The Growing Strategic Importance of End-of-Life Product Management

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Throughout the last century, most product manufacturing companies focused their management efforts on design, procurement, manufacturing, and marketing. Once a product left the factory gates, the only future contact the manufacturer might have with it was in providing aftercare support such as maintenance or repairs. New regulations, however, are forcing companies to take another look at their products when customers are ready to dispose of them. End-of-Life (EOL) take-back laws have proliferated over the past decade, imposing a host of new requirements on manufacturers. In some sense, this represents a new manifestation of other environmental laws that have increasingly held manufacturers responsible for the environmental impact of their products throughout an increasing number of product life-cycle stages.

In part, this follows a 1972 recommendation by the Organisation for Economic Cooperation and Development (OECD) Council that its members base their environmental policies on the "polluter pays principle."[1] Under this principle, designed to internalize environmental externalities, "States should take those actions necessary to ensure that polluters and users of natural resources bear the full environmental and social costs of their activities."[2]

The U.S. has employed this principle in several major federal environmental laws dealing with hazardous waste,[3] though only over the past decade have policy makers given serious attention to reducing the environmental

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impact associated with disposal of mainstream products by holding manufacturers responsible for these costs. To do so, several countries have passed "take-back" laws that impose requirements on manufacturers to manage the products they manufactured at their end of life. Policy makers expect manufacturers to pass along these costs down the supply chain to consumers, who would then pay the full cost of their products through higher prices. This would create a feedback mechanism to product designers and manufacturers, whose incentives would be realigned to design products to minimize costs across their entire life cycle.

The Objectives of Take-Back Legislation

Take-back legislation has three primary objectives. The first objective is to reduce the amount of hazardous materials heading to landfills, where they can leach into the environment,[4] and to incinerators, where they can be released into the atmosphere. The volume and toxicity of waste has grown dramatically over the past decades. In Europe, nearly 40% of all lead in landfills and 50% of lead in incinerators comes from waste electrical and electronic equipment, and this equipment is the fastest growing portion of the waste stream.[5] European studies estimate that the volume of Waste Electrical and Electronic Equipment (WEEE) is increasing by 3-5% per year, nearly three times faster than the municipal waste stream.[6] In the U.S., the EPA estimates that 30% of lead in landfills comes from electronic products.[7]

The second objective is to increase the availability and reduce the price of recyclable materials relative to virgin materials. By increasing the supply of recycled materials, some of the demand for virgin materials is anticipated to shift to recycled materials. In addition, increasing recycling rates will provide manufacturers with a more reliable stream of recycled material. Manufacturers including Hewlett-Packard, Sony, and IBM have long proclaimed a desire to use recycled plastics but have been thwarted by insufficient supply.[8] Switching to recycled materials not only achieves the first objective of reducing the waste stream, but also creates additional environmental benefits when the materials and energy required to extract and process virgin materials exceeds that required to reprocess recycled materials. Recycling is often less energy intense. For example, aluminum produced from virgin ore is 20 times more energy intensive than that produced from recycled aluminum.[9] For basic raw materials such as steel, glass, cement, silicon, and resins, three times as much energy is used to extract virgin or primary materials than is required to manufacture products from those materials, suggesting that substituting reused or more durable manufactured goods for primary materials will often be less energy intense.[10]

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These two objectives—reducing the toxicity of materials sent to landfills and incinerators and increasing the availability of recyclable materials—could

be achieved by several traditional policy instruments. For example, several countries have imposed bans on disposing various materials via landfills or incineration,[11] mandated recycling, removed subsidies or imposed taxes on virgin materials, or subsidized recycled materials. However, the truly unusual feature of take-back laws is that they can accomplish these two objectives while achieving a third objective: preventing pollution by reducing the environmental burden of EOL products at their source. This environmental burden is a function of the amount and choice of materials used in products. Materials are selected during product design, engineering, and manufacturing. There are essentially two ways to meet this third goal: directly, through prescriptive regulations that require or ban the use of particular substances; and indirectly, by imposing full life-cycle management costs onto manufacturers through product take-back legislation. By allocating disposal costs to producers, take-back regulations are intended to create incentives for manufacturers to decrease the cost of collection, disassembly, and remanufacturing (creating products with at least some refurbished parts). Specifically, manufacturers may then incorporate EOL concerns into product design by increasing the durability of products, components, and materials—and by facilitating their repair, disassembly, refurbishment, and recyclability.

The Explanatory Memorandum that accompanied the EU's *Proposal for a Directive on Waste Electrical and Electronic Equipment* states: "Producers should take the responsibility for certain phases of the waste management of their products. This financial or physical responsibility creates an economic incentive for producers to adapt the design of their products to the prerequisites of sound waste management."[12] The memo makes explicit the particular leverage of assigning responsibilities to producers. "Producers of electrical and electronic equipment design the product, determine its specifications and select its materials. Only producers can develop approaches to the design and manufacture of their products to ensure the longest possible product life and, in the event that it is scrapped, the best methods of recovery and disposal."[13]

Examples of such design changes include the following:

- improving the ability for products to be refurbished or repaired (e.g., using modular components that can be re-used in new models or as spare parts);
- reducing disassembly and recycling costs by using snap-fit assembly, fewer materials and components, fewer toxic substances, and more clearly labeled material content;
- promoting recyclability by avoiding the use of coatings and paints;
- using recycled material; and
- incorporating residual value into material selection (i.e., considering material costs as the difference between their initial purchase price and residual price, rather than simply the former).[14]

The European Environmental Bureau, a federation of 135 environmental citizens organizations throughout Europe, supports take-back regulations

because they believe such laws can stimulate innovation to "improve the durability, the repair-friendliness, the modular construction, the use of non-hazardous substances and the recyclability of consumer goods."[15]

Mandated Producer Responsibilities

Types of Responsibility

Take-back laws impose various combinations of economic, physical, informative, or liability responsibilities upon manufacturers.[16] Economic responsibility involves requiring manufacturers to pay at least a portion of the EOL costs incurred in various stages of product recovery: collection, separation, recycling (which may include disassembly), and disposal. This can assume the form of a fee levied on products based on criteria related to their EOL costs (e.g., shipping bulk, potential thermal energy, whether toxic disposal is required). Regulations that assign physical responsibility require manufacturers to engage in the physical management of their EOL products, and thus these regulations imbed economic responsibility. Regulations that impose informative responsibility could require manufacturers to maintain information about their customers and products (e.g., component lists, material composition) to reduce the cost of third-party involvement in EOL stages. Finally, regulations can impose liability for environmental damages resulting from the disposal of products.

Which Product Recovery Stages?

When imposing economic or physical responsibilities, legislation can also specify which parties are responsible for each stage of the product recovery process. Perhaps the most controversial step is collection from households. The collection of household waste is typically paid for by municipalities, as is the collection of recyclable household commodities such as glass, paper, and aluminum. Even on occasions where they must use third-party contractors to provide these services, municipalities still pay. Drafting take-back legislation presents the question of who should perform and who should pay for household collection of the targeted products. The initial WEEE proposal sought to make producers financially responsible for the collection of WEEE from all locations except private households. The final version of the WEEE proposal requires Member States to establish collection systems and ensure that WEEE is collected separately. Producers are held responsible for the subsequent costs of transporting their own products from these collection points for treatment, re-use, and recycling. In many cases, responsibilities imposed on producers are also imposed on importers.

Disposition Requirements

Take-back legislation may also define the forms of disposition that are deemed acceptable. The EU's *Packaging and Packaging Waste Directive* and its proposed WEEE Directive incorporate in their definition of "recovery" several options including recycling, waste-to-energy incineration, and composting.[17]

Recovery and Recycling Targets

Beyond imposing take-back responsibilities, some regulations have gone farther by stipulating target rates for collection, re-use, and recycling. These may either be mandated hard targets or they may assume softer objectives. The EU's Packaging and Packaging Waste Directive required Member States to impose hard targets for packaging waste by mandating that, within five years, at least 50% recovered, at least 25% recycled, and at least 15% of each material type recycled.[18] Japan's *End-of-Life Vehicle Recycling Initiative (*1996) establishes minimum recycling rates of 85% by 2002 and 95% by 2015.

Dealing with Historical Waste

Legislators have also addressed "historical waste," products sold before take-back regulations enter into force. This consists of two kinds of products: those whose producers still exist, and those whose producers no longer exist. The latter is referred to as "orphan products." In regimes where take-back regulations promote fees at point-of-sale of new products, some additional provision has been made for funding the take-back of existing products. This can be accomplished by either raising the point-of-sale fee on new products, using public funds, or imposing an additional tax on producers. If fees are imposed on producers, policy makers must make two fundamental decisions: which firms to include, and how to allocate the costs. The WEEE proposal has pursued this route by calling on Member Countries to assess their current producers of electrical and electronic equipment, allocating charges based on current market share. Japan's *Home Appliance Recycling Law* takes a different tact, funding its take-back scheme with fees imposed on customers when they drop off their WEEE at collection centers.[19]

Preventing Future Historical Waste

Policy makers can also design mechanisms to prevent the existence of future orphan products. This is particularly important for products with longer life spans and in industries with high rates of company exit. For example, with strong backing from industry, the WEEE proposal calls for Member States to require producers to provide a financial guarantee as their products are sold. This guarantee, which could assume the form of insurance, would ensure that the producer pay the waste management costs upon the product's EOL. Orgalime—a federation that represents over 100,000 companies in the mechanical, electrical, electronic, and metal-working industries across 21 European countries—has referred to this as being "of utmost importance as it establishes a means by which enforcement authorities would be able to prevent free-riding."[20]

Institutional Features and Product Design

Beyond deciding on the types of responsibilities to impose, legislators must also decide whether to impose these responsibilities individually on

companies or collectively on entire industries, and whether specific fee and pricing mechanisms should be stipulated.

Individual or Collective Responsibility?

Take-back legislation can impose individual or collective responsibility on manufacturers to finance EOL product recovery. With individual responsibility, manufacturers are held responsible only for their own EOL products. Collective responsibility, as its name implies, imposes this responsibility on all companies within an industry for the industry's products. While collective operations can reduce the cost of sorting EOL products by manufacturer, it creates the need for regulations to define the boundaries of each industry. In addition, this distinction is of critical importance to achieving take-back regulations' third objective: creating incentives for producers to prevent pollution and waste through changes in product design, engineering, and manufacturing. Many companies and trade associations maintain that only individual responsibility provides this incentive. If companies were made collectively financially responsible for their industry's waste, the reduced recycling costs that derive from investments in product design changes will not accrue exclusively to those who make such investments. Instead, the benefits will be diluted, reducing the entire industry's recycling costs. As such, the incentives to make such investments will be substantially eroded, and companies will have the incentive to free ride. Furthermore, in a collective responsibility model, it is unclear who would be liable for regulatory infractions, especially since producers can only be made responsible for costs under their control.[21]

Despite these benefits of individual financial responsibility, take-back legislation in Austria, Belgium, The Netherlands, Norway, and Sweden imposed collective financial responsibility.[22] Companies including Electrolux, Nokia, Ericsson, Intel, IBM, Hewlett-Packard, and Sony, as well as the European Committee of Domestic Equipment Manufacturers (CECED) and the European Information and Communications Technology Industry Association lobbied the EU for the WEEE Directive to provide for individual financial responsibility.[23] Their position on this issue was shared by the European Environmental Bureau, which represents many environmental citizen groups across Europe.[24]

In some cases, individual responsibility may be impractical, such as when dealing with orphan products. The WEEE Directive, for example, assigns collective responsibility for historic waste, but individual responsibility for products sold after the Directive enters into force.

Operational Structure

Klaus Hieronymi, General Manager of Hewlett-Packard's Environmental Business Management Organization Europe, argues that while EU legislation should provide for individual financial responsibility, it should stop short of mandating operational structure. Instead, producers should be afforded the flexibility to choose between individual efforts and consortia to manage the collection and processing of WEEE. Similarly, CECED articulates the important

distinction between imposing individual versus collective financial responsibility and the subsequent decision of how to conduct recycling operations:

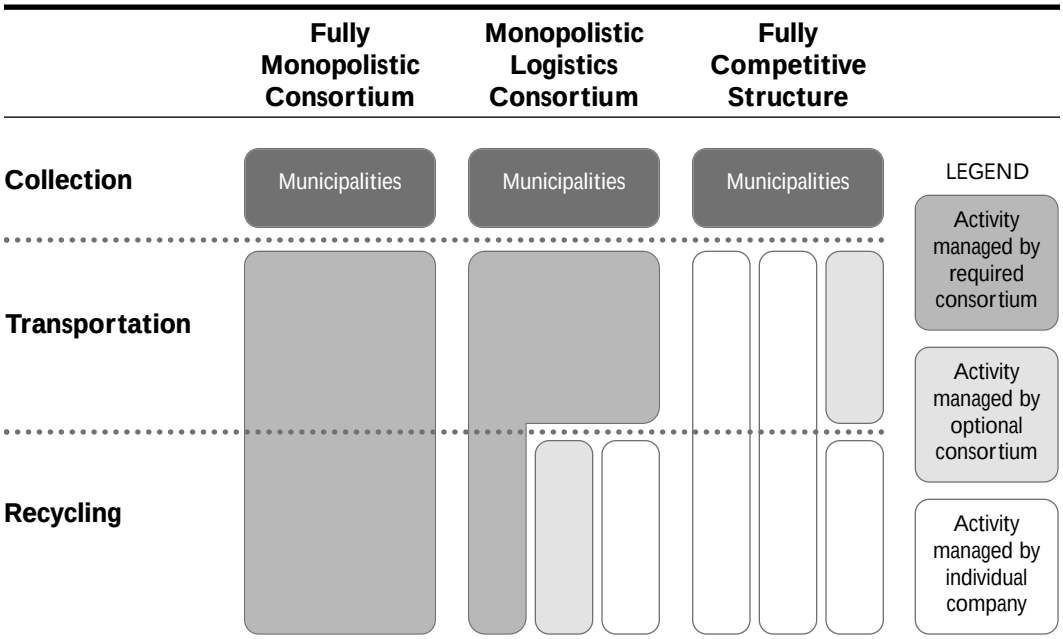
> Individual financial responsibility . . . is a matter of attributing the right bill to each producer. Solutions exist that may make actual sorting unnecessary. Technology for tracking and product identification are available. However, it will only be used if the benefits outweigh the disadvantages. For this reason, our industry can predict that small appliances like electric toothbrushes, hand-held vacuum cleaners, toasters and irons, will in all likelihood be treated together and their recycling jointly financed. It would be premature to make such a statement for the larger and more complex products like washing machines, where recycling properties and values may differ. They might be treated and financed together in some cases, but it might also be more beneficial for the actors to separate the financing. The practical implementation will change over time as products and systems develop.[25]

The trade association Orgalime points out that those claims that individual producer responsibility necessitates that each producer establish its own take-back, treatment, and recycling system and prohibits producers from organizing collective recycling systems are based on a misunderstanding. "Individual responsibility can be achieved within and is compatible with collectively set up and operated take-back, treatment and recycling systems."[26] Furthermore, Orgalime urges the EU to provide for operational flexibility to accommodate unforeseen changes: "Even if it is unlikely that a company would choose to set up its own recycling system, this should still be a possible alternative."[27]

Consider what happens to the incentives to invest in design changes to reduce the cost or environmental burden of recycling in the following case. Suppose producers are required to use an industry consortium that charges the same up-front fee on new products regardless of brand or the model's estimated recycling costs, and the consortium also charges its members a fixed charge-back for processing each unit, again regardless of brand or model. In this scenario, manufacturers cannot recoup their investment on the revenue side via a smaller up-front fee, providing a price advantage and the opportunity to expand sales. They also cannot recoup such investments on the cost side by realizing a lower recycling charge-back. A classic commons problem: collectively, all companies would benefit if they could profit from design changes that reduce recycling costs, but individually, each has an incentive to free ride. The scenario is not purely hypothetical: for several countries with WEEE regulations, including The Netherlands and Belgium, all models are subject to the same up-front fee and all models are assessed the same charge-back fee from the single operating consortium.

The flexibility many companies and trade associations sought was granted in an October 2002 agreement between the European Parliament and the European Council over details about WEEE proposal. They announced that the WEEE Directive would stipulate individual responsibility, but leave the choice of recycling operations—whether to use a consortium or develop their own infrastructure—to each producer.[28] The EU's desire to force manufacturers to reduce the costs associated with handling EOL products was made explicit by

FIGURE 1. Alternative Operational Institution Designs



Source: Based on Klaus Hieronymi, "Business Management Perspective for a Sustainable, Efficient, Low-Cost WEEE-Implementation Scheme," Presented at the European Electronics Take-back Legislation: Impacts on Business Strategy and Global Trade Workshop, INSEAD, Fontainebleau, France, October 17-18, 2002.

Environment Commissioner Margot Wallström, who commented "I am particularly happy that we could convince Member States to strengthen the individual responsibility of producers for the waste from their products. This will be an important incentive to producers [to] take the environmental consequences into account already when they stand around the design table."[29]

Three Scenarios

Figure 1illustrates three of the many possible scenarios that could emerge under various forms of take-back regulations. In each of these, municipalities are responsible for collection. The first column illustrates a fully monopolistic consortium, where a single entity manages the transportation and recycling for all producers. The second scenario requires all producers join a consortium to transport waste from collection points to recyclers, but allows producers to decide whether to manage recycling on their own, through the transportation consortium, or by creating another consortium specifically for recycling. The third scenario provides the most operational flexibility, by allowing producers to work individually or together, and supports the emergence of multiple consortia.

While a single consortium evolved in several European countries (including The Netherlands, Sweden, and Belgium), the operational flexibility provided in Japan's *Home Appliance Recycling Law* coupled with its larger market led to the

development of two consortia, each of which has established its own recycling infrastructure including collection depots and recycling plants.

Harmonization versus Subsidiarity

An institutional design issue legislators face involves the subsidiary principle. The Treaty establishing the European Community restricts the EU from taking action unless it is more effective than action taken at national, regional, or local level.[30] The U.S. has enshrined a similar tradition in the Constitution's 10th Amendment.[31] Legislators must decide which institutional features to stipulate centrally and which to leave up to local governments or producers. For example, take-back legislation dealing with household products, including the EU Packaging Directive and WEEE proposal, often requires that recycling must be free of charge to consumers to deter consumers' illegally dumping the targeted products to avoid disposal fees. Beyond this, various take-back regulations have not stipulated many other institutional details, leaving these to be resolved by subsidiary governments and companies. What organizations will serve as collection points for waste equipment: retailers, municipalities, and/or an industry consortium recycling company? Must recycling also be provided free of charge to business customers? Should producers fund product recovery via up-front fees on new products? Must the fee be the same across various product classes (e.g., TVs and toasters) and among all brands and models in each product class? If a consortium is allowed or mandated, will it charge member companies *ex ante* based on projected processing volumes or *ex post* based on actual volumes? Must the per unit charge be the same across all brands and models, or can it vary based on actual processing cost?

The EU Directive on Packaging and Packaging Waste provides two types of flexibility. First, it allows Member States to develop their own financing schemes for the recovery of packaging. For example, the United Kingdom allocates the costs of packaging recovery to four different players with 6% to raw material suppliers; 11% to converters; 36% to packing and filling businesses, and 47% to retailers or end users. Each company's annual packaging weight is multiplied by this percentage factor and by the recovery rate to calculate its annual fee.[32] Second, the Directive provides the targeted companies with flexibility regarding operational structure: they can develop their own packaging recovery infrastructure or they can hire third parties to manage the recovery of their packaging. Several packaging manufacturers and distributors decided to work together and created Duales System Deutschland (DSD), a non-profit organization. Companies join DSD by paying a fee—which varies by packaging material and weight—in order to be able to place its green dot logo on their products.

Target Industries

Product take-back laws have proliferated for electronic and electrical equipment in Europe and East Asia. Take-back regulations have targeted packaging, batteries, automobiles, as well as electrical and electronic products.

Packaging

In 1991, Germany imposed the first mandatory take-back program with its *Ordinance on the Avoidance of Packaging Waste* (Packaging Ordinance), which made manufacturers responsible the cost of collecting, sorting, and recycling packaging associated with their products. Companies were required to label packaging with its material composition and its return/reuse system.[33] Germany's packaging take-back regulations have forced the redesign of packaging.[34] Several years later, the European Union (EU) passed a *Directive on Packaging and Packaging Waste* requiring EU members to pass national legislation with minimum-waste packaging recycling targets, and to develop a method to allocate recycling costs across suppliers of raw materials for packaging, packaging manufacturers, distributors, and retailers of packaged goods—but not customers or taxpayers.[35]

Batteries

Batteries are also subject to take-back laws in some European nations. Germany's Batteries Ordinance requires battery manufacturers to manage their EOL products and requires battery consumers to return all EOL batteries. In response, several manufacturers have joined forces to commission waste disposal companies to collect and sort batteries from retailers and public waste disposal sites and deliver their parts to disposal companies.[36] Dutch regulations make manufacturers and importers responsible for collecting and recovering batteries, while a Norwegian regulation requires retailers, importers, and producers of rechargeable batteries to be responsible for take-back and safe disposal.[37] In response, Norwegian retailers, importers, and producers have established and fund a nationwide return and collection system. Several U.S. states have also passed take-back regulations on batteries. For example, regulations in Florida, Minnesota, and New Jersey require manufacturers to take back and manage the disposal of the rechargeable batteries they produce, while rechargeable battery manufacturers in Rhode Island and Vermont must ensure that a collection, transportation, and processing system is established.[38] In response to various landfill bans being imposed on their products by a growing number of U.S. states and municipalities, with many more threatening, the rechargeable battery industry initiated a voluntary take-back program in the U.S.,[39] seeking to deter additional states from passing legislation.

Automobiles

In Japan, the Ministry of International Trade and Industry's *End-of-Life Vehicle Recycling Initiative (*1996) advocates raising the recycling rate of end-of-life vehicles. Following initiatives by several Member Countries including France, Germany, Italy, and The Netherlands,[40] the EU *Directive on End-of-Life Vehicles* (2000)[41] assigns automakers the financial and physical responsibility to meet new car recycling targets. The Directive requires automakers to reuse or recycle 85% of an EOL automobile's weight by 2006, a target that increases to 95% by 2015. The Directive requires manufacturers to set aside billions of dollars to

Major Product Take-Back Bills Introduced into U.S. State Legislatures

While the United States has largely eschewed legislating product take-back, the past two years have seen bills calling for electronics recycling and deposit schemes introduced in many state legislatures. Bills have been introduced in California, Massachusetts, Minnesota, New York, New Jersey, North Carolina, Nebraska, Oregon, South Carolina, and Hawaii. On the national level, a bill was introduced to the U.S. House of Representatives (HR 5158) in July 2002 that seeks to impose a fee on the sale of cathode ray tubes (CRTs) and possibly other electronic devices. Some of more ambitious legislation that has been introduced is described below.

California

In California, two bills (SB 1523 and 1619) were introduced in February 2002. They would have created a surcharge on the sale of CRT devices (e.g., televisions, computer monitors). Initially, the bill sought to defer setting the fee amount, and then responded to industry lobbying efforts by first imposing a $30 limit, and eventually stipulating a $10 fee. The bill stated that the collected fees would establish a government-managed fund that could only be used to provide grants to local governments, CRT material handlers, and non-government organizations (NGOs) involved in recycling and refurbishing CRT devices, to support CRT manufacturers' recycling efforts, and to provide public education to increase CRT recycling rates. Furthermore, the bill prohibited exporting CRTs to countries that have ratified the Ban Amendment of the Basel Convention on the Control of Transboundary Movement of Hazardous Waste, such as China. This is a substantial clause, because the U.S. has not ratified the Basel Convention and thus this state law would impose new restrictions on Californians not faced by CRT recyclers from other states.

Potential grant recipients—including county and municipal governments, recycling and waste management companies, and various NGOs —supported the bill. Many electronic manufacturers including Hewlett-Packard, JVC, Panasonic, and Gateway opposed the bill, as did the Silicon Valley Manufacturers Group and the Electronic Industries Alliance, major trade associations. In late 2002, California's Governor Gray Davis vetoed the bill, claiming it would require the government to hire more staff to manage the funds during a budgetary crisis leading to the loss of thousands of government jobs. In his letter that announced his veto, the Governor stated, "I believe that building a state bureaucracy to address this problem is not the best solution for managing electronic waste."[a] Arguing that industry should be required to solve this problem with minimal government bureaucracy, Davis cited the European Union's efforts and indicated his desire to sign similar legislation in 2003, which would make California the first state to assess a recycling fee on new CRTs sold to residents. At an "Electronic Waste Forum" sponsored by various state agencies in November 2002, several legislators indicated their intent to work with the Governor to ensure the passage of legislation in 2003 that would make producers responsible for at least some of the state's electronic waste.

Massachusetts

A bill introduced into the Massachusetts House of Representatives (Bill 4716) in November 2001 takes a more flexible approach than California's bills. Rather than imposing a statewide fee, it would have required CRT manufacturers to design a program to manage the collection of their products. The bill included several minimum criteria for the collection system, including a 95% recycling target rate. This bill died in committee. A more comprehensive bill (Bill 1533) was introduced into the Massachusetts House in January 2003 that calls for manufacturers of both computers and CRTs sold in Massachusetts to establish and fund a collection system. This pending bill has been endorsed by more than one hundred cities and towns.[b]

Minnesota

Two Minnesota bills (HF 2815 and SF 2979) introduced in February 2002 contain three requirements. First, if a national recycling system for electronic products is still not implemented in Minnesota by July 2003, electronics manufacturers would be held responsible for the costs of collecting and managing their products, and they would be required to implement programs to collect 90% of their waste products generated in the state by January 2004. Second, the bill would prohibit the disposal of these products in mixed municipal solid waste effective July 2004. Finally, the bills require the state government to purchase televisions, computers, monitors, and printers only from those manufacturers that participate in a national electronics products recovery and recycling programs, provide take-back services for their products, and whose products minimize the use of hazardous materials. While these bills failed, they were re-introduced in early 2003 (as HF 882 and SF 838) and remain pending.

a. Gray Davis, "SB 1523 veto message," September 30, 2002, available at <www.governor.ca.gov/govsite/msdocs/press_release/L02_246_SB_1523_veto_message.doc>.
b. The Massachusetts Producer Take Back Campaign," available at <www.producertakeback.org/>, accessed March 24, 2003.

process cars built before 2002, while cars built after 2002 will include a tax to fund processing at end of life.[42] Prior to the EU Directive, Germany proposed legislation to require automakers to take back and recycle their cars, which had begun stimulating carmakers to rethink their entire auto production process, giving greater consideration to disposal issues.[43]

Electrical and Electronic Equipment

Eleven countries—Belgium, Denmark, Italy, The Netherlands, Norway, Sweden, Switzerland, Portugal, Japan, Taiwan, and Korea—have promulgated product take-back regulations for waste electronic equipment.[44]

Japan's *Household Appliance Recycling Law* (2001) imposes physical take-back requirements on manufacturers to recycle televisions, refrigerators, washing machines, and air conditioners,[45] and its *Law for Promotion of Effective Resource Utilization* (2001) imposes similar requirements on rechargeable batteries and personal computers (PCs) used in offices.[46] PCs used by consumers will likely

be included in 2003.[47] Taiwan requires computer users to recycle them at EOL at one of several hundred recycling operations across the country, compensates these users a few dollars, and charges a fee to new equipment manufacturers.[48]

To harmonize requirements across the EU, the Council of Ministers recently adopted a *Directive on Waste Electrical and Electronic Equipment* (WEEE).[49] The WEEE Directive requires EU Member States by 2005 to establish collection systems for waste electrical and electronic equipment and ensure that such materials are collected separately. The Directive's scope includes many types of electrical and electronic equipment including many household appliances, computers, telecommunications equipment, lighting equipment, electrical and electronic tools, toys, leisure and sports equipment, and medical devices. Disposal of these products must be free of charge to consumers. Manufacturers will bear all costs incurred from the collection points to the treatment, re-use, and recycling for their own products. By 2006, Member States must provide evidence that they are meeting a binding collecting rate of 4 kg per person per year and that they are recycling 50% of EOL small household appliances and 75% of EOL large household appliances. At the same time, the EU Directive on the Restriction of Hazardous Substances (RoHS), also adopted by the European Council and Parliament in December 2002, requires Member States to ban the use of four heavy metals (lead, mercury, cadmium, and hexavalent chromium) and the brominated flame retardants PBB (polybrominated biphenyls) and PBDE (polybrominated diphenyl ether) in many electrical and electronic products beginning July 1, 2006.[50] This is motivated by the desire to protect workers involved in manufacturing electrical and electronic equipment and to reduce the environmental burden of the products at their EOL. The RoHS Directive calls on electrical and electronic equipment manufactures to avoid using substances that become dangerous materials in waste treatment.[51]

Potential Impacts of Take-Back Legislation

Take-back legislation is meant to transfer disposal costs to producers—and ultimately to consumers. What is the magnitude of this cost? Will the anticipated environmental benefits associated with source reduction actually materialize?

Design Impact

The extent to which producer responsibility legislation will impact product design remains an open question. In some industries, such as personal computers, a single product design is distributed globally. In these cases, if a substance ban or take-back requirement leads to a design change, it is likely to be promulgated globally. On the other hand, many household appliances are designed for national markets, and so design changes made to accommodate national regulations may only affect products in the regulated market. In general, substance bans such as the proposed RoHS Directive and recycled-content mandates are likely to be more influential in instigating design changes than take-back requirements. At the same time, as designers continue to reduce the

amount of metals in products, both to reduce the cost and environmental burden, recyclers lose some of the "nuggets" with recovery value that helps to offset recycling operations.[52]

Cost Impact

According to Dr. Kieren Mayers, Manager of Sony's Environmental Center Europe, the cost to producers of complying with the pending WEEE Directive will be 1-2% of revenues.[53] In aggregate, Orgalime estimates the anticipated cost of implementing the proposed WEEE Directive to the electrical and electronic industry will be €40 billion to deal with historical waste, and €7.5 billion in annual costs.[54] The UK Department of Trade and Industry recently estimated that implementing the WEEE Directive in the UK would cost £328 to £509 per tonne of collected WEEE for collection, treatment, reuse, and recovery activities.[55] Annual costs of these activities are estimated at £175 to £419 million. Providing information to consumers, treatment facilities, and program registers was estimated to cost an additional £37 millon per year. Electrolux estimates that the WEEE and RoHS Directives could add over $20 to the price of a new washing machine.[56] Most, if not all, of these costs will like be passed onto consumers through higher prices. It remains unclear how governments will respond to their cost savings from no longer being responsible for handling WEEE. Options include reducing tax assessments, delaying increases, or using the funds to provide additional government services.

Environmental Impact

Environmental concerns associated with landfilling waste electronics include the leaching and evaporation of hazardous substances including lead, mercury, cadmium, PCBs, and brominated flame retardants.[57] Incinerating electronics elicits other problems, including the mobilization of heavy metals and the creation of dioxins, furans, and other hazardous combustion products. The resulting incinerator ash also contains high levels of metals. Take-back regulation can make a profound impact on diverting waste destined for landfills or incinerators. For example, in its first year, Japan's *Household Appliance Recycling Law* collected over 8.5 million WEEE units, including 3 million televisions.[58]

While recycling may reduce the volume of toxic materials heading to landfills and incinerators, the transportation and reprocessing entailed in recycling also has environmental effects. Three studies have used a life-cycle assessment approach to evaluate the net environmental impact of the EU WEEE Directive. Two studies were conducted for the UK's Department of Trade and Industry that evaluated several household electronic products and concluded that the higher recycling rates mandated by the Directive would reduce most environmental impacts associated with landfilling WEEE, the prevailing practice in the UK.[59] Another study focused on computer printers and reported mixed results, concluding that the WEEE Directive would improve some environmental aspects such as air acidification and resource depletion but would worsen others including ecological toxicity and global warming potential.[60]

RosettaNet

In response to new regulations that limit or outright ban particular hazardous substances in various products, companies are becoming increasingly interested in the material composition of their supplies. For example, Intel Corp received more than twice as many inquiries in 2002 regarding the materials it is using in its manufacturing process compared to the year before.[a] In addition, companies are facing more scrutiny by customs agents seeking to ensure the contents of imported products are within legal limits. For example, The Netherlands halted the sale of 1.3 million Sony PlayStation One consoles and 800,000 accessories because their cables contained three to 20 times the amount of cadmium permitted by European Union regulations.[b] This apparently resulted in millions of lost revenues, and portends a larger concern articulated by Holly Evans, Environmental Advisor of the Electronic Industry Alliance (EIA): "This is going to be a major trade issue for our industry….You will not be able to sell your products in some international markets if you don't know what's in your systems."[c]

These concerns about clearing customs have sparked the development of an industry initiative to standardize material composition aggregation and labeling, according to David Kraemer, Vice President-Industry Development of RosettaNet.[d] The members of RosettaNet, manufacturers of electronic products and components, are developing open process standards called Partner Interface Processes® to improve the efficiency of transactions across the supply chain, such as design modifications, order management, and virtual manufacturing. The recent effect to create a standard process to enable manufacturers to clearly understand the aggregate material composition in their products is based on the need to more efficiently meet material bans and restrictions. If the standard were extended to include a material composition breakdown by component, it could also facilitate recycling by alerting recyclers about hazardous material contents of various components, and the exact material content of the residual. This is especially useful for materials that are not easily distinguishable without the use of expensive technology, such as some plastics. Creating greater awareness of material composition can also enable designers to improve the recyclability of products.

a. Jennifer Baljko Shah and Laurie Sullivan, "Firms Warned to Brace for Environmental Fallout: New Laws Threaten to Disrupt the Unprepared," EBN, September 27, 2002.
b. Reuters, "Sony Swaps PlayStation One Cables," CNET News.com, December 5, 2001.
c. Jennifer Baljko Shah and Laurie Sullivan, "Firms Warned to Brace for Environmental Fallout: New Laws Threaten to Disrupt the Unprepared," EBN, September 27, 2002.
d. Personal communication with David G. Kraemer, Vice President-Industry Development, RosettaNet, November 4, 2002, see <www.rosettanet.org/materialcomposition>.

Voluntary Product Recovery

Product recovery also occurs in many industries and countries that lack regulatory mandates. In these circumstances, a different set of drivers encourages such initiatives. Some initiatives seek to forestall or shape new legislative action, while others respond to pressure from customers and non-governmental organizations.

To pre-empt, influence, or delay regulations that mandate product recovery, companies can pursue a variety of strategies and may work individually or

coordinate their efforts through trade associations.[61] Firms may also seek to reduce the pressure for regulations by improving their own performance. For instance, in response to drafted regulations, major manufacturers of power tools sold in Germany agreed to voluntarily take back their EOL products from customers at no charge.[62] Similarly, to "forestall over-legislation by doing something," Frigidaire is implementing design changes to facilitate disassembly and recycling of its products by independent recyclers.[63] In response to various landfill bans being imposed on their products by a growing number of U.S. states and municipalities (with more threatened), the rechargeable battery industry initiated an industry-wide take-back program in the United States.[64] These efforts are not always successful. The Electronic Industry Alliance (EIA) laments, "Despite EIA's voluntary environmental initiatives, a growing number of nations and states are considering legislation and regulations, which would severely impact the ability of the electronics industry to ship and sell its products globally."[65]

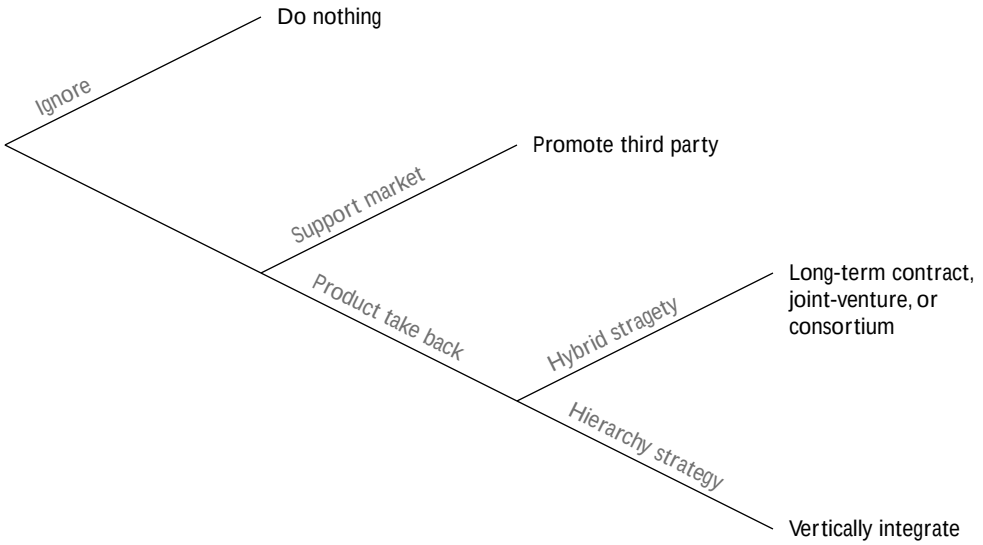
Some manufacturers have also voluntarily instituted product recovery initiatives to reduce production costs by substituting recovered components and materials for virgin ones. Perhaps the most famous example is Xerox Corporation, which has eliminated millions of dollars in annual logistical, inventory, and raw material costs by disassembling its EOL photocopiers and then cleaning, sorting, and repairing components for remanufacturing into new models and also by recycling residual materials. In the automotive industry, Ford—motivated to reduce the flow of auto parts to landfills, gain a new source of spare parts, and get closer to its customers after the sale—is buying salvage yards to dismantle EOL vehicles and sell their parts to repair shops and retail customers.[66] Some of these efforts may also be motivated to reduce the supply of used parts that compete with the sale of manufacturers' spare parts.

Product recovery can also improve a company's environmental performance and enhance its brand image. For example, Kodak initiated a voluntary take-back program to overcome the negative image associated with its single-use cameras. After Kodak launched this product in 1987, consumers began referring to them as "disposables" or "throwaways"[67] and the media reported environmental groups' concerns of their wastefulness.[68] In response, Kodak and Fuji-Film began taking back and recycling more than 90% of their single-use cameras, and in doing so reversed this product's poor environmental image.[69]

Product Recovery Strategy Alternatives

Manufacturers are pursuing several strategies to deal with pressures to take back their EOL products. There are seven main product recovery strategies. Companies operating in regulated markets face a subset of these choices. The six strategies are illustrated in Figure 2 as a decision tree and are summarized in Table 1. This presents a continuum of governance structures, from promoting markets to vertical integration, with intermediate "hybrid" solutions including long-term contracts, joint ventures, or consortia.[70]

FIGURE 2. Product Recovery Strategy Decision Tree



Do Nothing

Producers operating in regimes that lack take-back regulations face this strategic alternative, where they take no action to recover their EOL products and do nothing to support product recovery.

Promote the Market

This strategy consists of a manufacturer providing arm's-length market support for the existing third-party recycling infrastructure by providing information to customers. An example of this strategy is a computer manufacturer that merely directs its U.S. customers to the EIA's Consumer Education Initiative[71] for information on recycling and reuse programs in their state. Another example is Gateway's Recycling Benefit Program, which provides customers a $50 rebate off the purchase of a new computer when they donate their old computer to a charity or a recycler. Gateway lists several recyclers and donation programs on its web site.[72] Apple Computer designs its products to reduce the cost of their disassembly and recycling, but is not involved in product recovery for its mainstream U.S. customers. Canon, Hewlett-Packard, Sony, Toshiba, and other appliance manufacturers have sponsored WEEE collection events in the U.S. at Best Buy stores, a major retailer of consumer electronics.[73] Some of these events charge consumers up to $15 per item, while others are free.

Long-Term Contract

This strategy involves a manufacturer signing a long-term contract with a company to recycle and possibly recover components from EOL products. For example, Nokia authorized ReCellular, Inc. to be its North American service and

TABLE 1. Summary of Product Recovery Strategies

Manufacturer Product Recovery Strategy	PC Industry Example
1. Do Nothing	
2. Promote the Market	In the U.S., Gateway provides a rebate to customers who donate their PC to a recycler or charity, Apple designs its products to reduce recycling costs, and the Electronic Industry Alliance provides information about recycling programs across the country. Canon, Hewlett Packard, Sony, and Toshiba, have sponsored EOL product collection events at Best Buy retail stores.
3. Long-Term Contract	In the U.S., Dell's Value Recovery Service packs up EOL computers from customers and ships most to a contracted recyclers.
4. Joint Venture with a Recycler	In the U.S., Hewlett-Packard developed a partnership with Micro Metallics to establish recycling facilities for EOL products.
5. Joint Venture with Competitors or Establish an Industry Consortium	Electronic equipment manufacturers and importers have established consortia in Austria, Belgium, The Netherlands, Norway, Sweden, and Japan.
6. Vertically Integrate into Product Recovery	In the U.S., Dell operates a PC recycling facility in Dallas. Globally, IBM operates nine major Asset Recovery Centers that conduct dismantling and recycling operations.

remanufacture center for its cellular telephones.[74] In the computer industry, Dell offers a Value Recovery Service where it packs up EOL computers from customer sites and ships most of them directly to a few recyclers with whom it has long-term relationships.[75]

Joint Venture with a Recycler

Manufacturers may also choose to engage in a joint venture with a recycling company. For example, in 1998, Deere & Company and Springfield Remanufacturing Corporation formed a 50-50 joint-venture company, ReGen Technologies, to remanufacture diesel engines and engine-related components for Deere's dealers and customers. Hewlett-Packard formed a joint venture with Micro Metallics Corporation, a wholly owned subsidiary of Canadian metal mining company Noranda Inc. At their Roseville, California, facility, Hewlett-Packard supplies the warehouse facility and Micro Metallics supplies the process technologies and staff for the disassembly and recycling operations. While Hewlett-Packard sells the recovered components that have value on the secondary market, the recovered fine metals are shipped to Noranda's smelters.

Joint Venture with Competitors or Establish an Industry Consortium

To reduce collection costs, several manufacturers may work together to gain economies of scale by designating one company in each country or region to manage the initial stages of EOL product recovery. EOL products can then be disassembled and their components inspected before they are shipped to their respective manufacturer, reserving this additional transportation cost for only those components with residual value. The manufacturers of "ready to use" cameras in Europe have established such a system. "In each country or geographic region in Europe, a different manufacturer coordinates the collection and transportation of used cameras from photo development laboratories where they are stored. The cameras are taken to an independent separation warehouse where they are sorted and sent to the appropriate remanufacturer."[76]

Manufacturers facing the same challenges in developing a cost-effective product-recovery system may benefit by working together to establish a consortium. Even when take-back regulations provide operational flexibility, consortia may provide the most cost-effective solution, particularly in small countries. For example, responding to the flexibility provided in the German Packaging Ordinance, manufacturers across various industries established a non-profit organization called Duales System Deutschland GmbH. This organization charges manufacturers to place its green dot logo on their product packaging. Fees are based on the type and weight of the packaging materials. In return, the organization collects, sorts, and distributes to recyclers packaging that displays its logo.

In several European countries that have implemented take-back regulations on WEEE, the targeted industries have created a single consortium to manage product recovery and recycling. These include Umweltforum Haushalt in Austria, Recupel in Belgium, and Nederlandse vereniging Verwijdering Metalektro Producten in The Netherlands.[77] In Sweden, the Swedish Association of Local Authorities (RVF) and El-Kretsen AB operate the Elretur system where local authorities manage collection operations and the producers collectively manage treatment.[78] In Norway, three companies manage WEEE collection and recycling.[79] The latter two created a joint venture, El-retur, that has contracted with several other companies for collection and treatment.[80] In response to the EU WEEE Directive, four companies that produce 14 percent of Europe's electronic waste—Braun, Electrolux, Sony, and Hewlett-Packard—recently announced their intention to collaborate recycling efforts throughout Europe to negotiate lower prices with recyclers.[81]

In Japan, the electronics industry developed two consortia to manage WEEE collection and recycling. The "A" Group is an alliance between Matsushita and Toshiba. The "B" Group is an alliance among Sony, Sanyo, Sharp, Hitachi, and Mitsubishi.[82] In the U.S., an industry consortium was created by the rechargeable battery industry. After eight states implemented varying regulations that held manufacturers responsible for the disposal of the nickel-cadmium rechargeable batteries they produce, the battery industry established

the Rechargeable Battery Recycling Corporation to manage the collection and recycling of these batteries.

Vertically Integrate into Product Recovery

When manufacturers vertically integrate into product recovery, they invest in the infrastructure and skills required to recover and disassemble EOL products, refurbish components, and recycle materials. With vertical integration, the manufacturer may acquire tacit knowledge about its EOL products. In such cases, it can modify future product designs to alter their durability and facilitate component recovery from EOL products. In the PC industry, IBM and Dell have pursued this route. IBM's wholly-owned Asset Recovery Centers accept any manufacturer's central processing unit (CPU), monitor, and peripherals (keyboards, mice, printers, scanners) and then refurbishes, donates, or recycles them.[83] These recovery centers "share their experiences and recommendations with IBM product development teams to ensure that issues affecting the end-of-life management of products can be addressed early in the design of new products."[84] IBM designs their products for upgradability, reusability, recyclability, and safe disposal.[85] To achieve economies of scale with respect to transportation (a substantial cost of processing recovered products), IBM's recovery facilities in Europe collect all types of IBM products to initiate local disassembly and ship only those components valuable for remanufacturing to product-specific factories.[86] Dell offers PC Recycling Services, where it packs and ships EOL computers from customer sites to their Dallas facility, where they are partially disassembled and ground into various residual materials.[87]

Selecting EOL Product Recovery Strategies

There are four factors managers should consider when selecting among these seven strategies. The types of responsibility and operational flexibility provided by each country's legislation may narrow the available set of strategic options. Furthermore, a manufacturer's product recovery strategies may depend on product characteristics including the forecasted cost differential between refurbished, recycled, and virgin components and between recycled and virgin materials. In addition, national differences in the geographic concentration of customers, transportation infrastructure, as well as recycling infrastructure will play an important role in selecting a product recovery strategy. A company's strategy may differ by product and country.

Forward and Backward Integration?

When refurbished or recycled components are expected to reduce manufacturing or repair costs, the decision of whether to vertically integrate into product recovery should be viewed as *both* forward integration into a post-distribution activity and backward integration into a new source of supply. For example, Xerox Corporation has taken back their EOL photocopiers for decades and has refurbished their components for reuse as substitutes for virgin components.

Similarly, Kodak and Fuji take back their single-use cameras and reuse their frame, many small parts, metering system and flash circuit board to produce new cameras.[88]

In other cases, manufacturers' vertically integrating into product recovery is limited to forward integration. For example, while Dell collects EOL PCs from their commercial customers in the U.S. as a service associated with the sale of new equipment, Dell does not re-use the components or materials in its own operations. Instead, it resells some components on the secondary market and then grinds the residual, which is separated and sold to metal smelters and plastic manufacturers. HP does the same thing with EOL computers sent to its EOL equipment recycling facilities and the 39 million printer toner cartridges that customers have returned since 1992.[89]

Sharing Proprietary Information

If a manufacturer chooses to employ an independent recycler or join a consortium, minimizing product recovery costs may entail sharing proprietary information. For example, consider the costs involved in identifying the material composition of unlabelled plastic composites. Whereas an independent recycler would have to use expensive specialized equipment, the manufacturer may be able to identify the materials based on its proprietary specifications. A manufacturer may be inhibited from disclosing proprietary information to a consortium co-owned by its competitors. Similarly, manufacturers with different design strategies may wish to invest in different types of recycling equipment. For example, one manufacturer may designs its products to enable its components to be recovered for refurbishment, while another designs its products for its components to be crushed into recyclable material. These design choices are influenced, in part, by forecasted costs of virgin materials, product recovery, refurbishment, remanufacturing, and recycling—and companies may well have different forecasts.

The Role of Specialized Materials

A manufacturer's product recovery strategy may also be influenced by the materials it employs in its products. If these materials can be recycled into a commodity, the manufacturer may be more likely to contract with an independent recycler or join a consortium. The recovered materials would be sold to one of many bidders. If the manufacturer uses specialized materials, it may value the recovering materials more than other companies. In this case, contracting with an independent recycler can present problems, especially as the discrepancy of valuation enlarges between manufacturer and other potential users of the material.[90] While the manufacturer can be expected to drive the price down to the collection cost or the amount the second highest bidder is willing to pay (whichever is higher), the independent recycler would seek to price the recycled material as close to the manufacturer's outside option, virgin material. Hold-up by the recycler may be particularly effective against manufacturers with just-in-time delivery systems because their smaller buffer inventories increases the

importance of supply reliability, which increases the manufacturer's dependency on the recycler. On the other hand, if recovery operations can be accomplished more cost-effectively when specialized assets are applied, once the independent recycler makes this investment, it becomes more vulnerable to being held-up by the manufacturer. Consequently, manufacturers employing specialized materials may be face problems by contracting with independent recyclers, and instead may find it more beneficial to create a joint venture or vertically integrate into product recovery. The latter options will be favored over contracting with recycling companies as the difficulty and costs of monitoring contractors' performance increase.

Leveraging Competencies

A manufacturer's decision to vertically integrate into product recovery should also depend upon the extent to which it can leverage its existing competencies. Manufacturers that possess competitive advantages in logistics, manufacturing, or assembly may be able to leverage these competencies into product recovery's reverse logistics, remanufacturing, or disassembly stages, respectively. Similarly, manufacturers may be able to leverage their service and repair capabilities into competitive advantage in quickly and accurately identifying repairable products and reusable components. This capability may be enhanced by tacit knowledge of component quality inspection and testing acquired in manufacturing processes. As a consequence, original equipment manufacturers (OEMs) with a long history of conducting manufacturing in-house may be more likely to vertically integrate into product recovery, whereas OEMs that largely outsource manufacturing may be more likely to outsource product recovery activities.

Conclusions

Manufacturers selling products into markets with take-back regulations are already facing new requirements to manage or at least pay for disposal of EOL products. In most regimes, manufacturers have been required to conduct take-back operations collectively. The EU WEEE Directive will dramatically increase the number of countries with take-back regulations for electronics products, and it provides manufacturers with greater operational flexibility than many other take-back laws. As a result, manufacturers that sell anywhere in the EU must now develop strategies to address EOL product recovery.

Furthermore, with take-back regulations spreading both geographically and across additional industries, the number of companies that will face the challenge of crafting cost-effective EOL product management strategies will continue to grow. In the U.S., legislation addressing waste electronics is expected to be introduced in ten states this year,[91] perhaps with the ultimate aim of prompting industry calls for federal legislation to harmonize requirements. California Governor Gray Davis has indicated his willingness to approve take-back legislation in 2003, stating "California needs a comprehensive and innovative state law

that partners with product manufacturers, establishes recycling targets, and provides for the safe recycling and disposal of electronic waste."[92]

Therefore, comprehensive management strategies to address product take-back will involve both the political and market environments. In the former, proactive companies will learn from the institutions in countries with take-back laws and will seek to shape take-back legislation and regulations. In the market environment, companies that perceive this as a strategic issue will begin contemplating how to gain competitive advantages by developing cost-effective product recovery operations and reevaluating product design priorities.

Notes

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3. For example, the Resource Conservation and Recovery Act (1976) required hazardous waste to be controlled from the "cradle-to-grave" (including generation, transportation, treatment, storage, and disposal). U.S. EPA, "Finding Answers: Resource Conservation and Recovery Act," 2002, available at <www.epa.gov/region5/defs/html/rcra.htm>, accessed February 18, 2002. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (1980) dramatically extended companies' responsibilities by assigning financial responsibility for cleaning up hazardous waste sites to companies that generated hazardous substances disposed of at the site, current and former owners and operators of the site, and transporters who selected the site for disposal of hazardous substances—even when decisions and actions were in full compliance with EPA regulations. U.S. EPA, "Superfund (CERCLA) Cleanup Enforcement," 2000, available at <es.epa.gov/oeca/osre/superfund.html>, accessed February 18, 2002. Seeking to make those who financially benefited from the production, transport, and handling of hazardous waste also bear its full costs, Congress had CERCLA impose strict liability on these parties for the full cleanup costs of hazardous waste sites. *Comprehensive Environmental Response, Compensation, and Liability Act*, 42 USC 9607(b), 1980. The courts have supported this intent. For example, a Supreme Court decision notes "CERCLA . . . imposes the costs of the cleanup on those responsible for the contamination." *Pennsylvania v. Union Gas Co.*, 491 U.S. 1, 7, 1989.
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12. European Commission, "Explanatory Memorandum to the Proposal for a Directive of the European Parliament and of the Council on Waste Electrical and Electronic Equipment and Proposal for a Directive of the European Parliament and of the Council on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment, COM(2000) 347 final," Brussels, 2000.
13. Ibid.
14. Electronic Industries Alliance, "Addressing End-Of-Life Electronics Through Design: A Compendium of Design-For-Environment Efforts of EIA Members," Arlington, VA, 1998, p. 5.
15. European Environmental Bureau, "Waste from Electrical and Electronic Equipment," (undated), available at <www.eeb.org/activities/waste/weee.htm>, accessed November 22, 2002.
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27. Ibid.
28. The proposed WEEE Directive provides operational flexibility: "Member States shall ensure that producers or third parties acting on behalf of them set up systems *either on an individual or collective basis* . . ." [italics added] (Article 7:1). Individual financial responsibility for new products is provided: "For products put on the market later than [thirty months after entry into force of this Directive], each producer is responsible for financing the operations . . . related to the waste *from his own products*. The producer can choose to fulfill this obligation either individually or by joining a collective scheme" [italics added] (Article 8:2). Collective financial responsibility is imposed on existing products: "The responsibility for the financing of the costs of the management of WEEE from products put on the market before [the historic waste period expires] . . . shall be provided by one or more systems to which all producers, existing on the market when the respective costs occur, contribute proportionately, e.g., in proportion to their respective share of the market by type of equipment" (Article 8:3). European Parliament & European Council, "Directive of the European Parliament and of the Council on Waste Electrical and Electronic Equipment (WEEE), joint text

approved by the Conciliation Committee provided for in Article 251(4) of the EC Treaty, PE-CONS 3663/02EN," November 8, 2002.

29. European Commission, "Commission Welcomes Agreement on Waste Electrical and Electronic Equipment and the Restriction of Hazardous Substances (IP/02/1463)," October 11, 2002.
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38. Bette Fishbein, "EPR: What Does It Mean? Where Is It Headed?" *P2: Pollution Prevention Review*, 8/4 (1998): 43-55; U.S. EPA, "Product Stewardship," 2001, available at <www.epa.gov/epr/about/index.html>, accessed February 18, 2002.
39. Fishbein, op. cit. There are many examples outside the environmental arena of industry self-regulation intended to forestall government regulation. In the media industries, such actions have answered calls for U.S. government censorship: the National Association of Broadcasters developed a Code of Conduct, the Motion Picture Association of America developed a list of "Don'ts and Be Carefuls" in the 1920s and a voluntary rating system in the late 1960s. Similarly, the Record Industry Association of America developed the Parental Advisory program in the 1980s to include warning labels on records with explicit lyrics.
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41. Directive 2000/53/EC of the European Parliament and of the Council of September 18, 2000 on end-of life vehicles. See 269 Official Journal L 34, October 21, 2000.
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