# A VERY SHORT
# POLICY BRIEF

Improving E-Waste Management in India

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The Australia India Institute's A VERY SHORT POLICY BRIEF series examines key questions facing contemporary India and the Australia-India relationship. It combines in-depth academic analysis with clarity and policy relevance.

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# Summary

India is the 5th largest producer of electronics waste, or e-waste, in the world, generating close to 2 million metric tonnes in 2016. It faces a huge crisis with e-waste management. Although the Indian Government introduced its first dedicated e-waste management policy in 2011 and expanded its scope in 2016, less than 5% of e-waste in India is recycled through formally regulated units. The informal sector handles the rest, with very little control for environmental and worker health and safety. Several million informal sector workers are involved in recovering valuable metals from e-waste, largely through hazardous and unsafe practices such as open-air incineration and acid leaching.

This Very Short Policy Brief proposes five solutions for linking e-waste management policy and practice, including:

1.  Providing market information regarding e-waste prices

2.  Incentivising e-waste recycling

3.  Upskilling informal sector players

4.  Deploying readily available and mature recycling technologies

5.  Developing innovative methods and technologies for processing new forms of e-waste.

# What is E-waste?

E-waste is one of the fastest growing categories of waste on earth, increasing at a rate of 3-4 % per year. Globally, 44.7 million tonnes were generated in 2016 and is estimated to reach nearly 50 million tonnes in 2018.[1,2] E-waste or electronics waste is defined as all items of electrical and electronic equipment, including their components, which have been discarded with no intention of further re-use. The term is used interchangeably with others such as WEEE (Waste Electrical and Electronic Equipment) or e-scrap.[1]

Only one-fifth of the total global e-waste is collected and recycled through formal channels.[1] The rest is dumped in landfills or incinerated without any formal control. This results in the release of toxic chemicals such as mercury, lead, and dioxins into the environment, as well as significant loss of valuable resources in e-waste such as gold, copper, platinum and high-quality plastics that can be recovered, reused, and recycled. The Global E-waste Monitor estimated the combined value of all recoverable materials from e-waste in 2016 at US$ 64 billion.[1]

# E-waste in India

India is the 5th largest generator of e-waste in the world, contributing almost 2 million metric tonnes to the global total in 2016. Its major cities are the largest producers, with Mumbai being the leader (120,000 metric tonnes/ year), followed by Delhi (NCR), Bangalore, Chennai and Kolkata. Government and industry sectors generate more than 70% of e-waste, while households contribute around 15%. Delhi functions as the country's biggest market for e-waste recycling, channelling between 30 and 40% of the total volume.[3]

The bulk of India's e-waste recycling is handled by the informal or unregulated sector.[4] The formal sector units, i.e., government-approved recycling centres located in different parts of the country, have the combined capacity to handle about 20% of total annual e-waste generation.[5] In reality, however, they process less than 5% of the total annual e-waste. More than 95% is recycled by millions of people who make a living from collecting e-waste, recovering valuable materials, and processing these for reuse in various manufacturing industries. They do this work under unsafe conditions and are exposed to numerous health and environmental hazards. They extract valuable materials from e-waste by open-air incineration and acid leaching, and are directly affected by the contaminated water, acids and other by-products that are dumped after the process.

The major challenge for India's policy makers is to improve the effectiveness of e-waste management and reduce associated environmental and health risks in cities and communities. This requires finding ways to increase the responsible disposal of e-waste by producers and users, improve recycling practices and methods of informal sector processors, and enable technologies that are cost effective and have capacity to process large volumes of waste.

1. Baldé, CP, Gray, VF, Kuehr, R, Stegmann, P (2017) *The Global E-waste Monitor – 2017*, Bonn/Geneva/Vienna: United Nations University (UNU), International Telecommunication Union (ITU) & International Solid Waste Association (ISWA).

2. Sahajwalla, V, Gaikwad, V. (2018) The present and future of e-waste plastics recycling. *Curr. Opin. Green Sustain. Chem. 13*: 102–107.

3. ASSOCHAM India (2016) India to sit on e-waste pile of 30 lakhs MT with Mumbai on top of heap, *ASSOCHAM-Frost & Sullivan Study*, http://www.assocham.org/newsdetail.php?id=5642 (accessed 2 Oct, 2018).

4. ASSOCHAM India (2016) India among the top five countries in e-waste generation, *ASSOCHAM-NEC Study*, http://www.assocham.org/newsdetail.php?id=6850 (accessed 2 Oct, 2018).

5. Central Pollution Control Board (2016) *List of Registered E-Waste Dismantlers/Recyclers in the country*, http://cpcb.nic.in/cpcbold/List_of_E-waste_Recycler_as_on_29.12.2016.pdf (accessed 2 Oct, 2018).

# Regulation of E-waste in India

Despite the huge increase of e-waste over the past decade in India, the regulatory framework for management is weakly articulated in terms of implementation and compliance. The first policy effort towards addressing e-waste was the 2008 *Guidelines for environmentally sound management of e-waste,*[6] which provided information about various types of e-waste components, methods for assessing their hazardousness, and appropriate technologies for processing or managing them. The guidelines proposed the Extended Producer Responsibility (EPR) as a mechanism for managing e-waste, but did not provide any details on how it would be implemented. The EPR requires the producer to take back their end-of-life products returned by consumers for recycling and disposal.

The second major policy introduced in 2008 was the *Hazardous Wastes (Management, Handling and Transboundary Movement) Rules*,[7] which banned the importation of e-waste to India for disposal. The rules prescribed allowable concentration limits for all the hazardous and non-hazardous substances in e-waste components, but provided no clear framework for monitoring and enforcing compliance.

In 2011, the Indian government established the E-Waste (Handling and Management) Rules, which was subsequently replaced by the revised E-waste (Management) Rules of 2016.[8] These rules provide the most comprehensive information regarding the responsibilities of various players in e-waste management. They incorporate the Hazardous Waste Rules (also revised in 2016) for specifying concentrations of hazardous compounds in e-waste and their transboundary movements.

The 2016 E-waste Rules outline the procedures for producers/manufacturers, dealers, recyclers, and dismantlers to obtain authorisation from relevant government agencies and administrative bodies to manage e-waste. They also identify the responsibilities of collection centres, refurbishers, individual and bulk consumers for handling e-waste. All electrical and electronic equipment and their components are classified and assigned unique e-waste codes. Producers are prescribed recycling targets based on the amount of e-waste they generate.

The Extended Producer Responsibility (EPR) mechanism is a mandatory component of the 2016 Rules. The rules define the term 'producer' as any person or entity that manufactures and/or sells electrical and electronic equipment and components under its own brand, and/or other domestic and imported brands. All producers are required to prepare an EPR plan according to a prescribed framework and steps for obtaining authorisation. The Central Pollution Control Board (CPCB) holds responsibility for authorising EPR applications, but the responsibility for compliance monitoring is vested with the relevant State Pollution Control Boards (SPCB). The Rules also suggest the introduction of a Deposit Refund Scheme which allows producers to charge a deposit fee when selling a product and refunding the amount, along with interest earned, when the consumer returns it at the end of its lifecycle.

Although the 2016 Rules are more comprehensive in scope, they are relatively weak in term of ensuring compliance. They do not specify the penalties imposed on EPR defaulters, or on consumers who do not dispose e-waste at dedicated recycling centres, or on dismantlers that contribute to environmental pollution and hazards through unsafe practices.

6.  Government of India (2008) *Guidelines for environmentally sound management of e-waste, 2008*, New Delhi: Ministry of Environment and Forests.

7.  Government of India (2016) *Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016*, New Delhi: Ministry of Environment, Forest and Climate Change.

8.  Government of India (2016) *E-waste (Management) Rules, 2016*, New Delhi: Ministry of Environment Forest and Climate Change.

The main problem with the current regulatory framework is that it fails to directly address the major role played by informal sector workers in handling and recycling e-waste. Unless the informal sector actors are recognised and incorporated into the policy development framework, e-waste management will remain ineffective in practice. The critical issue is to find ways of linking market information for e-waste with appropriate financial incentives for consumers, and upskilling informal sector players in handling and processing methods that are linked to readily available and mature e-waste recycling technologies.

# Challenges for E-waste Management in India

Waste recycling in India is predominantly an informal sector activity. There are many thousands of poor households eking a living from scavenging materials from waste dumps. The common recycling practices for middle class urban households, particularly for waste paper, plastic, clothing or metalware, is to sell these to small-scale, informal sector buyers known as *'kabadiwalas'* that, in turn, sort and sell these on as input material to artisanal or industrial processors.[9]

E-waste collection follows a similar pattern. The informal e-waste recycling sector employs thousands of households in urban and peri-urban areas in collecting, sorting, repairing, refurbishing, and dismantling disused electrical and electronic products.[10] Consequently, unlike the situation in advanced economies, there is no concept in India of consumers voluntarily donating their end-of-life electrical and electronics equipment at formal e-waste recycling centres. Nor is there the concept of consumers paying for disposal of the e-waste they generate.

The heavy reliance on the informal sector for e-waste recycling gives rise to three key challenges. First, any attempt to impose stringent financial penalties for non-compliance or violation of e-waste handling and processing rules is ineffective. Second, broader public knowledge regarding market prices or health and safety costs of e-waste recycling is severely lacking because this work is done by poorly paid workers. Third, despite the massive increases in the volume of e-waste generated each year, there is very little investment in large-scale industrial infrastructure for recovery and recycling.

## Lack of market information and financial incentives

Various surveys conducted in India have shown that public awareness of e-waste hazards and recycling is low.[11–14] Most consumers know very little about the hazardous nature of e-waste components or the penalties for improper disposal. They do not know how e-waste is managed by urban municipal or state government agencies. Cities have very few dedicated collection depots or formal recycling centres where consumers can voluntarily drop-off their e-waste. The majority of individual and urban household consumers sell their waste to *kabadiwalas* or get some discount in exchange when purchasing new electrical or electronic products from small-scale retail shops. Since consumers lack market information about prices for e-waste and various e-waste components, they have few financial incentives for disposing their e-waste in a responsible manner.

9.   Doron, A, Jeffrey, R (2018) *Waste of a Nation – Garbage and Growth in India*, Cambridge, MA: Harvard University Press.

10.  Raghupathy, L, Krüger, C, Chaturvedi, A., Arora, R, Henzler, MP (2010), E-waste recycling in India: Bridging the gap between the informal and formal sector, in *International Solid Waste Association, World Congress 2010*, Hamburg, Germany, 14-19 November.

11.  Borthakur, A, Govind, M (2017) Emerging trends in consumers' E-waste disposal behaviour and awareness: A worldwide overview with special focus on India. *Resour. Conserv. Recycl.*, 117: 102–113.

12.  Bhat, V, Patil, Y (2014) E-waste consciousness and disposal practices among residents of Pune City. *Procedia - Soc. Behav. Sci.*, 133: 491–498.

13.  Venkatraman, T (2015) Mumbai: 62% not aware of e-waste, reveals survey by students, *Indian Express*, 25 September https://indianexpress.com/article/cities/mumbai/mumbai-62-not-aware-of-e-waste-reveals-survey-by-students/ (accessed 2 Oct, 2018).

14.  Kwatra, S, Pandey, S, Sharma, S (2014) Understanding public knowledge and awareness on e-waste in an urban setting in India: A case study for Delhi. *Manag. Environ. Qual. An Int. J.* 25 (6): 752–765.

## Poor infrastructure for enabling industrial-scale recovery and recycling of e-waste

India has extremely limited infrastructure capacity for large-scale management of e-waste. There are 178 government approved e waste recycling centres in the country, with a combined capacity of around 400,000 metric tonnes per year.[5] This capacity constitutes only about one-fifth of the total amount of e-waste generated each year. The Indian Government offers a co-funded grant scheme that covers between 25 and 50% of the project costs for establishing e-waste management facilities and building capacity for e-waste businesses. However, the uptake of the scheme has been very limited.[15,16] In addition to the shortage of formally approved e-waste recycling centres, the currently existing centres operate far below their capacity due to poorly organised supply chains between them and the majority of informal sector collectors of e-waste.

Formal sector recycling is limited to manual sorting and mechanical dismantling of e-waste. India presently lacks industrial e-waste smelters with appropriate environmental controls required for large-scale recovery of precious and base metals. There are a few emerging Indian companies such as Attero which extract metals from e-waste, but these have limited processing capacity. Most of the e-waste processed by the formal sector is exported to countries such as South Korea and Belgium which have the necessary large-scale infrastructure for metals extraction. The informal sector, in contrast, extracts metals using methods such as open-air incineration and acid leaching that are hazardous and exacerbate environmental pollution and health risks.

Although the E-waste guidelines prescribe several technologies for recycling and processing different types and components of e-waste, both the formal and informal sector have mainly focused on metals recovery and less on the plastics, glass, and ceramics that comprise a significant proportion of e-waste. The recycling of plastic e-waste is more complicated due to the presence of flame retardants and other persistent organic pollutants.

# Improving E-waste Management in India

There are five key components that need to be linked together for improving e-waste management. These are: 1) providing market information regarding e-waste prices; 2) incentivising formal e-waste recycling; 3) upskilling informal sector players; 4) deploying readily available and mature recycling technologies; and 5) developing innovative methods and technologies for processing new forms of e-waste.

## 1. Providing market information regarding e-waste prices

There is a well-established market for e-waste within and between informal and formal sector operators. However, the prices for e-waste and its components are not widely known or publicised among urban consumers. A consolidated price list updated on a weekly basis would be a powerful market signal for consumers who sell their e-waste to *kabadiwalas*. The price list should cover all components of e-waste, starting from bulk e-waste to various metals, glass, plastic, ceramics, and batteries. The information could be presented on dedicated websites of urban municipalities and in local newspapers in a format similar to commodity price listings or foreign exchange rates. The price list would not only reflect prevailing market demand for e-waste components, but also

15. Government of India (2013) *Invitation of proposals for establishment of common treatment and disposal facilities for hazardous, bio-medical and e- wastes viz., Treatment, Storage and Disposal Facilities (TSDFs), Secured Land Fills (SLFs), Integrated E-Waste Recycling and Treatment*, New Delhi: Ministry of Environment Forest and Climate Change.

16. NDTV (2017) How To Make E-Waste Recycling Commercially Viable, Government Looks At Options, 21 August, https://swachhindia.ndtv.com/make-e-waste-recycling-commercially-viable-government-looks-options-11076/ (accessed 2 Oct, 2018).

enable informal sector collectors to buy and sell e-waste at fair market prices to private processors or government-approved recycling and dismantling centres.

## 2. Incentivising formal e-waste recycling

The Indian Government could introduce a point-based reward system of E-waste Recycling Credits (ERCs) for formal organisations to incentivise them to channel their e-waste through government-approved recycling centres. Since the E-Waste Rules of 2016 already classify and code e-waste such as computers, laptops, and mobile phones, these categories could be correlated with different ERC reward levels. Depending on the volume and type of e-waste supplied, organisations would earn the requisite ERCs which could be used to offset energy utility bills. Such an initiative would also provide a strong incentive for informal sector e-waste businesses to formalise their operations and establish supply chain links with approved recycling centres.

The ERCs could be piloted over a three- to five-year period to assess efficacy and fine tuning for further implementation. Since government and industrial sectors in metropolitan cities generate more than 70 % of e-waste, the ERCs could be trialled with a few large industries and government organisations in Mumbai, Delhi, or Bangalore.

The Indian government could also expand formal e-waste recycling capacity by co-funding infrastructure upgrades and processing systems at existing government-approved recycling centres. It could provide co-funding incentives to metropolitan city governments to set up new recycling units through public-private partnerships with large e-waste companies.

State and city governments could also develop grant schemes for incentivising small-scale informal e-waste recycling players to upgrade their facilities so that they comply with environmental and occupational health and safety regulations. Cities could apply for national urban development funding schemes that can be used to link the well-established informal sector network of decentralised collection and small recycling units with large-scale industrial recycling centres.

## 3. Upskilling informal sector players

The majority of the informal e-waste recycling workforce needs upskilling, particularly for handling and dismantling hazardous materials, ensuring environmental and occupational health and safety of their work, and linking supply to formal sector processors. This could be pursued through the Indian government's National Skill Development Mission.  Innovative short courses and training programs could be specially designed for e-waste collectors, handlers and dismantlers by the combined expertise of the Electronics Sector Skill Council, the Green Jobs Sector Skill Council and regulatory agencies such as the State and Central Pollution Control Boards.

Upskilling of informal sector workers should be accompanied by a concerted, nationwide campaign by central, state, and city governments to increase public awareness about the hazards associated with e-waste, the importance of informal sector players in e-waste collection, the penalties for e-waste dumping, and the locations of formal e-waste collection depots and government-approved recycling units.

## 4. Deploying readily available and mature recycling technologies

There is urgent need for deploying mature recycling technologies alongside existing manual techniques to improve recycling efficiency of the large volumes of e-waste being generated in India. Global e-waste recycling companies such as Umicore and Glencore have mature technologies and well-tested systems for dismantling, sorting and resource recovery. India also has a very large and mature plastics processing sector that can recycle plastic material from e-waste.

The Indian government should promote joint ventures between international and domestic companies for setting up large industrial e-waste recovery plants. These ventures could be funded through a combination of public and private investment.

## 5. Developing innovative methods and technologies for processing new forms of e-waste

The composition of e-waste is changing rapidly as new electrical and electronics devices enter the market. This requires significant investment in research and development for innovative recycling methods and technologies for future-proofing India's e-waste policies and management. For example, smart phone usage has expanded dramatically in India over the past five years, but the lithium-ion batteries that power these devices are not yet covered by any e-waste recycling rules. There are various new battery and materials technologies being developed for manufacturing next generation electronic devices. It is thus critical for the Indian government to promote and fund research that develops innovative, future-oriented technologies for recycling and transforming new e-waste streams into high value products.

# Australia's Role

Australia has considerable expertise in e-waste policymaking and management. Organisations such as the New South Wales Environment Protection Agency (NSW-EPA) and Sustainability Victoria (SV) are experienced in co-funding and regulating large- and small-scale e-waste recycling centres. Major players in Australia's recycling sector have developed excellent systems for handling and dismantling of e-waste in a safe and responsible manner. They could develop joint ventures with government-approved recycling companies. They could also collaborate with the relevant Sector Skills Councils, regulatory bodies, Australian TAFE colleges, Indian Vocational Training Providers, and informal sector NGOs to develop short training courses for informal sector e-waste workers on various aspects of e-waste handling, dismantling and management.

Australian universities have developed several innovative technologies that could be effectively scaled and utilised to tackle India's large volume of e-waste generation. For example, ISASMELT, microfactories, sustainable 3D printing filaments from e-waste plastics are some of the innovative technologies and products which have been developed in Australia.[17,18]

Australian industries and researchers could also collaborate with their Indian counterparts on joint research projects to test and further develop innovative technologies and processes that respond to the specific regional, social, cultural contexts of e-waste recycling in India. They could seek funding from sources such as the Australia India Strategic Research Fund (AISRF) and the Indian Government's Imprint India Initiative for research projects on e-waste utilisation and management.

17.  UNSW (2018) World first e-waste microfactory launches at UNSW, 6 April, https://newsroom.unsw.edu.au/world-first-e-waste-microfactory-launches-unsw (accessed 2 Oct, 2018).

18.  Gaikwad, V, Ghose, A, Cholake, S, Rawal, A, Iwato, M, Sahajwalla V (2018) Transformation of E-Waste Plastics into Sustainable Filaments for 3D Printing. *ACS Sustain Chem Eng*. https://pubs.acs.org/doi/10.1021/acssuschemeng.8b03105, (accessed 2 Oct, 2018)

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