

Current Status of Extended Producer Responsibility Legislation and Effects on Product Design

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ABSTRACT

Increased environmental awareness is contributing to new government regulatory measures that address disposal of consumer products. Governments are implementing a concept called Extended Producer Responsibility (EPR) which places the responsibility of disposal on the producer. Financially, and/or physically, the producer is legally required to recover the product from the consumer and dispose of it in an environmentally-responsible manner. The most direct form of EPR implementation is take-back legislation.

This paper surveys the current state of take-back legislation for packaging, automobiles, and electronic products. The most activity is in Western Europe followed by Asia.

One of EPR's main objectives is not only to mitigate harmful environmental impacts at products' end of life, but to do so by influencing the product design process. The take-back regulation link to the design process is shown through legislation wording and demonstrated in industry examples.

INTRODUCTION

Disposal of such items as packaging, automobiles and electronics in large quantities is seen as a problem of depletion of natural resources including landfill space. Government regulations are being used to mitigate this problem.

A concept behind regulation is Extended Producer Responsibility (EPR). EPR places end-of-life disposal responsibility on the manufacturer. One of the most direct interpretations of EPR is a take-back system, where, financially, and sometimes physically, the environmental impact (i.e., handling and disposal of waste) becomes the producer's responsibility. A take-back system extends the producer's responsibility for the product beyond manufacturing to post-consumer disposal. Thus, the producer is encouraged to design a product which is easier to dispose of by environmentally-preferable methods. Producers are targeted because they have considerable influence over the design process. (See Franklin, 1997, p. 2. and Epstein, 1996, p. 32.)

Prompted by consumer pressure and limited landfill space, countries in Europe and Asia started implementing take-back

measures in the early and mid-1990s, respectively. Canada and USA have not implemented take-back legislation nationally.

Encouraged by legislated producer responsibility, recently developed are design methodologies to address products' environmental effects. Almost all the methodologies incorporate a form of environmental consciousness during product design.

Government EPR policies are still being formulated, therefore, we first surveyed the current state of legislation. We focussed on three main product areas: packaging, automobiles and electronics. These areas include complex products which are not simple to reuse or recycle. This was meant to be a thorough, albeit not exhaustive, review. Secondly, the link between EPR legislation and the design process was explored.

Information was gathered through books, journals, conference proceedings, news and magazine articles, and consulates. The search was limited to available English translations for many documents. English translations of legislation were for convenience only and not legally binding.

RELATED WORK

As mentioned, one of EPR's main objectives was to emphasise environmentally-friendly disposal. Boks et al. (1998) performed an international overview and compared legislation with end-of-life scenarios for consumer electronics. They concluded that legislation and market forces are major factors determining the end-of-life scenarios. However, some form of legislation was preferred to manage products that had little or no recycling value on the market.

Fishbein (1998) provided a thorough background paper on EPR, its origins and early results. She noted that Germany's packaging ordinance was implemented to address both the diminishing landfill capacity and to instigate change in product design to favour sustainability. She concluded that EPR has had a positive environmental impact and has encouraged manufacturers to rethink their product design. Fishbein (1998) and Willard (1999) highlighted key EPR issues such as trade problems, producer definition, logistics and assignment of finan-

cial responsibilities, free riders¹, and retroactive legislation. Willard concluded that firms practicing EPR principles will have a market advantage when take-back legislation is implemented.

Ryan (1998) contended that an EPR system could be capable of reducing environmental impact if used as a feedback loop for producers to redirect design and stimulate ideas.

Finally, it must be remembered that Europe is not alone in adopting EPR. Kurasaka (1995) surveyed EPR in Asian countries and confirmed that it is prevalent in this area of the world. Therefore, North America would be able to draw on the experience of Asia as well as Europe.

CURRENT STATUS OF LEGISLATION

Several regulatory instruments, e.g., taxes and bans, are available to government to implement EPR. The instrument currently drawing attention is take-back legislation. Take-back legislation has the potential to encompass the physical and financial issues related to end-of-life disposal while directly involving the product's manufacturer. Europe's use of take-back may have been triggered by lack of landfill capacity. Japan and Taiwan face similar problems with limited landfill space. Japan's landfill capacity is estimated to be zero by 2008 (Hiroshi, 08/98, p. 4). North America is using voluntary efforts and elective government programs rather than regulatory action.²

Different governments can implement EPR in various ways. For example, the Netherlands' approach is consultative, while Belgium uses a command-and-control approach.³ Government, however, is ultimately responsible for enforcement through mandatory regulations that serve the purpose of controlling and monitoring, setting of goals, and establishing enforcement rules.⁴

A watershed in the development of take-back legislation was the implementation of the German packaging ordinance. Packaging was the first major implementation of take-back legislation followed by automobiles and then electronics.

Packaging

The German Ordinance on the Avoidance of Packaging Waste required that industry take back packaging, prohibited incineration, and imposed reclamation quotas (Kruszewska & Thorpe, 1999, sec. 6.1). The legislation's goal was to minimise weight and volume of packaging, encourage recycling⁵ or reuse, and use environmentally-safe materials.

¹ Free-riders: those companies benefiting from, yet not paying for, the take-back system infrastructure.

² Examples: Canadian Institute for Environmental Law and Policy, (May 1993).

³ Comparative study in Fonteyne, J., et al. (1998). Also see Ministry of Housing, Spatial Planning and the Environment for the Netherlands, (Oct. 1998).

⁴ See Organization for Economic Co-operation and Development, (1998) and Gouldson and Murphy, 1998, p. 41.

⁵ The term 'recycling' can be interpreted differently by different organisations. In some literature it is a broad term which includes

TABLE 1: Current Status of Packaging Take-Back Laws

REGION	NOTES
Australia/New Zealand ⁶	Voluntary covenant based on shared responsibility along the supply chain and government. Focus is on consumer packaging and household paper.
European Union ⁷	Directive in place from 1994, but awaiting standards later in 2000. ⁸ Covers all packaging on the market. ⁹
Canada	Voluntary National Packaging Protocol with targets set for year 2000. ¹⁰
Canada – various provinces	Focus on beverage containers. ¹¹
Denmark	Stipulation of returnable beverage containers caused trade dispute. EC ruled that Denmark's environmental concerns justified system. ¹²
Germany	Ordinance in place from 1991. ¹³ One of the oldest take-back systems in place.
Japan	Japan Container and Packaging Recycling Association established June 1995. Law in effect April 1997 (complete enactment in 2000). Currently for glass and PET bottles. Expanding 1 April to paper and plastic. ¹⁴

In response to pressures from retailers held responsible for collecting packaging by the ordinance, industry created the Duales System Deutschlands to construct an infrastructure to identify and collect the products of their corporate members.¹⁵

Take-back legislation for packaging has been enacted in Europe and Asia. Voluntary efforts can be found in Australia, New Zealand and Canada (see Table 1).

The Directive on Packaging and Packaging Waste, developed for all European Union (EU) member states, has been in place from 1994, but standards will probably not be in place until later in the year 2000 (see Table 1). The essence of the directive is that:

“Packaging shall be designed...to permit reuse or recovery...and to minimize its impact on the environment when...disposed of.” (European Union, (20/12/94), Annex II)

It also required that companies assess their packaging to identify: ways to reduce packaging, requisite recycling

reuse and elsewhere it denotes reclamation of reusable material. It is used here as a general term to signify disposal methods other than landfill unless otherwise noted.

⁶ See Australian and New Zealand Environment and Conservation Council: *The National Packaging Covenant and Information Bulletin no. 1.*

⁷ As this affects all member states, individual member states' legislation is omitted with the exception of Denmark and Germany.

⁸ Bell, (Oct. 1998), para. 2.

⁹ European Union, (No Date), *Packaging and Packaging Waste*, sec. 3, para. 1.

¹⁰ Environment Canada, (7 Jan. 1997), para. 2.

¹¹ See “Canada” in Raymond Communications, (1999) for a survey of all provinces.

¹² See Rolfe (1993), section “Deposit Refund Systems,” para. 6. and U.S. Office of Technology Assessment, (1992), para. 13-14.

¹³ Fishbein, (1998), para. 13.

¹⁴ “Recycling Boxes in Packaging Firms Boxed in by New Law,” 3 Jan. 2000, para. 1, 2, 6.

¹⁵ This is described in several articles. See Bolgiano (1996), Fishbein (1998) and (1994), Kruszewska & Thorpe (1995) and (1999).

technologies, and packaging purpose, e.g., safety, storage (Bell, 10/98). The Japanese directive allocated roles to the different players: consumers separate waste, local government collects it, and business recycles it (Hiroshi, 08/98, p. 7).

Automobiles

Following packaging, automobiles were targeted (for product take-back, see Table 2). It should be noted that automobiles, due to the high metal content, have been heavily recycled without legislative requirement.

TABLE 2: Current Status on Automobile Take-Back Laws

REGION	NOTES
European Union	Proposed directive passed second reading. If accepted, full enforcement for all cars by 2006. ¹⁶
Germany	Since 1993, the focus has been on old cars. ¹⁷
Netherlands	Manufacturer pays a fee into a recycling infrastructure fund for every car sold. ¹⁸
Sweden	In place from 1998. Targets for recycling by weight set for 2002 (85%) and 2015 (95%). ¹⁹

Presently, automobile manufacturers are concerned about the EU directive on end-of-life vehicles affecting all member states. The proposal is headed to a EU conciliation committee despite interest groups' efforts to amend its retroactive implications (see Table 2). The European Committee's (EC) proposed directive has undergone many drafts and amendments but the main idea still encompasses EPR:

"...in accordance with the polluter-pays principle and...the principle of producer responsibility, collection and recovery of end of life vehicles...should be shifted to economic operators;...[to]...promote the design and production of new vehicles which...facilitate the dismantling, reuse and recovery...of end of life vehicles..." (European Commission, 09/07/97, p. 20, 24.)

Electrical and Electronic Products

Electrical and electronic products, including appliances and computers, are the third major product area of EPR implementation. Take-back legislation is either in process, or has been passed, in several countries in Europe and Asia (see Table 3). In the USA, some individual states are proposing such actions (e.g., for Minnesota see Spencer-Cooke, Jan./Feb. 1998, p 16). The EC directive for electronic products is modelled from the vehicle directive.²⁰

The Flemish region in Belgium had set recycling targets of ferrous metals – 95%, non-ferrous – 85% and other – 20% by 2000 ("Flemish Government Expands Take-Back Law",

TABLE 3: Current Status of Electrical and Electronic Product Take-Back Laws

REGION	NOTES
European Union	Proposed directive. ²¹ Covers 11 categories of equipment, e.g., household appliances, information technology equipment and toys. ²²
Belgium – Flemish Region	Scheduled for: 1 July 1999 (not confirmed) ²³
Denmark	Responsibility assigned to municipalities due to multitude of different types and brands. ²⁴
Germany	On hold. ²⁵
Italy	In place 1996 for refrigerators, washing machines, TVs and computers. Collection system established 1997. ²⁶
Japan	In place for appliances May 1998. Covers TVs, refrigerators, washing machines and air conditioners. ²⁷
Netherlands	In place for appliances: 1 June 1998. ²⁸
Norway	Currently voluntary, but to be made mandatory by 2001. Covers personal computers, phones, cables, electronic and industrial electric equipment. ²⁹
Sweden	Scheduled for year 2000. ³⁰ Covers waste from households, offices and laboratory equipment. ³¹ Does not include refrigerators, freezers or industrial equipment.
Switzerland	In place: 1 July 1998. ³² Applies to retailers, manufacturers and importers.
Taiwan	In place 1998. ³³ Covers computers, TVs, refrigerators and washing machines.
USA – various states	Landfill bans on CRT disposal, proposed retailer or manufacturer responsibility. ³⁴

Apr./May 1998, p. 2). Norway's scheme, slated to be implemented July 1999, called for manufacturers to establish regional collection centres to process the products, recycling where possible and economically viable ("Norway Electronic Takeback Scheme," 29/04/99, para. 2).

EPR AND DESIGN: INDUSTRY EXAMPLES

Design Methodologies

There are a plethora of names for environmentally-conscious design methodologies: Environmentally Conscious Design and Manufacturing (ECDM), Design for the Environment (DFE), Green Engineering, Life Cycle Analysis

²¹European Union, "Explanatory Memorandum on Directive on Waste from Electrical and Electronic Equipment (WEEE)."

²² Reuters News Service, (12 Aug. 1999), para. 1.

²³ "Flemish Government Expands Take-Back Law," (1998), p 2.

²⁴ Danish EPA, June 1999, para. 4.

²⁵ "Product Stewardship Advisor," (14 Feb. 1998).

²⁶ "Product Stewardship Advisor," (14 Feb. 1998).

²⁷ Reuters News Service, (21 Jun. 1999), para. 3.

²⁸ Ministry of Housing, Spatial Planning and the Environment for the Netherlands, (1998), "Non-authorized translation: Decree of April 21, 1998."

²⁹ EnviroLink News, (16 Mar. 1998), para. 3.

³⁰ "Sweden: Electronic Recycling Regulations Finalized," 12/99, p. 8.

³¹ Håkansson, (1998), p. 1.

³² Swiss Agency for the Environment, Forests and Landscape, (14 Jan 1998), Art. 4, 13.

³³ "Product Stewardship Advisor," (14 Feb. 1998).

³⁴ Pitts, (25-26 Nov. 1997).

¹⁶ Mitchener, (02/00), para. 6.

¹⁷ Kruszewska & Thorpe, (1995), section 6, para. 12.

¹⁸ Kruszewska & Thorpe, (1995), section 6, para. 14.

¹⁹ Gustafsson, (01/00), para. 7.

²⁰ See European Union, "Explanatory Memorandum on Directive on Waste from Electrical and Electronic Equipment (WEEE)."

(LCA) and Sustainable Technology. Many methodologies target the early stages of product development where efforts will be most cost-effective.

ECDM and DFE are similar. They incorporate environmental considerations into the design process with the goal of minimising negative environmental impact over the entire product life cycle. LCA is an accounting procedure that tracks environmental impacts and could potentially include everything from raw material processing to product disposal.

The application and outcome of any of the methodologies are not standard. Some companies may use LCA to identify problem areas on which to focus. This and other analyses can be based on economics. It may also be possible to use a narrower design-for-X methodology, where X is recycling or disassembly, etc., to tackle one aspect of negative environmental effects. This is by no means an exhaustive list of options open to designers.

Industry Response

Much of the legislation allows industry to be innovative with respect to the methods of reducing waste. Therefore, industry may focus on the treatment of waste at the end of product life, or on the product design stage to eliminate waste or to facilitate the end-of-life treatment of waste.

Many companies are realising the advantages of rethinking product design. Focussing on product redesign may have multiple environmental benefits and may be a better economic choice for companies over the end-of-pipe approach. By changing the design to eliminate waste, resources can be conserved in the original manufacturing (e.g., less material used) and in the disposal (e.g., less material to process).

The awareness of the importance of product design is becoming evident at a policy level. An argument against the retroactive application of the automobile take-back law is that the old products would have been designed before the directive was in place and, therefore, implicitly stated, without environmental considerations (Reuters News Service, 17/06/99, para. 15).

Recycling/Reuse Initiatives

At the level of company strategy planning, several companies in Europe and Japan are preparing recycling/reuse facilities in response to passed or anticipated legislation. Included are D2D (a UK electronics-recycling company), IBM (UK), [Spencer-Cooke, Jan./Feb. 1998, p. 16] and BMW and Renault in Germany (Blumenfeld, Sept./Oct., 1998, p. 41). Several Japanese companies have announced recycling ventures in response to the electronics law. These include Matsushita Electric, Toshiba Corp., (Reuters News Service 21/06/99, para. 10), Sharp, Sony, and Mitsubishi Materials (see Kyodo News articles). One of the largest efforts in response to Japan's electronics directive is a demonstration plant established by Japan's Association for Electric Home Appliances (Lloyd-Owen, Sept./Oct. 1998, p.16). The plant's objective is to process 150 000 units of appliances per year.

Product Design Initiatives

Companies are also exploring ways to facilitate these recovery operations through product design. Xerox remanufactures their photocopiers, learns from the old products and makes design changes accordingly while anticipating legislation (Cutter Information Corp., 1996, pp. 105-111). Furniture companies such as Steelcase Inc. and Wilkhahn GmbH use DFE and Design for Disassembly methodologies to first, remanufacture their product and second, recycle once the product is beyond reuse (Gertsakis, Morelli & Ryan, 1998, pp. 12-13). Philips is in the process of developing eco-design guidelines for the industry on behalf of the Dutch government (Spencer-Cooke, Jan./Feb. 1998, p. 16). Siemens Nixdorf has stopped painting computer housings to facilitate recycling, and are using clips instead of permanent rivets to facilitate disassembly (Cutter Information Corp., 1996, p. 95).

Other changes that have been considered or implemented are as follows. The electronics industry is interested in incorporating such strategies as standardising fasteners, avoiding permanent fasteners, identifying materials, and using materials with recycling properties to facilitate end-of-life processing (Electronics Industry Environmental Roadmap: Disposition, No Date). Apple Computer, Inc. anticipates electronics take-back legislation and is focussing on longer product lifetimes, modular construction for easier disassembly, semi-permanent fasteners and material identification (Cutter Information Corp., 1996, p. 75).

New Products

New products include energy-saving designs from Matsushita Electric Industrial (Hiroshi, 08/98, p. 9) and new transport packaging used in shipping goods. A case study by Fishbein (1994, p. 35) profiled a Multi-Use, Returnable Transport Packaging System (MTS). Schoeller International designed modular plastic containers which can assemble into five different heights and collapse for storage. The binding straps and crates are all made of polypropylene to facilitate recycling.

EARLY AND ANTICIPATED EFFECTS OF LEGISLATION

Direct Effects

Most take-back system evaluations are on the most developed application: packaging. While this application is still relatively new, preliminary effects of the legislation may be found. One direct benefit from the enactment of take-back legislation is reduction of waste in landfills (See Table 4).

The Group on Pollution and Prevention Control of the OECD performed two case studies which reported changes apparent to the consumer (05/98, Case Study on Dutch and German Packaging Ordinance). Some noticeable changes were reduction or elimination of secondary packaging, e.g., the box around the toothpaste tube. Major packaging changes included hybrid packaging: comprised of returnable and non-returnable parts, and in the Netherlands, entire structures that were lighter

or returnable. In Germany, composite and plastic packaging were used less, possibly because the plastics recycling infrastructure was not as well developed as for metals and paper. Other changes included increased use of product concentrates such as detergents, paper or cardboard cushioning rather than foam, refillable beverage containers, and reusable crates (Raymond, 05/98, para. 35).

Table 4: Early Effects on Landfill Waste

REGION	TIME	NOTES
Sweden	1992-1995	Recycling/Reuse for paper, glass bottles and containers rose ³⁵
Germany	1991-1995	1 000 000 tonnes less packaging ³⁶
	1993-1996	Recycling increase from 52% to 84% ³⁷
France ³⁸	1995	700 000 tonnes recycled or incinerated
	1998	1 500 000 tonnes (approx.) recycled

Secondary Effects

The increase in recycling has stimulated research and innovation in the waste management industry. Development, and now exportation, of infrared and laser systems for sorting and recycling were seen in Germany (Fishbein, 1998, para. 18).

New packaging designs are also affecting other sectors. Material-minimised transport packaging prompted insurance companies to include possible increases in damage during transport in their rates (Fishbein, 1994, p. 34). The MTS packaging mentioned previously eliminates the need to cut cartons open (a potential source of worker injury). However, the internal dimensions of the MTS crates are different from the existing standardised cartons and product manufacturers must redimension products for packing (Fishbein, 1994, p. 35).

Manufacturers reported that the pressure of legislation encouraged their suppliers to respond more readily to appeals for reduction in packaging. Also, positive consumer attitudes towards the more environmentally-friendly packaging enabled the use of the improved packaging as a marketing tool. (See Fishbein, 1994, p. 70, 78).

On the negative side, storage of collected plastics posed a different environmental hazard. In one case, stored plastics caught on fire and produced toxic emissions. Additionally, critics claim that the ease of the curbside collection of packaging made it more convenient for the consumer to recycle than to reuse containers. (See Fishbein, 1994, p.115, 116).

Anticipated Effects

Although few automobile or electronic-product take-back systems are in effect, parallels may be drawn to the packaging experience. It is expected that reduction of landfill waste will also be a direct result of automobile and electronic-product take-back. Techniques to recycle and reuse these products are being, and will continue to be, researched and developed. As mentioned, companies in Japan set up pilot project recycling

centres for this purpose. As in packaging, materials that are easier to recycle will be preferred when specifying materials in product design.

However, the complexity of automobiles and electronic products will raise substantially different issues from packaging. Disassembly problems must be considered, especially for parts to be reused or for products with different materials that must be separated for recycling. Durability and quality will be concerns for reuse. Heavy-metal content will be an additional challenge to recycling of electronics. The collection infrastructure for large items, such as washing machines, may be substantially different from curbside collection of packaging and require the consumer to play a greater role in the return of these products to appropriate depots.

EPR REQUIREMENTS AND CHALLENGES

Despite the apparent governmental enthusiasm for EPR, there are obstacles to implementing take-back schemes. These include the requirement for appropriate collection infrastructure and recycling/reuse facilities for used products, disparities between neighbouring regions, free-riders, and obtaining financial support.³⁹ All of the above issues were encountered in the German experience with packaging take-back. Rousoo and Shah (1994) concluded that the rapid implementation was a factor in the difficulties that occurred.

In Germany, the surplus of used material collected was dumped on other markets causing other countries to lodge trade complaints and formal charges (Rousoo & Shah, 09/94, p. 700). In the case of the EU automobile take-back, markets for recycled materials are also a concern.⁴⁰

Another issue which has been raised is that of who is the producer in Extended Producer Responsibility. In some cases, responsibility is shared between many producers along the supply chain (Fishbein, 1998, para. 89-93).

An interesting development is that since many of the take-back laws apply to what is sold, as well as produced, in the country, importers are affected. International companies must make appropriate provisions when designing their products.

SUMMARY

Legislation incorporating the concept of EPR is a reality or will be a reality in many countries around the world. Even companies in North America will be affected if they wish to sell products abroad, regardless of whether such legislation is adopted at home. Currently, packaging, automobiles, and electronics are affected, but there is potential that the producer will be required to take back many other products.

Industry’s constructive response to EPR has not only been to prepare recycling plants for the discarded current products, but to also rethink product design. Using environmentally-

³⁵ European Environment Agency, (1997), p. 20.

³⁶ Fishbein, (1998), para. 13.

³⁷ Fishbein, (1998), para. 16.

³⁸ DSD AG, (06/99), p. 31.

³⁹ See Fishbein, (1994) & (1998), especially paras. 24, 25.

⁴⁰ See Nankivell, (18/08/93), and Reuters News Service. “Recyclers say EU wrong on car Scrap Law Priorities.” (04/02/00).

conscious design methodologies, products are being designed to be easier to disassemble, reuse, recycle, and with all stages of the life cycle in mind. Industry is beginning to take advantage of the information loop by taking the lessons learned in the disassembly and recycling of their products and feeding this back to design. Thus, EPR has successfully motivated environmentally-conscious product design through take-back legislation.

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