

GOING FOR THE GOLD

IN INDIA, A NEW GENERATION OF SOPHISTICATED ELECTRONICS PROCESSING AND METAL REFINING FACILITIES WANTS TO MEET THE COUNTRY'S NONFERROUS METAL SUPPLY NEEDS. COULD THESE COMPANIES BE THE KEY TO MOVING THE LEGIONS OF INFORMAL PROCESSORS INTO THE FORMAL SECTOR?

BY ADAM MINTER

The past and present of India's massive informal e-scrap industry is on the east side of Delhi, in a winding set of canyon-like streets and alleys known as Old Seelampur. All day and night, delivery trucks arrive with stacks of monitors and laptop and desktop computers, supplying hundreds of narrow storefronts already stacked with used hard drives, picture tubes, and circuitboards. Workers labor over the used electronics. Some dismantle; some repair; others pack; and still others market the goods in one-on-one negotiations that take place in doorways, in the middle of streets, and over tea in the few cafés that dot the district. By most accounts, this is the largest e-scrap market in India.

The future is uncertain for Old Seelampur, however, and for the smaller markets like it across India. On May 1, 2012, India's first e-scrap recycling law came into effect, and with it began a concerted effort by large recyclers, nongovernmental organizations, and local governments to turn India's vast informal e-scrap trade into a technologically and environmentally advanced electronics repair, refurbishment, and recycling industry. The need is pressing: Indians are rapidly joining the global middle class, buying new gadgets and unloading old ones. No one has reliable statistics on the volume of e-scrap in India. Even government estimates conflict, with the best estimates coming from anecdotes, company information,



local government data, and industry experience. Industry participants and observers agree on one point: The domestic supply is growing. Priti Mahesh, a senior program manager with Toxics Link (New Delhi), an environmental NGO with more than a decade of experience working on e-scrap issues, emphasizes that in India, electronic scrap is primarily a domestic issue, not an import issue. By her estimates, based on a decade of work by Toxics Link, more than 60 percent of the e-scrap that gets processed or repaired in India today comes from within India. The imported e-scrap that once fed places like Old Seelampur is unquestionably a shrinking proportion of the overall market.

Transforming India's informal recycling businesses into modern, clean operations will not be easy. Over the decades, the informal sector has developed into an efficient and profitable industry that employs hundreds of thousands—if not more—of mostly uneducated laborers in cities up and down the subcontinent. Moving them out of informal recycling requires an economically viable alternative that's at least as profitable, if not more so, than what exists now. Fortunately, in Mumbai, Delhi, and Bangalore, several promising efforts are underway, spurred by government initiatives, NGOs, and brave entrepreneurs who see opportunity in India's growing demand for the raw materials that recovered electronics can provide.

PHOTOGRAPHS BY ADAM MINTER



INDIA IS NOT EUROPE

India largely modeled its new e-scrap recycling law on the European Union's e-scrap directives, especially its producer responsibility and takeback provisions. But India's law might seem modest compared with the EU's comprehensive approach to e-scrap management. The new law establishes loose guidelines for acceptable e-scrap processing methods, primarily by specifying what not to do: It forbids the wet shredding of circuitboards, for example, which uses water to dampen dust and heat and aid with downstream separation but generates effluent. It doesn't address the handling of focus materials such as batteries. Further, it leaves implementation and oversight to state pollution control boards. This results in wide regional variation in enforcement. For example, Delhi prohibits the small-scale refining of circuitboards within city limits; Bangalore not only allows this family-workshop-style refining, it regulates it. During a meeting at Toxics Link's Delhi office, Mahesh explains that varying levels of regulation are inevitable in a country as complicated and vast as India.

Implementing these EU-style regulations could pose a challenge in India for several reasons, Mahesh says. First, like many developing countries, India has a thriving reuse and repair culture that you won't find in Europe and the United States. Televisions that might only last five years

Eco Recycling (Mumbai, India), one of India's most sophisticated, licensed e-scrap recyclers, uses a proprietary automated system to remove electrical components (above left) from circuitboards. CEO and Managing Director B.K. Soni stands with precious metal refining equipment the company also developed—at substantial expense (above).

in the developed world are reused, repaired, and refurbished into 10- to 15-year lifetimes in India. As a result, gadgets—and, equally important, their parts—that might only have scrap value in the West have a greater reuse value, and more markets, in India. This sets up an inevitable conflict with the takeback and manufacturer-responsibility provisions that are central to India's new e-scrap law.

Also, Indians tend to think of recycling in terms of price, not environmental protection, Mahesh says. To explain, she picks up her Nokia smartphone. "This mobile will maybe fetch 1,000 to 2,000 rupees [US\$17-\$37] in the informal marketplace," she says, "but Nokia just asks me to drop it into a bin. Most Indians won't do that." Unless there's some mechanism—a subsidy, perhaps—to make the Nokia bin more attractive to consumers than selling used electronic products in Old Seelampur—or to the guy on a bicycle who then sells it in Old Seelampur—takeback programs will largely capture electronics generated by the business sector, where regulatory and, perhaps, shareholder pressures force large

companies to deal only with registered, environmentally conscious recyclers. Gadgets individual consumers discard will continue to flow to the informal sector.

Takeback programs are not the only approach India is taking to formalize the informal electronics processing sector, however. Delhi and other Indian cities are requiring information technology companies and other large e-scrap generators to use recyclers that are registered and licensed with the government. Theoretically, at least, informal recyclers determined to get a share of the large volumes and typically higher-quality e-scrap such companies generate will work to meet those registration and licensing requirements.

To show me this transition in action, Toxics Link sends me to Green E-Waste Recyclers, one of the 77 e-scrap companies in Delhi that

have registered so far. Founded and owned by Mohammad Sabir, Green E-Waste Recyclers has operated for 30 years in Delhi's Shastri Park, a neighborhood well known for PC dismantling—but not recycling. (India makes a legal distinction among the steps in the recycling chain: Collectors and segregators cannot dismantle; dismantlers cannot recycle.)

Sabir's business operates in a single-room office around the corner from what he estimates are 350 businesses devoted to dismantling PCs and selling their components into the reuse and recycling markets. For most of its 30 years, Green E-Waste Recyclers operated as a dismantler, Sabir says, but Delhi will not license dismantlers within the city limits. It considers dismantling a polluting business that attracts other polluting businesses, like refining and plastics recycling. Sabir's license only allows him to collect and segregate electronic products, despite the hundreds of unlicensed dismantling businesses just outside of his door.

Why did Sabir agree to give up his dismantling business to become a licensed collector? Even before the new e-scrap law, he says, large companies were increasingly choosing to work only with licensed collectors who—according to the terms of their licenses—can deliver the material they collect only to licensed dismantlers and recyclers, all of whom are outside of Delhi. Sabir pursued a license to obtain access to the supply of electronics from those larger companies. The license was

The Old Seelampur neighborhood of Delhi houses what is probably India's largest informal e-scrap market. Vendors tend to specialize in specific components, such as steel desktop PC cases (left), and appliances, such as photocopiers (below left). This family-owned shop (below) resells electronic components removed from computers.



not quite the blessing he imagined, he says. "Most of the big companies only want to send their scrap directly to the big recyclers. So I can only collect from small companies." As a result, Sabir's business is down—way down, he says. "I am a small fish," he sighs. The big recycling companies "are the big fish. They are eating me up. If the government policy doesn't change to allow dismantling [in addition to collecting], I will die."

Toxics Link's Mahesh concedes it's difficult to imagine an economically viable future for all of India's informal recyclers. "The industry and its employment will have to shrink. Not everyone is going to be able to remain in this business. Other opportunities will need to be found."

THE BIG-FISH PERSPECTIVE

A few days later I'm riding in an SUV heading north out of Mumbai with B.K. Soni, CEO and managing director of Mumbai-based Eco Recycling, or Ecoreco, as it's widely known. The first Indian e-scrap recycler licensed by India's Pollution Control Board and the first licensed by Maharashtra, the state in which Mumbai is located, Ecoreco also is India's first publicly traded e-recycling firm. If Old Seelampur and Shastri Park are the past and present of India's e-scrap recycling industry, B.K. Soni is its future. This savvy businessman is leveraging technology, environmental safety, and first-rate entrepreneurship to draw discarded electronics away from the informal sector.

We're en route to Ecoreco's repair, refurbishment, and recycling facility in Vasai, a small town about an hour from Mumbai's international airport. It's a good location: Many of the multinationals that Ecoreco serves are in the area. Like other licensed recyclers, Ecoreco focuses on the large volumes of high-quality e-scrap available from commercial sources. Unlike many of its peers, however, Ecoreco sells its material into the reuse and refurbishment market—it's a Microsoft-authorized refurbisher—as well as the recycling market.

The Ecoreco facility is in a multistory building 20 minutes away from the research center. Across the highway is a 25,000-square-foot lot where Soni plans to build a new refurbishment facility. He leads me into the current facility, past neat stacks of PCs and laptops, piles of mice, rows of ATM-like automatic bill payment kiosks, boxes of printed circuitboards, and pallets of cathode-ray tubes. Around the corner is a small group of technical workers refurbishing laptop and desktop



Mohammad Sabir recently turned his dismantling business—Green E-Waste Recyclers, in Delhi's Shastri Park neighborhood—into a licensed e-scrap collector with the hope of securing a portion of the city's growing volume of commercially generated, high-quality electronics.

computers. They work quickly and expertly, replacing old or broken components with newer, used ones. They replace a slow hard drive with a fast one, a broken keyboard with one that works. One-third of the devices the company receives it refurbishes and sells for reuse. "It's more profitable," Soni says, and the machines fill an important market niche. Only 5 percent of India's population has access to a computer, he says, and only 3 percent can afford to buy a new one. Low-cost repaired and refurbished machines can cross that digital gap. Ecoreco's refurbished machines are easy to sell, Soni tells me. "We don't need to market for sales."

Still, many of the company's suppliers don't want their products sold for reuse, and much of Ecoreco's supply is too old or otherwise unsuitable for resale. To handle that material—roughly two-thirds of the company's volume—Ecoreco has some of India's most cutting-edge processing facilities. "If we want the corporate customers, then we need to show we are close to EU levels" of operating safely, efficiently, and cleanly, he says. He walks me out of the refurbishment area to where a conveyor is dropping cases from PC central processing units into a shredder. The PCs have been stripped of everything of value, from



Eco Recycling—or Ecoreco—is a licensed dismantler and recycler with a substantial reuse and refurbishment business. Here, a company technician refurbishes a desktop PC (above left) to sell in India's thriving reuse market. In another part of the facility, a worker feeds PC cases into a shredder (above right).

circuitboards to components. After the cases are shredded, a simple magnetic separator clears the remaining ferrous from the plastics. The company converts the plastics into diesel fuel, Soni tells me. Around the corner, an Ameri-Shred 150-HD hard-drive crushing unit can meet customers' demands for data destruction. Across from it is a Guidetti Sincro 430E wire chopper, which separates insulation and other contaminants from copper. Ecoreco purchased both devices with the support of India's Department of Scientific & Industrial Research (Delhi).

The most significant piece of equipment at Ecoreco is one of the newest: a precious metal recovery system developed entirely in house with the support of government agencies and corporate partners. The prototype is an unusual-looking device: Four ATM-sized control units are attached to individual copper coils, each roughly the size of a 2-gallon jar. Those, in turn, attach to smaller control units. Working in combination, they function like miniature sweat furnaces, melting out the various precious metals—gold, palladium, platinum, and silver—that integrated circuits and other valuable electronic components contain. The system doesn't use acids or other caustic chemicals; it functions using gravity and heat alone, Soni says, with one unit capable of processing 50 kg of precious-metals-containing scrap an hour.

Ecoreco has spent three years and US\$2 million to develop the system and, if successful, it has the potential to revolutionize Ecoreco and

Indian e-scrap recycling. Soni tells me he's been storing circuitboards and components for years, turning down entreaties from European buyers to sell the material to them, awaiting the day the in-house system comes online. When it starts operating on an industrial scale, the payoff will be significant both for his company and for other Mumbai-area recyclers, who will no longer have to sell their precious-metals-containing e-scrap to overseas smelters.

Soni assures me that "there's a big transition coming" to licensed, regulated e-scrap processing in India, and he's ready for it. He's not the only one. India's big cities are brimming with e-scrap entrepreneurs who see the potential of processing facilities that work to meet international standards, even if they currently fall short. The progress they've made—and continue to make—is remarkable.

THE UPHILL BATTLE

Ecoreco and similar companies undoubtedly will continue to face competition from the informal sector, especially for the large volume of post-consumer electronics that still flows to places like Old Seelampur. To get the perspective of those at the other end of the spectrum, I charter a taxi to take me two hours north of Delhi to a difficult-to-find village called Mandoli. On the way there I pass villages and towns, farms, and structures that seem to be primitive brick kilns, with men and women carrying raw mud into their smoking interiors.

According to Toxics Link and one other source, Mandoli is a major center for informal, low-grade copper recovery—it's where many of India's recovered circuitboards go after they've

been stripped of reusable and recyclable components. I see few roofed buildings; instead, knee-to neck-high walls separate small plots of land. Burnt circuitboards flow down the streets and into the fields. The city feels abandoned, but here and there I find young men laboring over plastic barrels filled with chemicals and circuitboards. Nobody seems to mind my presence, and some even smile and wave. I find that odd: In most other parts of the world, this is not the sort of place that would welcome visitors. I see the sickly orange smoke of an acid-stripping operation rising over a wall. I rush to find the source of the smoke: an open set of barrels where acid hisses and buzzes as it eats away at nonmetallics and liberates the copper. The workers labor without respirators, gloves, boots, or even heavy clothes.

Later, when I discuss this visit with Toxics Link's Mahesh, she tells me the village is accustomed to visitors, including those from her organization. Toxics Link has expended considerable effort to educate those who run the town's businesses on the harm they're causing themselves, but with few alternative sources of employment and consistent demand for the copper, the organization has made little headway. "We've given them health and safety training," Mahesh tells me, "but we don't see any spark that they're interested in implementing it. Instead, they always ask us: 'Can you get us more material?'" The female workers make roughly \$2 a day; the men make \$3.



The town of Mandoli, about two hours from Delhi, is a center for the informal acid-stripping of copper from circuitboards denuded of their precious-metals-bearing components.

Unlike China, where wages are rising in scrapyards, India's wages are stagnant. "For now there's no formalized alternative to the acid-stripping they do," Mahesh says, "so it continues. Maybe there will be [an alternative] soon."

Still, there's reason for hope. In other developing countries, especially China, low-cost shredding and separation via electrostatic and hydraulic means have largely replaced acid stripping for the recovery of copper from circuitboards. It's more expensive to buy a shredder than a barrel of acid, but as India's standard of living improves and its e-scrap industry achieves some scale, the capital will exist to build those cleaner alternatives. For Ecoreco and India's other up-and-coming e-scrap refiners, the process of separating circuitboards from their copper is a comparatively cheap problem for them to solve.

ANOTHER STATE'S APPROACH

One solution evolving far south of Delhi has the potential to create a partnership between informal and formal recyclers, between low-tech and high-tech processing, that eventually evolves into something new and unique to India's circumstances. On a sultry Friday afternoon, I visit the five-story headquarters of the Pollution Control Board for Karnataka state in Bangalore, a city roughly 1,300 miles south of Delhi. I'm there as the guest of Venkatesha (Venky) Murthy, the CEO of VANS Chemistry (Singapore), an e-scrap consulting firm that sees huge potential for integrated e-scrap recycling plants (including dismantling and refining capacity) in Bangalore. It's an ideal location: Bangalore is the high-tech heart of India, the "Silicon City" of call centers, software developers, and hardware designers. It's also home to a well-documented informal e-scrap recycling trade, much of which subsists on the scrap from those manufacturing facilities. Still, the same culture of innovation that created the high-tech industry is finally turning its attention to e-scrap.

Murthy introduces me to Vaman Acharya, the newly appointed chair of the state's Pollution Control Board, who goes out of his way to impress upon both of us that e-scrap is low on his list of environmental concerns. Bangalore lacks a modern sewage system in many places, he points out, and the sewage system that does exist needs massive upgrades. The city also is plagued by industrial pollution, dust particulates generated by construction projects, and biological wastes from medical facilities. The city needs better solutions