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Product Take-back Systems: Mandates Reconsidered

by Lynn Scarlett

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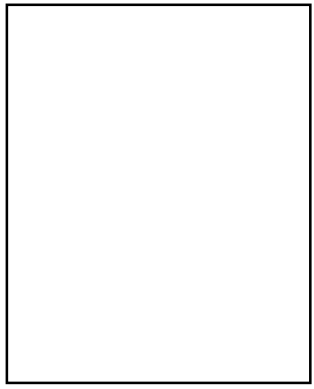

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Contents

List of Tables and Figures

"Producer responsibility is a philosophy,
not a description of a cheap and reliable system."
—Ib Larsen
Denmark Environmental
Protection Agency

I. Introduction

Frustrated with the challenges—and costs—of meeting state and local recycling goals, mayors and their public works teams are wondering if laws mandating that producers take back their discarded products would, once and for all, impel manufacturers to design for recyclability. The U.S. Conference of Mayors has debated the merits of product take-back schemes for nearly a decade, but by 1999 the debate had begun unfolding with renewed vigor. In 1999, Minnesota legislators moved ahead with the "take-back" idea, introducing a bill that would require carpet manufacturers to recover carpets when consumers discard them.

Across the border in Canada, three provinces have outlined take-back programs for packaging, newspapers, and other products. The Paris-based Organization for Economic Cooperation and Development (OECD), a membership research organization of the major industrialized nations, is attempting to advance take-back programs by documenting case studies and developing templates for model programs.[1]

Product take-back programs, often called "extended producer responsibility" (EPR), have taken root internationally (see Table 1). Over 25 nations have some form of EPR program for packaging—the most celebrated program being Germany's packaging ordinance, which gave rise in 1991 to its privately operated Green Dot program. Nearly two dozen nations, including the United States, have EPR programs for some batteries. Others are rolling out EPR programs for automobiles, electronic and electrical equipment, appliances, and other products. Some of these programs—like Dell's computer take-back program—are voluntary programs set up by industries. Many, however, have resulted from legislation.

All EPR programs have in common one central feature: manufacturers arrange to take back, recycle, or reuse (either directly, or indirectly by contracting with a third party) some of their products

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Table 1

Worldwide Extended Producer Responsibility Laws

Country	*Products*	*Recycling or Recovery Target*
Europe		
EU Directive	Directive on packaging binding on national governments	50% minimum recovery by 2001; 25% minimum recycling rate.
Austria	Batteries, refrigerators, packaging	Various materials, 20%-70% recovery.
Belgium	Appliances, batteries, electronics, packaging	Recovery targets by 2000: 95% ferrous, 85% non-ferrous, 20% plastics; 50% packaging recovery by 1999.
Denmark	Batteries, packaging (voluntary)	54% overall recovery rate by 2000, with 50%-60% industrial waste.
Finland	Packaging	82% of packaging must be recovered.
France	Batteries, packaging	Follows EU directive.
Germany	Batteries, packaging	Various materials 60%-75% recovery targets.
Greece	Packaging	25% recovery by 2001.
Ireland	Packaging	—
Italy	Appliances, batteries, packaging	Recover 30,000 appliances a year; follows EU directive for packaging.
Luxembourg	Packaging	Recovery target: 55%.
Netherlands	Appliances, batteries, packaging	Appliance/battery recovery target: 90%; packaging recycling target: 65%.

Norway	Appliances, batteries, packaging	Appliances: 80% recovery within 5 years; ni-cad battery pilot: 20,000 households; packaging recovery follows EU directive.
Poland	Packaging	Follows EU directive.
Portugal	Packaging	25% recovery by 2001 and 50% recovery by 2005.
Slovakia	Packaging	Follows EU directive.
Spain	Batteries, packaging.	Follows EU directive.
Switzerland	Packaging	Follows EU directive.
United Kingdom	Packaging	Overall target 38%, increasing to 52% by 2001.
Czech Republic	Packaging	Similar to EU directive.
Estonia	Packaging	60% recovery by 2001.
Slovenia	Packaging	Recycling recovery: 48% by 2000, 78% by 2010.
Asia		
China	Packaging	
Japan	Appliances, packaging	
South Korea	Packaging	
Singapore	Packaging (voluntary)	To reduce waste 80% through recycling.
Taiwan	Packaging	
Latin America		
Brazil	Packaging	Specific manufacturers must set up recycling centers for products: combustible oils, cosmetics, etc.

Source: 1998 Raymond Communications Inc., www.Raymond.com.

after they are discarded by consumers. In essence, these programs rearrange the allocation of rights and responsibilities associated with products as they pass from producer to retailer to final consumer.

Most mandatory EPR programs have two components:

- They impose a fee, paid for by product manufacturers, on targeted products
- They establish specific take-back goals for each targeted material or product

The popularity of EPR as a public policy tool is growing. Some proponents view take-back schemes as necessary to inspire manufacturers to design products that minimize consumer waste or facilitate product recycling. Other proponents advance the more prosaic goal of shifting direct waste management costs away from taxpayers or waste-service consumers to product manufacturers.

Despite their popularity, mandated EPR programs provoke theoretical questions and face practical limitations to their efficacy as an environmental policy instrument. Voluntary take-back programs, on the other hand, are emerging in specific situations where manufacturers tailor such programs to "add value" by reducing product cost or improving product quality.

II. EPR Theory Revisited

The term *extended producer responsibility* first surfaced in Sweden in the 1980s.[2] Its proponents view the concept as an extension of a "polluter pays" principle; that is, pollution generators must mitigate or pay for their pollution. Put another way, proponents argue that EPR will internalize the costs of negative externalities (spillover effects) that result from production and consumption. On a more practical level, EPR proponents argue that the current allocation of responsibilities for pollution mitigation and waste management does not result in "environmentally optimal development."[3]

Few would dispute the idea that polluters should be responsible for the pollution they cause. But acknowledging this principle reveals little about the merit of EPR in theory or practice. Three problems cloud EPR theory:

- The "polluter pays" principle does not answer the question, "What is pollution?"
- The principle does not delineate who is the polluter.
- The principle does not define the dimensions or boundaries of the word "responsibility."

What Is Pollution?

In conventional environmental economics, pollution refers to the residuals from production and consumption that create harmful or unpleasant impacts—harmful air and water emissions, release of toxins into soils, and so on.[4]

The polluter is the generator of these harmful or unpleasant impacts. Under this definition, responsibility for pollution lies with the person or persons who directly generate these impacts. As ownership of a material or product shifts from the resource extractor to the manufacturer to the retailer to the final consumer, responsibility for waste and pollution generated at each stage also shifts.

EPR theory departs significantly from conventional environmental economics. EPR theory broadens the meaning of "polluter" to include "any person or organisation which produces a good that, if disposed of in a certain way, might cause pollution."[5] In some discussions of EPR, the actual use of resources, distinguished from any harmful residuals or waste associated with that use, is implicitly characterized as pollution.

Despite their popularity, mandated EPR programs provoke theoretical questions and face practical limitations to their efficacy as an environmental policy instrument.

These new definitions of pollution (and the polluter) are problematic. They blur the distinction between actual and hypothetical pollution, inviting the prospect that "pollution" fees or fines will be assessed even in the absence of any actual impacts. Such fees may add to the costs of goods without introducing tangible benefits. Moreover, these definitions erode any distinction between resource consumption and pollution externalities. The costs of resource consumption are typically already incorporated into the prices paid for goods and waste-management services. The costs of pollution externalities are not captured in economic transactions. Thus, the altered definitions of pollution embraced by many EPR proponents may distort, rather than improve, market pricing signals reflecting resource scarcities.

Who Is the Polluter?

Using the more traditional definition of pollution, the "polluter pays" principle requires that the person, firm, or organization that most directly generates environmental harms is responsible for their mitigation through prevention, emission control, or cleanup. This notion of responsibility underlies virtually all modern environmental management systems and laws. Miners are (in theory) accountable for mining waste; manufacturers are accountable for air, water, and solid waste emissions that occur during the production process; retailers are responsible for their waste; consumers (through taxes or service fees) are responsible for their sewage, their trash, and other environmental impacts they may cause.

It is not at all clear that the manufacturer ought to be responsible in all circumstances for a product once possession has been transferred to the consumer.

Mandated EPR programs depart from this traditional "polluter pays" principle, replacing it with a "producer pays" principle. This departure has two consequences. First, it diminishes responsibility of others along the production-consumption chain for pollution that they might generate. Second, it blurs the distinction between products per se and any pollution that those products might cause.

With regard to the first point, it is not at all clear that the manufacturer ought to be responsible in all circumstances for a product once possession has been transferred to the consumer. A brief mental exercise demonstrates why it is difficult, or even misguided, to apply this assumption as a general precept.

Think of automobiles. On the one hand, manufacturers are responsible (increasingly, through regulations) for producing cars that emit only small amounts of pollutants. But once these cars are purchased by motorists, these motorists control when and whether to maintain the car, how they drive their cars, and whether to have periodic tests to check that the car is still operating at low emissions levels. Asserting that the manufacturer is responsible for the car essentially lifts any personal responsibility from the consumer, which is not likely to result in good environmental outcomes over the long run.

Packaging is an example of the second consequence of replacing "polluter pays" with "producer pays." Packaging is not *per se* pollution. Packaging is deliberately produced; it is not a residual of production. It serves many beneficial purposes. Unless it is littered (an act by the consumer, not the producer) or discarded into improperly operated disposal facilities, the package does not cause harmful pollution.

Manufacturing packaging does, of course, require resources. But the use of these resources generally is not "external" to the economic transaction. Packaging is typically owned all along the continuum from production through sale, consumption, and disposal, though who owns the package varies as the package itself changes hands. As ownership shifts, costs to make, ship, store, and, finally, discard packaging are all incorporated into either the package price or waste-disposal taxes and/or fees paid for by the end user.

Boundaries of Responsibility

The term "responsibility" implies a duty, burden, or obligation to do something. But that "something" must be specified. In market economies, custom, contracts, tort law, and statutes jointly determine who is responsible for what. Unless contracts specify otherwise, consumers are generally responsible for the products they purchase. What they do with the product, when they sell it to others, or how they discard it is their responsibility. This arrangement ensures some level of security of possession and some level of stewardship for the product.

There are exceptions to this allocation of responsibilities, especially in the realm of liability laws relating to accidents or harms resulting from the use of a product. Here, product manufacturers (or even retailers) may be held accountable for these harms and product failures. In contrast to these liability laws, EPR laws do not target harms; they target the mere existence of a product.

Extended producer responsibility programs, which place some part of waste-handling costs in the up-front purchase price of a product, do not, therefore, internalize an externality. They shift some (or all) of the costs of waste handling from a back-end trash fee (or tax) to an up-front product fee. EPR programs cannot, then, be justified as a correction to some market failure or in purely philosophical terms as consistent with a polluter-pays principle. Instead, EPR programs must be judged based upon whether or not a shift of waste-handling fees, coupled with mandatory waste-recovery and recycling targets, generate hoped-for benefits (for example, resource conservation) and more efficient waste-management systems.

III. EPR Expectations and Implementation Challenges

At a practical level, its proponents advance EPR as a means of improving decisions about resource use. Because EPR programs attempt to incorporate product disposal or recycling costs as an up-front fee, they are expected to change how manufacturers design and market their products. Specifically, these changes might include design for:

- waste minimization
- reuse or recyclability
- material conservation
- pollution reduction
- lower toxicity

In addition to these environmental goals, some champions of mandatory EPR systems anticipate that these systems will generate a secure, nonvolatile revenue stream to fund waste collection, recycling, composting, and waste-disposal programs.

Because EPR programs attempt to incorporate product disposal or recycling costs as an up-front fee, they are expected to change how manufacturers design and market their products.

EPR began in Europe as a philosophy about product responsibility. In the United States, its proponents generally focus on more pragmatic concerns. Public works managers, faced with recycling and waste-diversion targets, express frustration that some new packaging forms entering the marketplace make recycling more, not less, difficult. They cite three recent examples:

- The introduction of pigmented HDPE milk containers, which mingle in the waste stream with the more traditional "natural" HDPE containers and make separation of those containers into a clean stream more difficult;
- The introduction of polystyrene "wrapper" labels around glass containers, which they fear may make glass recycling more difficult; and
- The introduction of plastic beer bottles, which may supplant the easier-to-recycle glass bottles or aluminum cans.

Table 2

Material Savings from Packaging Innovations

Flexible Packaging	Packaging Replaced	Material Reduction	
		Volume	Weight
Laminate brick pack	Metal coffee can	70%	55%
Fabric softener pouch	Plastic bottle	85%	84%
Plastic diaper wrapping	Folding cardboard carton	85%	86%
Peelable lid	Metal top	87%	50%
Plastic instant soup pouch	Metal can	93%	97%
Frozen food bag, plastic	Waxed-wrap carton	89%	83%

Source: Lynn Scarlett, "Packaging, Solid Waste, and Environmental Trade-Offs," *Illahee: Journal for the Northwest Environment* 10 (1), Spring 1994, 25.

While some public works managers see EPR as a potential new revenue stream, many hope that development of an EPR program in the United States will ensure that recyclability will move center stage as a design criterion for manufacturers. They view products primarily from the vantage of their waste-handling attributes.

Manufacturers, on the other hand, view products in terms of consumer preferences, overall product performance, and overall production and product-delivery costs. This vantage requires juggling multiple goals in a context of both technological and economic constraints. Waste-handling attributes are one of many performance, environmental, and other design criteria that a manufacturer considers in product design, development, and marketing.

These differences in vantage points make evaluation of EPR complicated. The local mayor or waste manager is generally seeking lower-cost waste handling; the manufacturer is seeking to anticipate consumer preferences and product-quality requirements while minimizing resource costs. Because EPR is typically advanced as a waste-management policy, the central question remains whether EPR programs are likely to result in efficient waste diversion and recycling.

Goal Tradeoffs

The various goals for EPR programs are not necessarily compatible. EPR design considerations depend on the size of the fee and

the criteria used to establish fee levels. Packaging fees set to reflect recycling costs and, thus, encourage "design for recyclability" may discourage source reduction and materials conservation.

For example, fees based on recycling costs will typically be higher for composites and laminated products than for single-material glass or paperboard containers. Recycling requires recovering clean streams of uniform materials. Segregating the different materials in a laminated or composite package is often difficult and costly. Yet substituting these packages for more traditional glass, metal, and paper packages has historically resulted in reductions in material use by both weight and volume (see Table 2).

A 1992 report on green product design by the U.S. Office of Technology Assessment (OTA) cautioned that "what is 'green' depends strongly on context."[6] Product-design choices are often subtle. The OTA report offers an example of potential tradeoffs between materi-

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How manufacturers respond to EPR fees will depend on the fee levels, packaging weight and volume, and other consumer-quality variables.

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als-use reduction and recyclability. A modern snack chip bag is made up of thin laminated layers of nine lightweight materials, each of which serves a different function in assuring overall product integrity and consumer utility. This multilayering makes recycling difficult. The package is, however, "much lighter than an equivalent package made of a single [recyclable] material and provides longer shelf life, resulting in less food waste."[7]

How manufacturers respond to EPR fees will depend on the fee levels, packaging weight and volume, and other consumer-quality variables. Materials-reduction opportunities may be foregone if fees push manufacturers out of laminates, composites, and plastics (or other innovative, new packaging materials) and into single-material paper, glass, wood, or metal containers.

While one can anticipate some general tension between source reduction and recycling goals through EPR programs, predicting the outcomes of different EPR fee structures for any given product is nearly impossible because of the multiple variables that affect product-design decisions. For example, in Germany, clear glass—which is easy to recycle—carries a much lower fee than HDPE (plastic). But the lower transportation costs associated with lightweight plas-

Table 3

Variation in European Packaging Fees

(1997 Fee Structures, $ per 1,000 containers)

Country	300ml Plastic Bottle	75 ml Glass Bottle	Granular Detergent Carton, Size 5
Austria	$67	$22	$48
Belgium	$10	$ 4	$ 7
France	$ 2	< $ 1	$ 4
Germany	$75	$26	$56
Sweden	$ 8	$ 2	$14

Source: Klaus Draeger, Principal Scientist, Procter & Gamble, Schwalbach, Germany.

tics, ease-of-handling, lower breakage, and better performance (from the consumer's standpoint) have still resulted in decisions by many manufacturers to use plastic containers for shampoo bottles, detergents, cleansers, and so on. Some of these choices, driven by EPR fees, have even made packaging more, not less, complex. Some cleansers, which had been sold in a single-material HDPE container, now are sold in very thin plastic containers held upright with a thin paperboard sleeve.

Setting Fees

There is no intrinsically right fee level. There is wide variation in packaging fees among European EPR programs, even where waste-management technology, wages, and other relevant cost factors are similar. Packaging fees among European nations vary as much as thirty-five-fold for identical products (see Table 3).

Differing fee structures for EPR programs in Europe result from a combination of political maneuvering, differences in waste-management infrastructure and program goals, and differences in how costs are allocated. In other words, fee setting is a political exercise rather than an economic calculation based on comprehensive assessments of waste-handling costs or relative environmental impacts of different products. The explosion in different fees confuses rather than improves the information about resource scarcities signaled through prices to product and packaging producers.

Political Maneuvering

Establishing back-end waste-handling fees is a fairly straightforward process. At the point of waste collection, the hauler/recycler has relatively clear information about the average and marginal costs to collect and recycle, compost, or dispose of a given amount of waste. Determining the collection, reprocessing, or disposal costs for individual items or for their various components (such as bottle caps, labels, safety enclosures, and so on) involves a much broader set of loose assumptions. Yet establishing up-front product fees requires making these kinds of item-by-item cost estimates.

As a result, fee setting is often subject to political jockeying. The German experience bears this out. In the mid-1990s, Germany's Duales System Deutschland (DSD, a manufacturer consortium set up to manage the Green Dot packaging recovery program) sought to raise fees to meet unanticipated costs. The proposed fee for glass changed at least three times over several months, as glass-container producers and fillers pressed for more favorable treatment.[8]

Program Goals

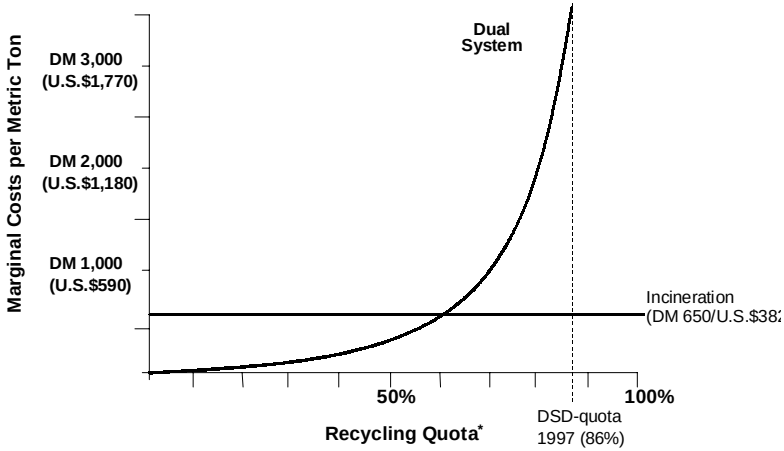
Fees also vary depending on program goals. Germany's EPR program emphasizes recycling and recovery more than waste minimization (source reduction). The DSD sets fees based on estimated costs to recycle or recover materials, with a special surcharge to cover plastics reprocessing costs. The result is costs for plastic containers that are about 20 times higher than the fees for glass containers. Glass and paper-based packaging compose 75 percent of packaging consumed in Germany by weight, but glass and paper-based packaging fees make up less than 30 percent of fees paid into the DSD system.[9]

These fee variations may approximate the differential recycling costs of the different materials. The net effect is to discourage waste minimization. Evidence of this result is offered by some German packaging anomalies relative to general trends. For example, in all other European nations, packaging for cat litter is made entirely of plastic. In Germany, it is made from paper with a plastic reinforcement of less than 5 percent of the package by weight (in order to still qualify as a paper package).[10] There is no obvious environmental benefit from this choice.

Goal details also affect fee structures. Denmark's EPR program for packaging offers reduced fees for packaging with recycled content. France allows waste-to-energy as a recovery option. Until recently, Germany required "mechanical recycling"—the direct

Figure 1

Inefficiency of Germany's DSD High Recycling Quotas



*Based on sales packaging consumption.

Source: Marcus Schroll, "The German Packaging Ordinance," Insititute for Applied Innovation Research.

fabrication of products from recovered materials—to meet recovery targets. Packagers may now meet 40 percent of the plastics recovery target through "feedstock recycling"—the conversion of plastics into their basic chemical elements for reuse.[11] Germany's very high recovery targets push fees upward, requiring increased processing while generating lower-quality materials (see Figure 1).

Cost Allocation and Cost Sharing

Some of the wide variation in fees seen in EPR programs results from different decisions regarding which costs to allocate to manufacturers and whether costs will be shared among producers/fillers and others in the manufacturing and product distribution chain (see Table 4). In Germany, packaging fees are much higher than in France, in part because German producers pay the total estimated waste-collection and handling costs for packaging and an additional fee for plastics that covers reprocessing costs. In France, producers pay the incremental cost associated with expanding recycling programs. Moreover, the French program relies on the

Table 4

EPR Cost-allocation Schemes for Packaging

Nation (EPR program)	*Producer Responsibility*		*Items Recovered*	
	Incremental Cost	Total Cost	Selected	All
Austria (ARA)		X		X
Belgium (FostPlus)		X	X	
France (Eco-Emballages)	X		X	
Germany (DSD)		X		X
Sweden (REPA)	X		X	

Source: Klaus Draeger, "Ist Der Grüne Punkt Zu Teuer?" June 10, 1997.

existing municipal waste-management infrastructure rather than on a parallel system operated under contract to the producer consortium.

In the United Kingdom, waste-handling costs for packaging are spread among raw material manufacturers (6 percent), converters (11 percent), packers/fillers (36 percent), and suppliers (47 percent). Companies that handle less than 50 tons of packaging are exempt, reducing potential participants from an estimated 200,000 to 11,500.[12] The exemption essentially legalizes "free riding" by small companies, since larger firms pay for the recovery of small-firm packaging.

Reporting Costs

Establishing fees and ensuring their payment by targeted firms is an information-intensive undertaking. Packaging consultant Victor Bell notes that:

> [I]n most cases, the cost of data collection and report preparation far exceeds the cost of the fees themselves....For example, a large personal care company, which manufactures and distributes its products globally, will spend millions of dollars creating and maintaining its environmental packaging database, which is necessary to complete all country reporting requirements. Additionally, it is spending thousands of dollars to complete each country report.... [O]ne company is spending more than [$1,000] each month in preparing its monthly reports to Svensk Glasatervinning in Sweden for their glass bottles and paying less than $200 in fees per month."[13]

Table 5

International Data Reporting Requirements for Packaging

- Weight of the package
- Shelf area
- Declared weight
- Declared volume
- Product-to-package ratio
- Empty-space ratio
- Specific material type
  - Resin type
- Fiber content
- Rigidity
- Heavy metal content
- Country of origin
- Packaging category
  - Primary
  - Sales unit
  - Transport
  - Service
- Packaging element
  - Cap, carton, etc.
- Percentage of recycled material
  - Postconsumer
  - Preconsumer
  - Industry scrap
- Data on recyclability
- Percent composition by component
  For example:
  - Fiber 84.5%
  - Aluminum film 5.8%
  - Acetate film 3.8%
  - Glue for acetate 3.8%
  - Ink 1.4%
  - Glue for aluminum 0.7%
  - Carton glue 0.3%

Source: Victor Bell, "How Manufacturers Are Responding to Extended Producer Responsibility Programs," paper presented at OECD Workshop on EPR, December 1–3, 1998, Washington, D.C.

At least 30 nations now require environmental packaging reports, often for the purposes of setting EPR fees and monitoring changes in packaging design on a national level. As Bell points out:

> [T]he data requirements are constantly changing, making the database requirements for multinational companies increasingly difficult. For example, in the EU alone the same piece of paperboard can be defined as paper in France, composite in Germany, aluminum in Spain, and other in Belgium.[14]

Criteria for determining packaging fees vary widely, with the result being that reporting requirements also vary widely. The cumulative list of required data elements is extensive (see Table 5).

While firms to date have the broadest experience with EPR programs that target packaging, any mandatory EPR program—whether for electronic equipment, automobiles, or appliances—needs data reporting to determine what fees must be paid and to track program compliance. Data-reporting costs depend on program complexity and numbers and types of program participants.

EPR and Packaging Design: The Bottom Line

Material competitiveness among packaging alternatives is related to the total costs associated with using a material to achieve the desired product performance. These costs include energy costs in production and transportation, productivity in handling, tonnage of material required to achieve particular packaging characteristics, and so on. For example, plastics may have a high cost per pound relative to some other materials, but may require much less material to create needed packaging characteristics compared with glass or paper. Thus, a substitution of plastics for more traditional materials may result in lower packaging costs.

As an example, EPR programs typically change the feedstock cost to the manufacturer. But how this change affects the choice of materials or design of the product will depend on:

- what percentage of total costs feedstock costs represent
- how changes in materials and design will affect other costs such as transportation, handling, and distribution
- how changes in design will affect product performance
- how big the differential is among different material options and how that cost difference affects total product cost

The outcome will vary for each product. Where thousands of different products exist in a product category (such as packaging), there is simply no way to know in advance how changes in fees will affect design choices. If the fees are high enough and the differential between one material choice and another is high, the fees will likely affect outcomes. But predicting which aggregate outcomes will result is not possible. EPR programs to date bear this caveat out.

IV. EPR Benefits: A Reality Check

Proponents of EPR list a variety of hoped-for product design benefits. However, most programs have based EPR fees on resource recovery and recycling costs and coupled these fees with recovery targets for specific products or materials. Proponents then evaluate success in terms of whether these targets are met.

Such a program evaluation is incomplete. Assessing whether mandatory EPR programs "work" requires two added steps. Target effects also should be compared to recycling and waste minimization trends in places that do not have mandated EPR programs. Analysis should also include opportunity costs—benefits that may

have been foregone by investing in EPR programs. For example, EPR programs may require greater materials use or stifle product innovations.

As there is no single model of EPR, evaluating a few experiences applied to one set of products is, at best, only suggestive. EPR systems, as implemented around the globe, share no common set of goals or uniform regulatory structure. Pricing schemes vary widely. Nonetheless, a look at several mature EPR programs for packaging is useful.

Targeting packaging for EPR raises some especially difficult challenges for a number of reasons. First, there are large numbers of potential participants that make heterogeneous products. Second, the value of each individual packaging transaction is small, even minuscule. Third, potential health and safety impacts from mishandling of waste may exist, but are small, limiting any harm-reduction benefits that might accompany an EPR program. Finally, packaging makers are already highly sensitive to price and consumer-preference signals. These characteristics all point to likely high system costs with limited environmental benefits.

What does the record show?

The Case of Germany

Germany's Green Dot program has the longest track record, dating to 1991. Germany had one explicit and one implicit goal in establishing its EPR program: waste minimization and increased recycling, respectively.

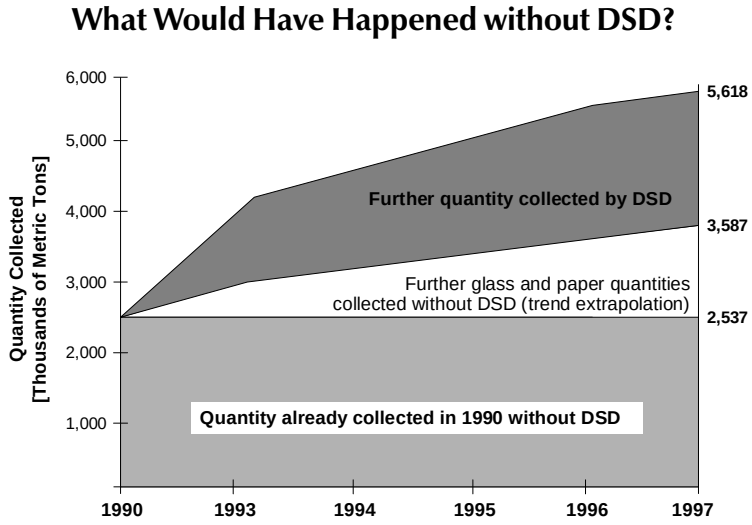
Absolute Benefits

Germany did see some decline in packaging waste. Outer (secondary) packaging was virtually eliminated but made up a small fraction of total packaging. Looking at a typical set of grocery products, packaging dropped from 2,500 pounds per gross production unit to just under 2,100 pounds, a 14 percent reduction between the outset of the program and 1994.[15] The program achieved an overall packaging recycling rate of around 78 percent by year-end 1996.

By 1998, 6.2 million tons of used sales packaging was placed in the containers distributed to communities by DSD for the purpose of collecting packaging waste containing the "Green Dot" DSD symbol. Of this amount, 5.6 million was recovered for recycling. Targets were achieved for all materials.[16]

These levels of recycling very likely exceed levels that would have

Figure 2



Source: Marcus Schroll, "The German Packaging Ordinance," Institute for Applied Innovation Research.

been achieved by market trends. However, only a portion of the total amount of recycling can be attributed to the EPR program. German economist Marcus Schroll estimates that without the DSD program, recycling would have increased from the 1990 baseline of 2.5 million tons to around 3.6 million tons (see Figure 2). The DSD program has, thus, resulted in about 2 million tons of additional recycling.[17]

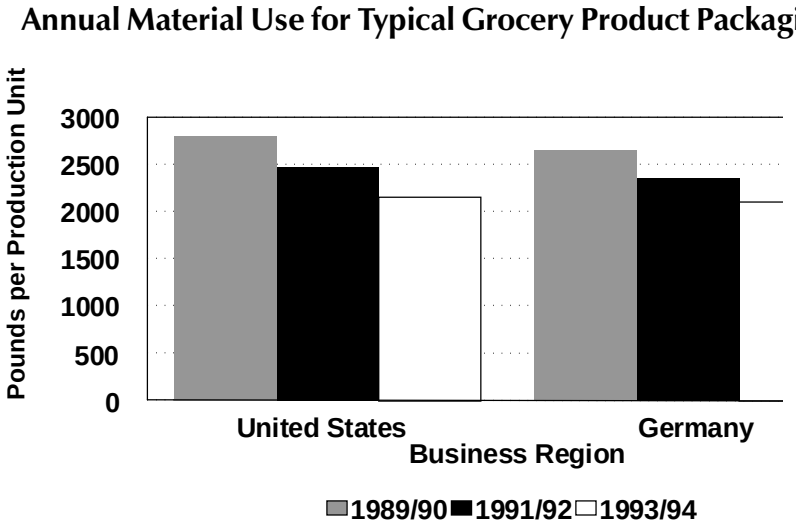
Cross-national Comparisons

In absolute terms, the German program has achieved (even exceeded) its waste-recovery targets. But these reductions in waste and increases in recycling need to be put into perspective. Cross-national comparisons are instructive.

Over the same time period, and with no EPR system in place, the same basket of grocery items in the United States experienced a reduction from 2,750 pounds per gross production unit to 2,100 pounds, nearly a 26 percent drop (see Figure 3). A 1999 analysis of waste-generation changes in the United States shows a reduction in projected rates of waste generation (before any recycling) of 23 million tons between 1990 and 1996, with 17 percent of this reduction coming from packaging.[18]

In 1988, Canadian packaging manufacturers voluntarily set as a

Figure 3



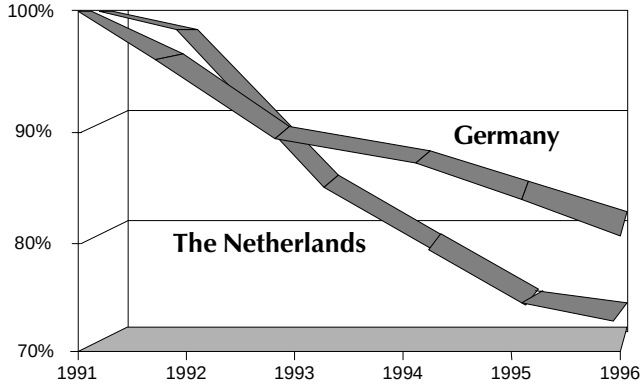
Source: Reason Foundation.

target a 50 percent reduction in packaging sent for disposal by 2000, with interim reduction goals of 20 percent by 1992 (over the 1988 baseline) and 35 percent by 1996. In January 1998, the Canadian Council of Ministers of the Environment announced that Canada's manufacturers had exceeded the 2000 goal four years ahead of schedule. Data from 1996 showed packaging disposal reductions by weight of 56 percent (from 5.4 million tons in 1988 to 2.6 million tons in 1996). These reductions were achieved despite an 11 percent increase in Canada's population.[19]

The Netherlands initially followed a similar approach, using a voluntary agreement rather than take-back mandates and packaging fees. They later modified their approach to comply with the 1994 Packaging Directive of the European Union. Upon implementation of the voluntary agreement, packaging consumption in the Netherlands declined 6 to 15 percent per year in the initial years, and dropped to 1.5 percent by 1996. Recovery rates in the Netherlands climbed modestly over this time (from 31 percent in 1991 to 47 percent in 1992), indicating that reductions were occurring primarily through waste prevention.[20] Overall, reductions in packaging consumption were stronger in the Netherlands than in Germany (see Figure 4), a possible indication of waste-reduction opportunity costs in Germany resulting from fees pegged to recycling costs.

Figure 4

Cumulative Reductions in Packaging Consumption in Germany and the Netherlands
(Adjusted to Economic Cycle)



Source: Andreas Troge, "Comparison of Cost Efficiency of Packaging Recovery Systems," University of Bayreuth.

Market-process Comparisons

Individual products show significant materials-use reductions *before* implementation of Germany's Green Dot program. Anticipation of the new program by producers cannot fully explain these reductions, since lightweighting and substitution toward more efficient materials predates discussion of take-back programs (see Table 6). In the years just prior to implementation of Germany's program, reductions were especially dramatic. For example, bar soap packaging declined by 35 percent; detergent packaging dropped 27 percent.[21]

Benefits—The Limiting Factors

While mandatory EPR systems have generally been successful in increasing material recovery and recycling rates, their overall environmental benefits are more ambiguous. They appear to have had only limited impact on overall source reduction. Several factors limit their effectiveness for this purpose.

First, fees are typically passed on to consumers, softening the role they might otherwise play in inducing manufacturers to redesign products to reduce costs.

Table 6

Reduction of German Packaging Material before Packaging Ordinance

Tinplate can 0.33 liter	Glass bottle 1 liter	Plastic tub 150g	Soft rinse plastic bottle 4 liter
1950=80g	1972=570g	1970=11g	1970=300g
1992=33g	1992=350g	1985= 5g	1985=100g

Source: Marcus Schroll, Institute for Applied Innovation Research, 1998.

Second, with the proliferation of fees associated with different programs, manufacturers designing products for international markets face no clear price signal. Packaging analyst Victor Bell points out that "since there is such a variance in the methods of calculating packaging fees in each country, making decisions regarding material substitutions that reduce the weight or volume of packaging is almost impossible."[22]

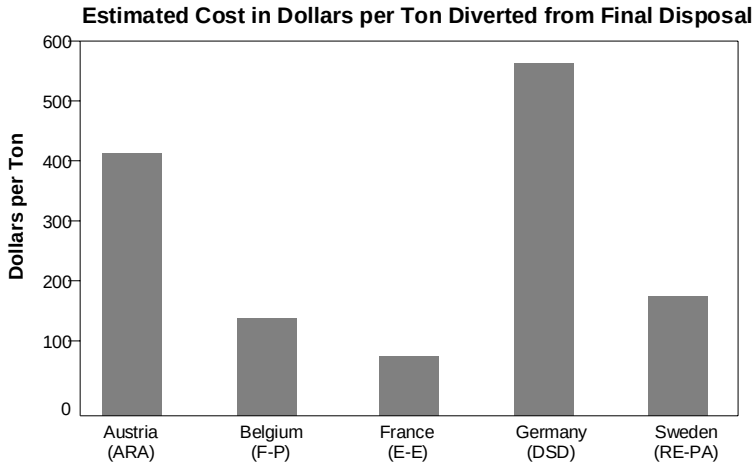
Bell offers several examples. In Germany, switching from a 50 ml glass container to a 50 ml plastic (PET) container will increase fees as much as 132.50 DM per 1,000 containers but will have no impact on fees in France. Fees for laminated paper send even more confusing messages. In Sweden, France, and the United Kingdom, a package is considered laminated if fiber content is 50 percent or less. In Germany, it's considered laminated if fiber content is less than 95 percent.

Third, fee structures change frequently in some programs. Belgium, which introduced EPR "eco-taxes" for a variety of products (batteries, disposable cameras, and packaging, for example), amended its law 17 times between July 1993 and 1998.[23]

Finally, all products must meet a variety of design goals. Notes German economist Eric Staudt, "measures concerning the design of sales packaging are oriented first and foremost towards the requirements of the packaging contents, the buyer, [retail] trade, and the packaging costs."[24] The EPR fees and take-back requirements are, therefore, only one of many considerations that manufacturers take into account when designing products. At the margin, the fees have some influence on packaging decisions, but product performance and total (rather than solid waste) costs dominate design decisions.

Figure 5

Differing Costs for European EPR Recovery Schemes



Source: Klaus Draeger, Principal Scientist, Procter & Gamble, Schwalbach, Germany.

V. The Matter of Costs

Any program that sets mandatory product recovery targets (and enforces compliance) will likely achieve those targets. However, at least as important as the achievement of stated targets is the cost to achieve those results.

The Case of Germany

Architects of Germany's EPR program acknowledge its high cost relative to other waste-management programs. Costs to collect, recover, and recycle packaging waste under the Green Dot program exceed $500 per metric ton.[25] Incremental costs of the program rise significantly for recovery rates above 65 percent. Germany's program costs are substantially higher than integrated waste management program costs in the United States that are achieving 30 percent diversion of the total waste stream, with an aggregate national diversion rate for packaging of around 40 percent.[26] While program costs vary widely, many U.S. programs operate recycling and waste diversion programs for under $200 per ton of material recycled. These U.S. figures, like the German figures, represent total collection, recycling, and disposal costs.

Germany's program costs are also higher than program costs in other European nations that operate some sort of extended (or shared) producer responsibility program (see Figure 5). However, a direct comparison using EPR program costs is misleading, since reported EPR costs in some nations represent only a portion of total waste-management costs. For example, some nations, like France, require that manufacturers pay only the added incremental costs of recycling through their EPR program. The remainder of waste management costs is covered in municipally operated or contracted programs covered through taxes or back-end (residential) service fees.

Several full-cost comparisons between Germany's EPR program and other, more market-driven voluntary programs do exist. One comparison of Germany's Green Dot program with the "packaging covenant" program in the Netherlands concluded that 1996 diversion costs in Germany were around 719 ECUs per ton. The Netherlands' diversion costs were 174.08 ECUs per ton. Adjusting the German costs to reflect different labor and other costs in the Netherlands, Germany's program required 639 ECUs per ton.[27] Even with 1998 projected reductions in Germany's program costs, the efficiency ratio would still be one to three for the Dutch system contrasted with the German system.[28]

Germany's packaging recovery rates (over 75 percent) are higher than in the Netherlands (50 percent). However, source reduction has been significantly greater in the Netherlands, where the waste-management program does not specifically favor recycling, than in Germany.

Implementation Lessons

Looking at Germany's program costs is instructive. Such an examination helps illuminate some of the implementation factors that affect costs. If the policy challenge is how to design a least-cost EPR program, understanding these implementation issues is useful. For example, the chief operating officer of Germany's Duales System Deutschland, Wolfram Bruck, points to four regulatory-design elements that pushed Germany's costs upward:[29]

- short set-up time to fully implement the program
- noncompetitive award of collection and recycling contracts
- very high recovery targets
- dual (parallel) collection system that operated alongside existing waste-management collection systems rather than being integrated into those systems (as in France)

Other analysts of the German program identify additional implementation issues that affect both its efficacy and efficiency. Klaus Draeger of Procter & Gamble points out the importance of how costs are allocated, whether and how free-rider problems are addressed, and how fees are structured.

Uniform fees for all packages, for example, are easier and less costly to develop and administer than are fees that vary by material, weight, and volume. However, they are less effective as a means of steering design choices in some predetermined direction. Cost-allocation among multiple "players" (as in the United Kingdom) reduces the cost burden on any particular participant, but substantially increases tracking and reporting costs. Shared cost structures also reduce the impact that fees might have on product design, since each participant pays only some fraction of the total. Free-rider problems (arising from both consumers who place non-licensed materials into collection containers and manufacturers who fail to pay fees for products they introduce into the market) can result in contaminated waste streams and higher costs to participating firms. On the other hand, reducing free-rider problems generates enforcement costs—the more extensive the enforcement effort, the higher the costs.

VI. The Rise of Voluntary EPR Programs

Heightened concerns about waste and other environmental impacts, especially for consumer products, have prompted a search for new institutional relationships—within firms, among firms, and between firms and customers—that:

- create incentives for companies to deliberately incorporate waste-minimization values into product design decisions;
- motivate firms to reduce the overall environmental impact of their production processes and products; and
- motivate consumers to generate less waste and reduce their environmental "footprint."

As firms compete to add value for customers, EPR has emerged voluntarily in some settings. What distinguishes voluntary EPR arrangements from other experiments in industrial ecology is one central feature—some or all responsibility for products at the end of their useful life span is reallocated from the end user to the manufacturer.

Three categories of voluntary programs that embody features of EPR can be identified:

- take-back and product-leasing programs
- private-sector "green design," recycling, and remanufacturing consortia
- producer leveraging agreements with private-sector suppliers

Take-back and Product Leasing Programs

Voluntary take-back programs in many ways mirror those created through legislation or public-private negotiated agreements. Individual companies or specific industries set up mechanisms to recover products, either directly by the manufacturer or through a designated collection network. Costs are borne either by an individual firm or through a fee system established collectively by the sponsoring industry.

As firms compete to add value for customers, EPR has emerged voluntarily in some settings.

In the United States, the only current industry-wide take-back scheme is the Rechargeable Battery Recycling Corporation. Several pilot industry-wide programs also exist, such as a windshield take-back pilot sponsored by the U.S. Council for Automotive Research (USCAR).

Other programs have been established by individual businesses independent of other firms operating in the same industry. These programs include:

- Nike's Reuse-a-Shoe program
- IBM, Dell, and Hewlett-Packard's computer-recovery programs
- Hewlett-Packard's printer toner cartridge return program
- several brand-name clothing return programs
- a number of returnable transport packaging programs
- Saturn's bumper fascia return program
- a furniture manufacturer's retrieval program for foam shipping material
- several returnable camera programs

Consortia for Green Design, Recycling, and Remanufacturing

Where manufacturers within an industry share common environmental challenges, especially relating to product reuse, recycling, and disposal, many collaborative research efforts have been undertaken. Well-known in this realm are efforts by trade associations such as the American Forest and Paper Association, the Steel Institute, and the American Plastics Council. Some industries have moved beyond these traditional joint research efforts to embark on direct, industry-funded research into reuse and recycling. Most notable of these efforts is the Vehicle Recycling Development Center (VRDC), established in 1994 as a partnership of American auto manufacturers, who also collaborate with the Automotive Recyclers Association, the American Plastics Council, and the Institute for Scrap Recycling Industries. The primary goals of VRDC include: 1) finding ways to recycle automobile "fluff"—the 25 percent or so of material remaining after recycling of the ferrous, nonferrous, and other readily recycled components; and 2) finding ways to more cost-effectively disassemble cars, including removal of fluids.

Producer Agreements/Collaboration with Private-sector Suppliers

Most manufacturers purchase parts and other production inputs from outside suppliers. These relationships are often stable and involve large transactions, giving the manufacturer substantial "leverage" over its suppliers. Through this leverage, firms invest in product redesign to meet company recycling, waste reduction, toxin reduction, and other environmental goals. Such "green partnerships" between manufacturers and suppliers are among the most common forms of voluntary extended (or shared) producer responsibility programs. Notable examples include:

- Dell's Environmental and Recyclability Design Guidelines for all input suppliers;
- Hewlett-Packard's "Controlled Materials List," which identifies 154 hazardous wastes suppliers must avoid;
- DuPont's Emerald Environmental Services, which works with DuPont clients to implement waste-recovery programs; and
- Bell Atlantic's coordination with Westvaco, supplier of billing envelopes, to create an envelope of 100 percent recycled content, half coming from recycled phone books, diverting 575 tons of waste from landfills.

Program Challenges

Program challenges vary by program type but generally include: 1) finding mechanisms to attract customer participation; 2) establishing cost-effective collection and return networks; 3) identifying markets and uses for returned items; and 4) achieving cooperation where multiple firms are involved.

Customer Participation

Some programs use incentives—such as Nike's $5 rebate on returned shoes—to generate customer participation. Other programs involve direct economic benefits to consumers—as in the case of Dell's computer leasing and take-back program—that stimulate consumer cooperation. Others, such as LensCrafters's eyeglass return program, use a social services approach by working with local nonprofit Lions Clubs to generate consumer responsiveness.

Preexisting relationships and economic incentives facing suppliers facilitate manufacturer-supplier leveraged agreements. The relatively small universe of suppliers that some companies interact with makes customer participation less of an issue for these agreements.

Collection Networks

Collection networks fall into several categories. These include: 1) contracting with professional shippers using prepaid shipping labels; 2) direct return to retail outlets, where product is reshipped to the manufacturer; 3) use of nonprofit service organizations as collection centers; and 4) use of a manufacturer-operated return network.

Hewlett-Packard's toner cartridge take-back program is an example of the first type of collection network. HP supplies all customers with prepaid United Parcel Service (UPS) shipping labels. Large customers also receive bulk shipping containers for multiple cartridges free of charge. The customer may request a UPS pick-up of the cartridge, or may take the cartridge to Mail Boxes Etc., where UPS will pick it up.

UPS now has over 200 clients that use its Asset Recovery Service (ARS) to provide for efficient, prepaid return of items. Some of these ARS programs have no environmental dimension; others, like the Hewlett-Packard program, are specifically designed with environmental goals in mind. The UPS program allows companies with take-back programs to take advantage of a preexisting, highly

efficient shipping network. Prepaid shipping programs appear most feasible when the returned product has high reuse, remanufacturing, or recycling value.

Numerous programs, such as Nike's Reuse-a-Shoe program and the Ecolog outdoor clothing program, are examples of the second category of collection network. When the manufacturer has a pre-existing, decentralized, and substantial network of retail outlets direct returns can be efficient. LensCrafters' Gift of Sight program uses its 700-plus retail outlets and the nonprofit Lions Club International to provide a product-return network.

Several product-leasing programs, including some returnable pallet programs, offer manufacturer-operated networks. Chep USA ships products in a variety of returnable containers and pallets, each marked with a bar code for tracking purposes. Chep provides participating customers with computer software to allow for track ing and return.

Mandated EPR programs ... stifle innovative approaches and impose added costs on consumers.

To date, voluntary take-back programs appear to have emerged in circumstances where there are one or several of the following characteristics:

- a high risk of improper disposal and associated liabilities
- a high value associated with the discarded product
- relatively low-frequency, high-value transactions between a manufacturer and a consumer
- a relatively close or ongoing relationship between the customer and manufacturer
- specialty or high-end products for which environmental or other social goals may enhance customer loyalty

In the absence of any of these qualities, environmental stewardship is more likely to take a different form. Environmental certification initiatives, firm-specific life-cycle analysis in product development, and source reduction offer viable alternatives.

Environmental progress involves not only technological innovation but also institutional innovation that links production and con-

sumption choices to the environmental impacts associated with those choices. Competitive markets help foster this institutional discovery process and allow firms and industries to tailor their environmental responses.

If take-back programs fail to emerge, this is not evidence of market failure. It is an indication that: 1) manufacturers anticipate more costs than benefits to their consumers from these programs; or 2) barriers exist (for example, disadvantageous tax treatment for leased rather than purchased products) that inhibit introduction of take-back programs.

VII. Conclusion

Twenty-first century business practices will increasingly move toward product-design and manufacturing decisions that routinely blend in environmental considerations. Moving toward this "industrial ecology" involves experimentation in product development and new technologies as well as in organizational strategy and institutional design.

As consumers press for continued environmental protection, firms competing in the marketplace are stepping up their efforts to provide "environmental value" to their customers through new products, new services, and new organizational arrangements. Markets offer a "discovery process" in which part of the search for adding value involves experimenting with new manufacturer-supplier-customer relationships. Different arrangements are emerging, depending on product and marketplace characteristics. EPR is one possible institutional arrangement for advancing industrial ecology, but it will not "add value" for all products in all circumstances.

Mandated EPR programs override this discovery process. Like earlier environmental regulations that prescribed technological responses, such mandates stifle innovative approaches and impose added costs on consumers because reporting requirement costs and EPR fees are passed on from manufacturers.

Endnotes

1. The OECD held four workshops from 1997 through 1999 on "extended producer responsibility," or product take back. The major focus of these efforts was how to implement such programs. Their literature accepts as relatively undisputed the philosophical merits of the concept. See, for example, OECD Environment Directorate, Environment Policy Committee, *Extended and Shared Producer Responsibility: Phase 2 Framework Report* (Paris: OECD, 5-6 November, 1997). That report states, "When properly undertaken, EPR's strength lies in its ability to simultaneously operationalise life-cycle thinking, the waste minimisation hierarchy, and the Polluter Pays Principle" (p. 6).
2. Thomas Lindhquist, "EPR as a Strategy for Cleaner Products," presented at Invitational Expert Seminar, Trolleholm Castle, Sweden, May 4-5, 1992. The term first appeared in 1988 in a report to the Swedish Environmental Protection Agency, "About a Waste Conscious Product Development," Swedish EPA Report 3488, Solna, May 1988.
3. Ibid. Lindhquist writes that EPR requires manufacturers of products to "bear a degree of responsibility for the environmental impacts of their products throughout the products' life cycles, including upstream impacts inherent in the selection of materials for the products, impacts from the manufacturers' production process itself, and downstream impacts from the use and disposal of the products."
4. See, for example, M. Porter, (ed.) *Environmental Resources and the Marketplace* (Sydney, Australia: Allen & Unwin, 1991); L. Ruff, "The economic common sense of pollution," in R. Dorfman and N. Dorfman (eds.) *Economics of the Environment* (New York: Norton, 1972); and P. Lewin, "Pollution externalities: Social cost and strict liability," *Cato Journal* 1 (1982), pp. 205-229.
5. Julian Morris, "Extended Producer Responsibility: Objectives, Incentives and the Impact on Trade," paper presented at the OECD Workshop on Extended Producer Responsibility, Helsinki, May 11-13, 1998, p. 1.
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9. Albrecht Schmidt, Kraft Jacobs Suchard, "Managing the Rising Cost of 'Producer Responsibility' for Packaged Products," seminar proceedings, Panel III, Questions and Answers (Brussels: EUROPEN, 1996).

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12. David Perchard, "Understanding System Differences," Seminar Proceedings: Managing the Rising Cost of 'Producer Responsibility' for Packaged Products, (Brussels: EUROPEN, 1996).

13. Victor Bell, "How Manufacturers Are Responding to Extended Producer Responsibility Programs and How These Programs Can be Made More Effective," paper presented at OECD Workshop on Extended Product Responsibility, December 1-3, 1998, Washington, D.C., p. 1.

14. Ibid., p. 2.

15. Scarlett et al., *Packaging, Recycling, and Solid Waste*, p. 86.

16. Duales System Deutschland, web site (http://www.gruener-punkt.de/e/content/daten/pmmenge.htm), news release, May 3, 1999.

17. Marcus Schroll, "The Challenge of the German Industry in Solid Waste Management: The Example of Packaging" (Bochum, Germany: Institute for Applied Innovation Research, 1998).

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version of diploma of Philipp Axt, translation from German, University of Bayreuth, 1999, Table 17.

21. Klaus Draeger, Principal Scientist, Procter & Gamble, Schwalbach, Germany.
22. Victor Bell, "How Manufacturers Are Responding."
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27. Andreas Troge, "Comparison of Cost-efficiency of Packaging Recovery Systems in Germany and the Netherlands," Tables 16, 25, and 29.
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29. Wolfram Bruck, presentation at the fifth meeting on "Implementation of the Packaging Ordinance and Packaging Waste Directive," Brussels, March 25, 1998.

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