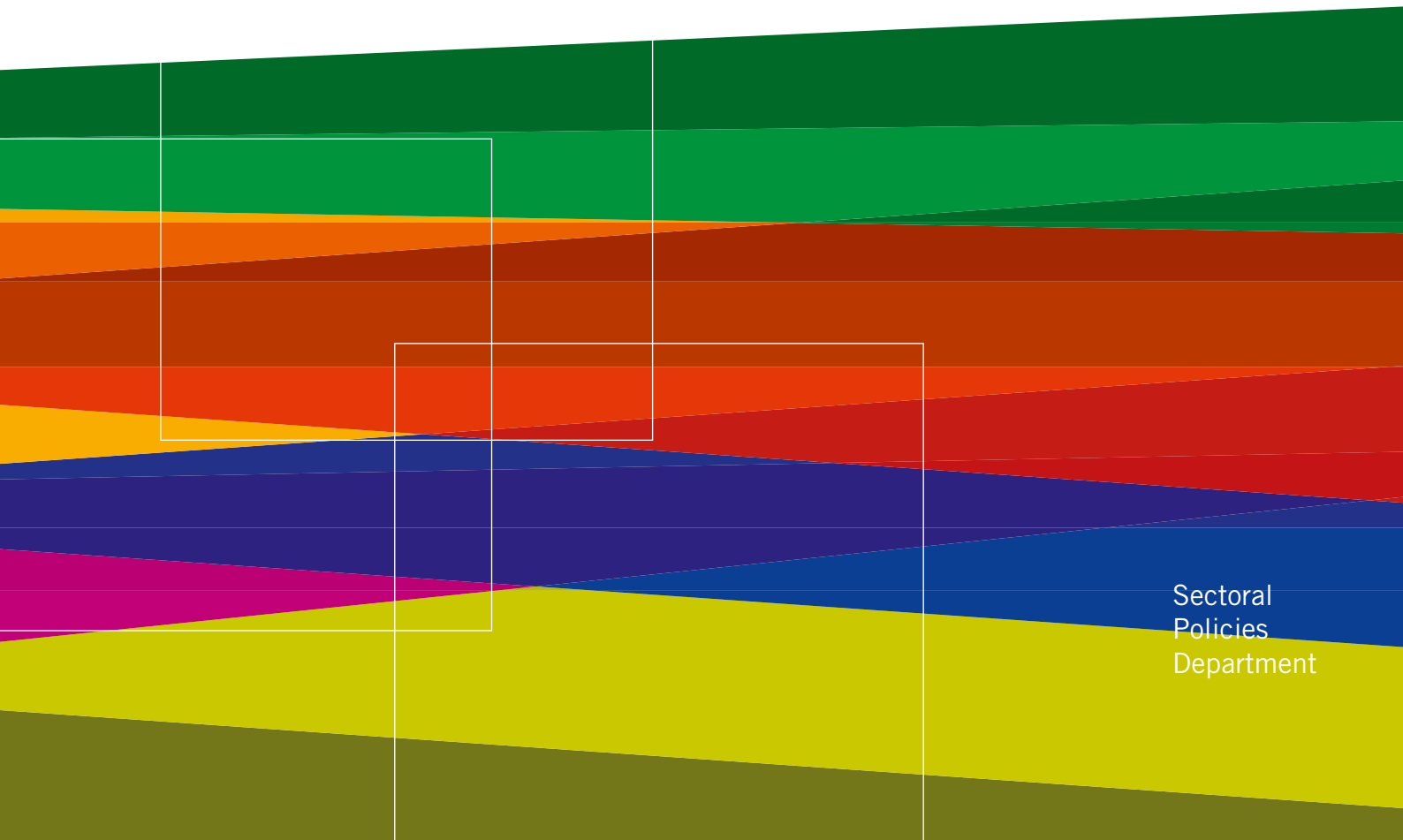
Working Paper No. **323**

International
Labour
Organization

From Waste to Jobs

Decent work challenges and opportunities in the management of e-waste in India



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From waste to jobs: Decent work challenges and opportunities in the management of e-waste in India

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Preface

E-waste constitutes a small but rapidly growing part of the approximately 2.01 billion metric tonnes of solid waste that are generated globally each year (Kaza et al., 2018). It is a waste stream that has a significant impact on the environment, society and human health, and that is becoming a growing challenge for the world of work.

What makes e-waste different from the waste streams of glass, paper, wood and other materials is that used electrical and electronic equipment (UEEE) contains hazardous substances alongside valuable materials, and hence requires special treatment. When managed well, e-waste offers opportunities for the generation of sustainable repair and recycling enterprises, and for the creation of green jobs in the circular economy.

As a major generator of and destination for e-waste, India has been addressing the challenge of e-waste in its legislation since 2011. Many businesses, workers' and civil society groups have been prompted to take further action to make recycling processes more sustainable. However, much remains to be done to protect the environment and human health and to advance decent work in the sector.

Alongside two complementary papers on decent work challenges and opportunities in the management of e-waste in Argentina and Nigeria, this paper is intended to enable better understanding by policy makers and stakeholders of the complexity of the e-waste challenge at the national level in different countries across the globe, and to develop a knowledge base for more informed decision-making and for taking action to advance decent work in the management of e-waste. The paper is a product of an extensive literature review and consultations with experts in India.

The International Labour Organization (ILO) is the United Nations (UN) specialized agency devoted to advancing opportunities for women and men to obtain decent and productive work in conditions of freedom, equity, security and human dignity. The ILO's Sectoral Policies Department (SECTOR) promotes decent work by supporting the Organization's tripartite constituents – governments, employers and workers – in seizing opportunities and addressing challenges in 22 different economic and social sectors, including electronics and e-waste. The ILO Decent Work Technical Support Team for South Asia and Country Office for India is a centre of technical excellence, which supports all countries in South Asia to realize decent work for inclusive growth and sustainable development.

The present working paper is the result of the combined efforts of colleagues in SECTOR and the ILO Decent Work Technical Support Team for South Asia and Country Office for India.

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Abbreviations

ASSOCHAM	The Associated Chambers of Commerce in India
CPCB	Central Pollution Control Board
DGFASLI	Directorate General, Factory Advice Service and Labour Institutes
EEE	Electrical and Electronic Equipment
EPR	Extended Producer Responsibility
EU	European Union
GIZ	Deutsche Gesellschaft für internationale Zusammenarbeit (German Corporation for International Cooperation)
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German Corporation for Technical Cooperation, which merged into GIZ in 2011)
ILO	International Labour Organization
IFC	International Finance Corporation
MAIT	The Manufacturers Association of Information Technology
MeitY	Ministry of Electronics & Information Technology
MoEF	Ministry of Environment, Forest and Climate Change [1]
PRO	Producer Responsibility Organization
PTI	Press Trust of India
SPCB	State Pollution Control Board
UEEE	Used Electrical and Electronic Equipment
UNU	United Nations University
US	United States
WEEE	Waste Electrical and Electronic Equipment, E-waste

[1] Prior to 2014, the Ministry of Environment, Forest and Climate Change was called the Ministry of Environment and Forests. The abbreviation of the previous name is the most widely used so it will be the one used throughout this document.

1. E-waste: an overview

Advances in information and communications technology (ICT) and increasing innovation and access to electronic and electrical products have benefitted countries, societies, enterprises and consumers across the globe. They are providing new opportunities in sectors such as health, education, entertainment and commerce, to name just a few. The number of people who connect to the global information society and digital economy and benefit from these new opportunities is growing rapidly.

The growth in e-waste is a consequence of the growing demand for electronic and electrical equipment (EEE), which is driven by population growth, rising disposable incomes in developing countries, urbanization, digitalization and other technological advances (Baldé et al, 2017). It has been estimated that by 2020, approximately 50 billion devices will be connected to the internet (World Economic Forum (WEF) and Platform for Accelerating the Circular Economy (PACE), 2019) — that is more than six times the number of people on the planet today.

This demand is also fuelling a competitive and dynamic global electronics industry, which in 2010 was estimated to employ 18 million women and men globally. Decent work challenges and opportunities in the industry – from the extraction of raw materials, to the manufacturing of electrical and electronic products, through to the management of e-waste – have been the subject of several ILO reports.

The 2019 Global Dialogue Forum on Decent work in the management of electrical and electronic waste (e-waste) was the first time the ILO and its constituents – governments, employers' and workers' organizations – discussed the challenges and opportunities related to e-waste in an official ILO meeting. The Forum adopted ambitious recommendations in the points of consensus concerning the protection of workers and the creation of sustainable enterprises and green jobs, which are reflected in the key considerations presented at the end of this report (ILO, 2019b).

1.1. Defining e-waste

The definition of e-waste has been a topic of debate for many years, and the absence of an agreed definition has contributed to the lack of a shared understanding of the size of the challenge.

At its 12th meeting in 2015, the Conference of the Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal adopted technical guidelines on transboundary movements of electrical and electronic waste and used electrical and electronic equipment, which contain the following definition:

"Electrical or electronic equipment that is waste, including all components, subassemblies and consumables that are part of the equipment at the time the equipment becomes waste".[2]

The Solving the E-Waste Problem (StEP) initiative, hosted by the United Nations University (UNU), defines e-waste as "all types of electrical and electronic equipment (EEE) and its parts that have been discarded by the owner as waste without the intention

[2] See *Technical guidelines on transboundary movements of electrical and electronic waste and used electrical and electronic equipment*, in particular regarding the distinction between waste and non-waste under the Basel Convention, Appendix I (United Nations Environment Programme, 2015).

of re-use". Items qualify for inclusion if they have "circuitry or electrical components with power or battery supply" (United Nations University/Step Initiative, 2014).

Under a directive of the European Parliament and of the European Council (Directive 2012/19/EU), e-waste is defined as electrical and electronic equipment, "including all components, sub-assemblies and consumables which are part of the product at the time of discarding". The Directive covers the following six categories of electrical and electronic equipment:

i. temperature exchange equipment;

ii. screens and monitors;

iii. lamps;

iv. large equipment (any external dimension more than 50 cm), such as household appliances, information technology and telecommunications equipment, and electrical and electronic tools;

v. small equipment (no external dimension more than 50 cm), such as household appliances, luminaires, musical equipment and toys; and

vi. small information technology and telecommunications equipment (no external dimension more than 50 cm).

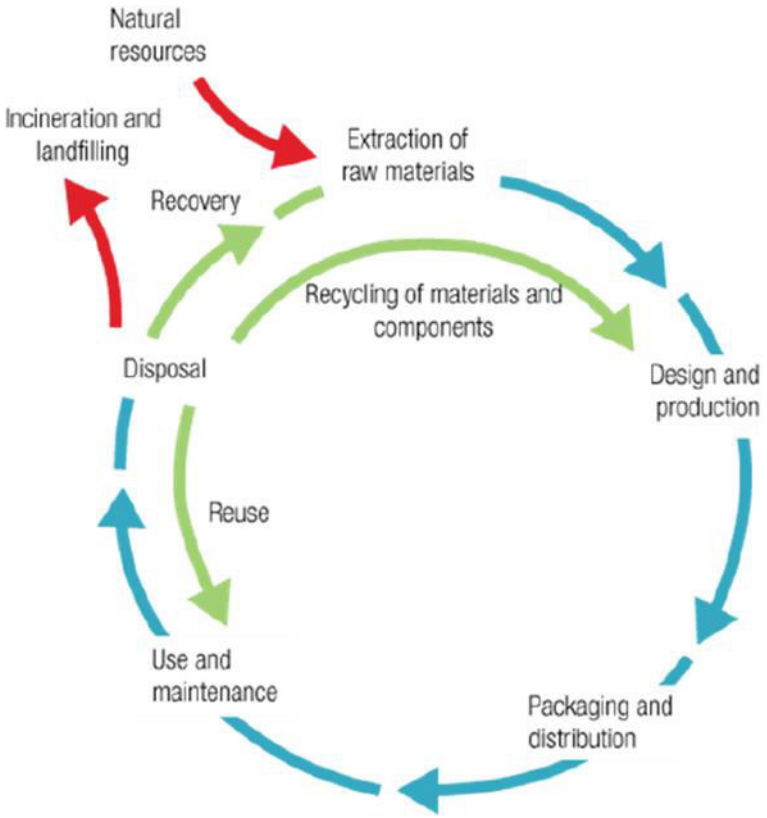
Differing definitions mean that materials considered as e-waste in one country may not be considered e-waste in another. Indeed, in some countries, e-waste is narrowly defined simply as electronic waste, whereas in other countries, it comprises both electronic and electrical waste (Baldé et al., 2015). Furthermore, definitions of e-waste often exclude certain products which contain electronic or electrical components. Cars, for instance, are not covered, despite the fact that they contain many different kinds of electrical and electronic components.

The term "e-waste" itself can be misleading, since it overlooks the inherent value of the discarded products. In 2016, the total global value of all raw materials in e-waste – including gold, silver, palladium, copper, aluminium and iron – was estimated at €55 billion (Baldé et al, 2017, p. 54).

1.2. Approaches to e-waste

Since the 1990s, discussion of e-waste has focused on actual and potential environmental damage; on major risks to human health, workers and communities; and on the flows of e-waste from developed to developing countries. Past policy recommendations have focused overwhelmingly on the introduction of environmental legislation and regulation. However, there is growing recognition that enterprises, employers, workers, cooperatives and other social and solidarity organizations, as well as ministries of labour or employment, and labour market policies all have a key role to play in advancing decent work in the management of e-waste.

Figure 1. A typical product life cycle

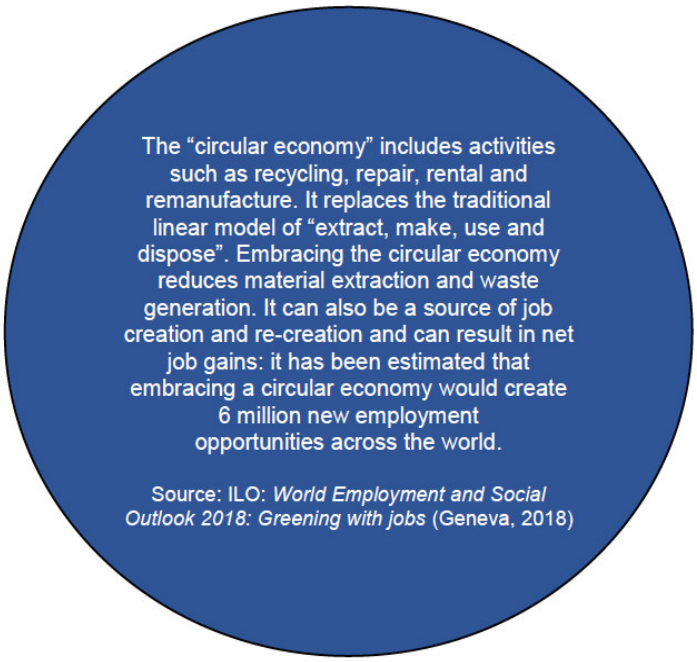


Source: Remmen, Jensen and Frydendal, 2007, p.12.

There is also growing recognition that the prevailing linear model of "take, make, use and dispose" generates waste that could — and should — be reduced throughout the life cycle of electronic and electrical products. If such products are designed to last longer, and if more e-waste is recovered, reused and recycled throughout the life cycle, there will be a reduced demand for virgin materials and less waste will be generated from the extraction of raw materials, packaging and transport.

Moreover, in applying a circular economy approach (see Figure 2), e-waste comes to be seen as a resource that, if properly managed, can support livelihoods, generate employment, provide access to technology, enable technological upgrading, skills and knowledge transfer, and provide capital to produce second-hand commodities and to recover materials (Lepawsky, 2015).

Figure 2. The circular economy



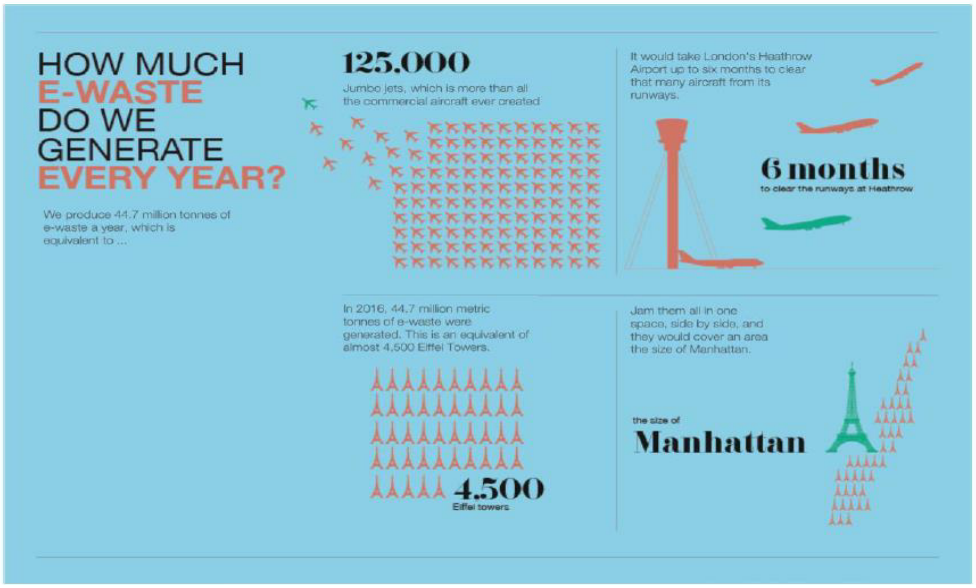
With the adoption of the 2030 Agenda for Sustainable Development, the issue of e-waste management became part of the broader quest for sustainability, including through sustainable production and consumption and shaping a future that works for all at all stages in the circular economy. Advancing decent work in the management of e-waste is key to the achievement of a number of the Sustainable Development Goals – including those on good health (Goal 3), industry, innovation and infrastructure (Goal 9), sustainable cities and communities (Goal 11), responsible consumption and production (Goal 12) and partnerships for the goals (Goal 17) – but particularly Goal 8, to "promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all" (Baldé et al., 2017).

Figure 3. E-waste management key to the achievement of Sustainable Development Goals

1.3. Generation of e-waste globally

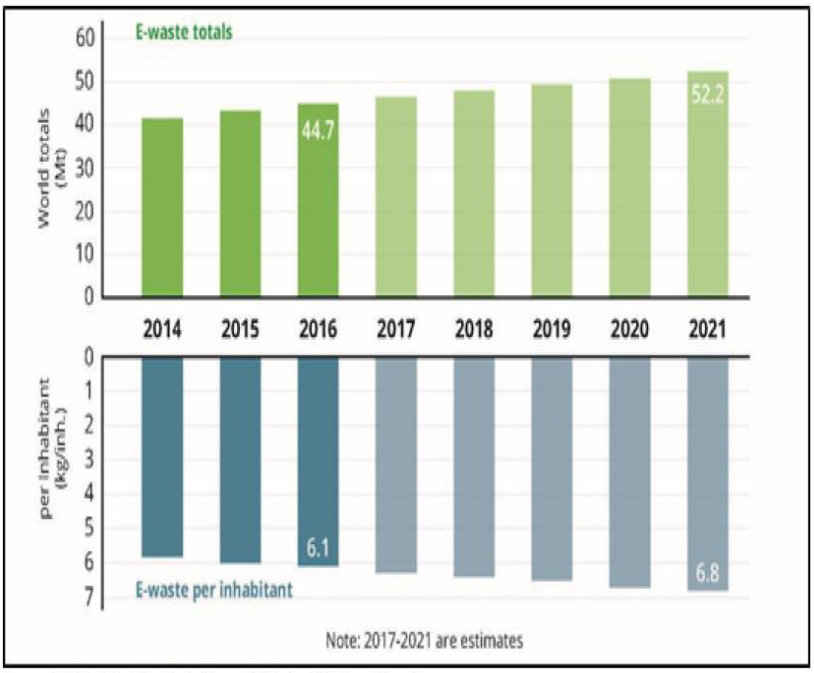
E-waste is generated by both the public and private sectors as well as by individual consumers. In 2016, a total of 44.7 million tonnes of e-waste was generated globally (see Figure 4). E-waste is the fastest-growing waste stream. It is expected to grow to 52.2 million tonnes by 2021, at an annual growth rate of between 3 and 4 per cent (see Figure 5).

Figure 4. E-waste generated globally



Source: WEF and PACE, 2019.

Figure 5. Actual and projected growth in global e-waste generation



Source: Baldé et al.: *The Global E-waste Monitor 2017*, op. cit., p. 5.

The limitations of the statistics on e-waste include the fact that only 41 countries have collected data. Data is especially lacking on the amount of e-waste generated, managed and traded. Furthermore, e-waste is commonly measured by weight, which does not indicate a given product's propensity for ecological harm (Lepawsky, 2018; Liboiron, 2013).

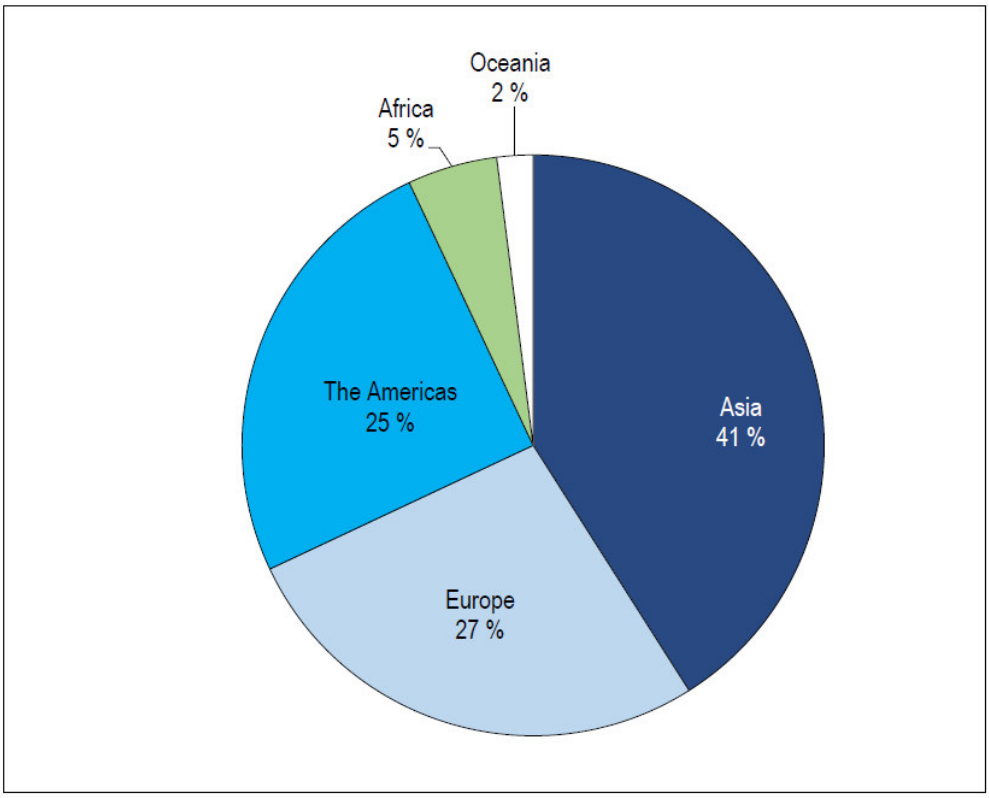
It should also be noted that e-waste statistics generally do not account for the significant amount of waste and pollution generated during the extraction and transportation of raw materials for the production of EEE, or when such products are manufactured, distributed and sold. The life cycle of a mobile phone is a case in point: extraction and production of raw materials generate 80 per cent of total greenhouse gas emissions, compared to 14 per cent from mobile phone use, and just 1 per cent from end-of life treatment (Lepawsky, 2018; Liboiron, 2013).

1.4. Generation of e-waste by regions

E-waste is currently the fastest growing waste stream on the planet. It is increasingly being generated in developing economies and can no longer be associated with developed countries alone (Holgate, 2018). The newly emerging middle class in developing countries – who aspire to have the same or similar electronic products as those enjoyed by their counterparts in the developed world – reached more than 3 billion people in 2016 and this number is expected to grow annually by 160 million in the next five years (Kharas, 2017; Cooper, 2005). This is creating an unprecedented global demand for electronic products. China and India are having the greatest impact on the current growth of electronics consumption and, as a result, on global e-waste generation.

In 2016, a total of 18.2 million tonnes of e-waste was generated in Asia, accounting for 41 per cent of e-waste generated globally. As shown in Figure 6, Asia generates the largest share of e-waste (41 per cent), followed by Europe (27 per cent) and the Americas (25 per cent). Africa generates approximately 2.2 million metric tonnes of e-waste, which accounts for just 5 per cent of the total.

Figure 6. E-waste generated in 2016, by region

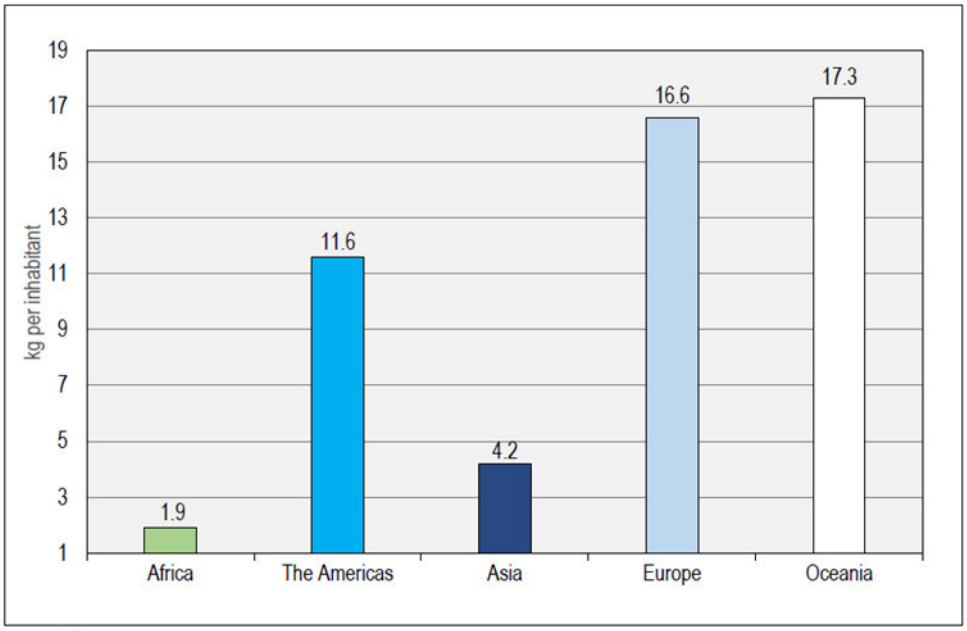


Source: ibid.

The picture changes when e-waste is measured per capita: inhabitants of Oceania [3] generated more e-waste per capita than those of Europe, the Americas, Asia or Africa (see Figure 7). This is a reflection of how in developed countries such as Australia and New Zealand, individual consumers, public and private sectors generate more e-waste per inhabitant than developing countries. Asia currently has the second lowest rate of e-waste generation per inhabitant, with each inhabitant generating 4.2 kg of e-waste on average.

[3] For the statistics discussed in this section, the Oceania region includes data from the following countries: Australia, Fiji, Kiribati, Federated States of Micronesia, New Zealand, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu.

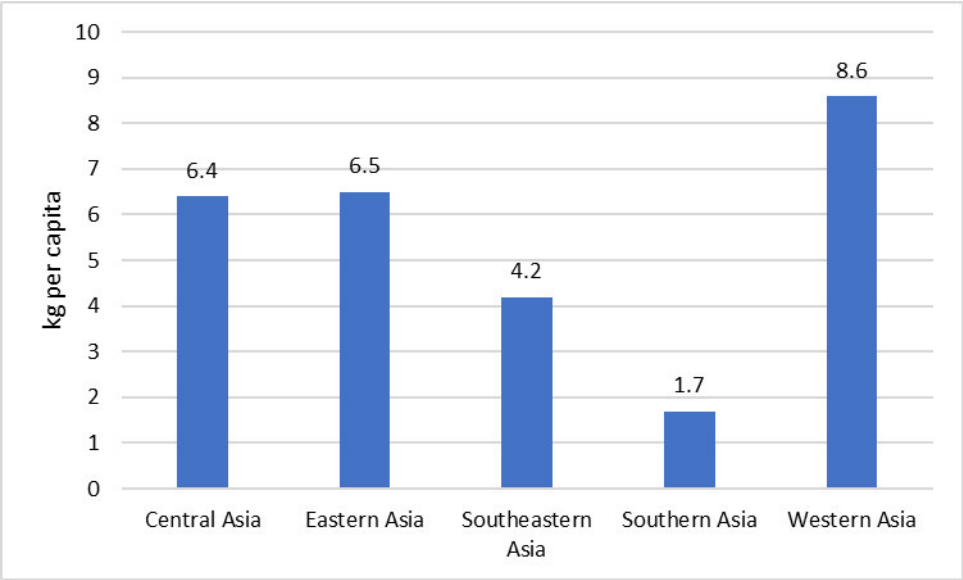
Figure 7. E-waste generated per inhabitant by region (kg per inhabitant)



Source: ibid.

However, Asia is a heterogeneous region. Countries range from developing to industrialized nations, resulting in large differentials in e-waste generation per capita as seen below in Figure 8.

Figure 8. E-waste generated per capita in Asian sub regions



Source: ibid

E-waste collection rates vary too. The official collection rate for e-waste is approximately 25 per cent in East Asia, whereas in Central and South Asia the official collection rate remains at zero per cent, and collection is mostly managed by the informal sector (Baldé et al., 2017).

The social and environmental sustainability of e-waste management operations is further jeopardized by the illegal trade of e-waste from developed to developing countries. The United Nations Environment Programme (UNEP) estimates that up to 90 per cent of global e-waste flows are illegally traded or dumped each year (UNEP, 2015).

1.5. The Indian context

India is a fast-growing emerging economy at a critical juncture in its development trajectory (ILO, 2018). India's Gross Domestic Product (GDP) has grown rapidly over the last two decades and GDP per capita has doubled over the past ten years although recently this pace of growth has begun to slow.

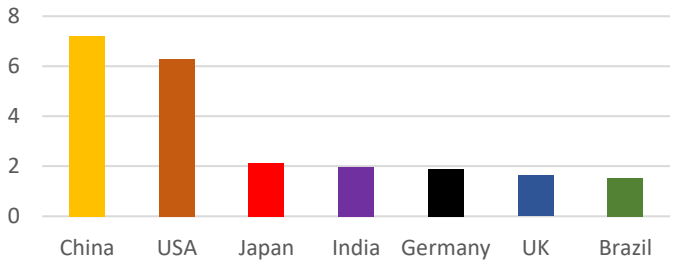
India is undergoing a rapid transition from a predominantly agricultural economy to one dominated by services, whilst relying on some strong emerging manufacturing industries, including EEE manufacturing. Industrialization, along with rapid technological progress, climate change, globalization and migration are also impacting the Indian labour market. Three main obstacles the country faces to achieving inclusive economic growth are its large youth population, high rate of informality and low female labour participation rate (ILO, 2018).

In light of these challenges, the Government of India, the employers' and workers' organizations of India, in the ILO Decent Work Country Programme (DWCP), selected increasing female labour force participation; tackling the high levels of informality; and addressing the small role played by manufacturing in job creation as policy priorities in the world of work. Although manufacturing is expected to absorb more workers, the ILO DWCP in India identifies persistent challenges, including but not limited to, employment opportunities for youth and women, re-skilling and up-skilling, establishing sustainable enterprises, green jobs and transitioning from informal to the informal economy (ILO, 2018).

1.5.1. The e-waste challenge in India

As the fourth largest generator of e-waste in the world – after China, the United States and Japan (see Figure 9) – India generated nearly 2 million metric tonnes of e-waste. In 2016, 70 per cent of this originated from computer devices. Mobile phones are another significant source of e-waste in the country: of the more than one billion mobile phones in circulation, 25 per cent end up as e-waste (Associated Chambers of Commerce and Industry of India (ASSOCHAM) and KPMG, 2017).

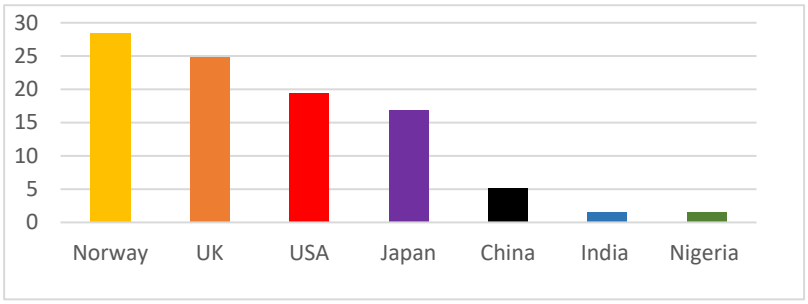
Figure 9. Seven countries with the most domestic e-waste generated in 2016 (metric tonnes)



Source: Based on Baldé et al. 2017

Per capita, India's generation of e-waste is much lower than developed economies, such as Japan, the United States or the United Kingdom. When measured per capita, the level of e-waste India produces is the same as Nigeria (1.5. kg of e-waste per person) (see Figure 10).

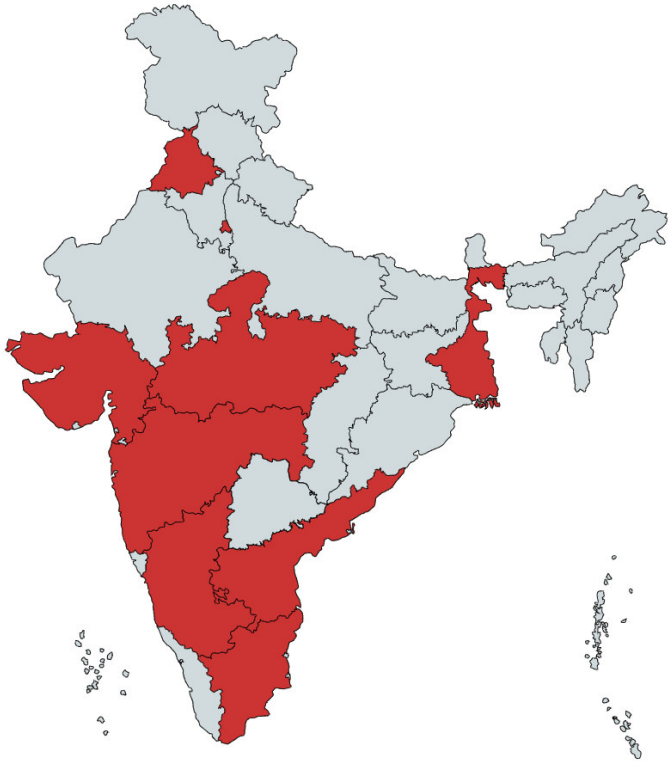
Figure 10. E-waste generated in selected countries in 2016 (kg/inhabitant)



Source: Based on Baldé et al. 2017

E-waste is predominantly generated in urban settings, which is also where most electronics are consumed. The Secretariat of the Council of States' reported in 2011 that 70 per cent of e-waste was generated in ten states, notably those with the largest urban centres: Maharashtra (urban areas of Mumbai, Pune and Nagpur), followed by Tamil Nadu (urban area of Chennai), Andhra Pradesh, Telangana (urban area of Hyderabad), Uttar Pradesh, West Bengal (urban area of Kolkata), Delhi (urban area of Delhi), Karnataka (urban area of Bangalore), Gujarat (urban areas of Ahmedabad and Surat), Madhya Pradesh, and Punjab. Mumbai, Delhi, Bangalore and Kolkata were the top four e-waste generating cities, accounting for nearly three quarters of all of India's e-waste (see Figure 11). However, the Digital India Programme (see section 5.5) is likely to change these dynamics. As more and more electronic and electrical equipment and devices are being made available to people in rural areas, the generation of e-waste can be expected to expand to semi-urban and rural areas as well.

Figure 11. States with the highest level of e-waste generation in India



Source: Based on Rajya Sabha Secretariat, 2011 and Singh and Kumar, 2013.

Moreover, in 2014, the Prime Minister of India, Mr Narendra Modi, launched the 'Make in India' programme to promote the country as a global manufacturing hub and strengthen its economy. This national programme has helped put India on the path of becoming a hub for hi-tech manufacturing — global giants such as GE, Siemens, HTC, Toshiba, and Boeing have all either already set up or are in the process of setting up manufacturing plants in the country (IBEF, 2019).

The conscious efforts to modernize and digitalize the Indian economy, the associated increase in the population's spending power and the sharp rise in the number of middle-class consumers[4] are contributing to a rapid increase in the consumption of EEE. According to estimates by the Indian Ministry of Electronics and Information Technology (MeitY) (n.d.a), demand for electronics hardware is expected to reach US$ 400 billion in 2020. India is expected to generate 5.2 million metric tonnes of e-waste per annum by 2020, which translates into a 30 per cent compound annual growth rate of e-waste (ASSOCHAM and cKinetics, 2016).

In addition to the e-waste it generates domestically, India is also one of the key destination countries for e-waste flows from the rest of the world, with the main destinations being Mumbai, Chennai, and Ahmedabad. Although the Government of India keeps no official records of the e-waste flowing into the country, the Manufacturers' Association for

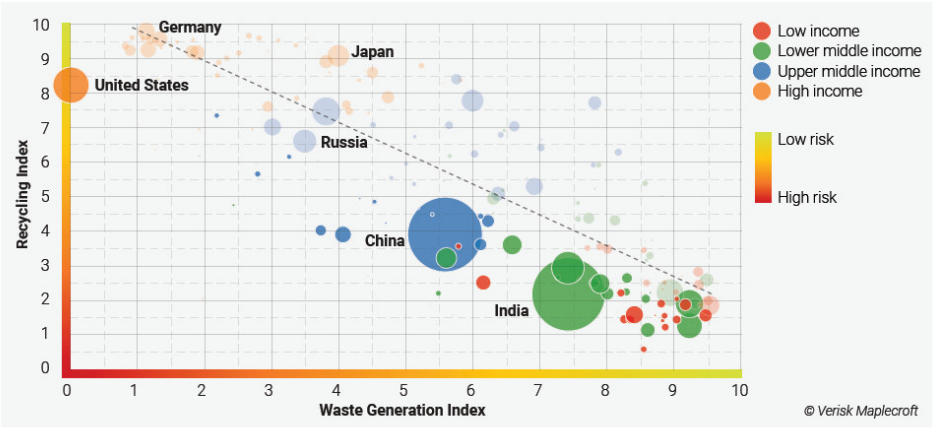
[4] Between 2004-5 and 2011-2, the Indian middle class – defined as those spending between US$ 2-10 per capita per day – doubled in size to reach nearly half of the country's population (Krishnan and Hatekar, 2017).

Information Technology – an industry body representing the information-technology sector – reported that India received around 50,000 tonnes of e-waste in 2007 (Kaur, 2018).

Importing e-waste for disposal is banned in India under the Hazardous and Other Wastes (Management and Transboundary) Rules 2016. Formal businesses that wish to import e-waste for treatment must obtain an operating license from the Government; in the past five years, no such license has been granted (ibid). However, there continue to be reports of illegal inflows of e-waste. Since the e-waste recycling industry operates predominantly in the informal sector (as discussed in the chapters below), it can be assumed that most domestic and imported e-waste in India is treated in informal and unsafe conditions.

Building on the Environmental Protection Act of 1986 and the Hazardous Wastes (Management and Handling) Amendment Rules of 2003, India first introduced e-waste regulations in 2008 (National Insititution for Transforming India (NITI) and MeitY, 2019). Nevertheless the country is facing a significant challenge in keeping up with the growing amounts of e-waste that it generates each year. Figure 12 below represents how much global economies are recycling as a function of their waste generation. The figure uses two indices developed by Verisk Maplecroft, a United Kingdom based risk assessment consultancy, to map waste generation and recycling quantitatively. The Waste Generation Index represents the rate of waste production at the country level.[5] The Recycling Index assesses a country's willingness and ability to manage solid waste in a manner that promotes circular material flows. [6]

Figure 12. Global comparison of Recycling Index as a function of the Waste Generation Index



Source: Verisk Maplecroft, 2019

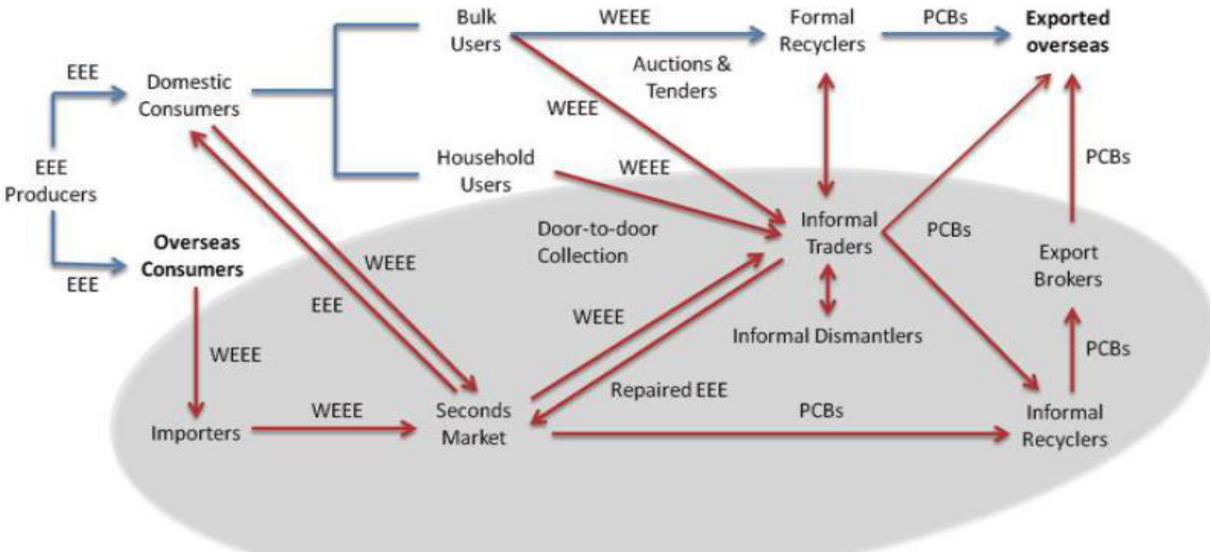
The diagonal line in Figure 12 represents the conditions where a country's Recycling Index is equal to its Waste Generation Index. Countries mapped above the line are recycling more than the amount of waste they generate, and those mapped below the line are recycling less. Although India is not producing nearly as much waste as developed economies, it is still lagging behind when it comes to recycling the waste it does produce (Verisk Maplecroft, 2019). Investing in waste management infrastructure in general, and introducing recycling systems for e-waste in particular, are key to ensuring safe and responsible e-waste processing in India (Heeks, Subramanian and Jones, 2015).

[5] Includes municipal solid waste (MSW) hazardous waste, food waste and plastic waste.

[6] Measures national rates of recycling, collection and adequate disposal as well as government's commitment to international treaties on waste.

2. Mapping the e-waste value chain and its actors

Figure 13. Indian material flow within and across WEEE formal and informal economies



Legend:

EEE	electrical and electronic equipment
WEEE	waste electrical and electronic equipment
PCB	printed circuit board
grey zone	informal economy
blue arrows	formal activities
red arrows	informal activities

Source: based on Laha, 2014

The e-waste value chain in developing countries is complex, with interlinking dynamics between formal, semi-informal and informal actors (see Figure 13). Wilson, Velis and Cheeseman (2006) have characterized the informal waste-management economy as small-scale, labour-intensive, largely unregulated and unregistered, with a focus on providing low-technology manufacturing or services. It is estimated that 95 per cent of the recycled e-waste in India is processed informally (GIZ, 2017).

2.1. Manufacturers and distributors

The e-waste value chain begins with the original equipment manufacturers, including but not limited to suppliers in China, Japan, Korea, the United Kingdom, the United States and Viet Nam. India is also emerging as a new manufacturing hub for electronic equipment. The 2018-2019 annual report from the Reserve Bank of India (RBI) showed that India's production of electronic goods more than doubled in value terms, from US$ 31.2 billion in the 2015 fiscal year to US$ 65.5 billion in the 2019 fiscal year, and that this growth was led by the production of mobile phones. Indeed, India has replaced Viet Nam as the second largest producer of mobile phones in the world; only China produces more (RBI, 2019, p. 70).

Distributors are entities that buy EEE and UEEE from various sources and sell to consumers directly. Distribution networks and sales channels in India have expanded significantly in recent years. The total number of retail distribution outlets in the country

is estimated at over 12 million, mostly family owned businesses, many of which sell EEE. Moreover, India is expected to become the world's fastest growing e-commerce market, driven by robust investment in the sector and the rapid increase in the number of internet users. Online retail sales are expected to double from US$ 32 billion in 2018 to US$ 60 billion by 2020 (ITA 2019).

2.2. Consumers

Consumers of new EEE and UEEE can be divided into three categories: private, institutional and corporate consumers (See Table 1).

Table 1. Categories of consumers of e-waste

Private Consumers	Institutional Consumers	Corporate consumers
• Households • Family businesses (predominantly agriculture)	• Public institutions Government • Health and education sector	• Large businesses • Industries • Small and medium enterprises (SMEs)

Despite the steady rise in the number of private consumers of electronics in India, it is estimated that more e-waste is generated by state-owned and private businesses and the public sector than by Indian households. Government institutions alone are estimated to generate approximately 15 per cent of the country's e-waste (Rajya Sabha Secretariat, 2011).

A study evaluating challenges of e-waste collection found that private consumers in India refused to deliver or recycle UEEE or e-waste without any financial incentive because it was considered a valuable commodity. By providing such financial incentives, the informal sector has contributed to increased collection rates (Shevchenko, Laitala and Danko, 2019).

2.3. Refurbishers

The global electronic equipment repair service market is anticipated to reach US$ 160.2 billion by 2024 and grow at a compound annual rate of over 8 per cent during 2019-24 (MarketWatch, 2019). India is in many respects leading the way as it has a lucrative market for reusable products through repair, reconditioning, component reuse, and refurbishing shops.

Refurbishers perform an extremely important role in the emerging circular economy for electronics, as they extend the lifetime of both new and used EEE. However, in doing so they invariably also generate e-waste from UEEE that cannot be repaired. Due to a lack of infrastructure and waste management systems, this e-waste is not always disposed in a safe and environmentally sound manner.

2.4. Collectors

Traditionally, India has had a longstanding culture of circularity. However, in the early 1990s, rapid growth and increased consumption pushed the country towards a linear system of production which was more compatible with global trade, global supply chains and economies of scale. This resulted in the traditional values of reuse and repair being pushed to the fringes and the jobs associated with the end of the value chain being transferred to the informal economy where they exist today (NITI and MeitY, 2019).

However, in recent years the return of circular economy principles has brought these traditional Indian values back into the mainstream. Businesses have begun to adopt resource efficiency and circular production in their operations, creating opportunities for the formal waste management sector. Formal enterprises, supported by the Ministry of Electronics & Information Technology (MeitY), are now involved in collection, repair, reuse and recycling, along with various civil society organizations (NITI and MeitY, 2019).

Nevertheless, the collection and segregation of e-waste is predominantly carried out in the informal sector (corresponding with the grey area of the diagram in Figure 13). Informal workers in a variety of occupations perform various interlinked and hazardous tasks such as collecting, segregating, sorting, disassembling, dismantling, shredding, burning, leaching, disposing and exporting electronic and electrical waste (Frost & Sullivan and ASSOCHAM, 2015).

The collection phase involves informal collectors, waste pickers, and door-to-door waste buyers, also known as kabadiwalas, who make up the two lowest rungs in the e-waste sector hierarchy, as illustrated in Figure 14. These kabadiwalas or kabaddis, who are predominantly women, are crucial intermediaries in India's recycling industry who have historically engaged in door-to-door scrap and e-waste collection as well as its resale (see Box 1). In the absence of adequate municipal infrastructure, their activities have long taken the place of local governments in waste collection for recycling. Even though most of these actors are not formally organized, they perform a critical role in the e-waste value chain (Laha, 2014).

Box 1. SWaCH front-end waste management services cooperative in Pune

SWaCH is a formal cooperative of waste collectors that covers over 70 per cent of the city of Pune, a wholly owned workers' cooperative that integrates door-to-door waste collection work. It was formed as a pilot programme in 2005 in collaboration with the Kagad Kach Patra Kashtakari Panchayat trade union and the Pune Municipal Corporation. The programme allowed 1500 waste pickers to become formal service providers for the door-to-door collection of waste from 125,000 households in Pune.

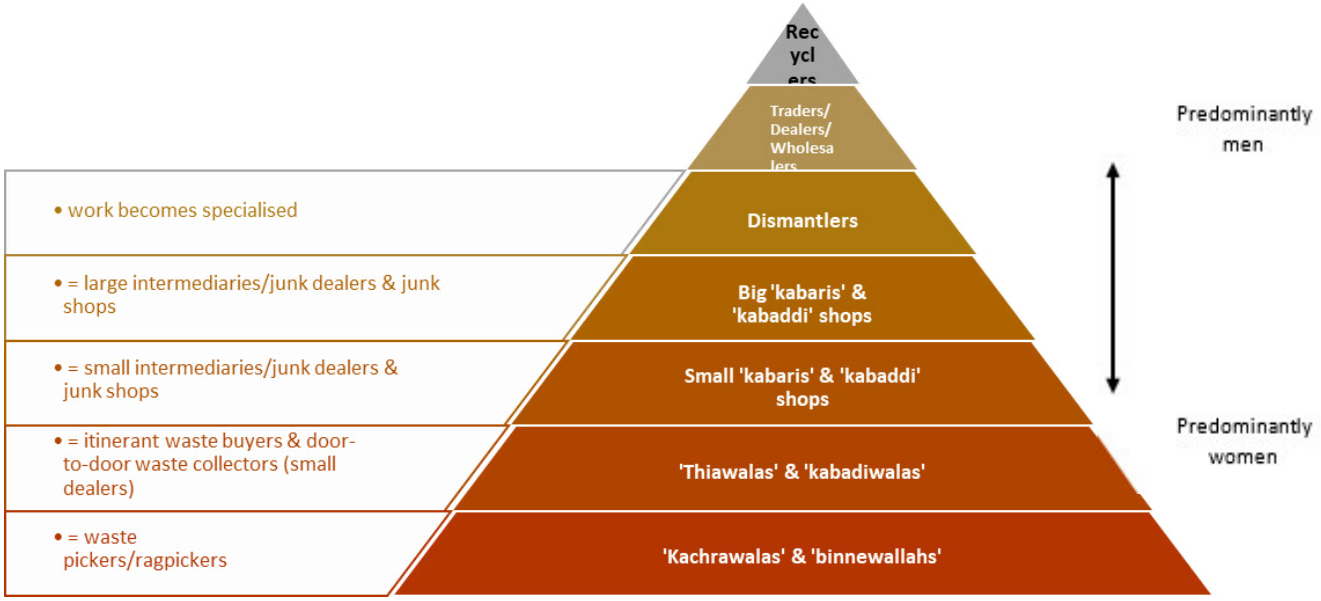
After the Ministry of Environment, Forest and Climate Change's (MoEF) amended regulations on e-waste management, SWaCH and its producer responsibility organization, Karo Sambhav Pvt. Ltd., became the Maharastra Pollution Control Board's first authorized e-waste collection agency. By allowing waste pickers to become service providers for the door-to-door collection of waste, the gap between households and municipal waste collection services was bridged and the waste pickers' working conditions and livelihoods were considerably improved.

It is also notable that many SWaCH members, like Sughandhabai, featured on the SWaCH website, are women. The cooperative is supporting women in the Indian workforce and allowing them to improve their livelihoods and those of their families.

The project is supported by the International Finance Corporation (IFC) and by several industry multinationals, such as Dell, HP and Lenovo. SWaCH has been handling an average of 500 metric tonnes of e-waste annually since 2014 (SWaCH, 2019).

Some e-waste collectors carry out primary segregation, which consists of classifying the different types of recyclables and separating e-waste components. They resort to manual dismantling, using screwdrivers, hammers, chisels, and their bare hands, to separate various components (ILO, 2019a). These informal waste collectors tend not to have the space and tools to transport e-waste in large quantities. Instead, they sell in small quantities to informal traders and/or dismantlers.

Figure 14. Informal e-waste sector hierarchy with segmentation by sex



Source: Own representation based on Laha 2014, Toxics Link 2012, GTZ and Sycoms Projects Consultants 2010, CHINTAN 2004, Lines et al. 2016.

2.5. Bulk traders

After collection, e-waste is traded by informal junk shops (small or large) and sold on to dismantlers or recyclers, who use their manual skills or specific recycling equipment to extract value from the waste (Khanna et al., 2014). Given the high demand for printed circuit boards (PCBs), some may separate the components of PCBs by heating them over coal-fired grills.

Bulk traders tend to have greater capacity to store and transport larger quantities and thus sell directly to dismantling workshops, informal recycling workshops, or formal recycling businesses at better prices.

2.6. Dismantlers and recyclers

Recyclers can be defined as any individual or organization engaged in dismantling, separating components and recovering metals from e-waste. Recyclers are primarily interested in aluminium, copper and steel fractions. The fractions separated by recyclers are sold to manufacturing suppliers as secondary raw materials.

Some components of electronic and electrical devices might reach formal recyclers through auctions and tenders. However, as stated above, approximately 95 per cent of e-waste recycling in India occurs in the informal sector. Because e-waste includes large

amounts of fractions that are of no economic value, informal recyclers generate a large amount of waste; which is often disposed of improperly, in an uncontrolled environment.

PCBs, which contain significant amounts of hazardous components and recoverable precious metals, are particularly sought after by trading shops, dismantlers and recycling facilities. Metals such as gold are stripped from electronic components in open-pit acid baths, plastics are chipped and melted without proper ventilation, and cables are burnt in the open air to recover copper. Contaminated and toxic waste waters deriving from these operations are often discharged into common water bodies, and the non-usable parts are discarded in unsanitary landfills, further affecting the environmental quality and health of nearby communities.

2.7. Recycling enterprises

As of June 2019, 312 formal recycling enterprises were registered with the Central Pollution Control Board (CPCB). [7] This constitutes a significant improvement compared to the 178 recycling enterprises registered in 2016.

There are formal recycling facilities located in 18 of the 29 Indian states (see Box 2). Together, they process approximately 782,000 metric tonnes of e-waste per annum, which is less than 40 per cent of the e-waste generated in India every year. Most of the e-waste sent to formal recycling facilities comes from bulk consumers (notably government institutions and businesses) who are aware of and abide by India's e-waste rules.

Attero Recycling, E-Wardd, E-Parisaraa and Earth Sense Recycle were among the first formal recycling facilities in India to be registered with the CPCB and the MoEF. Attero Recycling Private Ltd. and Sims Recycling Solutions continue to be two of the major formal e-waste recyclers in the country. Acer India and Samsung India, for instance, have partnered with Attero to ensure that e-waste deriving from their products would be recycled in accordance with the applicable environmental standards.

The formal system directly links producers, consumers and recyclers, without the need for intermediaries, traders or dismantlers. For instance, Attero Recycling, India's largest electronic asset management company, has the capacity to collect and process about 1,000 metric tonnes of e-waste each month and extract valuable metals in an environmentally responsible manner (Timmons, 2013).

However, recent accounts indicate that large formal recycling plants are unfortunately finding it difficult to collect sufficient e-waste to meet their targets and operate at full capacity. For various reasons, many bulk traders prefer to auction their e-waste to the informal sector. For example, they may make more money from informal traders, they may be unaware of the e-waste policies in place and how the formal system operates, or they may find the door-to-door collection service offered by informal actors quicker and easier to do business with (Bhaskar and Turaga, 2017).

[7] The list of registered recyclers and dismantlers in India as of June 2019 is available at https://cpcb.nic.in/uploads/Projects/E-Waste/List_of_E-waste_Recycler.pdf.

Box 2. Geographic distribution of e-waste recycling

E-waste recycling in India tends to be functionally specialized. For instance, lead recovery takes place in Mustafabad (New Delhi), gold recovery in Meerut, and recharging of cathode ray tubes in Shastri Park (New Delhi).

The vast majority of e-waste recyclers are located in densely populated urban areas, intermingling with residential or community areas (Agarwal and Wankhade, 2006). Some of them form 'small, unregistered, labour-intensive units' situated in industrial districts. They have frequently been described as 'backyard recycling units', which lack environmental protection and labour standards. Other forms of semi-informal labour structures include employment in family-run enterprises, casual and homework among others (Lines et al., 2016).

In terms of the geographic distribution of the e-waste value chain, New Delhi operates as the largest and most complex e-waste recycling market, followed by Bangalore and Chennai. According to Agarwal and Wankhade (2006), informal operation clusters in New Delhi were located in Karkarduma, Kirti Nagar, Lajpat Nagar, Mandoli, Mayapuri, Mustafabad, Nehru Place, Old Seelampur, Shastri Park, Turkman Gate; Meerut and Firozabad. There are additional centres for e-waste recycling near Delhi. The Parliament of India also noted the involvement of Bawana, Mandawali, Maujpur, Mustafabad, Narela and Shastri Nagar (Rajya Sabha Secretariat, 2011).

As this chapter illustrates, the e-waste sector is extremely complex, with informal and formal actors deeply interconnected. On the one hand, informal e-waste collection is hazardous with significant risks to the health of humans, local communities and the environment. On the other hand, the e-waste value chain presents tangible opportunities for job creation and sustainable enterprise development (Kumar, Holuszko and Espinosa, 2017). Various new entrants to the e-waste handling and recycling markets are attracted by growing demand for secondary raw materials found in e-waste, which are much more profitable than materials found in solid waste recyclables.

The rise of 'urban mining' – the possibility of recovering valuable metals – is considered to be up to 50 times more effective than mineral extraction from mines (Harvey, 2013). Formal recyclers are not only aware of these extensive market opportunities, but are already heavily engaged in competing for informal market shares. At the same time, e-waste actors at the bottom of the e-waste value chain pyramid continue to face deep inequalities, poverty and exploitation.

3. Decent work dimensions of e-waste

The ILO's decent work agenda serves to advance economic and working conditions that give all workers, employers and governments a stake in social justice, prosperity and progress. In 2013, the International Labour Conference identified waste management and recycling as one of three economic sectors (along with agriculture and construction) which present significant opportunity and an immediate need to advance decent work[8].

The decent work agenda is highly relevant to the management of e-waste because it addresses inter alia: employment and job generation, occupational safety and health, child labour, informality, working conditions, and social dialogue, with gender equality as a cross-cutting concern.

3.1. Jobs in e-waste management

There is no reliable data available on the number of workers in e-waste management in India, in either the formal or the informal sectors.

However, a few studies and reports do contain broad estimates of the number of e-waste workers and informal waste collectors. A 2018 study by the Associated Chambers of Commerce and Industry of India (ASSOCHAM), estimated that around 600,000 people work in official and unofficial e-recycling units in India's capital alone (ASSOCHAM, 2018).

What is clear is that the e-waste sector makes a substantial contribution to employment creation in both the formal and informal sector. According to the Press Trust of India (PTI), in April 2019, the IFC stated the e-waste sector could create approximately 450,000 direct jobs and 180,000 indirect jobs in areas such as transportation and manufacturing (PTI, 2019). However, it is also clear that, in order for the industry to contribute to the creation of sustainable enterprises and decent jobs, a circular economy approach and integrated policies are needed.

A study by the ILO and Women in Informal Employment: Globalizing and Organizing (WIEGO) (2013) reported that an estimated 0.2 per cent of women in informal employment and 0.1 per cent of men in informal employment were waste pickers in urban India. The Alliance of Indian Waste pickers (AIW) [9] claims that there are around 1.5 million workers involved in waste picking. The Alliance alone represents more than 40,000 individual members in 34 cities and 10 states across the country (AIW, n.d.). Despite the lack of reliable estimates of employment in India's e-waste sector, it is clear that processing e-waste is seen a source of livelihood for the urban and rural poor.

3.2. Occupational safety and health

Work with e-waste presents severe risks to human health and the local environment unless it is managed better (Schluep et al., 2009). Ground and water pollution levels in areas where illegal e-waste recycling operations exist are higher than in areas where such

[8] See *Report V: Sustainable development, decent work and green jobs (ILO, 2013)* https://www.ilo.org/wcmsp5/groups/public/---ed_norm/---relconf/documents/meetingdocument/wcms_207370.pdf

[9] The AIW secretariat is hosted in the Dalit Bahujan Resource Centre (DBRC) from April 2019.

activities do not exist (Panwar & Ahmed, 2018). The risks that e-waste pose to human health and the environment are outlined in the 2012 ILO report *The global impact of e-waste: Addressing the challenge* (ILO, 2012).

Because of these risks, individuals face several occupational safety and health (OSH) hazards including physical injuries, respiratory problems, asthma, gastro-intestinal and musculo-skeletal ailments, skin diseases and long-term incurable diseases such as cancer (Ganguly, 2016; Park, 2019; Grant et al., 2013; Global Alliance of Waste Pickers, n.d.). Additionally, informal workers generally face higher OSH risks as they tend to work without protection such as gloves or masks, and are exposed to released gases, acid solutions, toxic smoke and contaminated ashes. Many workers treat e-waste in their own homes, further exposing themselves and their families.

Awareness of how OSH control measures and procedures should be applied in the handling and processing of e-waste is very low. Many e-waste dismantling and recycling operations lack protective measures for workers, such as the enclosure of hazardous processes, the use of exhaust ventilation systems, or the provision of personal protective equipment (PPE). As a result, informal recyclers are exposed to burns, cuts, and inhalation of highly toxic fumes (Akormedi, Asampong and Fobil, 2013; The Lancet, 2013).

In order to address the risks faced by waste collectors, in 2010 the ILO developed a participatory, action-oriented training methodology, named the Work Adjustment for Recycling and Managing Waste (WARM) (Kawakami & Khai, 2010), which aims to use simple, low-cost improvement measures to improve the safety, health and efficiency of waste collection work. That training methodology has recently been adapted for use in the informal e-waste economy in India (Kawakami, 2019). A pilot training workshop was carried out in New Delhi, where managers and workers in informal e-waste workplaces actively discussed the improvements of their safety, health and working conditions.

3.2.1. Child labour

According to the report by ASSOCHAM and cKinetics (2016), about 35,000 to 45,000 children between the ages of 10 and 14 participate in scavenging (waste picking) and dismantling in the informal recycling sector in Delhi, India. Other reports claim that children as young as five to eight years old are also employed (Ganguli, 2016).

As children are still developing, they are more susceptible to threats posed by toxic substances from e-waste components as well as those released from e-waste processing activities. They may be at higher risk of suffering from permanent disabilities, asthma, psychological, neurological damages and stunted bone development. Specific substances can affect children in the following ways (Two Sides, 2014):

- The impact of exposure to lead is severe for children, resulting in damage to the brain and nervous system and possibly in lifelong behavioural, developmental, and learning problems;
- Chromium can cause severe allergic reactions; and
- An accumulation of Polybrominated Biphenyls (PBBs) may cause an increased risk of cancer in the digestive and lymph systems.

3.3. Informality

Although there is no specific or reliable data on the size and recycling performance of the informal e-waste recycling sector in India, it is estimated that approximately 95 per cent of India's e-waste management and recycling operations happen in the informal economy (GIZ, 2017).

According to the ILO's definition, workers and enterprises are considered to be part of the informal economy if they perform activities that are, in law or practice, not covered, or insufficiently covered, by formal arrangements (ILO, 2015). Some jobs in the formal economy are also considered informal if workers do not have access to employment benefits and social protection (Srija and Skirke, 2014; ILO, 2016).

The ILO Transition from the Informal to the Formal Economy Recommendation, 2015 (No. 204), provides guidance to governments, employers and workers on how they can promote employment and income opportunities, rights and social protection for the millions involved in the transition to the formal economy, including in the management of e-waste. A key challenge in formalizing e-waste management will be transforming the existing networks of e-waste management to improve the safety and health, working conditions and rights of workers while ensuring that existing livelihoods are preserved and improved.

3.4. Wages

The high incidence of informality means that information about the wages of workers in the e-waste value chain is not readily available. However, available studies and notifications indicate that e-waste workers are earning less or just about the same as the minimum wage:

- A field study in Seelampur – a hub for informal e-waste recycling activities in the Northern outskirts of New Delhi – reports that workers can earn between 200 and 800 Indian Rupees (INR) (approximately US$2.8 – 11) per day for disassembling and separating materials (Park, 2019).

- According to the latest minimum wage notifications issued by the state government between December 2014 and April 2019, the range of minimum wages for the scheduled classes, which include waste pickers, in Delhi is 538 INR to 710 INR (approximately US$ 7.5 – 10) per day (Ministry of Finance, 2019).

- On 23 October 2019, the Office of the Labour Commissioner of the Government of Delhi issued an order for the enhancement of Minimum Wages for the scheduled classes. The order calls for the minimum wages per day for these workers to be enhanced to 569 INR – 751 INR (approximately US $8 – 10.5) [10] according to their skill level and worker category (clerical/supervisory staff or not) (Office of the Labour Commissioner, 2019).

The incomes of collectors and recyclers generally correlate with the amount of scrap that is collected and recycled. Because of their access to higher quality UEEE and the resources or equipment to better separate materials, collectors who have the resources to purchase

[10] All conversions based on the exchange rate on 15 Oct 2019 of 1 Indian Rupee (INR) to US$ 0.014

scrap tend to generate more income than those who rely on free waste. In general terms, incomes and wages are much lower for occupations and tasks at the bottom of the pyramid shown in Figure 14 above.

3.5. Social dialogue

Social dialogue between government and representative employers' and workers' organizations is critical during the development of inclusive policies and integrated sectoral strategies, in order to ensure a just transition towards environmental sustainability, greening of enterprises, social inclusion and the promotion of green jobs in e-waste. The ILO's 2015 *Guidelines for a Just Transition* call on governments to "provide opportunities for the participation of social partners at all possible levels and stages of the policy process through social dialogue and foster consultations with relevant stakeholders"(ILO, 2015).

Consultations with e-waste workers and employers and their respective organizations is particularly important for the recognition of workers, the formalization of their activities and the promotion of decent work. Respect for, and promotion and realization of the fundamental principles and rights at work through the Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87), and the Right to Organise and Collective Bargaining Convention, 1949 (No. 98), is crucial in this regard. However, the informal nature of most work in e-waste and an absence of employers' and workers' organizations in the sector mean that consultations of this kind face considerable challenges in practice. In addition to the traditional social partners, India has a long history of organizations and associations being created to try to overcome some of these challenges, especially in the informal waste management sector (see **Error! Reference source not found.**).

Box 3. Beyond traditional social dialogue

In India, there has been a long history of organizations and associations among informal waste workers, but there are none that focus on e-waste exclusively. The Alliance of Indian Waste Pickers (AIW) is a decade-old national coalition of organizations working with waste pickers and other informal waste collectors. The Alliance was created to coordinate efforts and ensure the inclusion of waste pickers in various national level programmes and to support waste workers in organization/formalization processes. For instance, AIW was key in pushing for the issuance of occupational identity cards to waste pickers. The Alliance currently represents more than 40,000 e-waste pickers and other informal waste pickers in India, and brings together 35 waste picker organizations from different cities.

The AIW lists rights of waste pickers as prescribed in the Solid and Plastic Waste Management Rules 2016. These rights include but are not limited to the right to register and be issued an occupational identity card, the right to training for skills upgrading, and the right to representation in the advisory committee on solid waste management (AIW, n.d.). The social entitlements of waste pickers include training courses and low interest credit to better their livelihoods, enrolment in Ayushman Bharat[11], access to health camps for waste pickers and informal waste collectors, access to personal protective equipment (PPE), pre-matriculation scholarships for children of parents engaged in unclean occupations and participation in the National Urban Livelihood Mission (AIW, n.d.).[12]

In 2018, the All India E-Waste Recyclers Association (AEWRA) was created. The Association is a first attempt to build a common platform bringing all e-waste recyclers and dismantlers together to frame rules and administrative procedures for sustainable solutions. The objective of the Association is to secure the attention of the Government and the corporate sector, and raise awareness among the general public about issues relating to India's e-waste recycling industry. AEWRA also aims to facilitate the exchange of e-waste recycling ideas among its members through education and training. However, it is currently unclear how many members take part in the Association's work and initiatives (AEWRA, 2018).

[11] Ayushman Bharat is a flagship scheme of the Government of India launched in 2017 to achieve universal health coverage. The two pillars of the scheme are the establishment of Health and Wellness Centres and the Pradhan Mantri Jan Arogya Yojana (PM-JAY) which provides health insurance coverage and has been rolled out for the bottom 40% of the poor and vulnerable population (NHA, 2019).

[12] Deendayal Antyodaya Yojana – National Urban Livelihoods Mission (DAY-NULM) is managed by the Ministry of Housing and Urban Affairs and it aims to "reduce poverty and vulnerability of urban poor households by enabling them to access gainful self-employment and skilled wage employment opportunities" (Ministry of Housing and Urban Affairs, 2019).

4. The impacts of e-waste

4.1. Environmental impacts

Different types of EEE contain various chemical substances and pollutants (see Table 2). When disposed of improperly, these can lead to air pollution as well as to soil and water contamination.

Table 2. Pollutants in various types of EEE

EEE	Pollutant
Computers	Lead, mercury, cadmium and beryllium
Batteries (disposable, rechargeable, and lithium)	Cadmium, cobalt, lead, lithium, mercury, nickel, silver and zinc
Mobile phones	Lithium, copper, tin, cobalt, indium, antimony, silver, gold, and palladium
Photocopiers	Mercury, selenium
Circuit boards	Silver, lead, copper, cadmium, brominated flame proofing agent, polychlorinated biphenyls and arsenic
LED (light emitting diodes)	Arsenic
CRT (cathode ray tubes)	Cadmium, lead
LCD (liquid crystal displays)	Mercury

Source: Omole et al., 2015

The methods of handling and recycling e-waste used in India's informal e-waste sector have a significant impact on the natural environment. The burning of e-waste contributes to air pollution, which has become an enormous challenge in rapidly growing Indian cities. Water contamination can occur when heavy metals contained in e-waste (such as lead, barium, mercury, or lithium) reach groundwater, streams and ponds – the main sources of water for many local communities.

Furthermore, chemicals from e-waste are non-biodegradable and, as such, can contaminate soil, which may impact grazing livestock. As most of the chemicals in question have a low metabolic rate in animals, they tend to accumulate in tissue and end up in edible products, such as eggs and milk (Zhang, et al., 2012).

A study of New Delhi's industrial area, Krishna Vihar, where e-waste is informally recycled, analysed its environmental quality and compared it to five non e-waste locations.

The research concluded that there were dangerous levels of toxic heavy metals in soil and groundwater in the area. Copper concentration in the top soil was nearly 30 times higher, and cadmium concentration was 16 times greater, in areas with e-waste activities (Panwar and Ahmed, 2018).

4.2. Impact on health

The negative impacts of the toxins found in e-waste are not just limited to workers but can have detrimental impacts on human health in general. Humans may be exposed via ingestion, inhalation or dermal contact. Table 3 summarizes some of the toxic substances found in e-waste and the adverse effects that they can have on human health.

Table 3. Toxic substances in e-waste and their effect on human health

Materials	Effect on human health
Antimony	Severe skin problems.
Cadmium	Damage to kidney and bone structure, elevated blood pressure. Cadmium is a carcinogen.
Lead	Short-term exposure can initially cause malaise, muscle pain and headache. Long-term exposure can lead to irreversible damage to the nervous system, particularly in children.
Mercury	Short-term exposure can initially cause lung damage, nausea, diarrhoea, skin rashes, and high blood pressure. Long-term exposure damages the central nervous system and kidneys.
Nonylphenol	Damages sperm function and deoxyribonucleic acid (DNA).
Polybrominated diphenyl ether	Affects immune system, interferes with growth hormones, sexual development and brain development. Children who are exposed display increased risk of thyroid disease and neurobehavioural disease.
Polychlorinated biphenyls	Suppresses immune system, damages the liver and nervous system, promotes cancer, causes behavioural changes, and damages male and female reproductive systems.
Polychlorinated naphthalene	Can impact skin, the liver, the nervous and reproductive systems.
Triphenyl phosphate	Contact dermatitis, endocrine disruptor.

Source: Kumar, Holuszko and Espinosa ,2017; Grant et al., 2013

Some of the most significant consequences for human health include: damage to nervous and blood systems; detrimental impacts on the kidneys and on brain development; respiratory disorders; skin disorders; bronchitis; lung cancer; and heart, liver, or spleen damage (Grant et al., 2013). Some of the hazardous chemicals found in e-waste have also been shown to cause certain types of cancer.

Children who work in the sector or live close to e-waste operations sites are particularly vulnerable to the risk of hazardous chemical absorption because, compared to adults, their intake of air, water, and food is significantly higher in proportion to their weight (WHO, n.d.). The exposure to toxins hampers the growth of children's central nervous, immune, reproductive, and digestive systems.

In addition to affecting workers involved in the e-waste value chain, e-waste can also pose a threat to women and men living in cities near recycling sites. A comparative study on the environmental and health impacts of e-waste in China and Nigeria observed significant DNA damage to populations exposed to the processing of e-waste (Alabi et al., 2012).

4.3. Socio-economic impact

While there is no specific data available on the value of the Indian e-waste market and its contribution to GDP, the predominantly informal nature of the e-waste sector and the improper dismantling and recycling processes prevalent in the informal sector, suggest that valuable resources may be being lost.

Informal recycling provides employment and livelihoods to the rural migrants who move to large cities in search of employment. However, many types of waste collection and recycling practices have traditionally been considered to be a 'dirty' profession in India's caste hierarchy. Waste workers belong to one of the most marginalized groups, and are often members of scheduled castes or tribes (Deutsche Welle, 2013; Chikarmane et al., 2001).

Women and children are frequently involved in the lowest-paid jobs of both solid and e-waste management, and do not reap the same profits from their work as men. Jyoti Mhapsekar, President of the Women's Liberation Organization, notes that up to 80 per cent of waste pickers in India are female – often rural migrants, single parents and/or illiterate (Oneko, 2016). According to a 2001 study, 8 per cent of all collectors are sole earners and 45 per cent contribute more than half of their household income. In addition, 50 per cent began their working life in this sector and most see no alternative outside of this occupation (Chikarmane, et al., 2001).

The inequality of the gendered labour market is also reflected in the health hazards that affect female workers at the bottom of the e-waste value chain. McAllister, Magee and Hale (2014) observe that the e-waste sector unfairly and disproportionately burdens women, affecting their mortality and fertility. Of 14 major hazardous chemicals found in e-waste, more than half have been proven to affect women's reproduction and endocrine functions (ibid).

Other sources have also highlighted that e-waste collectors, mostly women, sell scraps to intermediaries for low prices. Links with formal recycling facilities and training about the financial potential of e-waste can help to ensure fairer payment. For example, a project by the German Corporation for International Cooperation (GIZ) and Microsoft, in collaboration with the Self-Employed Women's Association of India (SEWA), provides training to women collectors in India (See Box 4).

Box 4. Training women e-waste collectors in India (GIZ – Microsoft – SEWA)

Under the DeveloPPP.de project, Microsoft has partnered with SEWA to set up an efficient recycling system. Under this project, SEWA works with women collectors to collect e-waste more efficiently, by establishing direct links between women who are collecting e-waste and official recycling companies. As a result, the women receive fair payment for the waste they have collected.

SEWA has also partnered with another organization called Direct Initiative for Social and Health Action to train waste gatherers on the correct methods for collecting e-waste and teach them about its hazardous nature. This has provided women in the programme with jobs while educating them about the sustainable use of resources.

In addition to training and linking collectors with recycling companies, the project also raises awareness about e-waste among students and campaigns small repair shops and small intermediaries to sell their scrap to official recyclers.

Under this project, 200 women collectors have been trained and 1,100 intermediaries have agreed to sell their scrap to official recycling companies (GIZ, 2016).

5. E-waste governance

In this chapter, an overview is presented of the international instruments that govern the management of e-waste and of the relevant legislation at the national and sub-national level.

5.1. International instruments

5.1.1. International labour standards

According to the ILO Declaration on Fundamental Principles and Rights at Work and its Follow-up, even if they have not been ratified, all member States of the ILO have an obligation to respect, to promote and to realize, the principles concerning the fundamental rights which are the subject of the eight fundamental Conventions.[13] Additionally, the following ILO Conventions and Recommendations as well as conclusions and guidelines, are particularly relevant to advancing decent work in e-waste management:

- the Transition from the Informal to the Formal Economy Recommendation, 2015 (No. 204);
- the Labour Inspection Convention, 1947 (No. 81); the Occupational Safety and Health Convention (No. 155) and Recommendation (No. 164), 1981; and the Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187);
- the Chemicals Convention (No. 170) and Recommendation (No. 177), 1990;
- the Job Creation in Small and Medium-Sized Enterprises Recommendation, 1998 (No. 189);
- the Promotion of Cooperatives Recommendation, 2002 (No. 193);
- the Employment Relationship Recommendation, 2006 (No. 198);
- the Guidelines for a just transition towards environmentally sustainable economies and societies for all (2015), including Annex 1, which lists international labour standards and resolutions that may be relevant to a just transition framework;
- the Conclusions concerning the promotion of sustainable enterprises, adopted by the International Labour Conference at its 96th Session (2007); and
- the Points of Consensus adopted at the Global Dialogue Forum on Decent Work in the Management of Electrical and Electronic Waste (e-waste), from 9-11 April 2019.

[13] (1) Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87); (2) Right to Organise and Collective Bargaining Convention, 1949 (No. 98); (3) Forced Labour Convention, 1930 (No. 29) (and its 2014 Protocol); (4) Abolition of Forced Labour Convention, 1957 (No. 105); (5) Minimum Age Convention, 1973 (No. 138); (6) Worst Forms of Child Labour Convention, 1999 (No. 182); (7) Equal Remuneration Convention, 1951 (No. 100); (8) Discrimination (Employment and Occupation) Convention, 1958 (No. 111).

India ratified the Minimum Age Convention, 1973 (No. 138) and the Worst Forms of Child Labour Convention, 1999 (No. 182) in 2017, as part of the Government's efforts to work in a concerted manner to eliminate child labour from the country. Of the eight ILO fundamental Conventions India has also ratified the Forced Labour Convention, 1930 (No. 29), the Equal Remuneration Convention, 1951 (No. 100), the Abolition of Forced Labour Convention, 1957 (No. 105), and the Discrimination (Employment and Occupation) Convention, 1958 (No. 111). Overall, India's ratification of these Conventions demonstrates the country's commitment to improve working conditions and to promote decent work.

5.1.2. United Nations environmental conventions and frameworks

E-waste management is governed by a framework of UN conventions and instruments, including but not limited to the following:

The Basel Convention

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, adopted in 1989, aims to protect human health and the environment against the adverse effects of transboundary movements and disposal of hazardous waste, including by applying the prior informed consent procedure, which means that shipments made without consent are illegal. Parties are expected to minimize the quantities moved across borders, to treat and dispose of waste as close as possible to their place of generation, and to prevent or minimize the generation of waste at source.

An amendment to the Convention, the Basel Ban, was adopted in 1995 but has not yet entered into force. The aim of the Basel Ban is to prohibit all transboundary movements of hazardous wastes from member countries of the Organisation of Economic Co-operation and Development (OECD) destined for final disposal operations in non-OECD member countries. As of February 2019, the Amendment has been accepted by 95 states but has not been enforced; it has not yet been ratified by major e-waste producers.

India signed the Basel Convention on 15 March 1990 and ratified it in 1992. By adhering to this Convention, the Indian government banned all WEEE, including second-hand electrical and electronic equipment, from coming into the country without appropriate authorization.

Other Relevant Conventions

Another convention relevant to the management of e-waste to which India is party is the 1998 Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, revised in 2017. The Rotterdam Convention promotes shared responsibility between exporting and importing countries of hazardous chemicals. India is also party to the 2001 Stockholm Convention on Persistent Organic Pollutants, as last amended in 2015, which requires countries to take measures to eliminate or reduce the release of persistent organic pollutants into the environment.

5.2. National e-waste legislation

It is estimated that 67 countries have legislation in place concerning various aspects of e-waste management and that this legislation covers some 66 per cent of the world

population. These laws are primarily focused on protecting the environment through legislative and regulatory measures, and in many cases do not consider e-waste as a resource that, if better managed, could provide decent work opportunities for small and medium-sized enterprises, cooperatives and workers. These laws also tend to focus on the management of e-waste without considering how to ensure the well-being of workers and the importance of creating an enabling environment for sustainable enterprises in this sector.

India's regulation of e-waste dates back to 2003, when Toxics Link (2003), a Delhi-based non-profit organization, published one of the first reports on the environmental impact of illegal computer e-waste imports. E-waste was included in Schedule IV of the Hazardous Waste (Management, Handling, & Transboundary Movement) Rules 2003 and its subsequent amendments (MoEF, 2016c), making it mandatory for e-waste recyclers to legally register with the Central Pollution Control Board (CPCB). Subsequently, the CPCB also released *Guidelines for Environmentally Sound Management of E-waste* in 2008 (CPCB, 2008), which provided information on recycling and treatment options for e-waste management (Bhaskar and Turaga, 2017).

5.2.1. E-Waste (Management and Handling) Rules 2011

Building on the Environmental Protection Act (1986) and the above mentioned 2003 and 2008 legislation, the *E-Waste (Management and Handling) Rules 2011* by the Ministry of Environment, Forests and Climate Change came into force in May 2012. This legislation has been implemented at the state-level by the respective State Pollution Control Boards (SPCBs).

This legislation mandated that all collection centres, dismantlers, and recyclers involved in e-waste management register with the SPCBs of the states in which they operate and thus ensure proper handling and disposal of e-waste. The key objective of this document was to promote the implementation of environmentally sustainable recycling practices (MoEF, 2016b).

In these rules, the government mandated recycling plants to obtain authorisation from the governing body before importing WEEE. Among the conditions, the government requires that recycling plants have adequate storage space for storing imported e-waste. The recently revised e-waste management rules also prevent transboundary movement of WEEE, although some loopholes remain in the law.

For instance, according to the Hazardous and Other Wastes (Management and Transboundary Movement) Rules 2016, it is permitted to import second-hand electrical and electronic equipment or UEEE, including personal computers, tariff free, for the purpose of donating them to educational institutions. It is unknown how much of these UEEE are formally reused, refurbished or recycled.

The 2011 Rules also urged producers to take responsibility for e-waste management by introducing the concept of Extended Producer Responsibility (EPR) to the Indian context (see Box 5).

Box 5. Extended producer responsibility

National e-waste laws and regulations are often based on the principle of extended producer responsibility (EPR). The OECD defines EPR as "a policy approach under which producers are given a significant responsibility – financial and/or physical – for the treatment or disposal of post-consumer products". Assigning such responsibility to producers could, in principle, provide incentives to prevent waste at source, promote environmental product design, and support the achievement of public recycling and materials management goals.

EPR defines the electronics manufacturers' obligation to ensure responsible handling of their products throughout their entire life cycle, including end-of-life-cycle management, to prevent further pollution and waste (Garlapati, 2016). The EPR approach covers both physical and financial responsibility for the treatment or disposal of e-waste. In practice, this means that producers must create and fund collection systems, individually or collectively, for post-consumer waste and ensure it is channelled to businesses with suitable recycling technologies.

An EPR approach is also meant to incentivize producers to incorporate waste disposal costs at the design stage (OECD, 2006a). Because producers will bear the cost of safely disposing of products (including collection and recycling) at the end of their useful life, it can make economic sense for them to reduce these costs by incorporating the environmental issues at the design stage. For example, creating products with fewer toxic materials reduces the cost of processing the toxic products after their useful life. These two aspects — ensuring the internalization of product externalities and incentives for environment-friendly product design — are often cited as the two most important reasons for adopting EPR for treating e-waste (OECD, 2006a).

Despite the possible benefits of EPR, in many countries it is a policy that has proven challenging to implement in practice. Moreover, there are concerns that EPR initiatives by individual brands or companies may do more harm than good if they are not well coordinated with overall national waste management policies. Some have argued that in certain situations, EPR can discourage the repair and refurbishment of products.

5.2.2. E-Waste (Management) Rules 2016

The revised Indian E-waste (Management) Rules entered into force on 1 October 2016. According to a September 2018 study on plastic packaging and e-waste management in India conducted by the European Union's Resource Efficiency Initiative (EU-REI), the revision included several changes to close loopholes in the 2011 legislation. The revised Rules required the establishment of deposit-refund systems and compliance with specific targets, and introduced the concept of Producer Responsibility Organizations (PROs), which act as intermediaries between manufacturers and governments to facilitate compliance with Extended Producer Responsibility (EPR) legislation. Essentially, manufacturers can contract a PRO to handle all activities related to their used products, including disposal and recycling. The new rules "…expand the circle of affected stakeholders to manufacturers, dealers, refurbishers as well as Producer Responsibility Organizations (PRO) … Further, the types of materials addressed are expanded and now include components, consumables and spare parts of EEE which are listed in Schedule 1 of the Rules." (EU-REI, 2018, p. 36).

Because, under the EPR framework, e-waste has been designated the sole responsibility of producers, all producers must register with the CPCB or the respective SPCB. Registrations must be complemented by EPR plans that estimate the volume of e-waste that the company is expected to generate in the upcoming year. A detailed description of the collection strategy (either individual or collective) must also be provided and should identify the collection centres, PROs or dealers involved. As of September 2018, 625 EPR plans had been authorized by the CPCB (EU-REI, 2018).

Under the revised 2016 Rules, compliance with EPR is the responsibility of the CPCB rather than the SPCBs. Government proponents have argued that this provides for a more effective and harmonized e-waste management system (PTI, 2017). The SPCBs' responsibilities are focused on gathering e-waste data and providing generation estimates for future planning of e-waste infrastructure; unfortunately, none have complied with this to date (Kaur, 2018).

The E-waste (Management) Rules 2016 outline a binding, target-based approach for the collection and channelization of e-waste under EPR. In 2017, e-waste collection targets for industries were once again revised and reduced following stakeholder consultations and lobbying efforts by the EEE industry. The amended targets can be seen in Table 4.

Table 4. Amended collection targets under E-waste Management Rules, 2016 as quantity of waste generation indicated in the EPR Plan

Year	Target
2017 - 2018	10%
2018 - 2019	20%
2019 - 2020	30%
2020 - 2021	40%
2021 - 2022	50%
2022 - 2023	60%
2023 onwards	70%

Source: EU-REI, 2018, p. 36

The Rules give the CPCB the power to conduct random sampling of EEE to verify compliance with the targeted reduction of hazardous substances. In cases of non-compliance, the CPCB can impose financial penalties on manufacturers, importers, transporters and recyclers. Unfortunately, recent accounts assert that, although producers claim to have met their targets, it is not possible to verify these claims, and the CPCB has no records of checks conducted to date (Kaur, 2018).

5.3. National and state institutions

In addition to its robust e-waste legislation, the Indian government has created mechanisms for enforcing these laws. However, according to the Strategy on Resource Efficiency in Electrical and Electronic Equipment Sector by NITI and MeitY (2019), lack of awareness about the provisions of e-waste rules among all stakeholders and their implementation across the country are some of the current challenges to the management of e-waste in India.

The key overall public authority responsible for the identification and management of all streams of waste, including e-waste, is the MoEF. Because of the amount of e-waste coming to India from overseas, the Indian government has also established agencies that specifically address imports. The Directorate General of Foreign Trade (DGFT), which was created under the Foreign Trade (Development and Regulation) Act 1992, can grant or refuse licences for importing prohibited hazardous wastes, while the Port Authorities and Customs Authorities inform the MoEF of any illegal traffic and analyse wastes permitted for imports and exports (Kaur, 2018).

Tangible commitment to compliance with the E-waste Management Rules varies from state to state (see Box 6). While some states list details of licensed recyclers on their

websites (e.g. Haryana), many do not supply details of recyclers or collection points in the region (e.g. Arunachal Pradesh, Tripura and Jammu, and Kashmir). In some states, such as Kerala and Delhi, only partial information is provided (EU-REI, 2018).

Box 6. Telangana state

In contrast to other states, the Telangana State Government issued a comprehensive e-waste management policy in 2017. This policy includes financial incentives to boost refurbishing and recycling activities.

The policy is mostly in line with the E-waste Management Rules, but the state government has gone further by recognising the informal sector as an important stakeholder. The policy outlines actions to formalize the sector through self-help groups and capacity development in recycling and refurbishing. It also indicates a commitment to work closely with non-governmental organizations (NGO), and industry associations to create awareness in the informal sector about the environmental hazards of handling of e-waste improperly (EU-REI, 2018).

As the E-waste Management Rules place full and comprehensive responsibility for collection onto producers, questions are raised about how they can fulfil their legal obligations. Two possible approaches are individual producer responsibility and collective producer responsibility, with the latter being the most popular strategy. The vast majority of producers are affiliated with a PRO.

5.3.1. Implementation challenges of the E-Waste (Management) Rules 2016

Capacity-building initiatives complement implementation of the Rules. For example, in 2016, the National Institute of Electronics and Information Technology (NIELIT) provided e-waste training to state government employees in ten Indian states.[14]

Despite these efforts, according to Bhaskar and Turaga (2017), overall implementation of the E-Waste Rules on the ground has been unsatisfactory, depressing the flow of e-waste into the formal recycling sector. Through a case study in Gujarat, the authors found that most EEE producers did provide information on how to deposit their products at the end of their useful life and mentioned third party collectors. However, through phone calls, the researchers discovered that only three producers (out of 22) in the state had actual functioning take-back systems.

For the most significant bulk consumers, the researchers learned that banks generally had take-back agreements with their EEE dealers (and were unaware of how dealers dealt with the e-waste subsequently), while educational institutions and medium and small industrial units were largely unaware of the E-waste Rules – often gifting their old equipment to employees, exchanging it for discounts on new equipment or selling it to scrap dealers (see

[14] Further training was conducted in 2017 in Odisha, Manipur and West Bengal and in 2018 at the State Council of Education Research and Training (SCERT), Kohima (EU-REI, 2018).

Box 7). They also stated that consumers lack sufficient incentives – monetary benefits – to use authorized collection centres or recyclers.

Box 7. Addressing informality

The pervasive nature of informal activity in the e-waste sector makes informality a substantially important dimension to consider. The amended E-waste Rules fall short of integrating this dimension effectively.

Formal recyclers entering the scene must be in compliance with environmental requirements which requires high investment and overhead. Since informal actors have no such compliance requirements, they are able to offer more competitive prices compared to the formal recyclers. Additionally, formal recyclers struggle to access the materials because of the competition from the door-to-door collection services of informal collectors (Raghupathy, et al., 2010). The extensive network that India's khabadiwalas (collectors) have constructed allows them to easily reach isolated areas, which contributes to the impressive collection rates that are reported (EU-REI, 2018). The E-waste Rules, however, make no attempts to connect this capacity to the formal sector through collaboration and governance.

Partnerships between formal and informal actors have the potential to facilitate the integration of informal workers into the formal system. Guidelines governing these partnerships could promote these relationships and extend the reach of government policies. Such guidelines could be complemented by connecting informal workers with training programmes and capacity building measures to promote formalization and safe working conditions. (EU-REI, 2018)

Furthermore, Bhaskar and Turaga estimated that if all of the registered recycling centres in India were to operate at full capacity, they would be capable of processing approximately 30 per cent of the total e-waste generated in the country. In their case study of Gujarat, they found that very few e-waste dismantling centres were authorized by the state's SPCB.[15]

The lack of clarity about e-waste issues among SPCB officers further represents an obstacle to effective implementation. In Bhaskar and Turaga's interviews with officers from Gujarat's SPCB, the officers were unaware of significant recycling operations taking place within India. They argued that the amount of e-waste collected in the formal recycling sector was so low that it did not make economic sense to invest in scaling up the recycling processes that did exist, specifically in that state.

Bhaskar and Turaga also argue that inadequate formal collection and recycling systems making it difficult for consumers to deposit their waste is one of the reasons for low utilization of formal processing units. As suggested by Bernd Kopacek (2018), India's large size requires a decentralized approach to recycling; working with the large network of informal, small collector and dismantling units in the country could therefore be an effective way of optimizing recycling.

5.4. National labour legislation

The Ministry of Labour and Employment is responsible for formulating and administrating laws and regulations relating to labour and employment in India. According to the Ministry of Labour and Employment (2019), " at present, there are 44 labour related statutes enacted by the Central Government dealing with minimum wages, accidental and social security

[15] A total of 16 e-waste recyclers are registered in Gujarat as of 2019 (see appendix)

benefits, occupational safety and health, conditions of employment, disciplinary action, formation of trade unions, industrial relations, etc."

The Directorate General, Factory Advice Service and Labour Institutes (DGFASLI) is the central agency responsible for inspections related to OSH. The Chief Labour Commissioner (CLC), also known as the Central Industrial Relation Machinery (CIRM), is the central agency responsible for enforcing labour legislation related to wages, remuneration, child labour, contract labour, migrant labour, working time, industrial disputes, and maternity benefits. Both the DGFASLI and the CLC are attached offices of the Ministry of Labour and Employment.

Overall, labour law covers approximately 10 to 12 per cent of all workers; given the largely informal nature of e-waste management in India, a large portion of the workforce may not be covered by these laws. Central and state governments have tried to extend social security coverage to workers in the informal sector with limited success. In the Solid Waste Management Rules, 2016, the state acknowledged the primary role played by informal waste pickers in the waste management system for the first time. The legislation prioritizes the integration of informal waste collectors into the waste management system although it still uses the qualifier "authorised" when outlining specific actions related to these workers (MoEF, 2016d).

State governments also enact labour laws with more than 50 state laws applied around the country. At this level, the Inspectorates of Factories, under the control of each State Labour Department, enforce the Factories Act in their respective states. Safety and health inspections are carried out by different inspectors to those related to labour issues.

5.5. Other public awareness raising initiatives

India's urgent need to tackle the problem of e-waste gained greater public awareness following the launch of the 'Digital India' programme in 2015, led by the MeitY. The programme has three major objectives, namely to create a digital infrastructure for every citizen; to deliver governance and services on demand; and to empower citizens through digital literacy. The campaign intends to transform India into an inclusive knowledge economy with a particular focus on access to digital infrastructure in rural areas. (MeitY n.d.c.). The initiative 'Make in India' builds on this by promoting national electronics manufacturing with an aim to reduce dependence on imports by 2020 (DIPP, 2017)

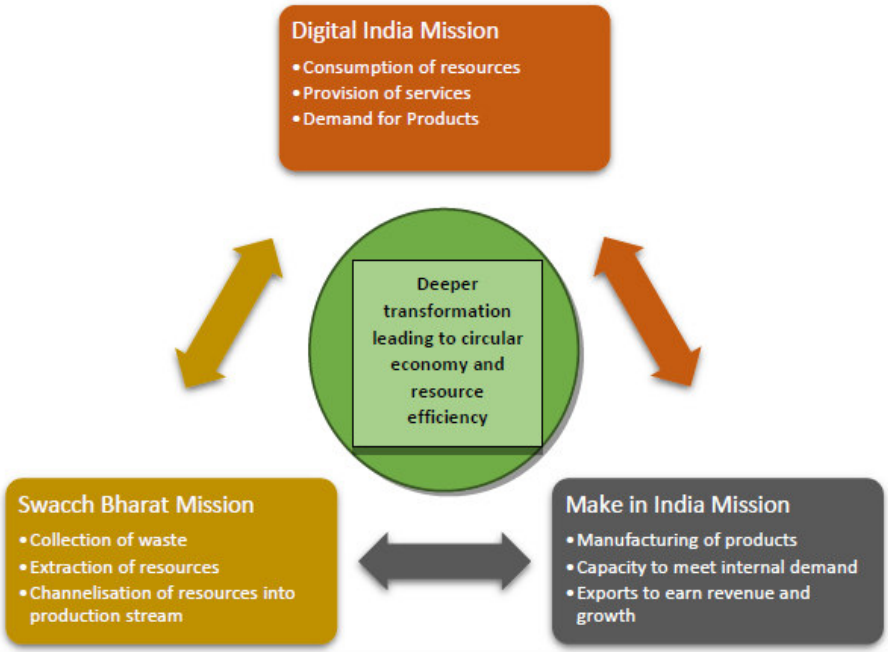
Another governmental initiative is the 'Swacch Bharat Mission' (*Clean India Mission*), aiming to create 'a clean India' by 2019 for Mahatma Gandhi`s 150th birth anniversary (MDWS, n.d.). There is important symbolism behind the campaign. Gandhi, a prominent critic of industrialisation and an advocate for cleanliness and good health, symbolizes the idea of 'Swachh', or 'clean', which is understood to define the uncontaminated state of air, water, and soil. [16] The campaign, also referred to as a national movement, encompasses the three goals of (a) cleaning the streets, roads and infrastructure of more than 4,000 towns across India, (b) achieving an Open-Defecation Free India, and (c) building 120 million toilets in rural India until 2019.

The synergy of the three above missions is illustrated below in Figure 15. The Swachh Bharat Mission deals with extracting waste that can then be fed into the production cycle.

[16] In 1938, Mahatma Gandhi warned the Europeans against the unmanageable desire for comforts and wealth, enabled through industrialisation, and its related generation of waste (Rajya Sabha Secretariat 2011).

The Make in India mission covers the reuse of the resources generated in domestic electronics production and the Digital India mission will enhance consumption leading to a sustainable, resource efficient economy (NITI and MeitY, 2019). However, there is a question to what degree the Swacch Bharat Mission intersects with the 'Digital India' programme in its efforts to address the challenge of e-waste recycling (Sainy, 2016).

Figure 15. Transformation to a resource efficient economy: Government of India mission synergy



Source: NITI and MeitY (2019)

Since Indian e-waste is experiencing a compound annual growth rate of about 30 per cent, by 2020 the country is likely to generate 5.2 million metric tonnes per annum even without imported electronics (ASSOCHAM and cKinetics, 2016). To address this, the Government has initiated the Awareness Programme on Environmental Hazards of Electronic Waste, which highlights the need for greater awareness of e-waste channels and the need for an established system of accountability in e-waste management. The programme offers financial support to public and private organizations for organizing awareness workshops, stakeholder consultations and economic research and forecasting (MeitY, n.d.a). It covers the states of Assam (urban area of Guwahati), Bihar (Patna), Goa (Panjim), Jharkhand (Ranchi), Madhya Pradesh (Indore), Manipur (Imphal), Orissa (Bhubaneshwar), Tamil Nadu (Puducherry), Uttar Pradesh (Moradabad) and West Bengal (Kolkata).

The Awareness Programme on Environmental Hazards of Electronic Waste includes the GREENE initiative, which "seeks to support the effective implementation of the E-waste (Management) Rules by implementing large-scale awareness-raising activities among different stakeholders regarding the adverse impacts on environment and health caused by improper disposal of e-waste" (EU-REI, 2018, p. 36). The Programme has conducted awareness-raising workshops for schools, bulk consumers, representatives from the informal sector and dealers, among others, and also developed a curriculum for schools and stakeholder training materials focused on e-waste recycling best practices (EU-REI, 2018).

Private actors have been involved in raising awareness about e-waste recycling too. Nokia is an example of an EPR pioneer in the country. In 2009, the company launched 'Planet Ke Rakhwale' (*Planet Keepers*) which was one of the first mass media campaigns (28

cities) that targeted young people to promote recycling of mobile phones and electronic accessories. While Nokia had declared that its e-waste collection grew from 3 metric tonnes to 65 metric tonnes in three years as a result of the campaign, the company also acknowledged some reluctance by Indians to engage in a take-back scheme without any financial gains. Since 2010, Nokia has also been a leading actor in removing hazardous chemicals from their products, such as polyvinyl chloride (PVC) in 2006 and brominated and chlorinated compounds (Sohail, 2013).

5.6. Initiatives by non-governmental and private organizations

In order to overcome risks and hazards in the e-waste value chain and promote the creation of decent jobs, some national and international stakeholders have attempted to formalize e-waste related operations and activities in India.

The German Corporation for Technical Cooperation (GTZ), now GIZ, began work on hazardous waste management in India in 2001. The Swiss Federal Laboratories for Materials Science and Technology (EMPA) began implementation of the global programme 'Knowledge Partnerships in e-waste Recycling' a few years later. The two initiatives joined forces, and the Indo-German-Swiss initiative on e-waste was established in 2004. Some of the major collaborators of the Indo-German-Swiss Partnership and e-waste advocates in India include the industry association MAIT, Toxics Link, and the Centre for Science and Environment (Sainy, 2016), which continue to be key contributors of e-waste knowledge and data.

In 2011, the IFC and Attero jointly launched the Clean E-India initiative, a take-back programme that aimed to build a sustainable market for e-waste management and responsible recycling practices by engaging directly with manufacturers, informal collectors and dismantlers (providing them with training and appropriate working gear) and other key players from the sector. The ILO collaborated with the IFC on the development of an action manual for improving the safety and health of e-waste workers (Kawakami, 2019).

Other initiatives have focused on the integration of informal e-waste workers into the formal economy. Examples include the Chintan Environmental Research and Action Group (CHINTAN 2004), the online mapping endeavour 'Delhi Digests: A Sketchbook on E-Waste' by Toxics Link and the Tactical Technology Collective, and the 'WEEE Recycle' scheme (by partners GIZ, Adelphi, EU, MAIT, Toxics Link).

The 'WEEE Recycle' programme (2010-2014) formed part of the EU's umbrella initiative 'SWITCH-Asia Project' and has constituted the largest EU programme on sustainable consumption and production in Asia to date. It strove to formalize and mainstream e-waste management to enhance environmentally friendly recycling and reduce the pollution arising from informal e-waste recycling. With a budget of €2 million, GIZ New Delhi helped formalize nine companies/associations representing more than 1,000 informal business units in Delhi, Bangalore, Kolkata and Pune, and offered training to fourteen SPCBs, three national ministries and four states on e-waste policy development and implementation (SWITCH-Asia, n.d.).

6. Key considerations

Due to significant flows into India from other countries, as well as to the nation's increasing demand for EEE and devices, e-waste has become one of India's most rapidly growing waste streams. Since recycling and reuse rates are low, e-waste poses a severe threat to human health and the environment. Unless urgent measures are taken, the workers who handle e-waste, their families and those living near disposal sites will continue to be exposed to hazardous substances.

E-waste differs from other streams of waste as it contains highly hazardous substances alongside valuable materials, as well as materials without current resale value. It is becoming an increasingly important resource for all economic units regardless of their size, as well as for informal workers along the e-waste value chain who recover, repair, refurbish, reuse, repurpose and recycle UEEE, bring innovative services and products to the market and facilitate the transition to a circular economy.

Once the right infrastructure, regulations, incentives, policies and processes are in place to manage e-waste in ways that advance decent work and protect the environment, UEEE has the potential to fuel the generation of sustainable enterprises and the creation of decent employment opportunities. This would be a significant step towards inclusive growth and decent work, towards more sustainable production and consumption, and achieving the 2030 Agenda for Sustainable Development.

Given the ILO's normative approach and unique tripartite structure, the Organization and its constituents can make an important contribution to advancing decent work in the management of e-waste, helping e-waste actors to capture the value of e-waste materials and improving the sector's productivity. Social dialogue in all its forms is essential to engaging governments and employers' and workers' organizations in the formulation and revision of laws, regulations and policies, and then to ensuring that they are effectively coordinated and implemented in practice.

Capacity strengthening should be an integral part of any future investment in e-waste systems. That includes: strengthening the capacities of the various branches of the Indian Government engaged in ensuring decent work in e-waste management; enhancing coordination between key ministries and agencies at both the federal, state and municipal levels; strengthening capacities for labour and environmental inspection; strengthening trade unions' capacity to organize and employer organizations' capacity to provide services, including more effective organization and convening of all relevant actors in the e-waste sector.

The considerable risk of injury, disease, and death that results, for example, from the absence of appropriate PPE, tools and processes, which leads to the inappropriate handling of e-waste and exposure to its hazardous substances, should be addressed as a matter of urgency. This includes developing specialized equipment and processes, raising the awareness of e-waste workers about the hazards and risks they face, and developing inclusive learning and training tools and methodologies for e-waste workers, including those in the informal economy.

The accepted prevalence of informality poses a major challenge – for the enforcement of legislation, for the growth of sustainable, productive and efficient enterprises, for the improvement of the livelihoods and working conditions of e-waste workers, and for the realization of their rights at work. The ILO's Transition from the Informal to the Formal Economy Recommendation, 2015 (No. 204), and Guidelines for a just transition towards

environmentally sustainable economies and societies for all (2015), provide guidance to governments and to employers' and workers' organizations on how they can help move informal e-waste workers and micro, small and medium-sized enterprises into the formal economy, while ensuring that existing livelihoods are preserved and improved.

Cooperatives and other social and solidarity economy organizations and enterprises perform a key role in e-waste management in many countries. They have promoted the rights of informal workers, advocated for their inclusion and recognition, and created formal and decent work opportunities. There are a few examples of this in India, such as SWaCH, mentioned above. Cooperatives could be further explored as a way to better organize informal e-waste workers.

Sustainable e-recycling enterprises have tremendous potential to ensure that e-waste is managed better, thereby advancing decent work and environmental sustainability. The conclusions adopted by the International Labour Conference in 2007 concerning the promotion of sustainable enterprises should be used by the Government of India, as well as by Indian employers' and workers' organizations, to foster an enabling environment to allow such enterprises to grow and to harness the potential of micro, small and medium-sized enterprises to create decent jobs, introduce new technologies, bring innovative business models to the market and contribute to productivity growth.

There is an urgent need to raise awareness about the growing challenge of e-waste management and effectively engage all relevant stakeholders – governments, employers, producers, workers and consumers – in promoting sustainable production and consumption, advancing decent work and protecting the environment during the entire life cycle of EEE, in particular through e-waste recovery, reuse and recycling. There is a need for more reliable, consistent and gender disaggregated data, analysis and research to identify effective ways of addressing the challenges of decent work, particularly in the informal economy.

In April 2019, representatives of governments, employers' and workers met in Geneva to discuss ways to advance decent work in the management of e-waste (ILO, 2019b). Building on the Points of Consensus they adopted, recommendations for future action by the Government of India, in collaboration with Indian employers' and workers' organizations, would include:

a) to increase and promote investment in waste management infrastructure and systems at all levels in order to manage the rapidly growing flows of e-waste in ways that advance decent work;

b) developing, revising, implementing and enforcing labour laws and regulations to ensure that the fundamental principles and rights at work and the international labour Conventions that India has ratified protect and apply to all workers engaged in the management of e-waste;

c) engaging in all forms of effective social dialogue at all levels to advance decent work in e-waste management and support a just transition towards environmental sustainability in e-waste management, while ensuring women's representation and voice;

d) collecting data, generating knowledge and raising awareness on decent work in the management of e-waste, including a better understanding of the functioning of the e-waste value chain;

e) protecting the safety and health of all e-waste workers and improving their working conditions through labour inspection and other measures;

f) supporting the formalization of enterprises, cooperatives and workers in the informal e-waste economy;

g) extending the coverage of social protection, including maternity protection to e-waste workers and their families;

h) promoting cooperatives and other social and solidarity economy organizations and enterprises in the e-waste sector; and

i) creating an enabling environment for micro, small, medium and large enterprises that provide sustainable services and products along the e-waste value chain and that enhance productivity growth.

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Appendix I

Registered e-waste dismantlers/recyclers, India – facts & figures (based on CPCB 2019).

State	Population[17]	No. of registered e-waste dismantlers/ recyclers (in units)	Total capacity in metric tonnes per annum	Largest unit in metric tonnes per annum processed
Andhra Pradesh	49 506 799	none	none	none
Arunachal Pradesh	1 383 727	none	none	none
Assam	31 205 576	none	none	none
Bihar	104 099 452	none	none	none
Chhattisgarh	25 545 198	1	600	ADV metal Combine Pvt. Ltd. (600)
Goa	1 458 545	1	103	Global E Waste Management Systems (103)
Gujarat	60 439 692	16	49 052.92	Basant Clean Enviro Ltd. (7200)
Haryana	25 351 462	28	87 378	R.K. Enterprises Ltd. (14,640)
Himachal Pradesh	6 864 602	1	1000	Shivalik Solid Waste Management Ltd.
Jammu and Kashmir	12 541 302	1	165	VRG Groups (165)
Jharkhand	32 988 134	none	None	none
Karnataka	61 095 297	71	52 722	E-Parisara Pvt. Ltd. (8 820)
Kerala	33 406 061	none	none	none
Madhya Pradesh	72 626 809	2	9 600	Unique Echo Recycle (6 000)
Maharashtra	112 374 333	75	78 179	R.T. Corporation (7 500); Environcare Recycling Pvt. Ltd. (7 500). Envirocare Recycling Pvt. Ltd. (7 500)
Manipur	2 855 794	none	none	None
Meghalaya	2 966 889	none	none	none
Mizoram	1 097 206	none	none	none
Nagaland	1 978 502	none	none	none
Odisha/Orissa	41 974 218	3	3680	Sani Clean Pvt. Ltd. (3 000)
Punjab	27 743 338	3	4850	K.J. Recycler (2 920)
Rajasthan	68 548 437	26	90 769	Greenscape Eco Management Pvt. Ltd. (18 200)
Sikkim	610 577	none	none	none
Tamil Nadu	72 147 030	24	97 271.2	TES AMM Pvt. Ltd. (30 000)

[17] Source: Census India, 2011. Available at: www.censusindia.gov.in.

Telangana	35,193,978	11	41 493	Earth Sense Recycle Pvt. Ltd. (12 775)
Tripura	3 673 917	none	none	none
Uttar Pradesh	199 812 341	41	243 627.5	Mahaluxmi metal Alloys (India) Pvt. Ltd. (30 000)
Uttarakhand	10 086 292	4	19 250	Attero Recycling Pvt. Ltd. (12 000)
West Bengal	91 276 115	3	1860	Lubrina Recycling Pvt.Ltd. (1 080)
TOTAL	1 190 851 623	312	782 080.62	