5. Deposit-Refund Systems

5.1 Introduction

Deposit-refund systems (hereafter referred to as "deposit systems") are a combination of a product charge (the deposit) and a subsidy for recycling or proper disposal (the refund). Manufacturers or vendors of products that are subject to deposits incur additional costs in handling returned products, but these costs are often partially offset by the interest earned on deposits, unclaimed deposits, and sales of collected, used products.

One of the objectives of a deposit system is to discourage illegal or improper disposal. Waste products that are discarded improperly have higher social costs than those disposed of properly, since such discards can become an eyesore or even an environmental or health threat. Improperly discarded waste is also quite expensive to redirect to the legal waste stream. Deposit systems are commonly applied to beverage containers, in part because these containers make up a large proportion of roadside litter. Another important objective of a deposit system is to divert recyclable items from the waste stream.

In addition to being used for beverage containers, deposit systems have also been used for other products such as pesticide containers, lead-acid batteries, and tires. Some of these systems are voluntarily implemented by industry, whereas others are implemented by state or local authorities. While federal legislation on deposits has been considered, none of these proposals has been enacted.

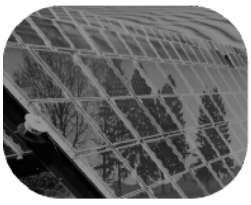
Several studies have concluded that deposit systems are more cost-effective than other methods of reducing waste disposal, such as traditional forms of regulations, recycling subsidies, or advance disposal fees (ADF) alone. A recent study by Palmer et al. (1995) concluded that a 10% reduction in waste disposal would cost $45 per ton of waste reduced under a deposit system, compared to $85 per ton under advance disposal fees and $98 per ton under recycling subsidies. However, the study noted that the relatively high administrative costs of a deposit system could outweigh these cost savings.

Administrative costs are an important consideration when determining whether to create deposit systems. Ackerman et al. (1995) estimate that administrative costs average about 2.3¢ per container—more than $300 per ton for steel containers and $1,300 per ton for aluminum cans—in states with traditional legislation on beverage container deposit systems. A full accounting of the desirability of deposit-refund systems would compare administrative costs and the costs imposed on consumers with the benefits of reduced disposal costs, energy savings, reduced litter, and other environmental benefits. Deposit-refund systems appear best suited for products whose disposal is difficult to monitor and potentially harmful to the environment. When the used product has economic value, the private sector may initiate the program.


Pollution Charges, Fees, Taxes

Deposit-Refund Systems


Trading Programs


Subsidies for Pollution Control


Liability Approaches

Information Disclosure


Voluntary Programs

Fullerton and Kinnaman (1995) conclude that fees for waste collection should be priced as if disposal and recycling are the only two disposal options. If illicit burning or dumping is also an option, the optimal policy is "a tax on output plus a rebate on proper disposal," in other words, a deposit system. While variable pricing programs for waste collection have the potential to give waste generators an incentive to improperly dispose of waste, deposit schemes give them an incentive to return waste for proper disposal or for recycling. For example, with beverage containers, roadside litter is an important issue, so a deposit system is a good policy choice.

As noted in this chapter, studies have found that deposit systems result in higher recovery rates of used products and less contamination of recyclables than curbside recycling programs. However, deposit schemes are also believed to cost more to administer than curbside programs.

5.2 Beverage Containers

Beverage containers have been subject to both voluntary and mandatory deposit schemes. In the past, the beverage industry made extensive use of voluntary schemes to recover refillable bottles. However, this practice nearly disappeared following the introduction of cheaper "disposable" containers.

As shown in Table 5-1, 10 states have passed "bottle bills" that mandate beverage container deposits ranging from 2.5¢ to 15¢ per container, the most common amount being 5¢ per container. Beer and soft drink containers are subject to deposits in all 10 states; mineral water containers in six states; malt containers in four states; and wine coolers, liquor, and carbonated mineral water containers in three states. Michigan includes containers of canned cocktails, New York includes containers of soda water, and Maine includes containers of juices and tea. In most states, deposit requirements apply to the full range of container types, including glass, plastic, aluminum, and steel. The State of Delaware, however, has exempted aluminum from its requirement.

Most states require retailers to take back containers that are in their product line, even if the container was purchased elsewhere. In Maine, however, retailers located within a certain distance of a certified redemption center are not obligated to take back containers. In addition to retail outlets, "redemption centers" accept containers in most states. Any organization may operate such centers, although certification of the center may be required. Some redemption centers and retailers could earn profits from mandatory handling fees of 1.5¢ to 3¢ per container, fees that are paid by distributors. As shown in Table 5-1, distributors usually keep unclaimed deposits.

Not included in this table is a deposit system that has been in effect in Columbia, Missouri, since 1982. Under this system, consumers pay deposits of 5¢ on containers of beer, soft drinks, malt, and carbonated mineral water. Although retail stores are required to take back containers, no handling fees are mandated. The overall rate of redemption is estimated to be 85% to 95%.

Although it is beyond the scope of this report to describe in detail every deposit system that is listed in Table 5-1, systems in Maine and California are discussed below as illustrative examples.

Table 5-1. State Beverage Container Deposit-Refund Systems

State	Since	Containers Covered	Deposit, Refund Amounts	% Returned	Redemption Sites	Unclaimed Deposits	Handling Fees
California	1987	Beer, soft drinks, wine coolers, mineral water	<24 oz, 2.5¢ >24 oz, 5¢	Aluminum 88% Glass 76% PET 50% Overall 84%	State-certified centers	Program administration grants	Per container processing fee
Connecticut	1980	Beer, malt, soft drinks, mineral water	Minimum 5¢	Cans 88% Bottles 94% Plastic 70-90%	Retail stores and redemption centers	Kept by distributor or bottler	Beer, 1.5¢; Soft drinks, 2¢
Delaware	1982	Non-aluminum beer, malt, soft drink, mineral water <2qt	5¢	Insufficient data	Retail stores and redemption centers	Kept by distributor or bottler	20% of deposit
Iowa	1979	Beer, soft drinks, wine, liquor	5¢	Aluminum 95% Glass 85% Plastic 70-90%	Retail stores and redemption centers	Kept by distributor or bottler	1¢
Maine	1978	Beer, soft drinks, wine, wine coolers, liquor, juice, water, tea	Beer, soft drinks, juice: 5¢. Wine, liquor: 15¢	Beer, soft drink 92% Spirits 80% Wine 80% Juices, non-carbonated 75%	Retail stores and redemption centers	Kept by distributor or bottler	3¢
Mass.	1983	Beer, soft drinks, carbonated water	5¢	Overall 85%	Retail stores and redemption centers	State	2.25¢
Michigan	1978	Beer, soft drinks, canned cocktails, carbonated and mineral water	Refillables: 5¢; Nonrefillables: 10¢	Overall 93%	Retail stores	75% environmental programs, 25% handling fees	25% of unclaimed deposits
New York	1983	Beer, soft drinks, wine coolers, carbonated mineral water, soda water	5¢	Wine cooler 63% Soft drink 72% Beer 81%	Retail stores and redemption centers	Kept by distributor or bottler	1.5¢
Oregon	1972	Beer, malt, soft drinks, carbonated mineral water	Standard refillables: 3¢; Others: 5¢	Overall 85%	Retail stores	Kept by distributor or bottler	None
Vermont	1973	Soft drinks, beer, malt, mineral water, liquor	Soft drinks, beer: 5¢ Liquor: 15¢	Overall 85%	Certified redemption centers and retail stores	Kept by distributor or bottler	3¢

5.2.1 Maine Bottle Deposit System

Maine introduced a deposit system for beer and soft drink containers on January 1, 1978.[81] In distributing beer and soft drinks to retailers, distributors (or manufacturers) levy a 5¢ deposit. Retailers in turn include this amount in their sales prices. The customer can obtain a 5¢ refund by returning the container to any retailer that sells the product or to a redemption center.

Distributors (or manufacturers) return the 5¢ deposit to retailers for every returned container. In addition, retailers are reimbursed a 3¢ handling fee, which provides a strong incentive for retailers to promote the return of containers. At times, demand by retailers for used containers is so high that customers can obtain refunds 10% to 20% higher than the deposit amount. In some places, reverse vending machines also offer refunds for returned containers.

Distributors typically pick up used containers while distributing new products. Distributors (or manufacturers) have at least three sources of revenue to offset the costs of handling containers. First, they can sell the collected containers to processors and keep unclaimed refunds and handling fees. Second, in the past distributors had to share one-half of their unclaimed refunds

with the state government. Distributors then complained about their costs. As a result of their efforts, distributors were allowed to retain all unclaimed refunds, effective January 1, 1996.[82] Third, distributors earn revenue by the interest earned on deposits and handling fees before redemption.

The deposit system was expanded to include liquor and wine containers on September 1, 1990, and bottled water, iced tea, and juice on December 31, 1990. This action resulted in new (and perhaps less cost-effective) types of deposit-refund arrangements. Unlike soft drinks and beer, several companies in the same geographic area often distribute juice. Consequently, each one often has difficulty determining which containers it is responsible for collecting. As a result, some distributors may pay more in refunds than they receive in deposits, while for others, deposits may exceed refunds. Because distributors fear that they will lose money in collecting deposits and paying refunds, manufacturers have had to collect deposits themselves and contract independent collectors to redeem containers. This method may be less cost-effective than collection by distributors who already travel to collection sites when they distribute new products.

Two redemption problems have been identified. One, the in-state distribution of containers can take place without deposit fees being imposed. Second, the in-state redemption of containers that were originally purchased outside the state also occurs. These errors have resulted in redemption rates in excess of 100% for certain products. For example, Coca-Cola reported redemption rates for Minute Maid Juices® and Hi-C® of 142% in 1993, 281% in 1994, and 126% in 1995. The same type of bottle deposit fraud is estimated to cost the state of Michigan more than $16 million per year.[83] Nearly one-third of the cans returned for recycling in southeast Michigan were purchased outside the state.

Retailers have complained that the deposit system (especially the expanded one) requires more storage space and more time for recordkeeping, receiving bottles and sorting bottles. In addition, traces of beverages in containers have attracted pests. The administrative burden probably became more severe following the expansion of the system because significant variations in the types of juice containers make them more difficult to sort and store.

The deposit system in Maine is reported to have significantly reduced litter. A 1979 study by the Maine Department of Transportation found that total litter declined by 10% and that container litter declined by 56%.[84] Since completion of the study, the redemption rate rose. Thus, it is likely that container litter has decreased further. In addition to reducing the incidence of litter, the deposit system also gave incentives to scavenge bottle and can litter to obtain refunds. The deposit also may have increased recycling capacity by creating a reliable supply of recyclable materials. Three container-processing facilities were established in Maine as a result of the

deposit system. These facilities can, in turn, stimulate demand for recyclables that are collected outside the deposit system.

Criner et al. (1991) estimate that the costs of Maine's deposit system exceed those of curbside collection programs, but the system also results in higher collection rates. They surveyed retailers, redemption centers, distributors, and manufacturers to develop cost estimates for the deposit system. Using a computerized waste management model, Criner et al. estimated that retailers incurred costs of 2.4¢ to 3.1¢ per container under the original deposit system and virtually the same costs under the expanded system. The high end of this range applies to smaller retailers. Based on these estimates, the handling fee of 3¢ per container appears to be set at a level that covers retailers' costs. The handling fee was originally one cent, but it rose to 2¢ in 1980 and to 3¢ in 1990.

Criner et al. estimated the costs incurred by distributors at 5.7¢ per container for beer and soda and 7.5¢ for juice products. (These estimates do not include the costs incurred by consumers in returning containers for refunds.) Collection costs, storage facilities, and labor can be more expensive for containers of juice than for other beverage containers. Two reasons for this difference are suggested: (1) significant Variations in the types of juice containers make them more expensive than other containers to sort and store; and (2) manufacturers hire companies specifically to collect used juice containers, which raises costs.

Table 5-2 presents cost estimates for collecting recyclables under curbside programs and deposit systems for a hypothetical Maine community of 25,000 inhabitants. The estimates are based on the assumption that curbside collection is present. They suggest that the costs of deposit systems are not only significantly higher than curbside programs but that they also raise the costs of curbside collection when the two activities are implemented at the same time. This latter effect is probably caused by the diversion of recyclable containers away from curbside programs, which reduces the economies of scale that were present in these programs.

Table 5-2. Beverage Containers: Estimated Tons Recycled and Costs of Collection in Maine

.Collection Method	No Deposit System	Original Deposit System	Expanded Deposit System
Curbside Programs: tons recycled (cost per ton)	2,538 ($41)	1,917 ($80)	1,378 ($100)
Deposit Schemes: tons recycled (cost per ton)	0	1,138 (567)	2,037 (402)
Total: Tons Recycled (weighted average cost per ton)	2,538 (41)	3,055 (261)	3,413 (280)

Source: Criner et al. 1991, p. 50.

A significant portion of the costs of Maine's deposit system appears to be passed on to consumers. Criner et al. compared beverage prices in Maine with those of neighboring New Hampshire, Rhode Island, and Massachusetts. Prices were very similar for juices, which were not subject to deposits at the time, but they were higher in Maine for soda and beer. As noted in Table 5-1, Massachusetts has a 5-cent deposit, as does Maine. Criner et al. speculate that the deposit system in Massachusetts has not resulted in beverage prices that are higher than those of New Hampshire and Rhode Island. Two reasons may explain this theory. First, distributors in Massachusetts face more competition than they do in Maine. Second, the state's population density limits the cost of handling and transporting used containers.

Criner et al. also found that the prices of most juices sold at two Maine supermarkets increased during the fall of 1990 to late February 1991. During the same period, the prices of orange juice in large plastic containers (64–96 oz.)—which was subject to deposit requirements—fell significantly. These findings suggest that expanding the deposit system to include juice containers an impact on the prices of these beverages. However, the price increases at the two stores were not compared with price changes elsewhere.

5.2.2 California Beverage Container Recycling Program

The 1986 California Beverage Container Recycling and Litter Reduction Act (AB2020) led to the creation of the Beverage Container Recycling Program (BCRP) in 1987. The program was originally intended to achieve an overall beverage container-recycling rate of 80%.

California's deposit system removes some of the constraints on vendors associated with other deposit systems. It introduces flexibility through simplification and leaves intact the incentive to consumers to return containers for proper disposal or recycling. California's system differs significantly from that of other states in two ways. First, retailers in the state are not responsible, for the most part, for collecting deposits and offering refunds to consumers. Second, used containers are not returned to their original distributors. Instead, manufacturers of most beverage containers pay a fee of 2¢ per container to a state recycling fund. When containers are returned, the fund pays 2.5¢ per container to the individual or organization that collected it. The beauty of this system is that anyone can be a collector: businesses or consumers. For containers of more than 24 ounces, the fee is 4¢, and the payment is 5¢. The payment may be passed on to consumers to entice them to return containers.

This system resembles an advance disposal fee, with fee revenues used to provide collection incentives. It is the result of compromise between various interests, including grocers (who did not want to manage used containers in their stores) and environmentalists (who wanted incentives to stimulate recycling).

Retailers with annual revenues of less than $2 million are not required to accept used containers, and larger retailers can be exempted if there is a recycling center located within a half-mile radius of their store. In areas where there are no centers, retailers usually hire a recycling business to establish a collection site or to install a reverse vending machine.

The state also assesses handling fees each year for each type of container. Manufacturers are required to either pay these fees or to guarantee a price for recyclable containers that is equal to the cost of collection. These requirements have increased the prices of recyclable containers in the state to the point at which incentives are provided to import these containers from other states. The law bans redemption for such imports.

In 1994 and 1995 the BCRP received about $333 million in revenues. However, this figure fell in the next few years because reductions in processing fees were required by 1995 legislation and container redemption increased. Unclaimed deposits and fees finance grants for private, non-profit programs and public-sector activities that help reduce litter and promote recycling.

Like all other states with deposit systems, California has specific labeling requirements for its beverage containers. All containers must bear the label "CA Redemption Value" or "California Redemption Value." To increase the public's awareness of the deposit system, the redemption value must be posted separately on store shelves, in advertising, and on retailer invoices.

The BCRP required that a government structure be created to manage the program. Initially, the program generated relatively low return rates. By the early 1990s, however, after the initial one-cent container fee had been more than doubled, the program had achieved return rates comparable to those of other states with deposit systems. As shown in Table 5-1, the overall recycling rate for beverage containers has risen to 84%.

Ackerman et al. (1995) observe that California's redemption system results in lower costs per redeemed container than systems in which redemption is managed through vendors. Containers are not sorted by brand and returned to their distributors as in other states. As a result, administrative costs are estimated at 0.2¢ per container in California and 2.3¢ in other states with deposit-refund laws.

5.2.3 Summary of Beverage Deposit/Refund Systems

Although data are incomplete, anecdotal evidence suggests that beverage container deposit laws have significantly reduced litter in several states, as would be expected. Maine reported decreases in litter following the introduction of its deposit scheme. Oregon reported a 75% to 85% decrease in roadside litter just two years after enacting deposit legislation.

Another probable impact has been an increase in the percentage of containers recycled, although this is difficult to confirm due to a lack of historical data on recycling. Wellman, Inc. (1994) estimate that the percentage of PET containers recycled in 1993 was about 80% in states with deposit systems (excluding California), 70% in California, but only 53% nationally. A 1990 GAO study found that almost two-thirds of the glass recycled in the United States. came from the deposit states, excluding California, even though these states made up only 18% of the U.S. population. If California is included, the 10 states accounted for more than 80% of this country's recycled glass. All deposit states also report return rates on aluminum cans that exceed the national average.

A related phenomenon is the relatively high market share for refillable containers in states with deposit schemes. In the case of beer containers, for example, all nine deposit states (excluding California) exceed the national average for market share of refillables. McCarthey (1993) calculated that the unweighted average for these nine states was 15% in 1990, which was three times the national average.

A comparison of deposit systems and curbside recycling programs by McCarthey (1993) found that deposits generally resulted in higher percentages of materials returned and less contamination of collected materials. Among states with large curbside programs but no deposit systems, the study found that none had attained a recovery rate equal to that of states with deposit schemes. Moreover, glass collected through curbside programs is much more likely to break before it can be sorted by color. Such breakage makes it difficult to recycle not only glass bottles but also other recyclables that may be contaminated with glass. The largest user of recycled polyethylene terephthalate reported that more than 90% of the PET it purchased came from states with deposit schemes because of its concerns over contamination.

The costs of deposit systems may be substantial for manufacturers, distributors, vendors, consumers, and regulatory authorities. One study found California's system to be more cost-effective than those in which retailers accept redeemed containers. Deposit systems could also divert revenues from, and lower the cost effectiveness of, curbside recycling programs. However, McCarthey (1993) found evidence suggesting that "local governments would achieve a greater

diversion of solid waste from disposal at a lower cost per ton if both a bottle bill and a curbside collection program were in place." One difference between the two approaches is that the costs of deposits are borne by manufacturers and distributors, who in turn pass on some costs to consumers, whereas the curbside programs are often funded by general revenues or waste tipping fees. Lack of information on the costs and benefits of litter reduction and recycling and on the costs incurred by consumers in returning containers makes it difficult to thoroughly evaluate beverage container deposit systems.

5.3 Lead-Acid Batteries

Lead-acid batteries are subject to mandatory deposit systems in several states and voluntary deposit systems in most other areas. The lead in used batteries has positive economic value for battery makers. Deposit amounts are typically $5 to $10 per battery. Consumers can obtain refunds by returning a used battery and proof of the deposit to the same retailer, typically within 7 to 30 days after the purchase of a new battery.

Despite the presence of numerous voluntary schemes, 11 states have required deposit systems. As shown in Table 5-3, state laws have addressed such questions as the refund period and what portion of unclaimed refunds should go to different parties.

Table 5-3. States with Mandatory Lead-Acid Battery Deposit Systems

State	Deposit/Refund ($)	Unclaimed Refunds	Refund Period (days)
Arizona	$5	Retailer	30
Arkansas	10	Retailer	30
Connecticut	5	Retailer	30
Idaho	5	Retailer	30
Maine	10	Retailer	30
Minnesota	5	Retailer	30
New York	5	Retailer	30
Rhode Island	5	State: 80%, Retailer: 20%	7
South Carolina	5	Retailer	30
Washington	Minimum of 5	Retailer	30

Source: Weinberg, Bergeson & Neuman. 1996.

As with beverage containers, deposit systems for lead-acid batteries appear likely to have a significant incentive effect because they offer motorists money in return for a used product. As shown in Figure 5-1, the percentage of battery lead that has been recycled nationwide has exceeded 90% since 1988. Lead prices appear to affect the recycling rate to a minor extent; the dip in the recovery rate in 1992–1993 coincided with a period of low prices for primary and secondary lead. (Scrap lead prices can be found at several sites on the Internet.[85])

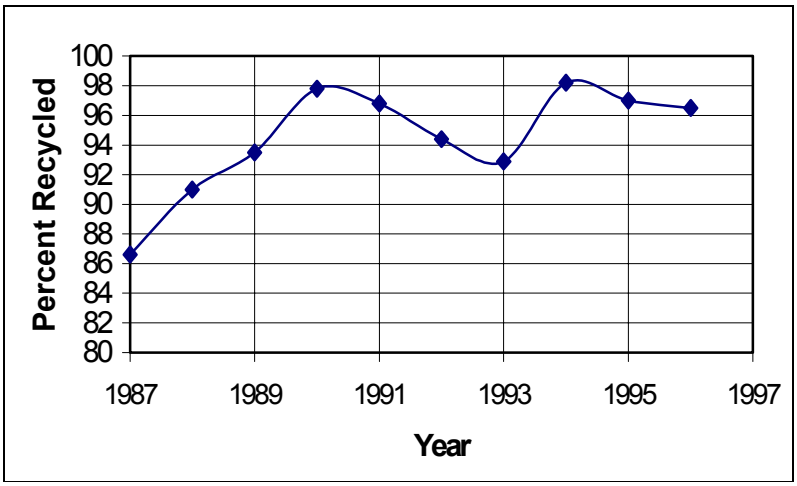
5.4 Maine Pesticide Container Deposit System

The discovery of more than 400 illegal disposal sites in Maine led state authorities to initiate a deposit system for pesticide containers in 1985. The rule applies to all limited-use and restricted-use pesticides sold in glass, metal, or plastic containers, a category that consists mainly of conventional agricultural and forestry applications. Deposit amounts are $5 for containers with less than a 30-gallon capacity and $10 for larger containers.

Farmers must rinse containers three times before returning them for refunds. Containers found to have significant traces of pesticides are not accepted for refunds. Collections are made at designated points once a year according to publicized schedules. Pesticide dealers arrange to have container-shredding equipment at the collection sites. According to the Maine Board of Pesticides Control, the deposit system has played a significant role in reducing the incidence of improper container disposal.[86]

In 1985, the first year that the deposit system operated in Maine, Board of Pesticides Control staff inspected all 7,055 containers that were turned in. Had these containers simply been drained rather than properly rinsed, 429 pounds of active ingredient would have been deposited into landfills. Since the containers were triple-rinsed and therefore were 99.998% clean, only 0.05 pounds of active ingredient was sent to landfills that year.[87] Published reports on the Maine pesticide container deposit system do not discuss the consequences of transferring pesticide residues to wastewater systems. It is possible that pesticide residues are managed in a more environmentally sound manner when they move through wastewater management systems than when they are sent to landfills.

Figure 5-1. Lead Recovery from Lead Acid Batteries



Source: Smith, Bucklin and Associates.

One problem with the deposit system is that it does not apply to general-use pesticide containers, which are far more numerous than containers for restricted-use and limited- use pesticides. One reason why general-use products are not included in the system is that inspecting them would require significantly more resources than are available at present. For a similar reason, a few larger states have considered a program similar to Maine's, but they have concluded that they would not be able to inspect a large number of containers.

5.5 Other Products

Since 1988, Rhode Island has required $5 deposits on all types of replacement vehicle tires. Customers can recover their deposits by returning old tires within 10 to 14 days after they purchase new tires. Their refund payments are limited to one tire for every tire purchased, and the refunds can be obtained only at the point-of-sale of the new tire. In addition to the deposit, Rhode Island—along with most other states—imposes product charges on tires to finance the cleanup of piles of old tires.

Outside the United States, deposit systems have been applied to car hulks, light bulbs, lubricating oil, and other products. An earlier EPA report by Anderson and Lohof (1997) describes several of these systems.

5.6 Voluntary Deposit Systems

In addition to lead-acid batteries, a few other products are subject to deposit schemes that are voluntarily operated by industry. Among such products are large paper drums, beer kegs, propane gas containers, and, in some areas, beer bottles and pesticide containers.

5.7 Performance Bonds

Performance bonds are fees levied upon companies that extract certain natural resources, such as timber, coal, oil, and gas. Amounts deposited with the performance bond can be refunded when the payer fulfills certain obligations. In that sense, a performance bond acts like a deposit-refund system.

An example of an environmental issue that has been addressed with the use of performance bonds follows. The Surface Mining Control and Reclamation Act (SMCRA) of 1977 requires the purchase of performance bonds before surface coal mining and reclamation permits can be obtained.[88] The amounts are determined by the regulatory authority, which can be either the state authority or the U.S. Department of the Interior. The fee amount depends on the reclamation requirements that are specified in the permit; the anticipated difficulty of reclamation due to factors such as topography, geology, hydrology; and the revegetation potential of the site. SMCRA requires that the amount charged be sufficient to finance reclamation by the regulatory authority in case the company forfeits its deposit. The minimum amount is $10,000 per permit area. Deposit amounts are adjusted as mined areas increase or decrease and as estimates of reclamation costs change.

Although such performance bonds give companies an economic incentive to reclaim mining sites, they are backed up by a regulatory requirement that is specified in a permit. The reclamation requirement may have more of an incentive effect than the deposit, since a firm's ability to obtain leases in the future is dependent in part on satisfying today's regulatory requirements.

Federal and state governments also use performance bonds to influence environmental management by the timber industry and oil and gas operators.