

## 5 End-of-Life Management of Electronics Abroad

Efforts to manage electronic waste around the world have been driven in large part by legislation developed in the European Union (EU). Some countries in Europe already have extended producer responsibility (EPR) programs for electronics. These include Sweden and the Netherlands, which belong to the EU, as well as Norway and Switzerland, which do not.\*

In some EU member nations, such as Austria and Germany, electronics take-back legislation is on hold pending adoption of two forthcoming EU directives, one on waste electrical and electronics equipment and the other on the use of hazardous substances in these products. Nations with existing take-back laws may have to make significant changes in their programs to comply with these directives. Throughout Europe, anticipation of the directives has led the electronics industry to implement voluntary take-back programs and has spurred research in technologies for managing electrical and electronic waste.

The following discussion focuses on the forthcoming EU directives. It also describes some other European take-back programs, the status of EPR for electronics in Japan, and Australia's national take-back program for cell phones.

### Components of an Effective EPR Program

In the previous chapter, an effective program — in which producers are responsible for their products at end of life — was defined as one that:

1. Focuses specifically on the waste generated by end-of-life products.
2. Clearly defines what financial responsibility producers have for the collection, transport, and recycling of their products at end of life.
3. Sets meaningful targets for collection and recycling.
4. Differentiates recycling from technologies such as waste-to-energy conversion.
5. Includes reporting requirements and enforcement mechanisms.
6. Provides producers with incentives to design for reuse/recycling.
7. Provides consumers with incentives to return their used products.

With respect to these elements, existing national programs in Europe and Asia all focus on waste. Generally, they clearly define the responsibility of producers, but this varies considerably from country to country and ranges from responsibility for all aspects of collection, transport, and recycling to responsibility for recycling only. The programs tend to be weak, however, when it comes to setting targets and differentiating recycling from other technologies, and programs that are voluntary typically do not include reporting requirements and enforcement mechanisms. Only Japan's program provides strong incentives to design for recycling, because producers there must pay to recycle their own products. Yet this program discourages consumers from returning their used products, because they are charged a fee for doing so.

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\* The European Union comprises the 15 member states of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom. Norway and Switzerland are not members of the EU.

In Europe, all of this will soon change with the adoption of the EU directives, which cover an extraordinarily broad range of products, set ambitious collection and recycling targets, clearly define recycling, and require strict reporting and enforcement. The EU directives will also mandate the elimination of many hazardous substances from electrical and electronic products.

## Europe's Twin Directives on Electronic Waste

The debate over how electronic waste should be managed and who should pay the costs has been going on in Europe for over a decade. Currently, two directives are going through the final stages of the EU adoption process: the *Directive of the European Parliament and of the Council on Waste Electrical and Electronic Equipment* (the WEEE directive) and the *Directive of the European Parliament and of the Council on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment* (the RoHS directive).

The legislative process in the European Union is complicated. The executive branch — the European Commission — is the source of policy initiatives; the Council, comprising the environmental ministers of the member states, adopts legislation in consultation with the European Parliament. There is now general agreement on the key issues addressed in the WEEE and RoHS directives, but many of the specific provisions are still not finalized. If the Council and the Parliament do not ultimately agree, the directives will go to a Conciliation Committee that will resolve the differences. As of December 2001, it is expected that the two directives will be finalized within the next year. Once the directives are adopted, the EU member states must pass their own national legislation to implement them.

The twin directives are sweeping in scope. They cover all products that come with a battery or an electrical cord, from heavy medical and telecommunications equipment to household appliances to small consumer items such as toys, clocks, and hair dryers. There are ten categories of products and each has its own recycling targets. Cell phones are in category 3, covering information technology and telecommunications equipment. Also in this category are mainframe computers, PCs, printers, calculators, fax machines, and wired telephones.

The issue of waste electronics was originally addressed by a single WEEE directive. In 2000, however, the Commission decided to split the provisions into two separate directives, with important implications. Since the legal basis of the WEEE directive is environmental protection, member states are free to pass more restrictive legislation in their own countries. The legal basis of the RoHS directive, on the other hand, is free trade, which prevents member states from adopting more restrictive legislation. In the future, the EU expects to propose a third directive, on the design and manufacture of electrical and electronic equipment.<sup>1</sup>

### **Directive on Waste Electrical and Electronic Equipment**

The context for the WEEE directive is the proliferation of electrical and electronic equipment entering Europe's waste stream. Electrical and electronic waste accounted for 4 percent of EU municipal waste in 1998, and is growing at 3 to 5 percent each year — three times faster than the average municipal waste stream. Over 90 percent of electrical and electronic waste in Europe goes to disposal facilities (instead of being reused or recycled), where it contributes a large proportion of the pollutants.<sup>2</sup> Many EU member states have either adopted policies to address the problem or have such policies under consideration. One of the goals of the WEEE directive is to "harmonize" these different approaches.

The directive's general aim is to avoid the generation of waste and preserve valuable resources. The WEEE directive firmly embraces EPR and states: "By establishing producer responsibility this Directive encourages the

design and production of electrical and electronic equipment which take into full account and facilitate their repair, possible upgrading, re-use, disassembly and recycling.”<sup>3</sup> The following are some key requirements of the WEEE directive that apply to cell phones:<sup>4</sup>

- Electrical and electronic waste must be collected separately from other waste.
- Households must be able to return used equipment free of charge.
- Producers must provide product information that allows consumers to identify components and hazardous substances.
- Hazardous substances must be removed from products and managed in accordance with the EU waste directives.
- By a specified date (still under discussion) 65 percent (by weight) of separately collected waste from products in category 3 (information technology and telecommunications equipment) must be reused or recycled, and 75 percent must be recovered (this includes waste-to-energy conversion, in which materials are burned to recover energy). These rates will apply to cell phones and other hand-held wireless electronic devices.
- Member states must collect data on the amounts of equipment put on the market each year, as well as on the amounts collected and recycled, and report this information to the European Commission at three-year intervals.

### ***Directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment***

The RoHS directive establishes restrictions on the use of some heavy metals and brominated flame retardants (see chapter 3 for a discussion of these substances). There is intense debate on the date of this phaseout, with the European Parliament supporting 2006, the EU Council supporting 2007, and industry supporting 2008. EU member states must ensure that new products put on the market after the specified date do not contain lead, mercury, cadmium, hexavalent chromium, or either of two types of brominated flame retardant: polybrominated biphenyls (PBBs) or polybrominated diphenyl ethers (PBDEs). Although PBBs are not being made at present, regulators concluded that a ban on these substances was warranted in case some company wishes to produce them again in the future.<sup>5</sup> Some exemptions will be allowed if substitution with a nonhazardous material is not feasible or would outweigh the environmental benefits.

### ***WEEE and RoHS Directives: Outstanding Issues***

Some substantive differences still exist between the legislation approved by the Council and by the European Parliament. Heavy lobbying from all sides continues, and changes in the directives will undoubtedly be made before final adoption.

**Target dates.** There is intense debate over the dates at which targets must be reached. In addition to the target date for phasing out hazardous substances, there will be a specified date for meeting the collection, recovery, and reuse/recycling targets.

**Individual versus collective responsibility.** A key issue is whether producer responsibility should be individual or collective. When producers have individual responsibility, they pay specifically for the recycling of their own brand products; with collective responsibility, all producers jointly share the costs of managing all their waste products. The Council wants this decision left up to the member states. The Parliament wants to require individual responsibility — a position supported by companies such as Electrolux, IBM, Hewlett-Packard, Sony, Nokia, and Ericsson.<sup>6</sup> Hewlett-Packard is a strong supporter of individual responsibility, advocating a system in which “the individual manufacturer has as much control over the take-back cost of its products as possible.” HP opposes systems with uniform take-back fees, even when these are controlled by industry, because they do not achieve the lowest possible overall costs.<sup>7</sup>

Although the terms have not been well defined, the distinction between individual and collective responsibility hinges on whether the system will reward companies that “do the right thing” by designing less wasteful, more recyclable products and developing economical recycling strategies. For example, if a company must pay to recycle its own products, it will benefit from product designs that are easier and cheaper to recycle. But if all companies pay the same fee (based on their market share) to recycle a product, such as \$20 per computer, there will be no incentive to make computers that are more recyclable. While collective responsibility provides a funding mechanism but no incentives for companies to design for recycling, individual responsibility does provide such incentives. However, individual responsibility also entails some sorting or tracking of used products by brand, which can be costly.

There are also some murky areas in between: for example, if companies do not pay to recycle their own products but do pay fees based on factors that determine a product’s recyclability, such as weight, material composition, and toxicity. Finally, it should be noted that individual responsibility does not preclude producers from working together to collect, transport, and recycle used products. They can set up joint programs under this model, but individual responsibility would require that the fees they pay be based on the cost of recycling their own products.

**Historical waste.** The debate on individual versus collective responsibility relates to new products only. Many of the products that will fall under the directives are “historical,” meaning they were sold before the directives came into effect. For these products, there appears to be agreement that responsibility should be collective, since there is no reason to provide incentives for product design.

**Orphan products.** Another contentious issue is the problem of “orphans.” These are products made by producers that no longer exist or cannot be found when the time comes to manage the waste. Industry strongly opposes having to pay to manage orphan products, which it sees as encouraging “free riders” (companies that benefit from a take-back/recycling system but do not contribute to it financially) and punishing companies that design products to facilitate end-of-life management.<sup>8</sup> Many companies have argued that government should pay the costs of managing orphan products.

**Other issues.** Remaining to be resolved as lobbying enters its final phase are the following:

- Collection targets for waste from households: the Council wants an average of 4 kilograms (8.8 pounds) per person per year; the Parliament wants 6 kilograms (13.2 pounds) per person per year.
- The point at which producers become responsible for waste equipment: will they have to collect it from households or can they pick it up at an aggregation point established by municipalities?
- Which products should be exempted from the phaseout of lead solder.
- Which brominated flame retardants should be phased out.
- Whether printed wiring boards from cell phones should be singled out for selective treatment (these components account for most of a cell phone’s environmental impacts).

Again, some changes in the directives are likely before they are finally adopted. But whatever their ultimate form, it is clear they will require substantial reductions in the toxic content of electrical and electronic equipment, along with substantial increases in the rates of reuse and recycling.

## The EU’s Directives Are Spurring Innovation

Research on recycling technologies is being conducted all over the world, but there is particular pressure to develop new, less costly methods in Europe, where collection targets and recycling rates will be mandated by the WEEE directive.

One example of this is the ADSM (active disassembly using smart materials) project funded by the EU and being conducted at Brunel University (UK), Stuttgart University (Germany), and Gaiker Technology Center (Spain). Researchers are evaluating materials to be used in fasteners that will be able to disassemble themselves at specific triggering temperatures. Designs incorporating such materials could lead to electronic consumer products that disassemble themselves automatically. Researchers have developed a simple cell phone that can disassemble itself in 1.5 seconds; the mean disassembly time for all cell phones tested was 8 seconds. The researchers note that component recovery is key to reducing environmental impacts and that the current practice of dismantling by hand discourages recovery because of its high costs. ADSM can also be used to separate materials for recycling.<sup>9</sup>

Another effort is under way at Nokia, the world's largest maker of cell phones. The company is developing biodegradable plastics that would allow every phone part to be reused or recycled. The new materials have been tested in clip-on covers for cell phones, but so far they have not passed performance tests.<sup>10</sup>

## **Other EPR Models Abroad**

EPR programs for electronic products in Sweden, the Netherlands, Norway, and Switzerland already include cell phones. However, none of these programs are based on individual producer responsibility, so they do not provide incentives to design products to facilitate end-of-life management. Typically, they use advance disposal fees paid by consumers to fund recycling. These fees are universal for individual product categories; for example, the fee for a cell phone is the same irrespective of actual recycling costs, even though these depend on a product's weight, material composition, ease of disassembly, and toxic components. Some national programs include recycling targets and reporting requirements and some do not. Even those that do, however, will have to be strengthened to conform to the requirements of the forthcoming WEEE and RoHS directives.

### **Switzerland's Take-Back Program**

One program that has been cited as a possible model for the US is Switzerland's electronics take-back initiative. The SWICO Recycling Guarantee program is run by the Swiss Association of Information, Communication and Organisation Technology (SWICO), a nonprofit company organized by industry with over 400 member companies. Participation in the program was originally voluntary but was mandated by a national ordinance in 1998.

Under the SWICO program, retailers, manufacturers, and importers must take back their equipment free of charge and manage it in "an environmentally tolerable way."<sup>11</sup> The scope of covered products is very broad and includes household appliances, consumer electronics, and information and communications equipment. Small consumer items like hair dryers, electric toothbrushes, and shavers are also included. Products covered by the WEEE directive and not by SWICO include toys, power tools, and light bulbs.<sup>12</sup> Consumers are required by law to return all covered products.

Switzerland's "Ordinance on the Return, the Taking Back and the Disposal of Electrical and Electronic Appliances" states that iron, copper, and other metals should be recycled, that problematic components such as mercury switches and PCB condensers should be removed, and that nonrecyclable mixed plastics should be incinerated.<sup>13</sup> The SWICO Recycling Guarantee includes no recycling targets, however.

SWICO sets a national fee schedule based on the sales price of equipment. Customers pay this fee when they purchase the product. A fee of 16 cents is imposed on each cell phone sold to cover the costs of recycling.

The cost is low because the number of phones sold greatly exceeds the number that enters the waste stream in a given year. By comparison, the recycling fee for a TV set is \$20.<sup>14</sup>

A 2000 report from Switzerland's environment office stated that the program was working well for larger items such as refrigerators, TVs, and office equipment. However, it was not working for small items like toasters and cell phones, which people were discarding along with their rubbish.<sup>15</sup>

### ***The ECTEL Project: A Voluntary Industry Program***

There have been a number of voluntary take-back programs for cell phones in Europe. The most notable of these was carried out by the Cellular Phones Take-back Working Group of the European Trade Organization for the Telecommunication and Professional Electronics Industry (ECTEL). In this pilot project, the participating companies (Alcatel, Ericsson, Motorola, Nokia, Panasonic, and Philips) took back their own phones in the UK and Sweden during 1997.

The ECTEL working group compiled detailed technical data on the program and analyzed the results. Key findings included the following:<sup>16</sup>

- Component recovery is far more beneficial to the environment than metals recovery.
- Significant environmental impacts of cell phone take-back and recycling come from collection and transport, not from the reprocessing of materials.
- The recycling infrastructure is immature.
- Recycling is not profitable and metals recovery is the least costly option.

Academics in the UK analyzed the ECTEL data using energy as a proxy for environmental impacts. End-of-life options studied were metals recovery through smelting or disassembly for component recovery with plastic recycling. For both options, the researchers found a positive energy balance. Their conclusion was that "it is to be expected that take-back (of cell phones) will have benefits in terms of improved materials recovery and avoided energy and environmental burdens."<sup>17</sup>

### ***EPR in Japan***

EPR has developed quite differently in Japan than in Europe. In particular, take-back in Japan does not have to be free — consumers pay when they bring used equipment back to retailers. Legislation making producers responsible for end-of-life refrigerators, air conditioners, TVs, and washing machines was passed in 1998. Take-back will soon be extended to include computers, and cell phones and other electronic products will ultimately be covered as well.<sup>18</sup>

When retailers take back used appliances in Japan, they send them to aggregation points set up by producers, which are responsible for their reuse and recycling. Producers set the take-back fees for their own products, and the expectation was that they would compete in setting those fees. In fact, however, the major producers all set the same fees and, according to the Ministry of Economy, Trade and Industry (METI), they are now competing fiercely to design lighter and slimmer products that are cheaper and easier to recycle. They are also designing for disassembly, reducing the number of plastic resins in their products, and reusing parts.<sup>19</sup>

This system is an example of individual producer responsibility. Since producers have both physical and financial responsibility for recycling their own products, they have a strong incentive to design for recyclability. This has

resulted in increased communication between product designers and those responsible for recycling, and has facilitated the incorporation of end-of-life criteria into new product design.<sup>20</sup>

On the minus side, the Japanese system creates a disincentive for consumers to bring used products back to the retailer, since they must pay to do so. While consumers may be willing to pay to return a refrigerator, they may be less willing to bring back a cell phone they can easily throw out in the trash. In fact, the country's environment ministry has reported an increase in illegal dumping of TVs.<sup>21</sup>

The take-back system for personal computers, scheduled to begin in April 2002, departs from the individual responsibility model. Unlike the system for appliances, it imposes an advance disposal fee on the PC sale price, with the revenues going into a fund for recycling. The fees have not yet been set but are expected to be about 3000 to 4000 yen (\$25 to \$33) for desktops and about 1000 to 1500 yen (\$8 to \$12) for laptops. There will be additional charges for collection. For computers already sold, consumers will have to pay recycling and collection fees when they turn in the used products.<sup>22</sup>

The government intends to negotiate recycling targets for electronics with industry and to require reporting. In addition, companies will have to develop design-for-environment programs and report on these to the government.<sup>23</sup> METI has already issued design guidelines for computers that require manufacturers to conserve resources and make long-lasting products that use fewer materials and include more recyclable materials.<sup>24</sup>

### **Cell Phone Take-Back in Australia**

Most national take-back programs for cell phones are part of a more comprehensive program for electronic products. Australia is unique in implementing a national program solely for cell phones. The Mobile Phone Industry Recycling Program (MPIRP) was launched in 1999. At that time, Australia closed down its analog network and installed a cellular network, making over one million cell phones obsolete. MPIRP was set up to keep these phones out of landfills.<sup>25</sup> The take-back program is voluntary and is run by the Australian Mobile Telecommunications Association (AMTA), which acts as its administrator and financial custodian.<sup>26</sup>

Each month, manufacturers pay a 30 cent (US \$0.15) fee for every handset they put on the market. Carriers pay a 12 cent (US \$0.06) fee per handset according to a formula based on their market share. AMTA collects the fees, contracts with recyclers, and pays all recycling and promotional costs from the revenues generated by the fees. Consumers can drop off phones free of charge at 1650 participating retailers. AMTA provides the retailers with bins and empties them when they are full. All brands of phones are collected, although two manufacturers do not participate in the program. All collected items, including handsets, batteries, and accessories, are sent to smelters for metals recovery.

So far, only 30 tons of equipment have been collected since MPIRP's inception in 1999.<sup>27</sup> To promote the program, AMTA entered into a partnership in 2000 with Planet Ark, a nonprofit environmental organization. The Phones 4 Planet Ark campaign, described as the "world's biggest mobile phone recycling program,"<sup>28</sup> aims to recycle 120 tons of cell phones and cell phone batteries each year — about 500,000 phones.<sup>29</sup> Participating manufacturers and network carriers include Alcatel, Ericsson, Mitsubishi, Motorola, NEC, Nokia, Panasonic, Philips, RF Industries, Samsung, AAPT, Cable & Wireless Optus, OneTel, Orange, Telstra, Virgin Mobile, and Vodafone.<sup>30</sup> The program's purpose is to keep cell phones out of landfills, but there appears to be no effort to reuse the phones or recover components for reuse.