BOMBAY CHAMBER
Bombay Chamber of Commerce & Industry

SQ
raising the Sustainability Quotient

In this Issue

KNOWLEDGE

E-Waste: An Urban Mine and an Untapped Business Opportunity
- Dr. Prasad Modak
- Vibhuti Agarwal

E-Waste in India - What we might learn from other and Markets
- Sanjay Saxena
- John Gertsakis

Sustainable Management of E-Waste: Example from Australia and Future Directions for Asia Pacific Region
- Dr. Sunil Herat

UPDATES

BOMBAY CHAMBER'S SUSTAINABILITY COMMITTEE ACTIVITIES

Vol.VI No.1

Editorial

E-Waste

In this issue of SQ, we are focusing on the challenges and opportunities in the management of E-waste. E-waste composes of used electrical and electronic goods such as mobile phones, TV sets, cables, batteries etc. that are not biodegradable and contain hazardous substances.

Ministry of Environment&Forests (MoEF) issued E-waste (Management & Handling) rules in 2011 responding to the concerns expressed by leading NGOs such as Toxics Link. The State Pollution Control Boards (SPCBs) were the implementing agencies.

In the last 6 years, the SPCBs have been enforcing these rules and authorizing E-waste recyclers in the various States of India. Currently it is estimated that India produces nearly 3.2million tons of E-waste annually that can be potentially collected for recycling. Accordingly, more than 130 recyclers have been authorized by the SPCBs across various States.

In October 2016, the MoEF and Climate Change (CC) amended the E-waste management and handling rules and emphasized the Extended Producer Responsibility(EPR) with targets assigned to the manufacturers and distributors for the "take back". Role of informal sector and that of Producer Responsible Organization (PRO) was also stated. The amendments made were devised to address the life cycle of E-waste and towards circular economy where the electrical and electronic products once used and disposed were to be collected, refurbished or dismantled to encourage recycling of the components. The idea was to, reduce consumption of virgin resources (especially the metals), generate green jobs and reduce disposal of E-waste to the landfills.

In this perspective, E-waste, can be considered as an opportunity towards economic gains and sustainable waste management. In this issue of SQ, we provide an overview of E-waste situation in India, case studies and international experience. We hope that this compilation of articles provides our readers an update, interesting data and statistics to gain an insight on managing E-waste.

- Prasad Modak

Knowledge Partner

emc™

www.emcentre.com

Published & Printed by :

Bombay Chamber
of Commerce and Industry
'The Ruby', 4th Floor, NW
29, Senapati Bapat Marg,
Dadar (W), Mumbai 400 028
Tel.: 61200200 Fax : 61200213
Email: bcci@bombaychamber.com

Subscription Cost :

Rs. 500/- per annum [hard copy]

Reader's Column

We invite feedback suggestions
and articles from our readers
Please write to um@bombaychamber.com

Knowledge

E-Waste: An Urban Mine and an Untapped Business Opportunity

Dr. Prasad Modak,
Executive President, Environmental Management Centre LLP
prasad.modak@emcentre.com

Vibhuti Agarwal,
Senior Research Associate, Environmental Management Centre LLP
vibhuti.ag@gmail.com

E-waste is discarded, damaged and obsolete electrical and electronic equipment such as mobile phones, IT equipment, household appliances etc. It is one of the fastest growing waste streams in the World. Increase in disposable income, rapid improvements in technology and competitive prices of electronic goods have exponentially boosted the electronics market while consequently generating e-waste at the end of the products' useful life.

In 2014 the total amount E-waste generated globally was 41.8 Million Metric Tonnes per annum (MMTA); forecasted to increase to 50 MMTA by 2018[1]. In India, E-waste is expected to increase at a compound, annual growth rate of 30% between 2016 and 2020[2]. Figure 1 below shows the estimated annual generation by various organizations over the years.

CPCB – Central Pollution Control Board; MAIT - Manufacturers Association for Information Technology; ELCINA – Electronics Association of India; UNU – United Nations University; ASSOCHAM - Associated Chambers of Commerce and Industry of India.

E-waste contains hazardous substances like lead, mercury, cadmium, arsenic and other metals thatarebeingrapidly depleted and that are environmentally harmful when disposed unscientifically. On the

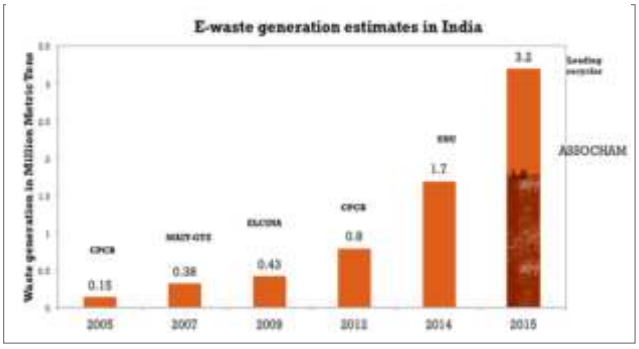

Figure 1: E-waste generation rates in India [5, 8, 5, 1,2, 4]

[1] *Baldé, C.P., Wang, F., Kuehr, R., Huisman, J., (2015), The global e-waste monitor – 2014, United Nations University, IAS – SCYCLE, Bonn, Germany, Page 50*

[2] *India's e-waste growing at 30% per annum: ASSOCHAM-cKinetics study, (2014), Online Source: http://www.assocham.org/newsdetail.php?id=5725; Accessed on Oct 22nd 2016*

other hand, E-waste contains metals and plastic components that when extracted, have high re-use potential and economic value. This makes the business of E-waste Management a very lucrative proposition.

E-Waste Management Policy of India

Until 2011, there was no dedicated E-Waste Policy in India. E-wastewas covered under the Hazardous Wastes (Management and Handling) Rules, 1989. E-waste is primarily handled by the unorganized (informal)sectororkabadiwallahs who follow crude and unsafe methods to dismantle and recover valuable components from e-waste. This has resulted in environmental degradation as well as poor health of the informal sector workers. In addition, there is wastage of precious resources due to inefficient resource recovery techniques being used.

Over the years, collaborative effort and pressure from groups such as MAIT, Green peace and Toxic Links culminated in the introduction of E-waste (Management and Handling) Rules, 2011 to channelize E-waste for environmentally sound recycling by the formal sector. The Rules defined key stakeholders like Regulatory Agencies (CPCBs/SPCBs), producers of electrical and electronic equipment (EEE), recyclers and consumers and also their roles and responsibilities. An important strategy introduced was the Extended Producer Responsibility (EPR). EPR was introduced for effective E-waste Management (EWM) and action by EEE producers to establish an operationally and economically viable E-waste management ecosystem. EEE producers are responsible for financing and developing environmentally sound 'end of life' management systems for their products.

The 2011 rules were superseded by the 2016 rules to include more stakeholders (like manufacturers, retailers, refurbishers), strengthen enforcement and monitoring, include penalties for non-compliance and training and safety for E-waste sector workers.

E-Waste: An urban mine and a lucrative business opportunity in India

India is a massive consumer of electronics. In 2014-2015, electronics worth $63.6 billion were consumed in India[3]. These electronics will turn into e-waste at the end of their useful life. E-waste is an *urban mine* that contains iron, steel, copper, aluminum and precious metals like gold, silver, palladium and plastics. See Figure 2 for the extraction potential and value of resources from E-waste on a global scale in 2014[1].

Material	Weight in Tons	Value in Million USD
Precious Metals		
Gold	300	11,340
Silver	1,000	630
Palladium	100	1,960
Other Metals		
Iron, Steel	1,65,00,000	9,810
Copper	19,00,000	11,550
Aluminum	2,20,000	3,490
Plastics		
Plastics	86,00,000	13,410

Figure 2: Resource content and monetary value of E-waste generated globally in 2014

In India, the monetary value of the recovered material from e-waste was $4 billion in 2015 and is expected to increase to $20 billion by 2020. The materials can be recycled or re-used for manufacturing products while providing jobs to a large, otherwise unemployed, workforce in the country.

Formal vs Informal E-waste Businesses

In India, 95% of the E-waste is handled by the informal sector and only 5% by CPCB registered formal recyclers[2].E-waste rules mandate that all recyclers obtain authorization to recycle E-waste. This resulted in an increase in the CPCB registered (formal) recyclers from 23 units in 2011 of capacity 0.09 MMTto 138 with a capacity of 0.35 MMT. But there is still a very long way to go. The 2016 rules can further boost the valuable formal recycling sector and curb polluting in formal sector activities.

The pool of 138 recyclers is a mix of small, medium and large-scale enterprises and includes recyclers that started their business operations well before the E-Waste rules. They realized the economic potential in the E-waste business. It is interesting to note that the 138 recyclers / dismantlers are spread across only 13 States in India which implies that the E-waste generated in other States is collected and transported to these 13 States or is disposed of unscientifically. Some of the successful Indian E-waste Business examples are detailed below:

E-Parisaraa Pvt. Ltd.

In 2005, E-Parisaraa started off as an R&D pilot plant that could process 1 ton per annum of E-waste in Bangalore. E-Parisaraa is one of the first movers in the sector. Its plant capacity has grown from 1 ton to 8,820 tons per annum. As a first mover, it engaged with major IT companies in

[3]*National Institution for Transforming India (NITI) Aayog, (2016), Make in India Strategy for Electronic Products, India, Page 2, Online Source: http://niti.gov.in/writereaddata/files/document_publication/ Electronics%20Policy%20Final%20Circulation.pdf; Accessed on October 21st 2016*
[4]*Ecoreco's CSR Plans & Partnership, (2016), Online Source: http://ecoreco.com/aboutus-csr.aspx; Accessed on Oct 25th 2016*
[5]*Rajya Sabha Research Unit (LARRDIS),(2011), E-waste in India, New Delhi, Page 5 & 99 Online Source: http://rajyasabha.nic.in/rsnew/publication_electronic/E-waste_in_india.pdf; Accessed on Oct 22nd 2016*
[6]*Central Pollution Control Board, (2014), List of Registered E-waste Dismantler / Recycler in the country, India Online Source: http://cpcb.nic.in/Ewaste_Registration_List.pdf; Accessed on Oct 22nd Oct 2016*

Bangalore like IBM, Intel etc. well before the E-waste and EPR regulations came into play. The incentive for the IT companies then was to comply with stakeholder demands and to document their social and environmental performance.

The services initially started with collection, dismantling and segregation and have now expanded to material extraction, gold and silver recovery, and lighting fixture component re-use. However, E-Parisaraa continues to export shredded PCBs and copper components to Umicore in Belgium for smelting and extraction. The company that was a pioneer in the industry and undertook R&D and education initiatives now faces stiff competition from other players in the industry.

Ecoreco, Eco Recycling Ltd.

Established in 2007, Ecoreco is one of more successful businesses in the sector. Its recycling facility is the first to be registered by CPCB. Ecoreco invited 100 corporates to their facility to showcase and encourage environmentally sound recycling. Ecoreco partnered with a logistics company to support their recycling and refurbishing business. Ecoreco provides its clients with onsite and offsite lighting recycling services. It supports manufacturers' with their EPR responsibilities via its take-back and recycling services.

E-waste Mukta Bharat (E-waste free India) Program - One of the key businesses challenges any recycler faces is collection of E-waste from the source of generation. Ecoreco recognizes that collection is the most crucial step of the E-waste management business strategy. To tackle this issue, Ecoreco launched a social program to set-up accessible E-waste collection centers for the masses. Ecoreco targets to install 100,000 bins and 5,000 Take Back Points (collection centers) across India by 2020 to help collect E-waste from corporates and the masses. In addition to the corporates, Ecoreco will install bins in strategic locations such as educational institutes and places of worship to reach out to the masses.

Ecoreco's Franchise model: Ecoreco is inviting NGOs, recyclers, dismantlers, collectors, informal sector workers and young entrepreneurs to partner with them in the 'Ecoreco Take Back Point' initiative as a franchise. Every franchise should set-up its own Take Back Point, a facility of minimum 1,000 sqft, which will require an investment of $8,200 or INR 550,000.

Attero Recycling Pvt. Ltd.

Founded in 2008, Attero's revenue increased 8 times from $1 million in 2009-2010 to $8 million in 2011-2012. 85% of their revenue comes from sale of re-usable precious metals from E-waste. Attero has a wide collection network across the country with over 25 warehouses and collection centers across 21 states.

With low-cost high efficiency technology that is relatively nascent in India, they recycle mobile phones, CRT and flat panel display units, batteries, PCBs and IT equipment. They refurbish mobiles and IT equipment and sell them under their brand, Gobol. To enhance their collection rates, Attero launched Atterobay, their e-commerce platform where consumers can sell their gadgets like smart phones with free shipping that are refurbished or recycled by Attero.

Operations and Business model

They collect 35% of their raw material from manufacturers or directly from their consumers, 35% from 500 large corporates who prefer Attero due to their nation-wide collection network and the remaining 30% from household or individual consumers via the informal sector. In order to streamline the informal sector, Attero educates them and incentivizes them by offering one and half times more value of E-waste than what they would otherwise make.[7]

GreenDust

Founded in 2008, GreenDust is a reverse logistics company that collects and refurbishes electronics that are returned due to damage or defect by customers to their manufacturers or are collecting dust in warehouses. GreenDust had the first mover advantage since few companies had heard of or practiced reserve logistics. With a return rate of 4-6% in India, electronics worth $12-$15 billion are returned every year. GreenDust conducted a study that helped companies realize that the cost to get back a returned product was higher than its original value and demonstrated the value in tying up with a reverse logistics firm. [8]All the collected products undergo a 50-point quality check before being put up for re-sale with a GreenDust certification.

GreenDust has partnered with brands like Apple, Samsung, Dell, Philips, Whirlpool and retailers like Croma, Homehop18 to refurbish rejected or damaged electronics and re-sell them at a 30% lower cost than the market price. GreenDust's main customer base is Tier II and Tier III cities where people are vying for brands. In three years, the company set-up 200 stores and 14 warehouses and repair units across the country and boasts of a customer base worth25 crores.

Business Challenges

Inventorization, collection, channelization and efficient extraction of E-waste are some of the key challenges faced in the handling and management of E-waste. Let's briefly look at them:

Inventorization - There is no established and agreed upon methodology to conduct e-waste inventory on a national or state level. Various public and private organizations provide significantly varying

[7]*Online Source: http://attero.in/latest_news.php?link=%20115 ; Accessed on October 28th 2016*

[8]*Online Source: http://attero.in/latest_news.php?link=%20115 ; Accessed on October 28th 2016*

annual volumes of generation. Issues like out flow to the informal sector, varying product obsolescence rates, lack of adequate data on product sales, storage and disposal makes inventorization an even bigger challenge. This issue is particularly challenging for E-waste businesses as unpredictable supply can lead to underutilized or insufficient recycling plant capacities; *Collection & Channelization* - Recyclers say that collection of E-waste is their primary business challenge. A mere 1.5% of the e-waste gets recycled due to poor collection efficiency[2]. E-waste is land filled, illegally burnt or handled by informal recyclers or stored for prolonged periods and does not get channelized for recycling affecting profit margins; *High Efficiency Technology Availability* - Manual extraction or burning of e-waste by the informal sector, technologies with poor resource extraction efficiencies lead to reduced profit. Many recyclers use inefficient technologies or export complex e-waste components. Some have developed their own technologies in-house. Importing high efficiency technology is a risk because of high capital costs and unreliable material supply.

Future Potential of E-waste businesses

Given the rapid growth of E-waste generation in the country, penetration of the electronics market in rural areas, the evolution of E-waste rules, increased stakeholder responsibilities and local technology development there is immense potential to set-up E-waste businesses all across the country. The challenges mentioned above have to be addressed in order to make a business economically viable and sustainable. Box 1 includes examples of potential E-waste business models that can be successful in the current E-waste sector landscape:

The above business examples and illustrations of potential business models demonstrate the high growth potential, economic potential and attractive profit margins in the E-waste management sector. Like in other sectors, E-waste businesses have their own set of challenges and business risks that need to be assessed and overcome to achieve success.

Box 1 – E-waste Business Models

Model 1 - Business tied with Producers Practicing EPR and Business with Bulk Consumers

A company can be set-up to provide EPR management services to EEE Producers that need to comply with EPR mandates such as Dell, HP, and Apple. They can start by helping the Producers develop an EPR management plan and assist in implementation. The company can use operational and financial instruments to incentivize bulk consumers and individual consumers and set-up a reverse logistics ecosystem. Contractual agreements with bulk consumers and economic incentives for individual consumers can abate the risk of unreliable material supply.

Model 2 - Business tied with Software Technology Parks of India (STPI) and Industrial parks (IP)

STPI and IP are bulk generators of E-waste. Companies can set-up shop in an STPI (53 locations across India) or Industrial Parks in cities like Pune, Bangalore, and Hyderabad where they collect and process all the E-waste generated by the organizations in the STPI or IP.

Model 3 - Business focusing on PRO that operates Collection Centres with Producers, Recyclers/Refurbishers

A Producer Responsibility Organization (PRO) can be set-up as a co-operative of Producers who are obliged to meet their EPR. Companies that provide collection, dismantling, recycling and/or refurbishing servicescanoperate the PRO. Producers can pool in funds to kick-start the process until the business becomes self-sustainable. Producers can benefit from this model by sharing their legislative, operational and financial responsibilities amongst all PRO members.

Model 4 - Business involving Informal Sector, their role & contribution in the value chain

One of the focuses of the E-waste sector stakeholders like government, recyclers, NGOs is the integration of the informal sector into the formal sector. This strategy has the potential to arrest out flow of E-waste to the informal sector and also to improve the working conditions and health of the informal sector employees. Companies can be set-up to focus on the business of training and building capacity of the unskilled labor so they can become part of the formal workforce.

E-Waste in India - What we might learn from other and Markets

Sanjay Saxena, Infoactiv,
Sr. Vice President Operations, India,
sanjay.saxena@infoactiv.comte

John Gertsakis, Infoactiv,
CSO & Communications Lead, Australia,
john.gertsakis@infoactiv.com

Background

E-waste is probably the fastest growing waste stream in India and will soon be a major environmental concern in India. It is growing at an exponential rate compared to other waste streams. Yet current schemes for responsible resource recovery are only scratching the surface in terms of product scope and volume. Electronic waste is still ending up in landfill, non-renewable resources are being lost and the environment is being exposed to hazardous materials. MOEF (Ministry of Environment and Forests) realising the need to tackle this issues released the first version of the rule titled, E-waste (Management and Handling) Rules, 2011, from May 1, 2012. The rules are largely based on the principles of Extended Producer Responsibility (EPR) and Product Stewardship.

Since the release of the E-waste Management and Handling rules 2011, India as a country has started to improve awareness about the importance of proper e-waste disposal. Campaigns organised by the Government, NGOs, IT companies, Recyclers and Trade Associations are appearing more regularly.

The rules were far from a success, the Original Equipment Manufacturers (OEMs), the bulk consumers and the recyclers were all working towards maximising their own benefits. Only a handful of companies were working towards environmental improvement and waste reduction, in a true sense.

Based on inputs from NGOs and other organizations, the Government on 23rd March 2016, released the second version of the rules titled E-Waste (Management) Rules 2016. This version simplified a lot of procedural issues, included Fluorescent and other Mercury containing lamps (CFL, Tube lights) and most importantly, laid emphasis on responsible EPR / Producer Responsibility Organisations (PROs). The Producers/ OEMs/Brands are required to submit their EPR Plan to the Central Pollution Control Board (CPCB) for approval. Furthermore, the CPCB to dispel any ambiguity, issued the "Implementation Guidelines for E-Waste (Management) Rules 2016" which apart from the details on implementation gives targets to the Producers for collection and reporting.

To put this in the right perspective, the producers have to collect, at a minimum, 15% for the financial year 2016 – 2017, doubling for the next FY. The targets would then increase to 40 % for next 2 financial years between 2018 – 2020, 50% for the financial years between 2020 - 2022 and 70% of the estimated E-waste generation for the financial years 2022 – 2023 onwards. Each and every category of the e-waste as per Schedule 1 has been defined a life span e.g. CPU is for 6 years, notebook, computers for 5 years, copying equipment for 8 years, smart phones 5 years, televisions and washing machines for 9 years, refrigerators and rir conditioners for 10 years etc.

Product Stewardship Opportunities in the Workplace in Australia

There are many models of Product Stewardship and EPR in Australia and abroad. It is a catalyst for innovation and new business models focused on social and environmental benefit, value creation and impact reduction, especially among progressive brands.

However, the essence of Product Stewardship and EPR remains intact i.e. that manufacturers, producers, retailers and brands take greater environmental responsibility for their products across the life cycle, and well after the consumer has finished with the product. It also requires consumers and other relevant stakeholders to play their part and ensure responsible disposal of products through official programs and schemes.

Action on product stewardship in Australia continues to increase and evolve.

EPR prompts companies to place greater emphasis on responsible design and manufacturing processes in addition to integrating systems to recover, reuse and recycle products once they are discarded.

Relevance of Product Stewardship in the workplace – Learnings from Australia

Going waste-free in the workplace is increasingly straightforward and uncomplicated as more Product Stewardship programs become available. More than ever before, there are accessible options for office, facility and environment managers to champion a worker-friendly workspace when it comes to reuse, recycling and waste reduction in general.

Procurement and purchasing is often the perfect point of intervention, and allows organisations to formally specify their environment and sustainability requirements through a competitive process. It not only levels the competitive landscape among product and service suppliers, it also demonstrates that low-waste solutions are increasingly viable and affordable.

In short, there are some key actions you can implement to help improve the level of reuse, recycling and waste reduction in your organisation. From simple inclusions in tender documents and RfQs through to uptake of free collection and recycling programs funded by producers, manufacturers and telcos.

Over and above the gains achieved in workplace tearooms for recycling packaging and food waste, some significant waste reduction opportunities rest with technology and associated consumables.

The combination of voluntary and government regulated Product Stewardship schemes, has resulted in a variety and electrical and electronic products being part of industry-funded 'take-back' programs. Most importantly, the genuine Product Stewardship initiatives are free of charge, workplace-friendly and geared towards corporates, institutions and government agencies.

Specific schemes and programs for technology products

Two of the longest running collection and recycling programs deal with mobiles and printer consumables. Both programs are free of charge to customers and organisations acting as collection points:

Cartridges 4 Planet Ark Product: Printer and copier cartridges and related imaging consumables[9]

Mobile Muster (Mobile Phone Industry Recycling Program) Product: Mobile phones, their batteries and accessories[10]

Australia also has specific legislation that requires producers and importers of televisions and computer equipment to fund the delivery of collection and recycling services for end-of-life equipment. While not as convenient as Mobile Muster and C4PA, the National Television and Computer Recycling Scheme is a free service for householders and small business, and involves weekend collection events or permanent drop-off points (usually at local councils or retailers).[11]

The collection and safe processing of mercury-containing lamps is another opportunity for workplace based recycling. FluoroCycle is a voluntary product stewardship scheme with Government Accreditation under the Product Stewardship Act. Its core aim is to increase the national recycling rate of waste mercury-containing lamps and keep waste lamps out of landfill. While not a free program to end-users, it has a strong education and PR focus underpinned by program signatories and facilitators. For more information about the program and its relevance to the workplace, visit the Fluorocycle website.[12]

An ongoing hotspot which flies under the radar yet needs prompt attention by the Australian Government and industry, is the continuing non-recovery of handheld or loose batteries – both single use and rechargeable. While various pilot programs, ALDI[13] and BatteryWorld[14] provide limited take-back and recycling services in some locations, the reality is that millions of batteries still flow into Australian landfills every year.

Some rechargeable batteries contain hazardous substances and it is essential that Product Stewardship programs are designed and funded by key brands such as Duracell, Energizer, Panasonic and various smaller suppliers. The time has come for these brands to make it easy for all battery users, including commercial and institutional consumers to have responsible disposal options. The Australian Battery Recycling Initiative is working hard with governments and industry to establish a permanent national battery recycling scheme. *More information visit http://www.batteryrecycling.org.au/home*

Most importantly, we need to move to higher levels of environmental performance for products. Driven by life-cycle thinking and good design, the opportunities to close loops and dematerialize are endless, provided producers and manufacturers have the appetite for step-change and meeting consumer expectations.

From design and cleaner production, through to greener supply chains and improved community education, it is vital that producers work collaboratively with retailers, government, the waste management industry and researchers to meet consumer expectations, which maximise environmental quality.

The opportunities to create waste-free product solutions that are cradle to cradle based directly facilitate a circular economy. However, we must move beyond 'old school' collection and recycling solutions, and focus on upstream priorities including product design, supply chain greening, low emission logistics, reuse, extended product life and environmentally driven consumer innovations.

Conclusion

The general public is changing its behaviour towards methods that dispose of e-waste in ways that may not necessarily provide monetary benefit but ensure disposal methods take into account the environment and human health. We expect the recyclers not to operate with their current business practices that involve incorrect volume reporting and selling e-waste to the informal or unorganised sector. Their aim should be to better the environment, improve the level of worker safety and environmental outcomes of the informal sector, thus retaining its vital role in supporting livelihoods. Government companies, NGOs and individuals must work cooperatively to ensure that e-waste is handled properly and to relevant standards and procedures. The Producers should take the EPR/ PRO models to own and support ethical recycling of the products that they have put in the market. Finally, there are a lot of ways in which we achieve such change in India. We can learn and implement some of the successful practices in the developed markets, while ensuring that these practices are localized to suit the Indian market.

[9] *For more information, visit: http://cartridges.planetark.org/*
[10] *For more information, visit: http://www.mobilemuster.com.au/*
[11] *For more information, visit: http://www.environment.gov.au/protection/national-waste-policy/television-and-computer- recycling-scheme*
[12] *For more information, visit: http://fluorocycle.org.au/*
[13] *For more information, visit: https://corporate.aldi.com.au/en/corporate-responsibility/operations/battery-recycling/*
[14] *For more information, visit: http://www.batteryworld.com.au/Recycling*

Sustainable Management of E-Waste: Example from Australia and Future Directions for Asia Pacific Region

Dr. Sunil Herat,
Senior Lecturer in Waste Management, Griffith School of Engineering, Griffith University, Queensland 4111, Australia,
s.herat@griffith.edu.au

Generation of E-Waste

The generation of reliable data on the exact amount of e-waste generated in different regions of the world is difficult to achieve as the amount of used electrical and electronic equipment (EEE) reaching its end-of-life cannot be measured directly with some reliability. The Global E-waste Monitor 2014, published by the United Nations University[15] estimates that the global quantity of e-waste generation in 2014 was around 41.8 million tonnes (Mt). This amount is estimated to reach 50 Mt by 2018, with an annual growth rate of 4 to 5 per cent. The study also found that the Asian region produced the highest amount of e-waste (16 Mt or 38% of total), followed by Americas (11.7 Mt) and Europe (11.6 Mt). The top three Asia-Pacific countries with the highest e-waste generation in absolute quantities are China (6 Mt), Japan (2.2Mt) and India (1.7Mt).

Issues and Challenges of Environmentally Sound Management of E-waste

The issue of environmentally sound management (ESM) of e-waste is a global problem arising from trans boundary movement among all countries and regions, and thus requires global solutions. Large amounts of e-waste are currently being exported to developing countries for the purpose of reuse, refurbishment, recycling and recovery of precious materials. Many recycling and recovery facilities in these countries operate in an environmentally unsound manner causing alarming environmental and health impacts. Significant amounts of e-waste containing hazardous materials can be seen dumped in open-land and waterways. The major environmental and health impacts occur during open burning of e-waste to recover precious metals. In spite of this, recycling and recovery operations have created a huge informal employment sector in these countries. In addition to receiving e-waste from developed countries, developing countries are also emerging as significant generators of e-waste themselves. One of the main problems faced by developing countries is the lack of funds and investment to finance formal recycling infrastructures, and the absence of appropriate legislation to deal with the issue. Extended producer responsibility (EPR) is seen globally as one of the most effective ways of dealing with the e-waste issue. However, unlike in the developed world, implementing EPR in developing countries is a major challenge for policy makers. The competition between the formal and informal recycling sectors to gain access to e-waste is also a major problem.

Significance of Resource Recovery and Recycling of E-Waste

Sincee-waste is usually regarded as a problem, it is easy to overlook the opportunities associated with e-waste, especially at a time where resource use and depletion is also a global issue. It can be argued that the problem with e-waste is not due to the materials that are contained in them but due to the inappropriate ways that they are dealt with at the end-of-life. EEE manufacturing consumes many precious metals and therefore it is an

[15] *The Global E-Waste Monitor - Quantities, Flows and Resources, (2014), United Nations University (UNU)*

important resource for the World's demand for metals. *Mining of used EEE to recover the metals contained in them needs only a fraction of energy required to mine them from natural ores.* E-waste contains many valuable materials such as iron, copper, aluminium and plastics and also many precious metals such as gold, silver, platinum and palladium. Global Waste Monitor 2014 (UNU, 2014) reports that the gold content of total e-waste generated in 2014 is roughly 300 tonnes, which represents 11% of the global gold production from mines in 2013.

Although the resource value of materials such as metals in EEE are well known and availability of technologies to recover these materials are increasing becoming available, only a fraction of e-waste is currently recycled even in developed countries. There are number of reasons why this is the case. Firstly, end-of-life EEE does not reach the recycling process as part of the EEE is stored at home. Secondly, of the collected e-waste, a part is sent directly to recycling for environmentally sound recovery of materials while the rest is reused and then recycled or exported for reuse in developing countries where environmentally sound recycling facilities rarely exist. Even in such facilities, materials can be lost in the process, as it is not possible recover 100% of the materials. However, rudimentary recycling processes employed in developing and transition economies achieve far less recovery yields, especially with valuable metals. Whereas an advanced integrated smelter could recover over 95% of the gold, recycling practices in developing countries could achieve only around 25%.

Role of Private Sector/ Manufacturers and Public Private Partnerships

The private sector (EEE manufacturers) and public sector (national and local governments) must work closely in order to meet the overall objectives of e-waste management. Governments require the assistance from the private sector to develop proper infrastructure to turn the growing e-waste problem into an opportunity. Environmental sound and economically efficient resource recovery and recycling of e-waste cannot be achieved by public sector (national of local governments) alone. In this regard it is very useful to explore the strengths that private sector can bring in to assist the public sector. Local governments need to explore opportunities to create shared value, where businesses and the community benefit from a product or service provided by the private sector. Private sector firms can derive economic benefits by reducing risk, enhancing productivity and expanding markets, while making a substantive contribution to improved and equitable service delivery by municipalities. Such arrangements are generally referred to as public private partnerships (PPPs). PPPs have proven to be remarkably successful in both accelerating progress in service delivery and areas such as environmental management, including business and value-chain programming. E-waste resource recovery and recycling industry is not an exception.

Role of Extended Producer Responsibility (EPR)

EPR is regarded as an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle. EPR typically involves a shift in administrative, physical and financial responsibility from governments or local authorities to producers. EPR also encourage producers to take environmental considerations into account during the design and manufacture phases of product development thereby seeking to achieve a reduction in the environmental impact of products, throughout their life span, from production through end-of-life. The key objective of EPR is to support improvements in the environmental efficiency of products throughout their life cycle. The following are regarded as possible achievements of EPR.

Australia's National Television and Computer Recycling Scheme

Australia's Product Stewardship (Televisions and Computers) Regulations 2011 (the Regulations) came into effect in November 2011. These regulations support a co-regulatory, recycling scheme for televisions, computers, printers and computer products under following objectives:

- Reduce e-waste and its hazardous materials going to landfills
- Increase recovery of reusable materials in a safe, scientific and environmentally sound manner; and
- Provide access for households and small businesses Australia wide, to an industry-funded recycling service at no cost to customers.

The design of the National Television and Computer Recycling Scheme is based on the principles of product stewardship, an approach to managing the impact that different products and materials have on the environment and on human health throughout their lifecycle. It contributes to resource recovery and hazardous waste management, requiring television and computer importers to fund the collection and recycling of a proportion of the electronic waste generated in Australia each year.

According to the scheme, the industry must take responsibility for a progressively higher proportion of total waste each year, from 30 per cent in 2012–13 to 80 per cent at the peak of the scheme's rollout. In 2014–15, industry's responsibility was to fund the recycling of 35 per cent of waste arising. Management of television and computer e-waste beyond these targets, as well as management of other waste, is the responsibility of state and territory governments and, through them, local governments.

Companies importing or manufacturing over a threshold amount of television or computer products are liable under the

scheme and must join and fund an approved co-regulatory arrangement to provide collection and recycling services on their behalf. There were 130 liable parties in 2014–15. Liable party compliance as a proportion of the weight of liable imports was 99.8 per cent at 30 June 2015.Currently there were four co-regulatory arrangements in operation: Australia and New Zealand Recycling Platform Limited (ANZRP), DHL Supply Chain (Australia) Pty Limited, Ecycle Solutions Pty Ltd and Electronic Product Stewardship Australasia (EPSA).

A total of 1,677 collection services were provided to the public under the scheme in 2014-15, and 1,060 of these services were shared between one or more co-regulatory arrangements. These included longer-term services, such as drop off points at major electronics retailers and local government waste transfer stations, as well as temporary collection events. An estimated total of 121,866.3 tonnes of televisions and computers reached end-of-life in Australia in 2014–15. Industry's target under the scheme was to recycle 35 per cent of this amount, or 42,653.2 tonnes. A total of 44,730.5 tonnes of recycling was achieved in 2014–15.[16]

From 1 July 2016, the Australian Government required co-regulatory arrangements to only contract with recycling service providers that are certified to AS 5377: the Australian Standard for the collection, storage, transport and treatment of end-of-life electrical and electronic equipment. This will ensure a consistent industry standard for scheme recycling providers and ensure positive work health and safety outcomes.

The Way Forward

As a way forward, the policy makers in Asia Pacific countries may find following activities useful in their attempt to achieve sustainable e-waste management, in particular, to create enabling conditions for enhancing the business and economic

potential of resource recovery and recycling from e-waste:

- Well defined national e-waste management strategy based upon 3R concepts. Such strategy should not only address the environmental and health impacts of e-waste (end-of-pipe) but also look at the reduction of e-waste through green design (up-the-pipe). It should also create enabling conditions for relevant stakeholders to develop business and economic opportunities to recover the materials
- from e-waste. The strategy should take into account the financial, institutional, political and social aspects of e-waste management, in particular, incorporating the activities of informal e-waste recycling sector.
- Well defined regulatory procedure adequate enough to control illegal exports of e-waste and to ensure their environmentally sound management.
- Improve country's ability to gather data and inventory on e-waste generation including their transboundary movement and to access appropriate and cost effective technologies to manage e-waste within their own borders. Such inventory should clearly identify the key players in the e-waste recycling value chain.
- Establishment of proper intuitional infrastructures for collection, storage, transportation, recovery, treatment and disposal of e-waste at regional and national levels.
- Development of scientific resources such as experts and laboratories to conduct environmental and human health impacts of e-waste.
- Improving the working conditions and minimisation of work related toxic exposure at e-waste collection, processing, recovery and disposal facilities.
- Awareness raising programmes and activities on issues related to health and safety aspects of e-waste in order to encourage better management practices.
- Develop public-private-community partnerships to encourage the establishment of formal e-waste recycling and disposal enterprises.

  Address the obstacles related to implementing EPR and mandating producers, importers, retailers with cost of collecting, recycling and disposal of e-waste.
- Require the countries that export used EEE to developing countries to formally test the equipment prior to export.
- Prohibit import of e-waste if the receiving country does not possess adequate capacity to manage these wastes in an environmentally sound manner.
- Identification of organisations or institutions with potential to develop innovation hubs and centres for excellence for developing and promoting environmental sound e-waste recycling technologies. These centres of excellence should conduct R&D on innovative technologies and should be able to assess the applications of relevance of technology transfer.
- Develop standards for collection, storage, transport, recovery, treatment and disposal to ensure environmentally sound management of e-waste.

[16] *National Television and Computer Recycling Scheme, Department of the Environment and Energy, Australian Government, Online source: www.environment.gov.au/ewaste, Accessed on: 13th January, 2017.*

'Regional E-Waste Monitor' a report by U. N. University released in January 2017, highlights the alarming rate of E-waste generation especially among East and South East Asian countries. The report looked at 12 countries showing a 63% jump in E-waste from the recorded levels in 2010. The many challenges and issues faced by the countries has been documented along with references to those countries that successfully managing this grave issue.

Visit the report here: http://ewastemonitor.info/E-Waste_Monitor_Southeast_Asia_2016_ebook.html#p=1

Different kinds of metal are being separated from e-waste at Stena Recycling in Oslo, Norway.

The Ministry of Environment in Norway signed an agreement to set up take back companies with the producers and importers of electronic waste as early as 1998. It was a voluntary agreement and was later followed by an e-waste regulation in 1999. Like the rules in India, management of e-waste in Norway is also a producer responsibility and producers are defined as Norwegian manufacturers and importers of EEE.

"EPR implementation in Norway mandates the domestic producers and importers to finance the e-waste collection and treatment systems. The financing can happen individually or collectively," says Silje Johanssen, an advisor with Section for Waste and Biocides, Norwegian Environment Agency (NEA). Silje explains that producers/importers of e-waste in Norway are obliged to be members of a take-back company and have to pay a fee for their membership to the take-back companies. This is how it provides the funding for collection and treatment of the waste. The price for membership differs according to product type. Currently, there are five approved take back companies in Norway with 5000 member producers/importers."

Excerpted from Down to Earth http://www.downtoearth.org.in/blog/e-waste-disposal-what-india-can-learn-from-norway-48398

step
solving the e-waste problem

The Step Initiative

The Step Initiative is based in Bonn, Germany and is hosted by the United Nations University – Institute for the Advanced Study of Sustainability (UNU-IAS SCYCLE).

Step facilitates research, analysis and dialogue among 65+ members drawn from business, international organizations, governments, NGO's and academic institutions around the world.

Step website hosts a number of publications on E-waste visit http://www.step-initiative.org/publications.html

For a List of Registered E-Waste Dismantler/Recycler in the country (as on 27-11-2014) visit http://www.cpcb.nic.in/Ewaste_Registration_List.pdf

A total of 138 units across 12 states. Maharashtra alone has 22 registered recyclers.

World Trade Centre (WTC), Mumbai in association with Ekonnect Knowledge Foundation (Ekonnect) organized a seminar on 'Managing E-Waste: Challenges & Opportunities'. The speakers included Dr. Prasad Modak, Executive President, EMC LLP on An overview on E-waste (Management & Handling) rules, 2016, Mr. Satish Sinha, Associate Director, Toxics Links on Extended Producer Responsibility at Indian Corporates, Dr. Aniruddha Agnihotri, Head-Environmental Sustainability, Health & Safety, Tata Consultancy Services on E-Waste Management Strategy, Mr. B.K Soni, Chairman & Managing Director, EcoReco on E-Waste Recycling and Ms. Deepali Sinha Khetriwal, Managing Director, Sofies India on Producer Responsibility Organizations-Experience from Switzerland.

Read the report here: http://ekonnect.net/images/E-waste-Management-Programme-WTC270716.pdf And view their presentations here: http://www.slideshare.net/EkonnectKnowledge Foundation

'Integrated Solid Waste Management' is a five day course as part of the Capacity Development on Environment Management (CDEM) by K.J.Somaiya and MMR-EIS.

The module on ISWM is designed to run across five days, mapped with the Waste Management Cycle following the hierarchy of reduce to disposal. The module covers the best practices across the globe with local examples as case studies. Learning will happen through the pedagogy of Project Case Work. At the end of the module, the participants will come up with an Integrated Solid Waste Management Action Plan for the "problem or opportunity statement" provided. The plan will include "solutions" and "innovations' for segregation of waste at source, recycling and reuse, collection & transport treatment and secured disposal. ISWM has been designed and will be conducted by Dr.Prasad Modak and the team at Ekonnect Knowledge Foundation.

Visit to register or learn more: http://ekonnect.net/index.php/our-programs/finishing-schools/somaiya

Cleaning Up Electronic Waste (E-Waste)

EPA collaborates with the United Nations University - Solving the E-waste Problem Initiative (UNU-Step) EXIT to jointly address the e-waste problem in developing countries. EPA and UNU signed a cooperative agreement to work on this topic in November 2010. EPA and UNU-StEP are working collaboratively on tracking global flows of e-waste. EPA is a founding member of the UNU-StEP initiative and serves on the UNU-StEP Steering Committee.

EPA also works bilaterally with governments and environmental officials around the world on e-waste management. EPA and Environmental Protection Administration Taiwan (EPAT) coordinate the International E-Waste Management Network (IEMN), which has brought together environmental officials from Asia, Latin America, the Caribbean, Africa, and North America to exchange best practices on e-waste management since 2011.

Excerpted from https://www.epa.gov/ international-cooperation/cleaning-electronic-waste-e-waste

The e-waste mountains - in pictures

Sustainable development goal target 12.5 is to reduce waste. But with a planet increasingly dependent on technology, is that even possible? Kai Loeffelbein's photographs of e-waste recycling in Guiyu, southern China show what happens to discarded computers.

Visit: https://www.theguardian.com/global-development-professionals-network/gallery/2016/oct/18/the-e-waste-reduce-waste-old-technology-mountains-in-pictures

"Mumbaiites' effort keeps 13 tonnes of toxic e-waste from dumps" an article by Badri Chatterjee in Hindustan Times on Jan 22, 2017.

A report by city-based NGO Stree Mukti Sanghatana states that from August 2015 to January 2017, more than 12,866kg of e-waste was prevented from being disposed of at Mumbai's overburdened dumping grounds. Fifteen schools and colleges, seven housing complexes and five private commercial complexes organised weekly collection drives and sent their e-waste to the NGO.

Excerpt from the article read more here: http://www.hindustantimes.com/mumbai-news/mumbai-recycled-13-000kg-of-e-waste-in-17-months/story-ilPZ8NKPSBwWNhWW1LHS6H.html

Symposium on E-Waste to No-Waste: Contributing to End-of-Life-Solutions - June 17, 2016

The Bombay Chamber conducted the Symposium on E-Waste to No-Waste: Contributing to End-of-Life-solutions to address the different components of in the E-Waste.

The key focus of the E-Waste Management and handling in Indian industry highlighted the key points on the new applicable rules to management e-waste effectively so as to reduce environmental impact. This program opened up the discussion on the roles and responsibilities of different stakeholders involved in the entire life cycle of e-waste. The event witnessed technology suppliers who threw light on the various ways to recycle and reuse e-waste. The key people from the Ministry of Environment Forest and Climate Change; Central Pollution Control Board and private market players shared their ideas and thoughts on ways to manage and handle e-waste which is a potential hazardous waste being accumulated at an alarming rate.

A Conference Paper on E-Waste Management in India: Key Issues and Recommendations, Authored by Ashish Chaturvedi and Jai Kumar Gaurav, Adelphi was presented. The same paper is given below.

Introduction

Electrical and electronic products have become mainstays of a modern life and are a sign of rising prosperity. While they provide services that enhance the quality of life, at the end of their useful life, they contribute to one of the fastest growing waste streams globally. The increased use of Electrical and Electronic Equipment (EEE) and their high rate of obsolescence is leading to around 41.8 million tons of e-waste generation globally that is growing at an annual growth rate of 4 to 5 per cent per year (Baldé, (2015):24-25). While e-waste has been recognised as a global challenge, in developed countries it creates a significant burden on the formal waste management system. As a result, there are significant leakages to the developing countries. For instance around 75% to 80% of e-waste is shipped to countries in Asia and Africa for "recycling" and disposal while majority of imported e-waste in developing countries is managed through informal unsafe recycling channels (Perkins et al., (2014): 287).

In India, as in several other developing countries, most of the e-waste is managed by the informal sector. With an estimated generation of around 1.7 million tonnes of e-waste and 7% growth rate, it presents a significant challenge (Baldé, (2015):42)), (ILO, 2014),Dwivedy and Mittal (2010a,b).

The private sector, both informal and formal, is at the forefront in managing this challenge globally. However, due to trans-boundary movements of e-waste (originating from developed countries)as well as the presence of the informal sector (in developing countries), the role of policy in managing this challenge becomes crucial. In India, policy response to this challenge was relatively prompt for a developing country. As early as 2008, the Government of India announced the Guidelines for Environmentally Sound Management of E-waste and in 2011 formulated the E-waste Management and Handling Rules (2011). The Rules announced in 2011 have been recently revised.

With the recent announcement of the amended Rules, there is renewed interest amongst the relevant stakeholders in responding to the challenge of e-waste management in India. This amendment also provides an opportunity to revisit some of the challenges and opportunities of e-waste management in India. In this paper we present an overview of e-waste management in India and highlight some of the critical issues. In what follows, we outline the key challenges and opportunities of e-waste management in the Indian context in the next section. Section 3 presents a brief excursus into the Indian policy response while section 4 presents the building blocks of a sustainable e-waste management system.

We conclude with the way forward and a set of recommendations.

1. Challenges and Opportunities in E-Waste Management

1.1 Challenges

Environmental Challenges

E-waste contains many toxic substances that are released into the environment, if not handled in a controlled environment. For instance, along with valuable materials, like Gold, Silver, Platinum, Palladium, Copper, plastics and glass, e-waste contains over 50 toxic elements like Mercury, Arsenic, Lead, Chromium, PCBs etc. These toxic elements can cause long-term health problems like neurological and endocrinal disorders and in some cases even cancer (Agarwal, (2012): 14). During unsafe recycling of e-waste by the informal sector toxic substances are likely to contaminate the environment and harm the health of the workers involved.

The informal sector workers are largely unaware about the health impacts and the use of protective gears is rare. Metal recovery, through the open burning of PVC wires releasing brominated and chlorinated dioxins as well as carcinogenic Polycyclic Aromatic Hydrocarbons (PAHs) into the soil, water and air, is rampant in the informal sector. One of the most valuable fractions of e-waste are Printed Circuit Boards (PCBs). In the informal sector, PCBs are de-soldered and chips are burned and/or put into acid baths to extract gold or other precious metals. Such extractions processes have the potential for tin and lead inhalation as well as inhalation of brominated dioxin, beryllium, cadmium and mercury by workers and residents. Further, fumes of acids, chlorine and sulphur dioxin gases can lead to respiratory problems such as pulmonary diseases, respiratory failure, and death (Nischalke, (2008)). The environmental challenges are further exacerbated because of the limited capacities of the State Pollution Control Boards (SPCBs) to monitor the diffused sources of environmental pollution.

Social Challenges

Despite widespread and extensive use of electrical and electronic equipment in India across income groups the awareness regarding e-waste is very limited. Advertising by electrical and electronic sector companies have negligible mention of how the equipment should be handled after end of life. At the same time, government or NGOs concerned about the issue of e-waste have also had limited success in creating awareness regarding e-waste. Arguably the limited awareness amongst consumers regarding e-waste indirectly promotes unsafe recycling as consumers are less likely to pay for recycling related services or deposit e-waste for safe recycling at prices lower than those offered by the informal sector. Another key social challenge is the integration of the widespread informal sector. Medina (2007) estimates that around 2% of the population in developing countries depends on waste picking or informal waste management sector for livelihood. For India, this number would be around 24 million people. Even if we assume 10% of these people are involved in e-waste management, this would imply that nearly 2.4 million people are involved in informal sector e-waste management either directly or indirectly. These estimates might not be completely inaccurate. For instance, according to estimates of the district administration, around 1 to 1.5 lakh people are involved in informal e-waste recycling in Moradabad (Uttar Pradesh) alone. Workers are paid around INR 200 per day for working in the e-waste recycling sector with women and children earning far less (CSE, 2015). However, the challenge is that there are few alternate livelihood opportunities for the people involved in informal e-waste recycling and they are likely to be harassed by police and environment department staff. The situation is likely to worsen if there is an exclusive environmental focus while implementing the e-waste rules with scant attention paid to livelihoods of the informal sector.

Economic Challenges

Developing countries have thriving informal e-waste markets that seem to have advantages when compared to their formal counterparts. The advantages stem from the historical building up of networks and market intelligence. Also, as the informal sector lies outside the ambit of regulatory oversight, it has cost advantages as compared to the formal sector by not being subject to the taxation and environmental laws. Most of these cost advantages occur particularly in the early stages of the value chain such as collecting, dismantling and refurbishing.

However, there are significant economic disadvantage to the informal sector as well. In spite of being extremely well networked and with significant business intelligence, informality does not allow these actors to access formal sources of finance limiting their ability to expand beyond a certain size. Also, the informal nature of operations makes them susceptible to the demands of the legal authorities.

In the case of e-waste management, the simultaneous presence of the informal and formal markets has the potential economic challenge of creating competition between the two. Such competition for e-waste has the potential to undermine the financial feasibility of the formal sector and can lead to environmentally inferior outcomes.

1.2 Opportunities

Social Opportunity

The social opportunity in e-waste management emanates from the possibility of raising awareness of communities, engagement of citizens and the main streaming of the informal sector. Public education and awareness can play a crucial role in conveying the benefits of clean and safe disposal of e-waste. Such awareness has the potential to create consumer pressure on electrical and electronic goods producers to develop approaches for environmentally sound disposal of e-waste.

While there is significant uncertainty regarding the role of the informal sector in waste management in the future, presently it plays a significant role (Schindler, Demaria and Pandit (2012):18-19). Further, it is argued that the impact of the informal sector in terms of economic, social and environmental aspects is mostly positive achieving a net benefit while formal waste management operations have a net cost (Ezeah, Fazakerley and Roberts (2013):2514). In spite of the synergies between the social and economic aspects of e-waste management in the informal sector, there are concerns regarding unsafe recycling practices emitting hazardous substances affecting health of informal sector workers as well as others (Wath et al., (2010):25). With the introduction of formal and safe recycling systems it is possible to create jobs in the recycling units as well as creation of livelihood opportunities for the informal sector workers in the formal ecosystem. However, the creation of such opportunities would require significant investment and support by the state.

Economic Opportunity

With 1.7 million tonnes of e-waste being generated annually, and assuming a conservative value of INR 1000 per ton, the sector could have a turnover of INR 1.7 billion. A network of collectors, traders and recyclers can create jobs and generate tax revenues for the government. In addition, due to the recovery of useful materials and the resulting reduction in mining of virgin raw material, e-waste management is expected to result in cost saving as well as reduced environmental cost of production.

In a recent paper, Gupta and Ganesan (2014) suggest that the raw materials required for manufacturing electrical and electronic equipment is in short supply in India. For instance, there are no known reserves of cobalt, poor reserves of boron, copper, lead, titanium; not well explored reserves of molybdenum, chromium, graphite, boron, rare earths, platinum Group, materials, gypsum, tungsten, gold, perlite, antimony etc. (Gupta and Ganesan, (2014)). By managing e-waste well, valuable secondary raw materials can be recovered that can reduce India's dependence on import of expensive minerals and metals for manufacturing IT and electronic equipment.

Also, there are significant greenhouse gas emission reductions possible from the associated reduction in mining activities. Further, refurbishing reusable parts makes it possible for households to access appliances and communications technology relatively cheaply, a particularly important consideration for low-income rural consumers in developing countries (Lines et al., 2016).

Environmental Opportunity

The environmental damage caused due to harmful air, water and land emissions from unsafe recycling practices create irreversible environmental damage. Introducing safe recycling practices reduce harmful emissions and helps maintain safe environmental conditions. India, a growing economy, needs significant amount of metals and minerals that are not available presently or would require large investment in mining, processing etc. Effective e-waste management can provide secondary resources that reduce the requirement for virgin raw materials.

2 Indian Experience of Implementing Policies Related to E-waste Management

Following advocacy efforts of several NGOs and international organizations, the government of India announced the e-waste (Management and Handling) Rules in 2011. These Rules came into effect from 1st May, 2012. The rules were applicable to every producer, consumer, and bulk consumer involved in the manufacture, sale, purchase and processing of electrical and electronic equipment (EEE). The Rules also fixed responsibilities for collection centres, recyclers, and dismantlers of e-waste. Further, the rules mandate registration of collectors, dismantlers and recycler from both the informal or formal sector. These rules also impose the Extended Producer Responsibility (EPR) and Reduction of Hazardous Substances (RoHS) provisions.

Despite the implementation of the E-waste (Management and Handling) Rules, 2011 for five years, not much has changed on ground. The informal sector still recycles most of the e-waste. A study by Toxics Link ((2014):12) puts the onus on both the producers as well as the SPCBs. The study founds that of the 50 major electronic and electrical equipment brands, 34% have taken no action in response to the E-waste Rules of 2011. Another 30% had taken few steps only to comply with the e-waste rules while most have not set up any physical take-back system. Further, State Pollution Control Boards and Committees, responsible for inventorisation of e-waste, grant and renewal of

authorisation, recycler registration, monitoring compliance and action against violations of these rules, were also found inadequately equipped. For instance only seven states had carried out a thorough analysis of e-waste generated and most had limited information on their web platforms. Most importantly, the report highlighted that Indian consumers, paid by the informal sector, have no financial incentive to return their products to formal channels in the absence of a financial incentive. As a result, very limited amount of e-waste is returned for recycling through the formal channels (Toxic Links, (2014): 30-47).

1.1 E-waste Management Rules (2016)

With the experience of implementing the E-waste Rules for 5 years and the renewed interest in waste management due to the Swacch Bharat Missions, the government has introduced the E-Waste (Management) Rules, 2016 that shall come into force from October 1, 2016. These rules *apply to every manufacturer, producer, consumer, bulk consumer, collection centres, dealers, e-retailer, refurbisher, dismantler and recycler involved in manufacture, sale, transfer, purchase, collection, storage and processing of e-waste or electrical and electronic equipment*. In this section, we highlight some of the key recommendations of the new rules that could have a significant bearing on enhancing environmentally sound management of e-waste in India.

Collection Centres

The new rules define that only the producer, individually or as an association jointly, can establish a 'collection centre' to collect the e-waste. Such collections centres would channelise the e-waste to the dismantler/recycler. The collection centres would act in accordance with the authorisation granted for Extended Producer Responsibility to the producer. The collection centres would follow the norms set as per the guidelines of the Central Pollution Control Board. The same norms would also apply to the collection centres established by the dismantler/ refurbisher/recycler. These collections centres would be approved as a part of the authorisation issued by the State Pollution Control Board where the facility exists. A key challenge of this amendment is that it excludes collection centres run by NGOs, informal sector organization or citizens unless they become partners of one or the other producers. Establishing such partnerships may not be feasible for decentralized collection centres and as a result the collection network would not be as extensive as it could have been in the absence of this amendment.

Deposit Refund System

A significant change in the new rules is the introduction of an economic instrument in the forms of a Deposit Refund System (DRS). The implementation of a DRS would involve collecting a deposit from consumer that is refundable when consumer deposits the e-waste for safe recycling. However, DRS schemes are unlikely to work for products that have relatively long lives. For instance, a television has a life of around 15-20 years in India. It is difficult to envisage a situation where the original owner of the product would safely keep the claim slip for DRS for this duration. The situation would be further complicated by extending the life of the product through reselling or just passing on the product to another entity. The implementation of DRS needs to be closely monitored and debated as it has the potential for significant impact. However, to create such an impact, DRS needs to be implemented under the close watch of the regulatory authorities and must be withdrawn if it does not yield the desired results within a short period of time. This is crucial because the consumers would bear the financial burden of implementing this scheme and unscrupulous actors have the potential to gain significantly from subverting such a system.

E-waste Exchange

An innovative instrument, introduced as part of the new rules, is the 'e-waste exchange'. The exchange is an independent market instrument offering services for sale and purchase of e-waste generated from end-of-life electrical and electronic equipment between agencies or organisations authorised under these rules. However, it is only available for large players. The scope of the e-waste exchange could be enhanced to include individual consumers as well as micro and small-scale enterprises (including those in the informal sector) that handle significant amount of e-waste. This is especially crucial because these actors might be most reluctant to deal with extensive paperwork required for compliance with the Rules. The e-waste exchange has the potential to use IT enabled services for effective implementation of the rules.

Extended Producer Responsibility

The new rules present a more stringent version of Extended Producer Responsibility as compared to the Rules of 2011. The clearest manifestation is the announcement of targets. The authorized EPR entities now have obligation to declare targets of how much e-waste they will recycle which should be 30% of the e-waste they are likely to generate based on past sales. As it is challenging to trace products and link them to individual EPR entities they are free to ensure processing of a certain quality of e-waste irrespective of the brand.

While targets have the potential to channelize investments by the producer for setting up of

infrastructure for e-waste management, it is unclear whether such investments would lead to enhanced environmentally sound recycling. This aspect is critical in the Indian context due to the presence of the informal sector. Most large brands have limited experiences of dealing with informality. By not making the informal sector as critical actor for the implementation of EPR, these Rules have missed a crucial opportunity. In the absence of clarifying the role of the informal sector, EPR might just be another step in privatising waste management without adequate social safeguards.

Further, given that most of the e-waste handling is managed by the informal sector, a low cost option for producers might be to source the material from the informal sector. While this may seem attractive in the short run, by not addressing the underlying problem of environmental violations in the informal sector, this option may lead to the continuation of environmentally damaging recycling. This risk becomes even more severe in the face of constrained capacities of the regulatory authorities, especially the State Pollution Control Boards.

2.2 Revisiting the Policy making Process for E-waste in India

Recent research shows that policy making in waste management is not a linear process as envisaged in the literature on policy cycles but is a complex process involving multiple actors with diverse objectives (Chaturvedi, Vijayalakshmi, and Nijhawan (2015) p.7). The e-waste stakeholder landscape is a prime example of such complexity. With actors in the formal and informal value chain and widely divergent objectives, policy making on e-waste has to be situated in the broader political economy of waste management. However, the e-waste regulations in India take a largely linear world-view and do not adequately take into account the complexity of the diverse actor-objective matrix. As a result, the focus is on certain aspects of e-waste management, of which the environmental aspect takes precedence. Such focus on environmental aspects leads to a further marginalization of the interest and objectives of major stakeholders whose interests might not primarily be driven by a concern for the environment. This is especially true for the informal sector whose primary interest in e-waste management is as a livelihood generating activity.

The attempts at regulating e-waste thus far have been as an environmental policy issue. A recent CSE report (2014:p.6-10) highlights that the approach is geared towards giving multiple clearances, consents and authorizations with poor monitoring and enforcement. The CSE report has highlighted that most State Pollution Control Boards (SPCBs) suffer from severe deficit of man-power, infrastructure, and competence in addition to the challenge of transparency and accountability. For example a technical officer in the Maharashtra PCB is responsible for monitoring more than 250 factories while only 30% of the sanctioned posts have been filled in PCBs of Haryana, Andhra Pradesh and Odisha. In present situation increasing the burden of monitoring on SPCBs by including enforcement of e-waste rules 2016 may not lead to effective compliance. It is argued that in place of command and control regulation that has had limited success so far it would be prudent to create incentive for a self-sustaining and safe business ecosystem for e-waste management.

While treating e-waste management as an environmental policy may yield desired results in the developed countries, in countries like India such attempts are unlikely to yield the socially and economically desirable outcomes. It is therefore crucial to announce accompanying measures that target the social and economic aspects of e-waste management along with the environmentally focused Rules. This insight to policy making is not recent. It was first suggested by the first Nobel Laureate in Economics, Jan Tinbergen in 1952 (see Tinbergen (1952)).

3. Building Blocks for Sustainable E-waste Management

The complexity of the e-waste landscape in India also presents significant opportunities. We now outline how the presence of different actors and ongoing initiatives provide the strengths for developing an effective and sustainable e-waste management system in India.

Informal Sector and its potential:

A key resource in India is the presence of the widely networked and experienced informal sector. There is widespread literature that establishes the strengths of the informal sector. However, there are limited experiences globally of working with the informal sector at scale. As a result, there are few role models to emulate (with possibly notable exceptions in Latin America). India can show the way in mainstreaming informality in waste management. However, this would require significant engagement of state agencies. It would be akin to reinventing the wheel if the formal sector establishes its own collection system while informal sector collection is considered illegal. We believe that the e-waste management challenge in India cannot be solved without involving the informal sector. Therefore, experiences from projects by NGOs and through bilateral cooperation in several large cities should be utilized to devise ways for engaging the informal sector in e-waste management.

Availability of skilled workforce and limited job opportunities:

India has a high share of working age population and there is a need to create employment opportunities. E-waste management can create new job opportunities and appropriately designed educational or skill enhancement programs can ensure that skilled workforce is available at reasonable costs to successfully implement safe e-waste management programs.

Developed culture of repair and reuse:

Traditional practices in India support the idea of reuse, repair and refurbishment and discourages wasteful consumption. This culture needs to be sustained especially given the experiences of Europe and United States. The renewed interest in Collaborative Consumption and Circular Economy shows that the traditional Indian practices need to be given active policy support so that we do not go through the same development process as in the US and Europe and build on the existing strengths of the Indian Economy.

Rapidly Rising Awareness:

Although countrywide levels of awareness regarding e-waste in India are low, due to the efforts of government and NGOs, there exist pockets of excellence especially in large cities. These pockets of excellence are concentrated in educational institutions in a few cities. Any future initiative should build upon these pockets of excellence and continue to concentrate on children and youth as agents of change. Also, significant experiences exist regarding awareness creation efforts for regulators as well as producers that can be utilized to design national level capacity development programmes. A notable addition to such initiatives is the intervention designed by the Department of Electronics and Information Technology (DeitY) to raise awareness amongst all the relevant stakeholders in India. The nationwide programme is likely to provide significant fillip to the capacity building of relevant actors for effective implementation of the Rules in India.

Relatively low levels of per capita waste generation – advantages of starting early:

India has a relatively low per capita e-waste generation at 1.3 kg per capita as compared to China's 4.4. The US, UK and Germany currently generate more that 20kgs on a per capita basis. This early start has the potential to develop effective systems that not only tackle the challenge when e-waste generation expands but also leapfrog the experience of the more developed economies. Further, starting early also provides a window of opportunity to scale-up recycling capacities while implementing measures to limit waste generation.

4 Strategic Approach

Having outlined the challenges and opportunities as well as the strengths of the e-waste management landscape, we now outline the key elements of a strategic approach to e-waste management in India.

State-civic-business alliances:

As mentioned above, there are multiple actors with diverse objectives involved in e-waste management in India. To devise and implement a sustainable working model, there is a need for across the board collaboration involving government, NGOs, informal sector and formal recycling businesses. There is significant evidence to suggest that large scale transformation in existing consumption and production patterns would require collaborative efforts of actors with diverse objectives. In e-waste management, models have been suggested that show that there are possibilities for cooperation between the informal and the formal sector in the e-waste management value chain. These opportunities need the enabling support of the producers as well as the regulators. As a result, state-civic-business alliances need to be developed. A key actor for developing such alliances would be local government officials (from ULBs) involved in waste management as well as in implementing environmental regulations (for instance, from SPCBs).

Deepening Engagement of SPCBs with OEMs and Formal Recyclers:

With numerous industries to regulate and limited number of staff, it is often argued that command and control measures are not the most effective means to achieve environmental objectives as envisaged in policy documents. Therefore, innovation in the form of next generation "policy" processes where the environmental regulator is seen as the facilitator for compliance to environmental regulations needs to be tested in India. Initiatives have already been launched in a few states and need to be further expanded and strengthened across the country.

Strengthening links between SPCBs and ULBs:

While cities, the biggest generators of e-waste, are managed by ULBs, the environmental monitoring of compliance to the e-waste rules falls under ambit of the SPCBs. This division of responsibilities has the potential for enhanced compliance, but experience of implementing other waste management regulations suggests that it is often difficult for the SPCBs to effectively monitor ULBs. By creating platforms for engagement between SPCBs and ULBs and developing model cooperation projects, effective implementation of the E-waste Rules can be strengthened. Expecting already burdened SPCBs to monitor all the relevant stakeholders involved in e-waste management is unlikely to yield desired results.

Debate and engage with informality:

Our discussion thus far has emphasised the key role of the informal sector in e-waste management in India. The government should collaborate with civil society organization as well as directly with actors in the informal sector to identify potential entry points for mainstreaming the informal sector. On the basis of such interactions, model projects should be developed that are based on the collaboration between the informal and formal actors in the private sector. Several examples of such collaborative projects exist in India as well as in other developing countries. However, the success of such models over time depend crucially on the

convening role of the state. India's leadership in debating and engaging with the informal sector has the potential to provide game changing results and create an example for other developing countries to follow.

Hub and Spoke Model for Infrastructure:

A high-tech refinery that can extract precious metals from sorted e-waste components needs billions of dollars in investment. Therefore, it is only possible to install such plants to cater to an entire region, while state-wide material recovery facilities and city-wide collection infrastructure is required to provide adequate amount of material for the regional refinery. This strategy for developing hub and spoke model for infrastructure can play a crucial role in maintaining viable recycling businesses. However, developing such models would require across-state discussions and overall leadership of the Central Pollution Control Board that provides the strategic orientation for development of adequate and appropriate infrastructure.

Capacity Building of Regulators:

With the introduction of new e-waste rules it is crucial to devote significant investments for capacity building of regulators. While training modules are available or are being prepared there is a need for hand holding and mentoring of officers at the local level to ensure enforcement. The Department of Electronics and Information Technology (DeitY)has also launched a nation-wide initiative for such capacity building. This initiative needs to be sustained and up-scaled for effective implementation of the e-waste rules in the long run.

5 Key Recommendations

Based on our analysis of the challenges and opportunities, the current policy response as well as the strengths of the Indian e-waste landscape, the following key recommendations emerge in line with the strategic orientation:

Develop a Raw Material and Secondary Resource Strategy for India:

E-waste management is directly linked to the need for developing a raw material and secondary resource strategy not only for electrical and electronic sector manufacturing but also broadly for the entire economy. With increasing production there is likely to be an increased demand for raw material that can be fulfilled by the secondary resources from the recycling sector. A technical advisory group that informs policy processes cutting across different secondary resources must be established. The recently established India Resource Panel by the MoEFCC could play such a role.

Creation of a Knowledge-base:

Most policy discussions in India on e-waste are based on anecdotal evidence or small sample studies. Evidence based policy advocacy and research needs significant investments by domestic and international sources that fund the creation of relevant knowledge products. For instance, there is a need to prepare inventories of e-waste generation at national and state level to enable better planning of recycling requirements. Similarly, database of appropriate technologies with suggested business models should be developed for entrepreneurs (including those from the small scale informal sector) interested in setting up their own e-waste recycling businesses.

Development of Appropriate Infrastructure:

While the experience of developed countries can provide suggestions for the development of state of the art technologies, the development of appropriate infrastructure would require adaptation of these technologies to the Indian context. Collaboration with bilateral and multilateral agencies could facilitate such transfer of technology and development of appropriate infrastructure. However, the development of such infrastructure could also be a result of domestic R&D. The DeitY has already developed some indigenous technologies but these require significant up-scaling and increased funding for further R&D.

National Programme on Awareness and Capacity Building:

Although the new e-waste management rules are in place, most stakeholders lack the awareness and capacities for effective implementation of the Rules. Therefore, there is a need to develop targeted capacity building programmes for SPCBs, schools and other key stakeholders. The DeitY has launched a programme in 10 states, however this programme needs to be expanded to the entire country. Also, such programmes need to be developed to leverage private sector finance to enhance the effectiveness and outreach.

Cross Ministry Collaboration for Developing Effective Policies and Programmes on E-waste:

The management of e-waste has implications for several stages of the life cycle of electronic and electrical products – from mining, design, manufacturing, consumption to the end of life stage. At the same time, different actors with diverse objectives in the private and public sector are involved in the management of e-waste. Therefore, it is crucial to develop cross ministerial collaboration to address the challenge at a systemic level rather than at a particular life cycle stage level. Such thinking could have significant implications for the implementation of flagship schemes of the government of India. For instance, our discussion thus far would suggest that the Digital India, Make in India and Skill India initiative can all include measures that help achieve the objective of the initiative while also contributing to sustainable e-waste management in India.

7. References

Agarwal, Ravi, (2012), E-waste law: new paradigm or business as usual, Commentary, Economic & Political Weekly (EPW), Vol. XLVII no 25.

Baldé, C.P., Wang, F., Kuehr, R., Huisman, J. (2015), The global e-waste monitor–2014, United Nations University, IAS–SCYCLE, Bonn, Germany,http://i.unu.edu/media/ias.unu.edu-en/news/7916/Global-E-waste-Monitor-2014-small.pdf

Chaturvedi, Ashish, Vijayalakshmi, Koneru and Nijhawan, Saksham (2015), Scenarios of Waste and Resource Management: for Cities in India and Elsewhere, Evidence Report No. 114, Policy, Anticipation, Response and Evaluation,

CSE, (2014), Strengthen institutions, reform laws and streamline processes Agenda for improving environmental governance in India http://www.cseindia.org/userfiles/strengthen-institutions-reform-laws-and-streamline-processes.pdf

CSE, (2015), Recommendations to address the issue of informal sector involved in e-waste handling, Moradabad, Uttar Pradesh http://www.cseindia.org/userfiles/moradabad-e-waste.pdf

Dwivedy, M., Mittal, R.K., 2010a. Estimation of future outflows of e-waste in India. Waste Manage. 30, 483–491.http://dx.doi.org/10.1016/j.wasman.2009.09.024.

Dwivedy, M., Mittal, R.K., 2010b. Future trends in computer waste generation in India. Waste Manage. 30, 2265–2277. http://dx.doi.org/10.1016/j.wasman.2010.06.025.

E-waste Management and Handling Rules 2011 http://www.moef.nic.in/downloads/rules-and-regulations/ 1035e_eng.pdf

E-waste Management and Handling Rules 2016, http://www.moef.gov.in/sites/ default /files/EWM%20Rules%202016 %20english% 2023.03.2016.pdf

Ezeah, Chukwunonye; Fazakerley, Jak A.; Roberts; Clive L., (2013), Emerging trends in informal sector recycling in developing and transition countries, Waste Management, Volume 33, Issue 11, November 2013, Pages 2509–2519.

GoI, e-waste management and handling rules 2015, supersession of the e-waste (Management and Handling) Rules, 2011, http://www.moef.nic.in/sites/default/files/notified%20ewaste%20rule%202015_1_0.pdf

Lines, K. and Garside, B., with Sinha, S. and Fedorenko, I. (2016) Clean and inclusive? Recycling e-waste in China and India. IIED, London.

List of Registered E-Waste Dismantler/ Recycler in the country (as on 27-11-2014) http://www.cpcb.nic.in/Ewaste_Registration_List.pdf

Medina, Martin (2007), The World's Scavengers: Salvaging for Sustainable Consumption and Production. Lanham, MD: AltaMira Press.

Nischalke, S. M., (2008), Sustainable E-Waste Legislation and Social Responsibility in India: Opportunities and Limitations, Master of Arts (M.A.), Albert-Ludwigs-Universität Freiburg i.Br. (Germany), University of KwaZulu-Natal, Durban (South Africa).

Schindler, Seth, Demaria, Federico and Pandit, Shashi B, (2012), Delhi's Waste Conflict http://www.jnu.ac.in/sss/cssp/Delhis_Waste_Conflict.pdf

Tinbergen, J. (1952), On the Theory of Economic Policy. Amsterdam: North Holland.

Toxics Link, (2014), Time to Reboot, http://toxicslink.org/docs/Time-to-Reboot.pdf

Vaibhav Gupta and KarthikGanesan, (2014), India's Critical Mineral Resources: A Trade and Economic Analysis, CEEW Policy Brief: http://ceew.in/pdf/CEEW-CMR-Policy-Brief8Jul14.pdf

Wath, Sushant B., Dutt, P. S., Chakrabarti, T., (2010), E-waste scenario in India, its management and implications, Environ Monit Assess, 172:249–262.

Sustainable Development Goals – How engaged is India Inc?:

The Indian Prime Minister has on several occasions stressed the importance of the post-2015 development agenda and India's commitment to the same. The Sustainable Development Goals (SDGs) presents us an excellent opportunity to further integrate and deal with challenges that our country is facing such as poverty, climate change, natural capital degradation and rising inequality. SDGs have also been linked to existing flagship programs like Make in India. There are forward looking businesses that have embraced SDGs and have factored in these goals as part of their strategy.

SDGs are a product of two years of multi-stakeholder negotiations which included the business/private sector, and all 193 UN member states have committed to achieving them. While SDGs are not legally binding on member states, they will act as the de facto roadmap for regulation and will drive the implementation of national policies and incentives for their success.

To better understand the work done and/or being undertaken by private sector, engagement of private sector, Bombay Chamber of Commerce and Industry have organized a Panel Discussion on SDGs was organised on January 19, 2017.

The Chief Guest Shri Praveen Pardeshi, IAS, Additional Chief Secretary presented Government Perspective on SDGs.

Dr. Aditi Haldar, Director, Regional Hub South Asia spoke on Linkage of SDGs to Sustainability Indicators.

The sessions were followed by PANEL DISCUSSION: SDGS – A CALL FOR ACTION

Moderator - Mr. Arvind Sharma, Sustainability Expert and Former Executive Director, PWC

Panel Members

1. Mr. Anirban Ghosh, Chief Sustainability Officer, Mahindra Group
2. Mr. Joe Phelan, Director, WBCSD India
3. Ms. Ruby Thapar, Director, Public and Government Affairs, India, Dow Chemical International Pvt. Ltd.
4. Mr. Shankar Venkateshwaran, Chief – Tata Sustainability Group, Tata Sons Ltd.

The panelist expressed their view point and Mr. Arvind Sharma was moderator engaging the panelists to deliberate on

- How engaged is your business with the SDGs?
- What are your organizations' priorities when it comes to SDGs?
- Are you using the available SDG related tools and frameworks? What additional resources do you need?
- Have you started engaging with your stakeholders around SDGs?
- Are you planning to integrate SDGs with your sustainability disclosures?

The feedback for the event was very encouraging as we received ratings to above 85%.

For more details contact:
Usha Maheshwari on Tel.:022 61200214, Email: sustainability@bombaychamber.com
Aneeha Neeraja Rajan on Tel.: 022 61200227, Email: csr@bombaychamber.com