CHALLENGING THE CHIP

LABOR RIGHTS AND ENVIRONMENTAL JUSTICE IN THE GLOBAL ELECTRONICS INDUSTRY

Editors: **Ted Smith, David A. Sonnenfeld, and David N. Pellow**

Foreword by **Jim Hightower**

Contents

Responsibility

Ravi Agarwal and Kishore Wankhade

21 Hi-Tech Heaps, Forsaken Lives

E-Waste in Delhi

In a dark alley in Mandoli, a backyard recycling area in New Delhi, a young boy sits on the floor, dipping a high-tech, multi-layered printed circuit board (PCB) into a crumpled metal bowl containing an acid-like liquid. He is unaware that his hands hold the past 50 years of human technological advancement in the form of integrated circuits and electronic components. Probably manufactured and assembled separately in several parts of the world by high-tech facilities using new-age materials, the PCB and the boy belong to different worlds. Wiping the board clean, he proceeds to heat it on a small cooking gas stove, trying to pull out the components. The few milligrams of metals they hold are his livelihood. At day's end, he may earn 50 cents or less, another day's survival. Like the computer, of "no use" to anyone, he too could be

a part of the heap. (See Photos 21.1 through 21.3.)

COMPUTERS ARE NOW at the core of every IT application and having a profound impact on business processes and life styles. Computers have become synonymous with a newly educated and technologically capable idea of the nation-state, and India hopes to become a powerful player in the information age. In this endeavor, computerization is being encouraged through all means, including the import of secondhand computers from the developed world, in hopes of penetrating price-sensitive markets. During 2002–03, India's production in this sector was approximately US$800 million, a growth of 10 percent over the previous year. Products in this category include personal computers (PCs), workstations, super computers, printers, digitizers, and networking products, such as modems and hubs (DoE 2002). The number of PCs in use in India is estimated to be over eight million, with 80 percent serving commercial segments and the balance serving residential segments. This figure is slated to rise by ten times (to 80 million computers) by 2008, as per government targets (DoE).

When it comes to computer waste, a very different picture emerges. A whole section of the population strives to deal with this waste under almost impossible subhuman working conditions, with little possibility of upward mobility in their lives. These workers, mostly in the informal sector of the economy and part of the urban poor, are India's other reality.

With more than 85 percent of its workforce in the informal sector, these people have been ignored by the major trade unions and have little power to negotiate their lives in India's political economy. These men, women, and children are the forgotten, invisible bodies who are not included in the dreams that India's leaders envision for the future. It is here that computer-waste recycling takes place, as computers sold by biggest and best-known brands in the world are finally smashed here physically.

PHOTO 21.1. Child laborer sorts through discarded electronic circuit boards in India. Courtesy of Toxics Link, India.

PHOTO 21.2. Man at e-waste recycling facility in India, melting and extracting precious metals from printed circuit board. Courtesy of Toxics Link, India.

PHOTO 21.3. Women using simple tools to remove semiconductor chips, transistors, capacitors, and other items from electronics circuit boards at e-waste facility in India. Courtesy of Toxics Link, India.

To investigate this reality, a study was undertaken to understand the nature, economics, range, market, and trade routes of electronic waste, with a special emphasis on computer waste in Delhi and Chennai.[1] Computer-waste recycling units were surveyed in Delhi to assess the technology used and the overall conditions of recycling from both environmental and occupational health perspectives.

Methodology

This study was based on field visits and the collection of primary data at various locations in Delhi. Initially, the study adopted the survey method supplemented with detailed, open-ended questionnaires. This method did not work well, however, because electronic waste traders and recyclers were reluctant to disclose information. Subsequently, some discussions were held with workers in recycling units, but this was limited, because the workers were afraid of being seen talking to strangers without the owner's permission. Moreover, their rigorous and long working hours did not allow much time for them to talk. It soon became evident that an understanding of the waste trade was possible only through informal discussions with various stakeholders.

During such discussions, questions were asked about the recyclable components, the hazards involved, and the economics of the trade. The interviews were kept informal to engage and elicit detailed information. This approach worked better, even though answers to certain questions dealing with the pollution caused by recycling were

difficult to unearth. Not surprisingly, the presence of the unit owners affected the answers, and workers were more forthcoming when managers were not around.

Delhi, India's Recycling Capital

Delhi, the capital of India, is one center where recycling of all types of waste takes place. Over the years, Delhi's strategic location, the presence of upstream markets, local entrepreneurship, and tiny-scale industries have made it a prime spot for trading recovering, reprocessing, and selling waste. More than one million urban poor people are engaged in this activity, which includes collection and recovery, with more than 10,000 of them being part of the trade and reprocessing units (Srishti 2002).

Most of the activity occurs in the form of backyard operations, using rudimentary technology, and in an environment where labor is openly exploited. Labor and environmental laws are peripheral in such operations and not enforced. Both traders and recyclers make substantial profits, whereas the workers subsist on less than a couple

of dollars a day.

This sector does not exist in isolation, but in an interdependent relationship with the other part of the economy. What are less evident are the links between the so-called informal and the organized formal sectors. Materials flow from the formal to the informal almost seamlessly, and one person's waste becomes another's livelihood. Computer waste is often routed through mainstream, institutional channels, such as customs ports, computer service centers, and registered computer dealers, and then passes onto the "gray" market. Businesses frequently auction old computers and households exchange them for newer models. With such transfers, the responsibility is also passed on, from the formal to the informal, as the computer industry and the state seem to rid themselves of any liability.

Electronic and computer waste —a relatively recent entrant in India's recycling back alleys, which have been more accustomed to plastics, paper, and industrial scrap— is now emerging as one of the more profitable activities as obsolescence rates increase, and the influx of computer scrap from local and overseas markets rises as well.

The Workforce

Over the years, there has been an increase in India's rural to urban migration. Because of its very high, per-capita investments, Delhi is a "hopeful" destination for the rural poor, especially those who are landless, from the neighboring states of Uttar Pradesh, Bihar, West Bengal, and Orissa. Of the city's 15 million people, 50 to 60 percent live in substandard and shanty housing and perform low-paying jobs (Tiwari 2003). The presence of a very active informal sector, several small-scale industries, and other cottage industries provides opportunities to find a livelihood. The recycling industry absorbs such migrants, because the skills needed for entry are low or nonexistent. Supply being more than demand; they are exploited in the ruthless labor market.

Finding shelter is as difficult as finding employment. Without social or kinship support, a guarantee is needed to gain access to the city and find a means of livelihood to survive. The waste dealers and recycling unit owners provide migrant workers both a shelter and a livelihood, a basis for exploitation. Although all the workers stated that

"poverty" was the main reason they moved to the city, 15 percent admitted that they would leave if they had options. The workers interviewed belonged to a highly varied demographic sample. Most were Muslims, but age, religion, community, or marital status revealed no singular trend for recycling workers. In some places, the recycling processes determined the type of workers. For example, women and children would segregate the products, but men would dismantle and break them.

The caste status of laborers was difficult to establish, but working in the waste sector is considered very low in the social order, even though earnings could be greater than that of j obs in local shops or roadside restaurants. Those from the upper castes feel it is beneath their dignity to engage in waste-related work. In the absence of any formal census, it is difficult to determine the exact number of people engaged in e-waste recycling.

The Materials

Sources of Computer Scrap. More than 70 percent of the personal computers in India are in the business and service sectors. It is estimated that of the eight million PCs in India, roughly two to three million are either obsolete or dysfunctional and end up as

scrap. Computers are constantly upgraded because of new software and hardware capabilities. Even in India, computers below the Intel Pentium IV exit the market for spare parts and recycling. In the home sector, the obsolescence rate is slower but growing. Home users often pass on their old computers to friends and relatives. However, there is a tendency for computer sellers to "exchange" old computers and offer a discount on newer ones. Old computers often end up in smaller markets and, ultimately, the scrap heap (Toxics Link 2003).

Another major source of computer scrap is imports. Large quantities of junk computer monitors, printers, keyboards, central processing units (CPUs), mobile phones, and polyvinyl chloride (PVC) wires enter the country illegally.

Inquiries revealed that the actual process of importing obsolete PCs was well established. Details of pricing and payment are often worked out in advance and negotiated through banking channels via international letters of credit. Shipments take approximately one month to reach an Indian port of entry, where it is the importer's responsibility to clear them through customs.

Dubai and Singapore often serve as transit points for waste from the United States, Europe, and

West and East Asia. At these points, waste is categorized according to its nature and coded. International traders are well aware of legal loopholes in India and routinely label scrap as "used working computers" or "metal scrap" to minimize customs' duties (see Figure 21.1).

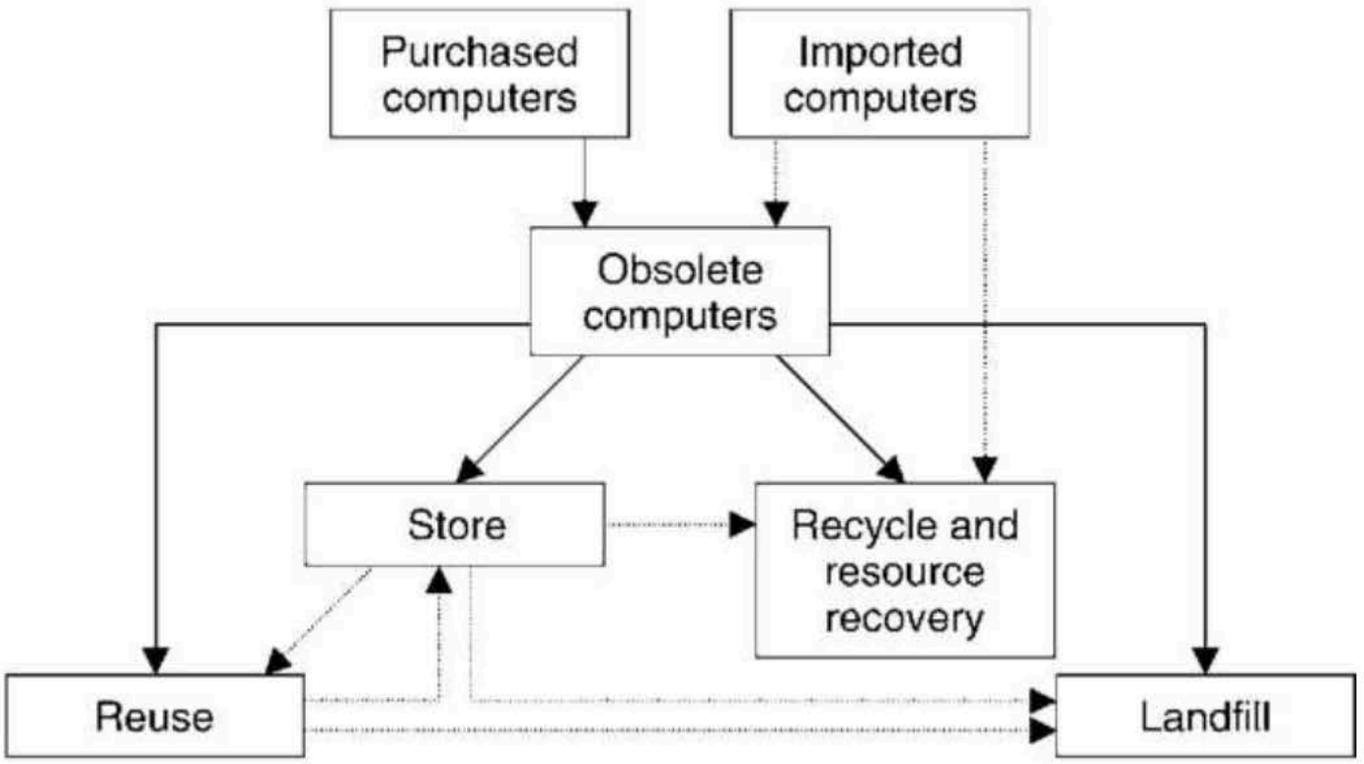

FIGURE 21.1. Flow Diagram of Computer Waste.
Source: Toxics Link, India.

THE ROUTE TO THE RECYCLER

Traders procure old computers as scrap and measure them by weight, from business users or even embassies, for as little as 50 cents per

kilogram. The trader decides whether the computer can be reused or must be scrapped. A parallel and independent secondary market for reselling old computers coexists synergistically with the recycling market. If destined to be demolished, the computer's monitors, casings, motherboards, keyboards, floppy drives, different components of printers are all segregated. Sometimes, high-value integrated chips (ICs) are pulled out and sold, but most computer parts are disassembled and sold separately to different recyclers for material recovery.

Often intermediaries (*kabadis*) operating in the market collect functional items from the retailers (as well as the scrap market) and sell them to repair shops and local computer assemblers centered in Nehru Place (see Figure 21.2) and other areas of Delhi. The most popular items in demand are CPUs, parts of power supplies, and ICs. Similarly, imported, nonworking computers are sold in bulk to big traders. After extracting valuable parts like CPUs, they are sold to smaller scrap dealers, where the real PC recycling process commences.

Recycling Locations

Computer recycling takes place in various parts of Delhi, each with its "specialization" (see Figure 21.2). All markets of e-waste and recycling units for computer waste are situated in densely populated areas of the city. The recycling areas have a pattern of mixed land-use, with recycling units intermingled among residential houses. Sometimes, parts of a house end up as recycling units, with the entrepreneurs and workers living in the remaining space. At Mandoli, an industrial area in Delhi, recycling activities (metal extraction) take place near residential areas, with little control over the fumes or emissions, which endanger the surrounding community.

FIGURE 21.2. Map of Electronics Disassembly (Recycling) Operations in Delhi, India. *Source:* Toxics Link, India.

Recycling clusters are found in Turkman Gate, Mayapuri, Old Seelampur, Mundaka, Mandoli, Kirti Nagar, Shastri Park, and Karkarduma (see Figure 21.2). In the "walled city" area [2] (Turkman Gate), disassembly takes place in cramped rooms, whereas in other industrial areas, such as Mayapuri, the waste is spread out. At one place surveyed, desoldering took place in a cattle shed (Table 21.1).

The Recycling Process

In the downward movement of PCs for recycling, different players specialize in recovering specific materials, as each PC component is disassembled and recycled separately. Some of these processes are detailed in Table 21.2.

Monitors. Monitors are much sought after by scrap dealers because they contain copper (in the yoke), circuit boards, and the CRT. If a monitor cannot be reused, it is broken down to recover the iron frames found only in color CRTs. The copper recovered from yoke coils is sold to copper smelters. Copper also is recovered from the transformers mounted on the computer's circuit board.

TABLE 21.1. E-Waste Recycling Areas in Delhi with Specific Functions[a]

Location	Component Recycled
Turkman Gate—Delhi	Disassembly of computer, CRT breaking
Mayapur—Delhi	Disassembly of every kind of electrical goods, open and drum wire burning
Old Seelampur—Delhi	Market of every kind of electronic scrap
Shastri Park—Delhi	Computer dismantling, recharging of CRTs
Lajpat Naga—Delhi	Disassembly of computer
Kirti Nagar—Delhi	Mainframe computer disassembling
Karkarduma—Delhi	Trade and recharging of CRTs
Mustafabad—Delhi	Lead recovery
Mandoli—Delhi	Circuit board recycling
Meerut (near Delhi)	Gold recovery
Firozabad (near Delhi)	Glass recovery
Chennai (South India)	Market of circuit board and speeder motor

[a] Refer to map, except for Chennai, Meerut, and Firozabad.
Source: Authors.

Functional monitors or CRTs are "regunned" for local-brand televisions or screens for video games at Lajpat Rai Market in Old Delhi. The plastic casings are sold to buyers who come from Mundaka or Narela to make plastic pellets.

TABLE 21.2. The Process of Recycling E-waste in Delhi

Component	Material Recovered	Recycling Process
Monitor	CRT or glass, circuit board, copper, steel, and plastic casing	Manually, using screwdrivers and pliers. CRTs are broken with a hammer
CPU	Different metals and nonmetals from hard disk, floppy drive	Manually, using screwdriver, hammer, and pliers
Circuit board	Lead, IC, CPU, few capacitors and condensers, copper, and gold	After preheating plate, working IC chip and capacitor are removed using pliers Open burning to recover copper film from circuit board Gold is recovered through acid bath
Printer	Plastic, motor, cartridge	Motor reused in toy manufacture; cartridge refilled for reuse if possible, else smashed for plastic recovery
PVC wire	Copper or aluminum	Open and drum burning
Hard disk, floppy drive and SMPS[a]	Copper and brass alloys, aluminum, iron, and magnets	Melted after manual separation of each part
Capacitors and condensers	Aluminum	Open, or *bhatti* (small furnace), burning to melt metallic parts

[a] SMPS, switching-mode power supply.
Source: Authors.

Plastics. The plastic casings of monitors are made of PVC or acrylonitrile-butadiene styrene (ABS). PVC was used commonly in old computer models, though ABS plastic is

more common now. Normally, the PVC casings were used as fuel because the silicate made them difficult to recycle. PVC is still used as an insulator of copper wires and cables, which is often burnt to separate copper.

Circuit Boards. The computers' printed circuit boards and their components contain such metals as antimony, gold, silver, chromium, zinc, lead, tin, and copper, which garner a fair market price. Recovering them is not easy, and it involves such destructive and hazardous processes as heating and open burning.

Generally, the gold-plated pins and the few inserted ICs that can be reused are removed manually. Laminated circuits, especially if they contain gold, are cut down and resold. The boards then are preheated on small household stoves to desolder resalable components like ICs and capacitors. The recovery of precious metals, such as gold or silver, occurs at a separate place.

Solder, which contains lead, is also recovered. The boards are manually held by metal tongs and heated on small kerosene burners, which are placed in a large water tub to collect the dripping molten metal. After desoldering, the circuit boards are open-burned in small furnaces or treated in acid to recover the copper.

Mechanical Components. Mechanical components such bearings, alloy, aluminum disc, and casings (called china steel) are recovered from the broken disk drives and sold to various recyclers. In the process of dismantling a computer, a considerable amount of aluminum, tin, and iron is recovered and sold to specialized dealers or to metal recyclers. Scrap leftovers, like ash, plastic residues from charred IC chips, and condensers, are landfilled. Sometimes the plastic residues from the recycling units are sold to brick kiln owners as furnace fuel, further polluting the air.

The Economics of Recycling

The medley of activities takes places in the context of the complex economics of the backyard recycling units. Each component or recovered item has a value and a market, so everything that can be sold is recovered no matter how small the profit margin.

The substantial profit margin that is possible in trading, recycling, and marketing these products prompts new entrepreneurs to enter the business. Yet, even though hundreds of small transactions take place between numerous players in a complex recycling market, the traders make the bulk of the

profits. For example, a local trader buys a single PC with a color monitor at US$ 10 to $15 per piece and sells it for up to US$40 to $50 by selling the disassembled parts separately to different recyclers or reusers.

To understand the complexity of the operation, let us take the case of a computer monitor (CRT). Color CRTs, which are sold for re-gunning, fetch US$25 to $30, whereas black-and-white monitors net US$2 to $3. Glass dealers purchase the broken glass from a CRT for as low as 2 cents per kilogram, but sell it for over 4 cents per kilogram to upcountry glass manufacturers in the nearby state of Uttar Pradesh. The iron frames extracted from a color computer screen, which weigh from 200 to 250 grams, are sold to an iron scrap dealer at 15 cents per kilogram. Copper from picture tube yokes is sold to copper smelters from US$1.3 to $1.5 per kilogram, a black-and-white or color picture tube yields from 60 to 200 grams, respectively. The CRT circuit tray also contains a number of condensers, and depending on their type, condition, and demand, the price ranges from 4 to 40 cents apiece. The PVC plastic casings are sold at 2 cents per kilogram, whereas the more commonly used ABS plastic ones fetch 32 cents per kilogram.

Another example is the circuit board, from which lead, copper alloy, and gold can be recovered. Recyclers buy circuit

boards at 13 cents per kilogram and resell them for 10 cents per kilogram, after lead recovery. About 3 kilograms of lead is recovered from 200 kilograms of motherboards. The market price of recovered lead is US$2.17 per kilogram. The gold-plated pins (if any), locally known as *kanga*, and laminated cores of gold are sold to goldsmiths from places like nearby cities such as Meerut. Gold pins are sold at US$60 per kilogram, whereas laminated cores are priced at US$30 per kilogram. Copper recovered from the plates is sold to copper-wire manufacturers at US$1.74 per kilogram. The desoldered plates are sold at 43 cents per kilogram. The price of a single chip can range from 21 cents to US$1.08, depending on the type, size, and demand. Defective ICs, capacitors, and transistors are reduced to aluminum and then sold for between 87 cents and US$1.08 cents per kilogram.

Conditions in Recycling Workplaces

In Delhi, the operation of e-waste recycling is clandestine, as tons of e-waste lay hidden behind the high-boundary walls of recycling units. Work occurs 12 hours a day, seven days a week. Outsiders are not welcome and shunned. Within these secure quarters, workers sit on the ground among piles of computer parts, separating them with amazing dexterity, bare

hands, and no masks.

E-waste recycling takes place in small, unregistered, labor-intensive units located in the industrial areas, though some also operate from houses in residential areas. Improper ventilation, excessive noise levels, high heat, and a lack of fresh air over a long period of time are some common features of the working conditions in the recycling units. Migrant and unprotected workers, including a large number of children, work in the recycling facilities, where the employers are neither aware of the hazards nor interested in the workers' safety.

Health Impacts

The recycling process is rudimentary and hazardous in nature, with a high health cost attached to it. Workers, however, are unaware of many physical hazards and routinely deal with toxic heavy metals as PVC, brominated flame retardants (BFRs), fumes, and various gases.

Heavy metals, like lead, cadmium, chromium, and mercury, can cause damage to the central and peripheral nervous systems. Lead has serious effects on children's brain development and damages human blood, as well as the kidneys and reproductive system. It accumulates in the

environment and has acute and chronic effects on plants, animals, and microorganisms. Mercury, which can be absorbed in the food chain, causes damage to the kidneys and the developing fetus. It also may convert to the more lethal methyl mercury. Chromium is easily passed through cell membranes and absorbed into the body. Exposures to beryllium, barium, and BFRs could cause cancer.

The Laws

Various laws—including import laws, labor and factory laws, and environmental laws— impact electronic and electrical waste. These laws are enforced by different arms of the state, which do not communicate with each other, leading to unusual situations. For example, though the central government claims that no mandatory clearance has been given to any importer for secondhand computers, they are being imported regularly through Custom's ports.

Trade Policy for PCs

Computerization in India is being promoted at all levels through liberal import polices (DGFT 2003). There are various tax incentives for donating computers to educational

institutions and hospitals; including a zero custom duty and an exemption from many local taxes. Interviews with the Custom's officials revealed many loopholes, which include illegally importing scrap computers. Although the hazardous nature of e-waste gradually has become recognized, only a few countries have outlawed their trade. Traders revealed that the main countries exporting e-waste to India are the United States, Korea, Singapore, Malaysia, Canada, Australia, and the United Arab Emirates.

Labor Laws

Legally, recycling operations come under the purview of various labor and industrial laws in India, as the local factories' inspectorate and the labor commissioner implement labor laws. However, almost none of the laws are applied to the informal sector. A wide range of laws, including the Factories Act,[3] provides stringent requirements for industrial operations and sets health and safety standards and working hours. The requirements for worker compensation and medical insurance fall under Employees State Insurance (ESI),[4] which includes maternity benefits and hospital care. The Provident Fund Act and the Workmen's Compensation Act provide savings for old age and joblessness.[5]

Finally, even though employing children is illegal,[6] many workers are children, supplying cheap labor for employers. Many policymakers understand this as a consequence of poverty but have failed to adopt adequate measures to counter it.

Environmental Laws. The provision of environmental protection is divided between India's various states. Although the central, state government lays down policy, national regulations, and minimum standards of various types (e.g., for permissible air and water emissions),[7] the laws are implemented by the State Pollution Control Boards, which have been known for their lax enforcement.

The classification of e-waste as hazardous is unclear within Indian legislation.[8] Its status depends on the extent to which hazardous constituents are present, and there are no specific laws or guidelines on this, except that its import needs special clearance from the central government. A lack of clarity makes applying the regulations difficult.

Local Actions

Lately, there has been an increased awareness of recycling activities and working conditions in India. This effort mostly

has been spearheaded by environmental groups, who examine waste from a life-cycle approach and the health impacts of dumping, recycling, and disposal. The issue of local working conditions has been raised in an attempt to integrate the concern for livelihood with waste disposal in a framework of extended producer responsibility (EPR). If computer producers invest in upgrading recycling facilities, it is then possible to both improve working conditions and engage in safer recycling.

Trade unions are key players in implementing laws, but they have ignored both occupational safety issues and India's informal sector. Some policy conversations have emerged with the aim of providing health insurance coverage for the recycling workers, subsidized by the state, and the intent to help organize the informal-sector workers.[9] These discussions need to progress beyond pronouncements, as there is currently no action on the ground.

On a broader level, some trade unions and environmental justice groups have been trying to work together on occupational safety and health issues.[10] This is a departure from the past, because traditionally, labor and environmental groups have posited the issues in adversarial frames of "cleanliness" versus "livelihood." The effectiveness of these new constituencies has yet to be proven.

Conclusion

Electronic waste in India has been an unrecognized problem so far. With countries like China banning imports of electronic wastes, there is likely to be increased pressure on countries like India to accept them. Not only does India have a large backyard-recycling sector, but also its many entry ports and lax laws make the free flow of hazardous imports difficult to combat. Moreover, indigenously generated electronic waste is on the rise, as obsolescence rates become higher and newer computers become more affordable. If policies allow secondhand computer imports, the problem of e-waste flow will be ever on the rise.

The recycling sector in India is a free-floating one, operated by small, backyard recyclers. Even though the same global companies, imposed by new laws and public pressure, are improving their practices of product design and waste management in the developed world, in India, it is business as usual. In fact, one of the hardest challenges of the environmental justice campaign in India has been to bring industry on board. The consequences are borne by the poorest of the poor and left untouched by fancy statements of Corporate Social Responsibility enunciated in companies'

annual reports and Web sites.

The issue requires urgent action, which includes a governmental ban on imports of such waste, and linking indigenously generated wastes with EPR. Best-practice models must be adopted locally by this global industry, leading to investments in recycling and redesign for environmentally sound products. The industry must become really "green" to be a part of a future, sustainable economy.

NOTES

1. Toxics Link has published reports on e-waste status in Delhi and Chennai. These may be accessed at www.toxicslink.org.

2. The old city of Delhi still has historical and cultural roots from the Mughal and British periods. There was a wall around it; thus it is known as a walled city.

3. The Factories Act [Act No. 63 of 1948] as amended by the Factories (Amendment) Act, 1987.

4. The Employees' State Insurance Act, 1948.

5. The Workmen's Compensation Act, 1923.

6. The Child Labour (Prohibition and Regulation) Act, 1986.

7. The Environment Protection Act, 1986.

8. The Hazardous Waste (Management and Handling) Rules, 1989, as amended 2003.

9. The Social Security Scheme, managed by the Employees Provident Fund Organization of Ministry of Labor, Government of India.

10. Organizations such as the Center for Environment and Communication, and Toxics Link are working in India on occupational health and safety issues, linking them with environmental concerns.