and deprived communities. In Bolivia most waste collectors associated with ARALPAZ are indigenous, Serbian waste collectors tend to come from the Roma community, while Indian waste workers often belong to the lower castes of society. Historically, e-waste recovery (and solid waste recovery in general) has been a sector in which poor and vulnerable communities find opportunities for survival and income generation. Therefore, excluding informal workers from local and national systems of e-waste management has direct and negative impacts on the livelihoods of these populations.

In all the above case studies, informal workers live off collecting and (pre-)treating e-waste, often in combination with the collection of other forms of solid waste. In their working experience with solid and e-waste, they have developed certain competitive skills that contribute to the recycling process. From these cases, as well as the broader literature, we can conclude that informal workers have a competitive advantage in e-waste collection, based mainly on their flexibility, broad networks and ability to provide door-to-door collection services. In addition, the collection phase requires the least capital investment.

Focusing on and formalizing the collection phase is an appropriate option for countries in which e-waste recycling companies (and technology) are limited. Handling the collection, transportation and sorting of e-waste poses lower risks to workers' health, and requires more accessible equipment, knowledge and skills, than the pre-processing and end-processing stages. Therefore, there is an opportunity to bridge the informal and formal sectors (collectors and recycling companies), to take advantage of the actors' respective skills and build more inclusive and sustainable e-waste chains. This step would require governments to adopt policies and legislation to promote the role and participation of informal workers, improve and formalize their performance and partner them with other players in the recycling industry. The Brazilian Government, having recognized informal collectors as environmental service providers, has implemented initiatives that partner informal collectors with recycling companies to train the former to handle e-waste safely, efficiently and with environmentally friendly techniques. Clear and compatible legislation on e-waste treatment, recycling and stakeholder competencies, and access to information for all involved, are fundamental for implementing sustainable e-waste practices at all levels.

From the workers' perspective, a clear advantage in organizing and training collectors is that they would have the capacity to gather larger volumes of e-waste and sell directly to the treatment and recycling industries. This would help them to move up the value chain, avoid dependence on middlemen and generate higher profits.

Overall, bridging the informal and formal economies of recycling would help build a more sustainable system of e-waste management. In order to integrate and regulate the implementation of OSH and other decent work principles in e-waste management, as well as environmental standards, governments must lead the way with clear guidelines. An integrated and regulated system would allow for marginalized and traditionally excluded communities to continue practising this occupation, rather than being left unemployed. The governments of Brazil and India seem to have understood that integrating actors in the informal economy of e-waste may bring

social and environmental gains. Such discussions are also evolving in Serbia and Bolivia, where policies and regulations are in the process of being defined. The employment dimension, including decent work and formalization, must be integrated into e-waste policies and regulations at an early stage.

The presence and role of cooperatives in e-waste recycling

One of the main objectives of this study was to determine the role that cooperatives and other SSE organizations play in the dynamics of the informal economy in the e-waste management value chain. Are these organizations as active and developed as those in solid waste management? Have these organizations helped informal e-waste recycling workers improve their working conditions? Given that this is a relatively recent topic of research, finding answers to these questions proved to be challenging.

There was some available information on Brazil's and India's e-waste recycling chains. However, most of those studies focused on the environmental performance of those chains rather than their labour dynamics. Even though the literature concurs on the broad existence of an informal recycling economy, it was difficult to identify studies which examined its structure and organization, in particular in the cases of Serbia and Bolivia.

The cases of Brazil and India provide some knowledge about the organization of informal workers. Both countries have developed strong workers' organizations in the solid waste management sector in the past two decades. In Brazil, the existing organizations of collectors are expanding their collection services to e-waste, particularly as e-waste is found in traditional municipal waste deposits and landfills. Brazilian waste collectors are highly experienced in building workers' organizations and creating cooperatives, associations and networks at local, regional and national levels. The MNCR (National Movement of Recyclers) stands out for its political activism to defend the rights and interests of waste pickers, as workers. The pressure exerted by organized waste collectors contributed to the adoption of the National Solid Waste Policy (2010) that recognized collectors as environmental service providers and implemented reverse logistics, based on the "polluter pays" principle, for special and hazardous waste, including electronic products and components. Within this policy framework, national and municipal governments will need to ensure that the cooperatives involved in the e-waste chain can continue to participate and offer their services safely and efficiently.

Brazil showcases how vulnerable and disadvantaged populations have organized over time. These communities have used their networks to expand their activities and improve their service provision, while also defending their occupation and sectoral interests, and demanding inclusion and recognition by government officials. There is a strong base of workers' organizations in waste management, which will likely shape the emergence of other informal groups. The challenge for Brazil lies more in the need to raise awareness among current workers on the dangers of e-waste, and providing them with opportunities to access information and receive formal training to improve efficiency – and meet the standards of the recycling industry. The government seems to have responded to this by implementing a national training programme for organized e-waste collectors.

India, too, has developed experience in building workers' organizations in certain regions. There are interesting and progressive organizations such as the SWaCH cooperative, which national and international groups of waste workers often consider as a good example of organizing. Indian workers' organizations have also been dynamic in connecting to regional and international groups of waste workers (e.g. WIEGO), NGOs and government authorities to progress their cause and improve the working conditions of their members. The NGO Chintan helped two groups of informal e-waste workers within its organization (Safai Sena and 4R). Having previously organized municipal waste pickers, Chintan provided the only documented case of the organization of e-waste workers to emerge during research for this paper. It highlighted some of the generic issues that will come up in e-waste value chains elsewhere. First, the members of Safai Sena had already worked with domestic waste for more than a decade. Second, 4R was an association of traders and dismantlers that opted to disassociate itself from the collectors' group, as its work was perceived to be more valuable and less stigmatized than collection. This demonstrates that, within the informal economy of a single sector, there are a variety of actors with differing interests and objectives. The mapping of actors within the informal economy is a necessary step prior to setting up policies and designing systems for the treatment of e-waste.

In the documentation of this case, Chintan provides suggestions to assist workers to become successfully organized. These suggestions are relevant for both workers seeking to organize and NGOs supporting informal workers in the process of organization. Due to the marginalized backgrounds of e-waste workers, and their inability to access resources and information, they will often need a partner to support and advise them on the process

of organization. Chintan speaks of the need to: i) partner with experts in the field of e-waste to better understand how its complex value chain operates; ii) provide capacity building on workers' rights, OSH and leadership skills; iii) advocate for inclusive legislation; and iv) seek new partners and rethink EPR schemes so they correspond with the particular city or country context. The documentation of this case not only provides concrete operational/technical steps on how to organize a group of e-waste workers but also offers less tangible lessons that come with experience. Chintan refers to the need to build trust between workers and their partner (e.g. an NGO), and the need to fully understand the entire e-waste scenario in order to avoid actions inconsistent with existing policies and regulations (Chaturvedi and Bhardwak, 2013). Overall, the case of Chintan highlights the importance of documenting and sharing information about the process of organization, to both learn and help informal workers implement sustainable organizations. Unfortunately, there is a lack of documentation on worker organization in the e-waste sector, but it is not clear whether this is linked to the absence of SSE organizations in the sector or the absence of academic research in this field.

According to field research for this paper, SSE organizations, and in particular cooperatives in the e-waste sector, are not active in Serbia and Bolivia. In both cases, the organizations dealing with e-waste are the same as those which have recovered municipal waste in the past. The Roma people in Serbia and indigenous waste pickers in Bolivia recover e-waste as an extension of their original activities. For both groups, the benefits of having organizational structures have been limited. In the past decade, with the support of international organizations and NGOs, Serbia has attempted to organize the Roma communities and establish successful and sustainable waste collection businesses. These attempts failed on several occasions, partly because Serbia has no clear policies that would support the creation and operation of cooperative enterprises. Additionally, Roma collectors have no access to information or financial support to maintain and expand their business activities or initiatives. In Bolivia, one association of collectors and sorters for recycling was identified in La Paz (ARALPAZ); 10 per cent of its members have extended their municipal waste collection services to e-waste. Despite being part of an established association, the members of ARALPAZ continue to work in precarious conditions without social protection schemes, and continue to live in poverty, as they operate mostly in the informal economy and live off low incomes.

Contrary to the informal sector, it appears that the formal sector in both Serbia and Bolivia is small, but it operates with good working conditions and follows environmental standards. The Serbian Government has supported the establishment of formal recycling companies and formal collectors through the Environmental Fund (which was recently abolished), in an attempt to harmonize Serbian practices with the European Commission's WEEE Directive. These companies currently have the appropriate infrastructure and capacity to recycle the amounts of e-waste estimated to be produced until 2020 (and when they do not have the appropriate technology, they export components to EU countries or China). The obstacle they face is their inability to access enough e-waste to operate at their full capacity. This problem is related to the absence of a formal system of collection of e-waste. Formal collectors collect almost 30 per cent of e-waste generated in Serbia, and deliver it to recycling companies. The present study suggests that the remaining 70 per cent of e-waste is collected by informal actors, who recover the most commercially lucrative parts and discard the rest in illegal dumps or incinerate it in open fires. This situation calls for creating partnerships between formal and informal actors to set up a formal collection system for e-waste. However, this would require the prior step of organizing informal workers.

In the case of Bolivia, the presence of three formal e-waste recycling companies is linked to the support of either foreign and national NGOs or private initiatives. The e-waste topic has been raised and promoted mostly by the non-profit NGO concerned with the environmental impacts of e-waste. Given that Bolivia lacks institutional policies and guidelines for e-waste management, these recycling companies operate alone, relying on their own pick-up arrangements with public and private entities or on deposit centres established by the Recycling Foundation (FUNDARE) where locals are encouraged to dispose of their e-waste. FUNDARE, with the support of NGOs and municipal governments, has led neighbourhood campaigns to raise awareness on the proper disposal of e-waste. The approach to e-waste in Bolivia has focused on raising awareness and educating citizens (as consumers of electronics). However, given the small-scale dynamics of e-waste in this country, e-waste collection and recycling have not yet been established as an attractive and profitable activity for informal collectors of conventional recyclables. This is perhaps the reason why cooperatives, or other forms of SSE organizations, were not found in the country. Bolivia is undergoing a rapid increase in the consumption of electronic equipment, and will very soon require responsible alternatives for e-waste management. This situation calls for early intervention, and design of an e-waste management scheme

that involves partnerships between existing e-waste recycling enterprises and organized collectors of waste – that could improve and provide decent jobs to collectors, traders and recyclers alike.

Insights and recommendations

The purpose of the present study has been to understand the role of formal and informal workers in the e-waste sector and determine how and where cooperatives and other SSE organizations could contribute to improving working conditions, while ameliorating environmental impacts, to lift e-waste workers higher in the value chain. Exploring how formal and informal stakeholders could cooperate to operate in a more effective and socially sustainable recycling chain has not yet been widely discussed, either at the policy level or by academics. This will need to be further developed if the needs for better e-waste management and more decent jobs are to be met.

At the same time, there is a need for informal actors to transition towards formality to be able to contribute to the environmentally sound recycling of e-waste. In current conditions, informal e-waste recyclers are often not efficient, their practices are environmentally harmful and they perform in highly unsafe conditions. The number of people working on e-waste is significant and will continue to increase. Governments and civil society must take these people into account when developing policies and regulations for e-waste management. E-waste recycling, as well as the traditional recycling of solid waste, must be viewed as providing opportunities for decent jobs for poor and unskilled populations. However, if informal workers (e.g. collectors) are to benefit, they must be organized into cooperatives and other SSE organizations which would gradually formalize their activities. Organizing informal workers would not only facilitate their daily work and improve their labour conditions but also has a potential to increase their skills, and raise awareness of the dangers of the substances they handle and measures to protect both their own health and safety and the surrounding environment. Furthermore, well-trained collectors and dismantlers would be able to recover more and purer valuable materials and sell them at higher values.

The ILO is concerned to improve conditions in the informal economy, and supports cooperative development. It can provide its constituents with guidance and assistance on the organization of informal workers.

In most of the cases presented here, informal actors can be competitive in the collection and preprocessing phases of e-waste management. These stages are labour intensive and require less capital investment, which could facilitate the entrance of informal actors into the formal market. Formal recycling plants, on the other hand, seem to face a deficit in e-waste supply across countries. The Best-of-2-Worlds concept (Wang et al., 2012) may be a useful approach to integrating the informal sector effectively. In countries with little industrial recycling capacity, it would be worth exploring possibilities to organize informal collectors and partner them with those traders who seek to collect large amounts of e-waste in order to export it to formal and responsible recycling plants in neighbouring countries. In countries which have a relatively well-established formal e-waste recycling sector, as in Brazil, partnerships between groups of collectors (e.g. cooperatives) and recycling plants must be encouraged.

Where there is experience in organizing general waste collectors there is a tendency to facilitate the organization of e-waste workers as well. It is common for cooperatives and organizations that collect "traditional" recyclables to extend their services to e-waste recycling. Even though workers in these organizations have acquired experience in working and cooperating as a collective, they still require capacity building on the specificities of dealing with e-waste. E-waste collectors must have access to training and information on the hazardous qualities of e-waste and the need to pay special attention to OSH.

In addition, existing waste management organizations can set an example, and share with e-waste workers their experience, lessons learned, strategies and other information related to the process of organization. The presence of cooperatives and other SSE organizations strengthens and empowers vulnerable workers, and raises their collective voice at the decision-making level. Therefore, information, training and capacity building among workers should be strengthened through networks, workshops and other kinds of cooperation initiatives. Existing cooperatives and associations of solid waste workers are a powerful resource for e-waste workers who have yet to tap into the formation of SSE organizations within their sector.

There is a need for governments to establish policy and legal frameworks based on the Promotion of Cooperatives Recommendation, 2002 (No. 193) (ILO, 2002) to allow for the development of sustainable cooperatives. While this paper does not focus on policies and regulations relating to cooperatives at a national level, it must be noted that there needs to be an enabling environment, with a supporting political framework, and adequate incentives in place for e-waste management cooperatives to grow sustainably.

There is a fundamental need for developing countries to establish official definitions and classifications of e-waste, and to design public policies, guidelines and regulations on e-waste management (in addition to legislation on e-waste imports). In most developing countries, e-waste is rapidly becoming more abundant and posing risks to human health and the environment. Economic growth and greater access to electrical and electronic devices also leads people to consume more such devices and generate more e-waste. At the same time, many developing countries continue to receive both legal and illegal imports of e-waste. The sooner countries implement effective systems of e-waste management, grounded in sound policies and effective regulation, the sooner they will be prepared to face and control the growth in e-waste, manage e-waste and its components in safe and environmentally friendly ways, and avoid the negative impacts of e-waste that has been poorly managed or inadequately disposed of. Such regulations would set standards or codes of practice for the people working with e-waste, and should encourage and incentivize training and capacity building by all contributors in the recycling value chain. Governments must ensure that, at all levels of society, there is broad and solid understanding of the dangers of e-waste, and that workers, their organizations and enterprises, and companies protect themselves, their communities and the natural environment from pollution and toxification. It is the duty of governments to implement and enforce strict regulations on the entry of e-waste from foreign countries.

Having clear government policies on the trade and management of e-waste will also make the issue more visible to government officials at all levels and the general public. It is essential that government officials appreciate the urgent need to enforce regulations and monitor the social, economic and environmental performance of e-waste recycling chains. In this respect, the ILO can encourage and assist its constituents to put in place e-waste management systems with adequate labour standards and regulations, and can support governments to identify good practices and establish overarching standards, regulations and guidelines.

Along with clear policies and effective regulations, governments must offer training and capacity building to ensure that the people who work with e-waste are aware of sound e-waste management techniques and good practices. These initiatives could take the form of workshops, certification programmes and South–South/North–South cooperation, and may involve partnerships and collaboration among local and national governments, NGOs, formal e-waste recycling companies and international organizations. The ILO, in partnership with governments, could play a role in providing training sessions and material on OSH to both formal and informal actors.

Furthermore, improving e-waste management systems will require the collaboration of civil society in recovering e-waste through appropriate waste streams. At present there is little awareness of the dangers of poorly managed (or unmanaged) e-waste and the labour conditions of e-waste workers. Furthermore, there is little understanding of the importance of having well-trained e-waste workers to protect both their own health and safety (as a decent work principle) and the wellbeing of entire communities – and of the environment. Governments at all levels, NGOs, neighbourhood councils (or any other forms of civil society organization) and e-waste workers themselves can help educate citizens on how to separate and handle, and where to deposit (or to whom to deliver), end-of-life electrical and electronic devices.

The ILO's work and findings on e-waste workers will be shared among its constituents to raise awareness at national and international levels, help constituents address the labour issues inherent in e-waste, and achieve safe and environmentally sound performance in the e-waste recycling sector.

References

Andre, C. 2013. "El 32,76% de las casas en Bolivia no tiene televisor y el 90,55% no tiene internet [32.76% of houses in Bolivia have no TV and 90.55% have no internet]", in *El Dia,* 31 July. Available at: www.eldia.com.bo/index.php?cat=1&pla=3&id_articulo=123576 [12 Aug. 2013].

Associated Chambers of Commerce and Industry of India (ASSOCHAM). 2014. "Press Releases: Over 4.5 lakhs child labours engaged in various e-waste activities in India: ASSOCHAM study; India's capital produces 67,000 MT of electronic waste a year ", 21 April. Available at: www.assocham.org/prels/shownews-archive.php?id=4476 [10 June 2014].

Balkan e-Waste Management Advocacy Network (BEWMAN). n.d. *E-waste management in Serbia, 2010*.

Chaturvedi, B.; Bhardwak, S. 2013. *Learning to re-e-cycle: What working with e-waste has taught us* (New Delhi, Chintan Environmental Research and Action Group).

Chaturvedi, B. et al. 2005. *Informal–formal: Creating opportunities for the informal waste recycling sector in Asia* (New Delhi, Chintan Environmental Research and Action Group).

Chi, X.; Streicher-Porte, M.; Wang, M.Y.L.; Reuter, M.A. 2011. "Informal electronic waste recycling: A sector review with special focus on China", in *Waste Management*, Vol. 31, pp. 731–742.

China Labour Bulletin. 2005. "The plight of China's e-waste workers", 15 Aug. [3 June 2014].

Chintan Environmental Research and Action Group. n.d. *Wastepickers*, Fact Sheet (New Delhi). Available at: www.CHINTAN-india.org/documents/fact_sheets/CHINTAN_wastepickers_fact_sheet.pdf [18 June 2013].

Delfin, M.; Guzman, D.; Garay, E.; Yañez, P.; Delfin, M. 2009. *Diagnóstico de residuos electrónicos en Bolivia* [Survey of electronic waste in Bolivia] (La Paz, Swisscontact, Caintec and Delfin Consultora).

European Commission. 2012. "Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE)" in *Official Journal of the European Union*, L 197/38, 24 July.

European Commission. 2013. *Serbia 2013 progress report accompanying the document Communication from the Commission to the European Parliament and the Council: Enlargement strategy and main challenges 2013–2014* {COM(2013) 700 final} (Brussels, Communication from the Commission to the European Parliament and the Council, 16 Oct.).

European Commission. *Eurostat*. Available at: http://epp.eurostat.ec.europa.eu/ [Oct. 2013].

Fonseca, F.; de Carvalho Matielo, D. 2009."Notes from the field: E-waste in Brazil: Lixo Eletrônico and MetaReciclagem", in *International Review of Information Ethics*, Vol. 11, No. 10.

Fonteneau, B. et al. 2011. *The reader 2011: Social and solidarity economy: Our common road towards decent work: In support of the second edition of the Social and Solidarity Economy Academy, 24–28 October 2011, Montreal, Canada* (Turin, International Training Centre of the ILO).

Gandhinagar, A. 2012. "Projeto capacita catadores de 53 cooperativas a separar o lixo eletrônico" [Project trains pickers of 53 cooperatives to separate electronic waste], 29 April. Available at: http://memoria.ebc.com.br/agenciabrasil/noticia/2012-04-29/projeto-capacita-catadores-de-53-cooperativas-separar-lixo-eletronico [3 July 2014].

Global Alliance of Waste Pickers. n.d. *About us.* Available at: http://globalrec.org/who-we-are/ [25 June 2013].

Gunsilius, E.; Chaturvedi, B.; Scheinberg, A. 2011. *The economics of the informal sector in solid waste management*, CWG Publication Series 5 (St Gallen and Eschborn, Collaborative Working Group on Solid Waste Management in Low- and Middle-income Countries (CWG) and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH).

Gunsilius, E. et al. 2011. *Recovering resources, creating opportunities: Integrating the informal sector into solid waste management* (Eschborn, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH).

Ilic, M. 2013a. Personal interview with Nebojsa Vranes, founder and co-owner of S.E.Trade, Belgrade, 5 Oct.

—. 2013b. Personal interview with Bozidar Potkonjak, Manager of Božić i Sinovi, Belgrade, 20 Oct.
—. 2013c. Personal interview with Marija Micakovic and Vladimir Zivaljevic, Managing team of Jugo-Impex E.E.R., Belgrade, Oct.
—. 2013d. "Potential for Green Employment Growth: Waste recycling sector in Serbia" (unpublished).
Instituto Boliviano de Normalización y Calidad (IBNORCA). 2012. *Catálogo de Normas Bolivianas 2012* (La Paz, Dirección Nacional de Normalización).
Institute for Sustainable Communities. 2012. "Urban miners: Roma scrap collectors press for recognition of their profession". Available at: http://www.iscvt.org/how_weve_helped/urban_miners/ [28 May 2014].
International Co-operative Alliance (ICA). n.d. "History of the co-operative movement". Available at: http://ica.coop/en/whats-co-op/history-co-operative-movement [19 June 2013].
International Labour Organization (ILO). 2002. *Promotion of Cooperatives Recommendation, 2002 (No. 193)* (Geneva). Available at: http://www.ilo.org/dyn/normlex/en/f?p=1000:12100:0::NO::P12100_INSTRUMENT_ID:312531 [1 Aug. 2013].
—. 2004. *Addressing the exploitation of children in scavenging (waste picking): A thematic evaluation of action on child labour: A global report for the ILO (*Geneva, ILO).
—. 2009. *Plan of action for the promotion of social economy enterprises and organizations in Africa*, paper presented at the ILO Regional Conference "The Social Economy: Africa's Response to the Global Crisis", Johannesburg, 19-21 Oct. Available at: www.ilo.org/wcmsp5/groups/public/---africa/---ro-addis_ababa/documents/publication/wcms_166727.pdf [3 July 2014].
—. 2012. *Working towards sustainable development: Opportunities for decent work and social inclusion in a green economy* (Geneva).
Jain, A.; Sareen, R. 2006. "E-waste assessment methodology and validation in India", in *Journal of Material Cycles and Waste Management*, No. 8, pp. 40–45.
Jovanic, P., Tosic, K., Rochat, D. 2011. *National e-waste assessment in Serbia* (Belgrade, UNDP, PACE Workgroup 3.1 and University of Belgrade, Institute of Multidisciplinary Research).
Krstić, G. et al. 2013. *The shadow economy in Serbia: New findings and recommendations for reform* (Belgrade, USAID Serbia, Business Enabling Project).
Kuehr, R.; Magalini, F. 2013. *UNU & WHO survey on e-waste and its health impacts on children* (United Nations University, Institute for Sustainability and Peace).
La Razón. 2012. "Fundidoras y chatarreros de El Alto no tienen aval municipal" [Smelters and scrap of El Alto city no guarantee], 18 June. Available at: www.la-razon.com/suplementos/informe/Fundidoras-chatarreros-Alto-aval-municipal_0_1634836532.html [30 Sep. 2013].
Leung, A.O.W.; Duzgoren-Aydin, N.S.; Cheung, K.C.; Wong, M.H. 2008. "Heavy metals concentrations of surface dust from e-waste recycling and its human health implications in Southeast China", in *Environmental Science and Technology*, Vol. 42, No. 7, pp. 2674–2680.
Lundgren, K. 2012. *The global impact of e-waste: Addressing the challenge* (Geneva, International Labour Organization).
Medina, M. n.d. *Waste picker cooperatives in developing countries*. Available at: http://wiego.org/sites/wiego.org/files/publications/files/Medina-wastepickers.pdf
—. 2000. "Scavenger Cooperatives in Latin America and Asia", *Resources, Conservation and Recycling*, Vol. 31, No. 1, pp. 51–69.
—. 2007. *The world's scavengers: Salvaging for sustainable consumption and production* (Lanham, MD, AltaMira Press).
—. 2008. "The informal recycling sector in developing countries: Organizing waste pickers to enhance their impact", in *Gridlines*, Note No. 44, Oct.
Muriel, V. 2011. "Plantean alianzas estratégicas entre Bolivia y Perú para el reciclaje de residuos electrónicos" [Strategic alliances are proposed between Bolivia and Peru for the recycling of electronic residues] in *Energy Press*, 19 Dec. Available at: http://energypress.com.bo/index.php?cat=337&pla=3&id_articulo=433#.U7VOK_mSySp [24 Sep. 2013].
Nordbrand, S. 2009. *Out of control: E-waste trade flows from the EU to developing countries* (Stockholm, SwedWatch).
Oxigênio. 2010. "Oxigênio realiza campanha de arrecadação de lixo eletrônico em parceria com a câmara municipal de São Paulo" [Oxigenio conducts campaign fundraising junk in partnership with the municipality of São Paulo], June 10. Available at: www.oxigenio.org.br/a_noticias_detalhes.asp?cod_noticias=514 [7 July, 2013].
Pena, R. 2012. *Wasting no opportunity: The case for managing Brazil's electronic waste: Project report* (Washington, DC, *info*Dev/The World Bank).

Pucket, J. 2006. "High Tech's dirty little secret: The Economics and Ethics of the Electronic Waste Trade", in Sonnenfed et. Al (ed): *Challenging the Chip: Labour Rights and Environmental Justice in the Global Electronics Industry* (Philadelphia, Temple University Press), pp. 225-233

Raghupathy, L. et al. 2010. "E-waste recycling in India: Bridging the formal-informal gap." *E-Scrap*, May, Annexure 5.3, pp. 80-83. Available at: http://weeerecycle.in/publications/research_papers/Article_in_RI_may_2010.pdf [3 July 2014].

RedTicBolivia. 2011. "Cada boliviano genera 4 kilos de basura electrónica al año" [Each Bolivian generates 4 kilos of e-waste each year], 26 July. Available at: www.ticbolivia.net/index.php?option=com_content&view=article&id=278:276&catid=52&Itemid=229 [12 Aug. 2013].

—. 2013a. "Esta cifra se duplicará para 2015, alerta un estudio de Swisscontact" [This will double by 2015, alerts a study by Swisscontact], 26 July. Available at: www.ticbolivia.net/index.php?option=com_content&view=article&id=278:276&catid=52&Itemid=229 [12 Aug. 2013].

—. 2013b. "Bolivia: Se entrego 110.308 computadores a maestras y maestros en todo el pais" [110,308 computers given to teachers across the country], 25 Jan. Available at: www.ticbolivia.net/index.php?option=com_content&view=article&id=3202:bolivia-se-entrego-110-308-computadoras-a-maestras-y-maestros-en-todo-el-pais&catid=52&Itemid=229 [12 Aug. 2013].

Renner, M.; Sweeney, S.; Kubit, J. 2008. *Green Jobs: Towards decent work in a sustainable, low carbon world* (Washington, DC, World Watch Institute for United Nations Environment Programme)

Republic of Serbia. 2009. "Law on Waste Management", *Official Gazette of the Republic of Serbia*, No. 36/2009.

—. 2010a. "National Environmental Protection Programme", *Official Gazette of the Republic of Serbia*, No. 12/2010.

—. 2010b. "National Waste Management Strategy for the Period 2010–2019", *Official Gazette of the Republic of Serbia*, No. 29/2010.

—. 2011. "National Environmental Approximation Strategy for the Republic of Serbia", in *Official Gazette of the Republic of Serbia*, No. 80/2011.

—, Office for Sustainable Development of Underdeveloped Areas. 2012. *Promoting human security for vulnerable communities in Southwest Serbia* (Novi Pazar, United Nations Trust Fund for Human Security, Embassy of Japan in Belgrade and Office for Sustainable Development of Underdeveloped Areas).

—. 2014. "Continued implementation of the program on improving the human security of vulnerable communities in Southwest Serbia", 29 Jan. Available at: www.kornrp.gov.rs/site/page/1133/nastavak-realizacije-programa-unapredjenja-ljudske-sigurnosti-ugrozenih-zajednica-u-jugozapadnoj-srbiji#site/setlang/english [30 June 2014].

—, Statistical Office. 2011. *Satellite accounts of the cooperative sector in the Republic of Serbia*. Available at: http://webrzs.stat.gov.rs/WebSite/userFiles/file/Nacionalni/Satelitski_racuni.pdf [30 June 2014].

—. 2013. *Labour force survey April 2013*. Available at: http://webrzs.stat.gov.rs/WebSite/public/PublicationView.aspx?pKey=41&pLevel=1&pubType=2&pubKey=1788 [12 Dec. 2013].

Rocha, G.H.T. et al. 2009. *Diagnosis of waste electric and electronic equipment generation in the state of Minas Gerais* (Belo Horizonte, E-waste).

Rodriguez, M. 2013a. Personal interview with Jonattan Butrón, Director of RAEE RECICLA, La Paz, 22 Aug.

—. 2013b. First focal group interview with 15 informal collectors, members of ARALPAZ, La Paz, 3 Sep.

—. 2013c. Second focal group interview with 11 informal collectors, members of ARALPAZ, La Paz, 11 Sep.

—. 2013d. Personal interview with Aldo Blanco, Director of TECMINAL, La Paz, 19 Aug.

—. 2013e. Personal interview with José Tapia, Director of RECYBEL, La Paz, 28 Aug.

Rojas, J.E. 2010a. *Gestión integral de residuos de aparatos electrónicos y eléctricos (e-basura) en Bolivia* [Integral management of electronic and electrical residues (e-waste) in Bolivia] (La Paz, Gobierno Autónomo Municipal de La Paz (GAMLP), Fundación Redes and Banco de Desarrollo de America Latina (CAF) (unpublished).

—. 2010b. "Progress and perspectives of integrated management of residues of electrical and electronic apparatus in Bolivia", in Association for Progressive Communications (APC) and Humanist Institute for Cooperation with Developing Countries (Hivos): *Global Information Society Watch 2010: Focus on ICTs and environmental sustainability*, pp. 81–94.

Rojas Jordan, G. 2013. "En Bolivia hay 13,8 millones de celulares; más que habitantes" [In Bolivia there are 13.8 million cellphones; more than inhabitants], in *eldeber.com.bo*, 26 Feb. Available at: www.eldeber.com.bo/2013/dyf/2013-02-26/ver.php?id=130225204458 [12 Aug.].

Scheinberg, A., Wilson, D.C.; Rodic, L. 2010. *Solid waste in the world's cities* (London, Earthscan Publications for and on behalf of the United Nations Human Settlements Programme UN-HABITAT).

Schluep, M. et al. 2009. *Recycling: From e-waste to resources*, Sustainable Innovation and Technology Transfer Industrial Sector Studies (Paris, United Nations Environment Programme).

—. 2010. "E-waste management in developing countries", paper presented at the ITU Symposium on ICTs and the Environment and Climate Change, Cairo, 2–3 Nov.

Silva, U. (ed.). 2009. *Gestion de residuos electronicos en America Latina* [E-waste management in Latin America] (Santiago de Chile, Ediciones SUR - Platform K SUR /IDRC).

Sinha-Khetriwal, D.; Kraeuchi, P.; Schwaninger, M. 2005. "A comparison of electronic waste recycling in Switzerland and in India", in *Environmental Impact Assessment Review*, Vol. 25, pp. 492 – 504.

Smith, T., Sonnenfeld, D.A.; Pellow, D.N. (eds). 2006. *Challenging the chip: Labor rights and environmental justice in the global electronics industry (*Philadelphia, Temple University Press).

International Labour Foundation for Sustainable Development. 2014. "Organizing waste pickers and building union power", *Sustain Labour*, 3 Feb. Available at: www.sustainlabour.org/noticia.php?lang=EN&idnoticia=707 [21 July 2014].

Tchami, G. 2007. *Handbook on cooperatives for use by workers' organizations* (Geneva, ILO).

Tuori, M. 2012. "The role of informal middlemen in the recycling supply chain in Bandung, Indonesia: A case study for policy makers", paper presented at the Business of Social and Environmental Innovation Conference, University of Cape Town, Graduate School of Business, 22–23 Oct.

Twinning. 2012. *Draft Serbian Waste Management Plan for Electrical and Electronic Equipment and Waste Electrical and Electronic Equipment: Draft version 0.2*. (New Belgrade and Wien, Serbian Ministry of Environment and Spatial Planning and Federal Environment Agency Austria).

Universidad Mayor de San Andrés, Facultad Técnica (UMSA); Swisscontact. n.d. *Obtención de metales preciosos a partir de residuos electrónicos descartados* (La Paz).

United Nations Environment Programme (UNEP). 2007. *E-waste Volume I: Inventory assessment manual* (Osaka/Shiga).

Vyrenhoek, L. 2012. *First Global Strategic Workshop of Waste Pickers: Inclusive Solid Waste Management, Pune, India, 2012*. Cambridge, MA and Manchester, Women In Informal Employment: Globalizing and Organizing (WIEGO), 2012.

Wang, F.; Huisman, J. 2010. "Formalisation of e-waste collection and recycling in China", in *Going Green: CARE INNOVATION 2010: Proceedings: From legal compliance to energy-efficient products and services: 8th International Symposium and Environmental Exhibition, 8–11 Nov., Vienna*.

Wang, F. et al. 2012. "The Best-of-2-Worlds philosophy: Developing local dismantling and global infrastructure network for sustainable e-waste treatment in emerging economies", in *Waste Management*, Vol. 32, No. 11, pp. 2134–2146.

Wang, F.; Kuehr, K.; Ahlquist, D.; Li, J. 2013. *E-waste in China: a country report,* SteP Green Paper Series (Bonn, United Nations University, StEP Initiative).

Wilson, D.C.; Velis, C.; Cheeseman, C. 2006. "Role of informal sector recycling in waste management in developing countries", *Habitat International*, Vol. 30, No. 4, pp. 797–808.

Women In Informal Employment: Globalizing and Organizing (WIEGO). 2013. *Waste pickers: The right to be recognized as workers*, paper prepared for the International Labour Conference, 102nd session, Geneva, 2013. Available at: http://wiego.org/sites/wiego.org/files/resources/files/WIEGO-Waste-Pickers-Position-Paper.pdf [4 July 2014].

World Health Organization (WHO). n.d. *Children's environmental health: Electronic waste*. Available at: www.who.int/ceh/risks/ewaste/en/ [3 June 2014].

—, WHO Project Office Serbia. 2012. *Good practice n°26: Serbia : Providing innovative employment solutions for Roma: SWIFT sustainable waste management initiative* (Council of Europe, 2013). Available at: http://goodpracticeroma.ppa.coe.int/en/pdf/145 [19 June 2014].

YUROM Center. n.d. *Yurom Center Niš*. Available at: www.yuromcentar.org.rs/ [1 June 2014].

The amount of electric and electronic waste is growing– and fast. As new products enter the market, the consumers get rid of their old computers, mobile phones and fridges. E-waste presents many challenges: it is hazardous to human health and the environment and it is complex and costly to treat. Moreover, e-waste is managed and recycled mostly by informal workers in developing countries, often under poor working conditions. But e-waste is also a valuable resource. If recycled properly, it can create many productive jobs, save raw materials and contribute to green economies. Cooperatives offer one effective way to achieve this.

This working paper explores the role and potential of cooperatives and other social and solidarity economy organizations in coping with the challenges of e-waste, and in contributing to more and better jobs in e-waste recycling.

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