Chapter 9

Beverage Container Deposit Legislation

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Introduction

Objectives and Questions Addressed

Legislation that mandates a minimum, refundable deposit for all containers used in the sale of carbonated malt beverages (beer) and soft drinks is one policy option for reducing the rate of solid waste generation. In its simplest form such legislation requires that all parties in the distribution train from brewers and bottlers to retailers charge a minimum deposit, say 5 cents per container, which must be refunded on presentation of an empty equivalent container. Such legislation neither mandates the use of refillable containers nor bans the use of nonreturnable ones. * The intent of such proposals, however, is that containers be used that are either refillable on cleaning or recyclable into new containers or other goods. If enacted, such legislation would require that the voluntary deposit system employed by industry for many years for refillable bottles be extended to all types of beverage containers.

The objectives of mandatory beverage container deposit legislation (BCDL) are:

1. To reduce the number of beverage containers that become littered.
2. To reduce the amount of natural resources, both materials and energy, devoted to beverage delivery.
3. To reduce the amount of beverage container materials that enter the solid waste stream.
4. To establish a public symbol of materials conservation.

Mandatory deposits have been considered for such other goods as automobiles, tires, electrical machinery, consumer durables, and food packaging; some of which could be reused and others of which would require some level of remanufacture.** This study, however, is limited to beverage container deposit proposals for several reasons: they are now on the public agenda, a body of analytical work has been done on them, and the congressional request for this study asked for investigation of this option. The major points addressed in this chapter are:

1. Options for addressing the beverage container issue.
2. The uncertainties in assessing the effectiveness and impacts of BCDL.
3. The history and background of the existing beverage container system.
4. The effectiveness of BCDL in achieving its goals.
5. The positive and negative side effects of BCDL.

*Containers designed to be used for beverage delivery only one time are denoted by a variety of adjectives including nonreturnable: nonrefillable: one-way: single-service: throwaway: no-deposit/no-return; recyclable; disposable: and convenience. In this study, the term ‘‘nonreturnable” is used to describe such containers. Containers designed to be collected, cleaned, and refilled are called “refillable.” Currently, all refillable beverage containers in commercial use are made of glass. “Recyclable” is used to denote containers whose materials can be reprocessed to make new containers or other useful objects.

**Figure 2 (see chapter 2) shows how reuse and remanufacture approaches (loops 3 and 4) differ from recycling and resource recovery options. Remanufacturing is one of the subjects covered in an OTA report on materials conservation.(1)

6. Current trends that may influence the future of the beverage delivery system, with or without BCDL.

Rationales For and Against Government Action

The economic rationale for mandatory beverage container deposits is that certain costs of the production, use, and disposal of beverage containers are not paid by the participants in those actions but by society at large. This happens because the market system does not provide incentives to the participants to pay for all of the costs they create. (In other words, there is a case of what analysts call "market failure.") These include litter costs (esthetic loss; pickup costs; injuries to people, livestock, and wildlife; and damage to vehicles and other machinery), pollution costs (some of the air and water pollution from producing materials and manufacturing containers), and solid waste management costs (collection, disposal, and landfill pollution). Both equity and economic efficiency might be served by Government action to ensure that the participants pay these costs, providing that such Government action does not create even greater problems.

Seven States and a number of local governments have passed beverage container laws. The provisions of the existing laws are detailed in appendix D for the States of Connecticut, Delaware, Iowa, Maine, Michigan, Oregon, and Vermont. Several other States have defeated beverage container deposit proposals in recent years, including four that have done so by popular referendum: Alaska, Colorado, Massachusetts, and Nebraska. Virginia has passed a law prohibiting local ordinances that require beverage container deposits, with an exception for ordinances previously on the books.

Proponents of BCDL argue that market forces, which exclude external costs, have led to adoption of a beverage container system that is wasteful of raw materials and energy and that provides little incentive to consumers to avoid littering or to reduce solid waste. As a result, industry produces billions of beverage containers each year that from a technical point of view are nearly but not quite reusable. Deposit laws would provide incentives to consumers to avoid littering and to avoid adding containers to the solid waste stream. At the same time they would provide an incentive to producers to consume less energy and materials by using containers that, while only marginally different from nonreturnable ones, can be collected and refilled a number of times. To BCDL proponents, the demise of the disposable beverage container, which has become symbolic of a wasteful society, would symbolize a new spirit of conservation.

Opponents of mandatory deposit laws argue that the current beverage delivery system is the most economical one and that consumers have chosen it by expressing their preferences in the marketplace. They argue that imposition of a deposit law would be costly for industry, would disrupt existing employment patterns causing a loss of skilled jobs in can and bottle production, and would place a hidden cost on consumers in the form of additional time and storage space requirements. They doubt that a deposit system would actually "work," in the sense that the container return rates and refillable bottle market shares required to achieve the intended benefits would not be reached if producers, sellers, and consumers do not cooperate. (Market share is defined as the percent by volume of packaged beverages sold in each container type.) Opponents also argue that beverage delivery costs would increase and would be passed on in the form of higher retail prices for beverages or as higher prices for other consumer products sold with beverages.

Sources of Uncertainty in BCDL

In the last several years, BCDL proposals have been discussed and analyzed extensively. A great deal of effort has been expended in making detailed projections of the effectiveness and impacts of deposits. * Yet little agreement appears to have been reached on the basic "technical facts, " let alone on the policy questions. There are a number of possible explanations.

First, the economic and political stakes in the deposit controversy are high. The direct economic costs of BCDL to industry, labor, and certain communities are perceived to be large. Similarly, there are serious political concerns about litter, solid waste, and materials and energy conservation. For these reasons, interested parties have worked hard to support their positions.

Second, proposals to require beverage container deposits are comparatively simple to understand and their effects are relatively easy to foresee. Studies have been carried out by private organizations, Government agencies, academic groups, and environmental organizations. Thus, a body of literature of diverse quality has grown up around the issue. Prior to this study, however, no critical review and evaluation of this literature has been made.

Third, certain key aspects of the response of the beverage container system to imposition of mandatory deposits cannot be accurately predicted either from current understanding of the functioning of markets or by extrapolation from the historical record. Return rates and market shares for various container types are difficult to predict along with such other factors as: the volume of sales and the prices of beverages, the additional costs to industry, the nature of technological innovation in the future, and the costs or benefits to consumers of changes in the convenience aspects of the beverage delivery system.

In appendix two widely quoted major studies are critically compared. One is a study of a ban on cans and nonreturnable bottles by the Wharton School of Business, University of Pennsylvania, for the U.S. Brewers Association and the other of a mandatory deposit system by the Research Triangle Institute for the Federal Energy Administration.

Fourth, various proposals for beverage container laws have been discussed at the Federal, State, and local levels. Some are for mandatory deposits, some for litter control, and others would ban nonreturnable containers altogether. Mandatory deposit proposals differ with respect to timing, range of container materials covered, treatment of nonrecovered deposits, and container design. Each of these proposals can lead to significant differences in their expected effectiveness and impacts. The specific proposal examined in this report is the one discussed by the Resource Conservation Committee (RCC) in its second report to Congress.(2) This choice does not represent an endorsement of the RCC model, but provides a basis for the analysis. (The RCC model is very similar to the Hatfield-Jeffords proposal. See appendix B.)

Fifth, many attempts have been made to forecast what the effects of a national law might be based on the experiences of four States that currently have functioning mandatory deposit laws: Oregon, Vermont, Michigan, and Maine. Widely different claims have been made in each case. Experience with these State laws has proven inadequate for judging a nationwide system for several reasons: there are no good baseline data available for any State on the situation existing before deposits were required, thus precluding valid comparisons; in the cases of Oregon and Vermont, producers have been able to influence the outcomes by withdrawing from the market or manipulating prices (many Vermont consumers can easily purchase beverages in neighboring States without deposit laws); and finally, many of the effects of these laws are felt outside the States, especially on out-of-State container, material, and beverage producers and labor. These limitations will apply to the performance of any deposit requirement imposed on a small area such as a State or a military facility.

Sixth, a number of emerging trends in the beverage industry may invalidate most of the analytic work that has been done on BCDL. These include the rapid acceptance of the plastic soft drink container and the recent

Federal Trade Commission (FTC) decision outlawing territorial franchises for soft drinks in nonreturnable containers.

It is unlikely that these uncertainties in the performance and impacts of a nationwide beverage container law will be resolved by further analysis. Wherever possible in this chapter, uncertainties in the analysis are emphasized, conflicting views are noted, and their implications for the conclusions examined. Attention is focused on the pivotal roles played by return rates and container market shares as determinants of the effectiveness and impacts of deposit legislation.

Beverage Container Policy Options

Description of Options

The current discussion nationwide centers on the mandatory deposit approach. However, table 60 lists other approaches, some of which have been adopted in certain States and localities. Each option, if adopted, would have different degrees of effectiveness in achieving the goals of beverage container legislation and different impacts. The options are described and discussed in this section.

NO ACTION

No action means that no change will be made in current Federal policy toward beverage containers. Such policy is limited to the health, safety, environmental, fair labeling, antitrust, and alcoholic beverage regulations. No other existing policies directly affect container choice and design. If no Federal action is taken continued beverage container control activity can be expected at the State and local levels.

PROHIBITION OF NONRETURNABLE BEVERAGE CONTAINERS

A ban on the sale in interstate commerce of beverages in nonreturnable containers would cause nonreturnables to disappear from the marketplace (presuming adequate enforcement). * It would, however, only achieve its maximum effectiveness if bottlers and brewers were to establish a voluntary deposit system for all refillables. Otherwise, a ban would fail to provide any new incentive for consumers to return containers or to cease littering.

A ban would have a number of disadvantages. First, it would eliminate the option of consumers to purchase beverages in lightweight, nonbreakable cans and plastic bottles since only glass containers are currently refillable. The desirability of cans and plastic bottles is likely to continue for carrying beverages long distances, for consuming beverages in areas in which broken glass would be a major hazard (recreation areas, around small children), or by those who prefer consuming beverages in cans.

A ban might also inhibit the development of new container systems, types, materials, or sizes that might otherwise evolve. For example, a nonrefillable but recyclable container might be developed from a new material and be less resource-intensive and less expensive than any currently available refillable or non-

Table 60.—Selected Federal Options for Achieving the Goals of Beverage Container Control

1. No action
2. Prohibitions (bans) on interstate sale of nonreturnable containers
3. Expanded litter control efforts including education, pick-up, and litter law enforcement
4. Litter taxes on containers
5. Mandatory labeling of container portion of beverage price
6. Excise taxes on nonreturnable containers
7. Policies to lower the prices of secondary materials relative to those of virgin materials (product disposal charge, recycling subsidy, reduction or elimination of percentage depletion allowance, severance tax)
8. Solid waste management options such as resource recovery or source separation
9. Prohibitions on particular materials of container construction
10. Prohibitions on particular container design features

SOURCE Off Ice of Technology Assessment

*The analysis of restrictive packaging legislation b the Wharton School for USBA is a study of this kind of prohibition and response, (See appendix D for an analysis of this study,) returnable container. Under a ban, the development of such new technology might not proceed.

Banning nonreturnables would be the most disruptive of current distribution patterns, and would require the largest additional industry investment of any of the policy options. It would also be likely to reduce beverage sales for the reasons of consumer preferences mentioned above. Therefore, it might be the most costly option for industry, workers, and consumers.

Finally, the prohibition of an economic activity is a very powerful tool of Government policy. It is best reserved for circumstances in which no other acceptable options exist. In this situation, the deposit option might work equally well if not better than a ban.

EXPANDED LITTER CONTROL

Expanded efforts both to control the generation of litter and to collect it have been widely proposed as an alternative to BCDL by Keep America Beautiful, Inc. (KAB), an organization in which representatives of the container and beverage industries play a central role,(3) KAB developed and promotes the Clean Community System, an approach to litter control that strongly depends on modifying community norms to reduce or eliminate sources of litter. It can be tailored to the particular litter problems of each community. KAB reports (5) that litter accumulations under the Clean Community System are typically reduced by 20 to 80 percent as measured photometrically. * No data are given on the effects of the system on beverage container litter.

Litter control programs can include more frequent and effective pick-ups and better law enforcement, as well as behavioral approaches. However, people usually litter items that are of little or no value to them, Direct litter control programs provide only a weak economic incentive to overcome this factor in littering and no incentive for pickup by scavengers. They also do nothing to reduce the solid waste disposal problem or to conserve material and energy. Litter laws are difficult to enforce, since constant surveillance is required. In addition, higher fines are probably counterproductive; they may lead to dismissal of charges and/or lax enforcement. The approach adopted by California has been to reduce litter fines to $10 per violation in the expectation that citations will become more frequent and enforcement more effective.(6)

*See the discussion on p. 192 for a description of this technique.

LITTER TAXES ON CONTAINERS AND OTHER PRODUCTS

A tax on litterable products, including containers, has been proposed as a State-level alternative to deposit legislation. It has been adopted by several States, notably Washington and California. Washington State's Model Litter Control Act was passed by its legislature in 1971 and ratified by its voters in the general election of November 7, 1972.(7) The Act places a gross receipts tax of $150 per $1 million gross sales on manufacturers, wholesalers, and retailers of any product ". . . including packages, wrappings, and containers thereof . . . reasonably related to the litter problem . . ." The proceeds of the tax are used for educating the public about the provisions of the Act, for purchasing litter receptacles, for funding a full-time litter patrol to enforce the litter law, and for paying for litter pickup.

The California Litter Control, Recycling, and Resource Recovery Act of 1977 was designed to provide funds for a variety of functions associated with these activities. Funds were to be raised by a surcharge of $0.25 per ton on certain MSW disposal facilities as well as by a system of taxes on retailers, wholesalers, and manufacturers.(6) In February 1979, the parts of the Act that imposed a tax on retailers were repealed and the remaining taxes were to be imposed gradually.(8)

If such a tax were placed on both refillable and nonreturnable beverage containers, a very small incentive would be provided to induce beverage producers, retailers, and consumers to favor refillables over nonreturnables. Thus, it would have little effect on the nonlitter goals of a deposit law because it would cause little change in container market shares and return rates.

MANDATORY CONTAINER PRICE LABELING

It has been argued that consumers are either unwilling or unable to decide whether beverages are cheaper in refillables or in nonreturnables under the existing voluntary system. This is presumably due to the large number of brands and container types and sizes; also because it is not always clear whether posted prices include the deposit. One approach would be to require labeling the deposit portion of the posted price so that consumers might more readily be able to determine the best buy. To the extent that price labeling would enhance the purchase of refillables, it might achieve the goals of a deposit law.

EXCISE TAXES ON NONRETURNABLES

This option, which would levy an excise tax of several cents per nonreturnable container, would make refillable containers relatively less costly than nonreturnables. By so doing it would serve to make beverages in refillables more attractive to both producers and consumers, and it might induce producers voluntarily to establish a comprehensive deposit system to ensure returns. Such a tax would have to be large to be effective—say 5 cents per container. Its administration would require making a potentially difficult determination of the types of containers that are indeed nonreturnable.

POLICIES TO RAISE THE RELATIVE PRICES OF VIRGIN MATERIALS

Broad policies such as the product disposal charge, recycling subsidies, severance taxes, and reduction of existing percentage depletion allowances for minerals would all serve to make virgin raw materials and new products made from them slightly more expensive in comparison with recycled materials and reusable products, than they are now. Each would raise the price of nonreturnables as compared with refillables. Such policies also provide direct or indirect incentives to recycling. This might stimulate an increase in voluntary deposit requirements as well as in the recovery of discarded containers. Some reduction in litter generation would be expected. However, the price changes and the effects of these policies on container use would be relatively small. (See chapter 8.)

SOLID WASTE MANAGEMENT OPTIONS

Both centralized resource recovery and separate collection (source separation) of municipal solid waste (MSW) have been offered as alternatives to beverage container deposit proposals. These approaches have a wider range of goals and impacts as discussed in chapters 4 through 7. Neither option contributes to solving the litter problem, which each might worsen by stimulating a further decline in the use of refillables.

The impacts of BCDL on the economics of separate collection and centralized resource recovery are examined in chapters 4 and 6.

PROHIBITIONS ON PARTICULAR CONTAINER CONSTRUCTION MATERIALS

Another option is a Federal ban on the interstate sale of beverage containers made of particular materials such as aluminum, steel, or plastic. Such a ban has many of the undesirable aspects of a ban on nonreturnables discussed above. It runs the risk of prohibiting the most desirable types of containers, at least in some regions. Furthermore, a ban on metal or plastic containers would not affect nonreturnable glass and would stimulate its use. In one case, a local tax ordinance directed specifically at plastic packaging was found to be unreasonably discriminatory by a State court.(9) It is reasonable that the Federal Government should exert control over the materials used in beverage containers in order to protect public health, as discussed later in this chapter.

PROHIBITIONS ON PARTICULAR CONTAINER DESIGN FEATURES

Proponents of deposit legislation often argue for a ban both on aluminum pull-tops on beverage cans and on plastic six-pack holders. Neither pull-tops nor plastic carriers have a significant impact on the use of energy and materials or on the generation of solid waste. Due to their small size, however, pull-tops are more likely to be littered and remain as permanent litter than are metal cans, and are hazardous to people and wildlife. Laws in 12 States currently prohibit the sale of cans with pull-tops. The beverage industries are rapidly replacing them with cans having non-removable opening devices.

The major problems associated with plastic six-pack holders are esthetic blight and the hazards they pose to wildlife. The use of the plastic six-pack holder would probably be reduced if a deposit law were passed, since it cannot easily be used as a holder for returning empty cans.

Design Considerations for the Beverage Container Deposit Option

INTRODUCTION AND CRITERIA

Since BCDL would be complex legislation, a number of design details need to be examined. Some of the details could be specified in legislation while decisions about others might be delegated to the department or agency responsible for administering a law. The choice among design options would have considerable influence on the effectiveness of a deposit law and would affect the extent and incidence of the impacts of a law on various parties. In this section, the design decisions are identified, and considerations with respect to their resolution are discussed. A variety of sources were used including the report on beverage container deposits by the staff of the interagency Resource Conservation Committee [11) and a study done by the University of Michigan.

Economic efficiency, fairness, effectiveness, and minimum Government involvement are useful criteria for decisions on design issues. Since correction of market failure is the rationale for a deposit system, a deposit law should not introduce additional market inefficiencies. In particular, the selection of specific materials, containers, or beverages to be covered by a deposit law is likely to create a system that is inefficient, ineffective, and unfair. One feature of the deposit approach is that it is nearly self-administering by the market, so that it requires very little administrative involvement by the Government.

NATURE OF THE DEPOSIT

Deposit or Refund.—BCDL could require either mandatory deposits or mandatory refunds for containers. Under the deposit approach the law would mandate that someone (see below) charge a deposit for the use of his containers and that the containers would remain his property. The parties further along the distribution chain would act as his agents in collecting and disbursing deposit funds. Under the refund approach ownership of the container would be assumed by each party that buys it and its contents. The law would require that parties up the distribution chain (retailer, wholesaler, producer) buy back (pay a refund for) containers of a type used or sold by them. The difference between a deposit and a refund maybe unimportant to the consumer, but it could influence the tax treatment of monies involved, product liability, and proprietary rights in container designs. Under a refund system, the “deposit” monies are treated the same for tax purposes as any other income or expense of doing business. No special levies would be needed for unrefunded deposits.

Amount of Deposit.—A minimum deposit of 5 cents is at the heart of all proposals. This sum apparently reflects current industry practice, since no analyses have been made of the quantitative response of the beverage delivery system to other deposit values. Generally, the deposit should be large enough both to stimulate a high return rate and so that retained deposits can help offset the producers' costs of running a deposit system. However, it should not be so high that returns are discouraged. If the sum of the deposit and the cost of handling refillables exceeded the price of a new container, producers and distributors would discourage returns.

One or Two-Tiered System.—BCDL might mandate minimum deposits only for nonreturnables, while allowing traditional market forces to establish the deposit amount for refillables. However, this approach could cause technical arguments over whether a particular type of container is, in fact, refillable. Furthermore, such an approach would have the effect of favoring glass and discriminating against metal and plastic.

Adjustment of Deposit Amount.—The amount of the deposit would need to be adjusted to account for inflation. This could be done by legislation, by administrative decision, or according to a formula indexed to a measure of inflation, such as the consumer price index.

Minimum or Maximum Deposit. --Producers might be given the option to set higher deposits to cover their costs or to cover large containers. No public purpose would appear to be served by setting a maximum deposit.

Establish Certified Containers.—The Oregon law sets a lower deposit (z cents) on containers that the State certifies as standard and usable by a variety of producers. Standard containers would be easier to use and return for both producers and consumers. For this reason, they would probably emerge as an economic response under a uniform deposit law. There appears to be no need for a lower deposit or a governmental certification apparatus.

Beverages Covered.—Most proposals cover carbonated beverages (soft drinks and beer) in individual, closed servings. It is reasonable to expect a marketing shift toward noncarbonated beverages in vending machines and small retail stores in response to a national deposit law on carbonated beverage. This shift could result in an undesirable circumvention of the goals of BCDL, and may ultimately lead to proposals to include other beverages. Other beverages that might be included are noncarbonated drinks, juices, milk, water, mineral water, iced tea, wine, and spirits. * Before such additions were made, it would be necessary to analyze their effectiveness, costs, and impacts.

Materials Covered.— Some proposals would establish different deposits for containers made of different materials. This approach would appear to be discriminatory and might inhibit innovation in the development of potentially desirable new containers such as refillable plastic bottles.

Require a Deposit on Secondary Packaging.—Under a container deposit system producers would be likely to adopt more durable and versatile secondary packaging (cartons, cases, and the like) to facilitate returns, obviating the need for a deposit system for secondary packaging. Such a requirement might be much harder to administer than the container deposit requirement.

ADMINISTRATION OF THE DEPOSIT SYSTEM

Which Agency and What Functions.—Most proposals call for administration of the deposit system by the Environmental Protection Agency (EPA). It might also be administered, in whole or in part, by the Department of Commerce (DOC), the Internal Revenue Service (IRS), the Federal Trade Commission (FTC), or a new agency. Federal agency functions could include education and technical assistance, adjustment of the amount of the deposit, decisions to require deposits on additional types of beverages, or enforcement of compliance with the deposit requirement. However, it should be noted that once established BCDL uses market forces, and would require little Government participation.

Enforcement Requirements.—A deposit law must include sanctions for the failure of producers, distributors, or retailers to charge

*Federal law currently prohibits commercial reuse of liquor bottles. (CFR-173.43, sec. 27 of the Internal Revenue Code.)

or refund deposits as required by law. It introduces an element of mandatory purchase into ordinary business transactions, since used containers must be repurchased. The refusal to do so would create a problem for consumers and small firms. A method of speedy, cheap enforcement is needed, therefore. Such enforcement should be discretionary, however, to avoid creating undue short-term cash-flow hardship for distributors or retailers subject to a heavy influx of returns, One can imagine a "reverse boycott" in which a retailer or distributor is intentionally subjected to a very heavy flow of returned containers as a form of economic harrassment. Similarly, retailers in vacation areas may experience an excess of returns over sales from travelers.

Point of Origin of Deposits.—The deposit could originate at several points: container manufacturer, bottler/brewer, distributor/wholesaler, or retailer. The logical points of origin for a national deposit are the bottlers and brewers, since the objective of the legislation is to create an incentive for these companies to reuse returned containers. It is the bottlers and brewers that have sufficient market power through economies of scale, advertising, franchising, and market shares to frustrate the functioning of the deposit system. There is little purpose in requiring distributor/wholesalers or retailers to recover used containers if bottlers and brewers refuse to take them back for reuse, so the participation of the latter must be assured. However, if deposits originate at the brewer/bottler, there is no need to require containers to be physically transferred back to particular bottlers or brewers, since these firms may be able to work out more cost-effective approaches based on the establishment of a private market for the exchange of used containers.

Treatment of Imports.—Special provision may be required for imported beverages. In this case the importer rather than the brewer or bottler might originate the deposit. Importers are unlikely to return containers to the country of origin, but in order to remain price competitive with U.S. brands they might adopt a standard container such as the 12-ounce beer bottle, which would retain high value under a deposit system. At any rate, fairness to domestic producers requires that imports be included in the deposit system.

Establishment of Redemption Centers.—Some proposals include Government operated or licensed redemption centers for returned containers, and some would excuse retailers from accepting returns if a redemption center is nearby. Oregon's law contains such a provision, but no centers have been established. Centers may arise independently if they can serve an economic purpose, Thus there is no evident need for a special provision for them. Likewise, a policy to excuse retailers near a redemption center would require an extensive administrative apparatus to make and police determinations of compliance.

Treatment of Retained Deposits.—Not all deposits would be refunded since not all containers would be returned. These retained deposits would accrue in the first instance to the originator of the deposit, i.e., to the bottier/brewer. It has been proposed by some that these deposits should be treated as a windfall profit to be taxed away by a special tax. Others have proposed treating them as ordinary business income, subject to income tax—an approach compatible with a mandatory refund rather than a deposit system. To the degree that beverage markets are competitive, it would be likely that any "excess" profit would be shared with distributors, retailers, and consumers through reduced prices, In this event, a tax on retained deposits would make beverage prices rise under a deposit system, rather than let potential cost savings drive prices down. On balance, a special tax on retained deposits appears to be unnecessary and to be undesirable from a consumer point of view.

Compensation of Retailers.—Some proposals would earmark a portion of the deposit, say 1 cent, for compensating retailers for extra effort in handling returned containers.

Some State laws have such a provision, If markets are competitive, such a provision is unnecessary and undesirable. If need be, retailers can set their prices to recover any extra costs. Furthermore, a l-cent rebate would reduce a retailer's incentive to control the costs of recovery.

IMPLEMENTATION OF THE DEPOSIT

Time-Phasing of Deposit Implementation.—A decision must be made on the time between the date of passage into law and the date of implementation, as well as about whether a law would take effect uniformly on a particular date or be phased-in gradually. Generally, time delays of 2 to 3 years are proposed in order to allow for orderly adjustment by the industry to the deposit requirement. While longer delays might allow for a smoother transition, in fact, during the transition, each producer, wholesaler, and retailer has an economic incentive to avoid instituting a deposit earlier than his competitors. As a result, all may put off necessary adjustments to the last minute. Thus, a shorter rather than a longer period may be just as effective.

Preemption of State and Local Laws.—A Federal law might preempt local laws, grandfather existing laws, or allow for optional higher State or local deposit requirements. Higher State or local deposits might be desirable to induce better local performance or as a testing ground for possible changes in Federal policy. However, State and local governments should probably be discouraged from retaining or establishing container design requirements that might unnecessarily frustrate the efficient functioning of a nationwide deposit system by forcing producers to serve disparate markets.

Special Impact Assistance Programs.—Depending on program design, time-phasing, and system response (sales, market shares, recycle/return rates), BCDL may harm particular sectors of labor, manufacturing, or retail trade. Proposals have been discussed for special aid, which includes financial assistance, job retraining, or technical assistance. Another view is that existing programs for economic assistance are adequate for this purpose. Special assistance programs could become a windfall for those who would otherwise successfully make the transition under existing assistance programs or with no assistance at all. Administrative costs could be high. See pp. 215 & 220 for discussions of impact assistance for industry and labor.

Dimensions and History of Beverage Container Use

Containers, Resources, and Waste

In 1977, the United States produced nearly 73 billion carbonated beverage containers, manufactured from 8.6 million tons of materials, as shown in table 61. These containers contributed over 8 million tons to the municipal solid waste stream; about 6 percent of the total. Beverage containers make up nearly half of all the glass and aluminum in MSW.

Table 61 shows that the production of containers for beverages is a large part of the production of rigid containers for all purposes. Over 95 percent of all aluminum cans, over so percent of all glass bottles, and over 42 percent of all steel cans are used for beer and soft drinks. While plastic beverage containers currently hold a small part of the beverage container market their market share is growing extremely rapidly for soft drinks in larger sizes (24 to 64 ounces].

The energy required in all phases of the beverage container delivery system in 1975 has been estimated to be between 358 and 465 trillion Btu, excluding the energy required to produce the beverage itself. (See table 60.) This energy represents between 0.5 and 0.66 percent of the total U.S. energy consumption for 1975, and is equivalent to 1.2 to 1.5 percent of the total U.S. energy consump tion for industrial purposes.

The historically increasing demand for beverage containers reflects: (i) growth in per capita demand for beer and soft drinks, (ii)

Table 61.—Beverage Container Production, Materials, and Wastes in 1977

Container type	Production (billion)[a]	Beverage containers as a percent by number of all containers of this material[a]	Gross material used (million tons)[b]	Gross material used as a percent by weight of domestic consumption	Beverage containers in solid waste (million tons)[b]	Beverage containers as a percent by weight of solid waste[d]	Beverage containers as a percent by weight of each material in solid waste[e]
Glass bottle							
Refillable	1.9[f]	. . . .	. . . .	. . . .	. . . .		. . . .
Nonreturnable	19.3[f]	. . . .	. . . .	. . . .	. . . .		. . . .
Total glass .	21 .2f	50.4?40	6.52	30.0%	6.52	4.80/.	48.00/.
Aluminum can . . .	25.8	95.6%	0.64	12.070	0.47	0.35%	48.00/.
Steel can							
Three piece[g] . .	18.3	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .
Two piece	7.3	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .
Total steel. .	25.6	42.4%	1.39	1 so/o	1.26-	0.90/o	1 2.00/0
Plastic.	0.3[h]	3.3%	0.01	0.07%	0.01	0.007%	0.2%
Total beverage containers	72.9	. . . .	8.56	. . . .	8.26	6.1 '/o	. . . .

[a]Industry data (15, 16)
[b]OTA estimates from table 67
[c]OTA estimates based on table 67, on domestic consumption of aluminum and steel from US Bureau of Mines(1 7), and on OTA estimates for total glass consumption of 22 million tons and plastic consumption of 141 million tons in 1977
[d]Based on assumed 135 million tons of net muncipal solid waste disposed of in 1977
[e]Based on table 3 composition data for 1975, the latest year available
[f]1976 data from Glass Packaging Institute (15)
[g]Usually made with aluminum lid
[h]OTA estimate

shifts in the kinds and sizes of containers used as beverage packages, and (iii) growth in the population. The first two factors are undoubtedly connected, in the sense that availability of convenience-oriented packaging facilitates increased per capita consumption, while increased per capita demand facilitates entry of new package concepts into the marketplace. This section examines trends in per capita beverage demand and in container use patterns, some of the forces that underlie those trends, and the history of the resulting demand for containers.

Beer and Soft Drink Consumption

The growth in total consumption of beer and soft drinks is shown in figure 6. Figure 7 shows the growth in per capita consumption for each beverage.

In a study for the Federal Energy Administration, Research Triangle Institute (RTI) [20] found that historical per capita consumption of beer over the period 1947-73 could be explained statistically by three independent variables: average personal disposable income, the price of beer relative to other goods, and the proportion of the population between ages 20 and 34. They found that consumption of soft drinks was strongly related to average personal disposable income and to the proportion of the population between ages 10 and 29. The relative price of soft drinks was not an important factor in explaining consumption. *

In a study for the U.S. Brewers Association (USBA), Weinberg argues that per capita beer consumption began to increase dramatically after 1958 due to the increased use of "convenience' (nonreturnable) packaging from 1947 through 1970.(21) He further con-

*price elasticities of demand were – 0.6 for beer and – 0.13 (not statistically significant) for soft drinks. Disposable income elasticities were + 0.25 for beer and + 1.47 for soft drinks. Population group elasticities of demand were + 0.70 for beer and + 0.79 for soft drinks,

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Figure 6.—Annual Beverage Consumption in the United States

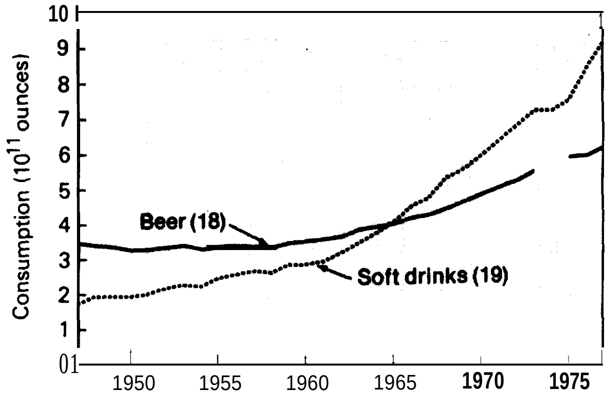
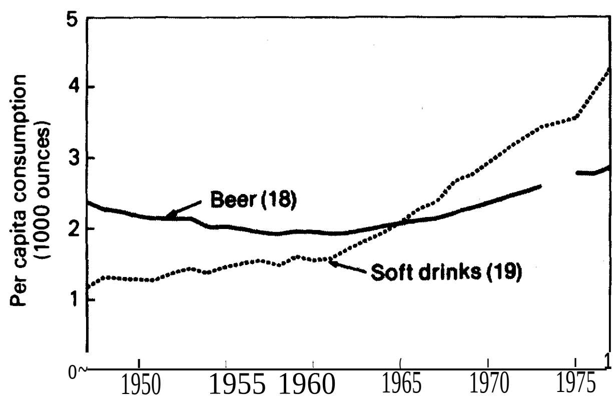


Figure 7.—Annual Per Capita Beverage Consumption in the United States



eludes that ". . . the increase in malt beverage consumption after 1958 cannot be explained in terms of shift in population (age distribution)." He also argues against a consistent influence of disposable income on beer consumption, because per capita consumption decreased linearly with income from 1947 to 1958 and then reversed to increase linearly from 1959 to 1970. These conclusions contrast with the RTI findings that the proportion of population between ages 20 and 34, along with disposable income and beer price relative to other commodities, are very significant in determining per capita beer consumption.

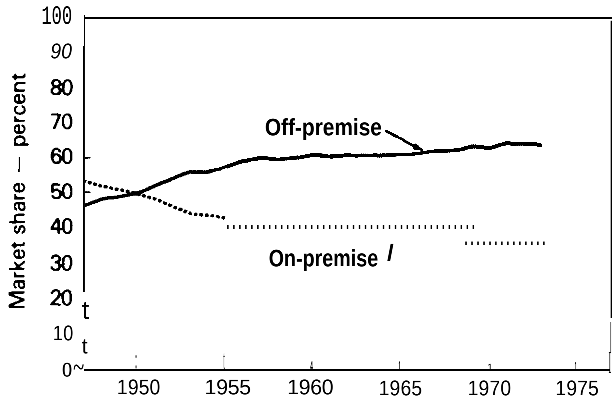
The differences between the conclusions reached by RTI and by Weinberg on the determinants of per capita beer consumption are important because they lead to different predictions about the response of beer consumption to a deposit system. If beer consumption has been stimulated by the availability of nonreturnable containers (the Weinberg argument), then a deposit law that would make nonreturnable packaging more expensive would tend to depress beverage consumption. If, however, beer consumption is determined by disposable income, price, and demographics (the RTI finding), then a deposit law would affect beer consumption only by having a direct effect on beverage prices and not by any effect on convenience. Both arguments are plausible; the RTI finding, however, is based on a statistical test while the Weinberg argument is more intuitive. In any case, statistical time series arguments of the sort made by RTI allow for the possibility that some other untested independent variable might also "explain" the observations. Weinberg's argument, on the other hand, tends to confound total beverage consumption with market shares by package type, both of which may be responding to untested external economic and social variables.

Over the years, the Nation has experienced a shift in the location of beverage consumption. Figure 8 shows the shift for beer from the on-premise market (taverns, restaurants) to the off-premise market (in the home or in recreational settings). Change in the places of consumption has stimulated change in container demand. Thus there has been a shift from bulk packaging to individual serving-sized packages for beer, while the trend for soft drinks has been toward bulk packaging. (See figure 9.) This difference may reflect the rapid growth of both "fast food" and institutional settings, where soft drinks are sold in open cups from bulk packages.

Historical Shifts in Container Types, Materials, and Market Shares

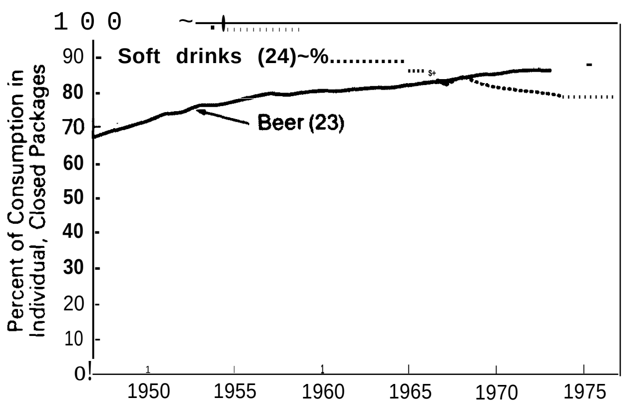
Until the 1930's all packaged beer and soft drinks were marketed in refillable glass bot-

Figure 8. —The Dual Beer Market



SOURCE (20)

Figure 9.— Packaged Beverage Market Shares

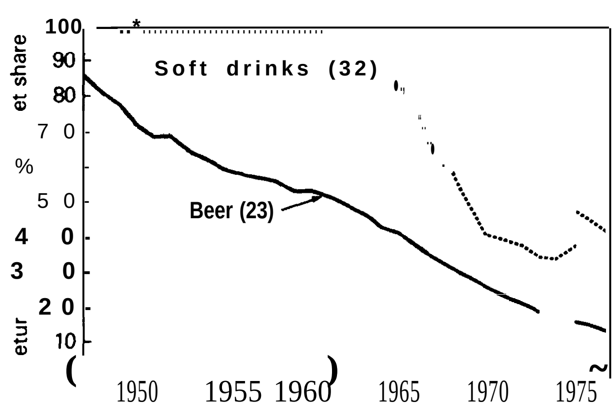


ties. * The soldered steel can made its debut in the beer market in 1935.(26) Steel cans entered the soft drink market in 1953.(27) The all-aluminum can first appeared in the general market in 1964,(28) although it had been used by Coors a few years earlier. The bimetallic aluminum-lid/steel-body/pull-top can began to be used in 1962.(29) Nonreturnable beer bottles were used for overseas delivery during World War II but their substantial domestic use for beer did not begin until 1959.(30) Having been introduced in 1948,(31) nonreturnable glass bottles played a small role in the soft drink market for some years. They were given considerable impetus by the twist-off cap, nonreturnable bottle introduced in part to help glass container companies retain their market shares in the face of inroads by metal cans. More recently, container manufacturers have developed new beverage container systems such as the two-piece steel can; various plastic bottles (polyacrylonitrile, ** polyester, and polystyrene foam-over-glass); and a laminated container made of wood fiber and plastic, None of these are refillable.

*In the early years of the packaged beer and soft drink industries, refillable bottles were a highly valued property of the brewers and bottlers. The American Bottlers' Protective Association, an organization of bottlers and brewers formed in 1889, proposed passage of a Federal Bottle Law to protect their property rights in bottles that were then being diverted with a loss of several million dollars per year. The proposed law passed the House of Representatives but not the Senate in 1896. In 1899, the Association abandoned the Federal approach in favor of seeking individual State controls. In 1901, the Association endorsed a proposal for industry adoption of bottle deposits. However, adoption of a deposit system took many years.(25)

Five container systems now serve the packaged beer and soft drink markets: refillable glass bottles, nonreturnable glass bottles, all-aluminum cans, bimetallic steel body/aluminum lid cans and polyester plastic bottles. Figure 10 shows the rapid decline in market share of refillable containers during the last

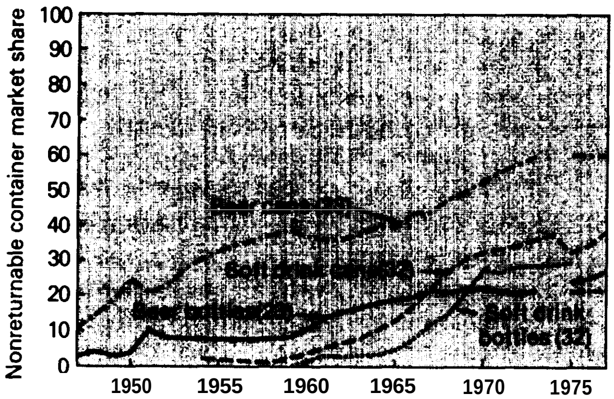
Figure IO.— Beverage Market Shares in Returnable Containers



**See page 229 for a discussion of the recent FDA ban on the use of acrylonitrile-based plastics for beverage containers.

20 years. Figure II shows the growth in market share of nonreturnable containers.*

Figure 11.—Beverage Market Shares in Nonreturnable Containers



A number of factors have stimulated the shift from refillable to nonreturnable beverage containers. Some have acted on producers, some on distributors and retailers, and some on consumers. They include:

Factors Affecting Producers.—

1. The lower weight of cans and nonreturnable glass and plastic bottles, with lower transportation costs, lower labor costs, and less worker injury than with refillables.
2. The absence of collection and back-haul costs for nonreturnables.
3. The increase in the optimum size of regions serviceable from a single bottler or brewer as a result of reduced transport costs due both to the lower weights of nonreturnables and to the improved highway transportation system.
4. The increase in industry concentration and a focus on nationwide marketing.
5. Reduced investment in inventories of bottles and secondary packaging.
6. The more rapid filling machinery for cans than for bottles.
7. The lower cost of the capital equipment used for filling nonreturnables.
8. The decline in refillable container return rates.
9. Short-term price promotions are more economical as a marketing tool with nonreturnables, since there is no need to make a longer term investment in bottle inventory.

Factors Affecting Distributors and Retailers.—

1. Shifts to self-service, high-volume supermarkets as beverage sales points.
2. Container inventory costs are lower with nonreturnables, particularly in the case of modern, low-inventory, supermarkets.
3. Reduced space and labor costs in handling nonreturnables.
4. The decline of the local tavern as a neighborhood center.

Factors Affecting Consumers.—

1. The increased acceptance of beer at home.
2. The growth in outdoor eating and recreational activities.
3. The growth in the demand for nonreturnables in response to the increased value of the time required to make returns, including the increased value of the time of housewives who are in the labor force.
4. The unavailability of refillables at many places where beverages are sold.
5. The unavailability of beer in convenient refillable packages such as six-packs.

The shift to nonreturnable containers has apparently facilitated the centralization of bottling facilities; the expansion of the marketing ranges of formerly regional brands, especially for beer; and a tendency toward a smaller number of larger companies. Nonreturnables supported these changes because it

*The National Soft Drink Association estimates and reports market shares in two ways: by survey of bottlers and by computation from container shipments. In recent years, the survey of bottlers has given larger market shares for refillables and lower shares for nonreturnables than have the calculations based on container shipments. For the present study, the survey of market shares is used to calculate materials used in 1977, NSDA statistics do not yet account for the market share of plastic containers, which, although currently small, is growing rapidly.

wasn't necessary to pay for the costs of returning bottles and because the lighter nonreturnables are cheaper to ship. Furthermore, larger bottling plants have lower average production costs than the smaller plants they replaced. The concentration and centralization of the beverage industries has also been facilitated by the economies of scale in the nationwide marketing of beverages on radio and television.

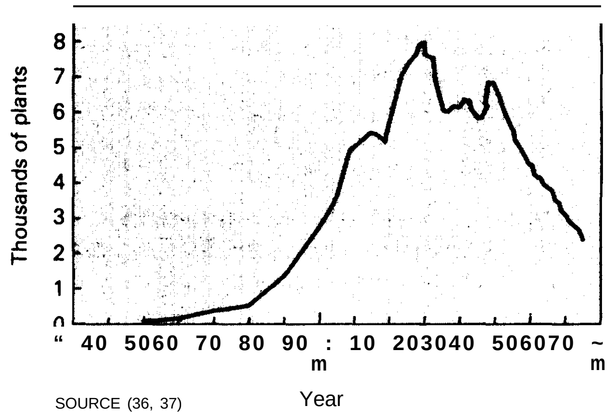
The centralization of production facilities was accompanied by a steep decline in the number of local soft drink bottlers and in the numbers of brewers and brands of beer. For example, in 1935 there were 750 beer-brewing plants in the United States. By 1978 only 96 plants remained.(34) Five major brewing companies controlled 68 percent of the market in 1976, up from 53 percent in 1971.(35)

In the 1940's there were over 6,000 soft drink bottling plants in the United States; by 1975, as shown in figure 12, there were less than 2,500. (36,37) The four largest brands accounted for about two-thirds of the market in 1974.(38) The structure of the soft drink industry may be altered considerably by the recent FTC decision outlawing territorial franchises for soft drinks in nonreturnables. See page 233.

The History of Return Rates

The effectiveness and impacts of a container deposit system depend on the average number of trips a refillable container makes to market; i.e., on the "trippage." Trippage is related to "return rate, " i.e., the fraction of all refillable containers that are returned and reused, as shown in the following equation:*

Figure 12.—Soft Drink Bottlers in the United States



SOURCE (36, 37)

$$\text{Trippage} = \frac{1}{1-\text{Return rate}}$$

As the return rate approaches 100 percent, the trippage becomes very large. (See table 62.) To achieve high return rates and therefore high trippages requires both using durable containers and the cooperation of producers, distributors, retailers, and consumers.

Under the industry's voluntary deposit system, beverage container return rates and trippage have decreased over time. The available data on return rates are uncertain because they are based on inference from container and beverage sales rather than on direct measurement. They differ for beer and for soft drinks, by region of the country, and by segment of the market (for example, for the on-premise and the off-premise beer markets.)

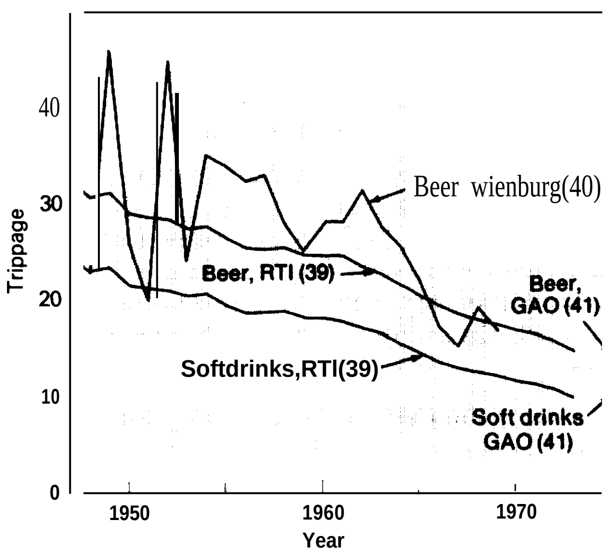
Trippages for the period 1947 to 1973 for beer and for soft drinks are shown in figure 13, taken from estimates by RTI (39) and by Weinberg. Also shown are estimates for 1975 by the General Accounting Office (GAO) .(41) The RTI estimates are based on an inventory model that infers trippage from nationwide beverage and container sales. The basis and scope of the Weinberg data are not known. Since the beer data include both on-premise and off-premise markets, they over-

*Not all returned containers are suitable for refilling. Some are broken during the cleaning and filling operations. The resulting loss of containers, or "shrinkage, " means that customer return rates are somewhat higher than the overall return rate, or refill rate, used here. This difference is small and is ignored in this study.

Table 62.—Relationship Between Return Rate and Trippage

Return rate	Trippage
50 percent	2.0
60 percent	2.5
70 percent	3.3
80 percent	5.0
90 percent	10.0
95 percent	20.0
96 percent	25.0
98 percent	50.0

Figure 13.— Historical Beverage Container Trippage in the United States



state current trippage in the off-premise, consumermarkets.

The Determinants ofMarket Shares and Return Rates

The decisions of consumers to purchase beverages in refillables and to return the empties for refund depend on the costs and benefits and on the availability of refillables in the marketplace. The consumer benefits include lower shelf prices* for beverages in refillables and the positive feeling of contributing to conservation. The consumer costs include time used to clean, transport, and return containers; storage space; and any forfeited deposits.

Return rates are determined bya number of factors including container durability, the convenience of the secondary packaging system, the ease of return, the amount of the deposit, and consumer choice. Consumers directly control only the last of these factors. The others are controlled by producers, distributors, and retailers, whose decisions are influenced by the market preferences shown byconsumers.

To encourage consumer cooperation the amount of time it takes to return containers for redemption must bekept as small as possible. This can be done by ensuring that containerreturn points are conveniently located and operated; usually at the place where beverages are retailed. The sale and return of beverages in refillable containers are discouraged by sales practices that include failure to stock beverages in refillables, failure to offer refillable beer in six packs, and failure to arrange procedures for convenient returns and deposit refunds. Many consumers may not want to take the time to return containers for deposit. Such consumers probably would not purchase beverages in refillables in the first place, being aware that their total prices, when the forfeited deposits are ineluded, might behigher.

One study found that for stimulating returns the convenience of the return processis more important than the amoun tofthedeposit.(42) This study also noted that the deposit must be set such that the sum of the deposit and the extra costs of handling refillables is lower than the price of a new container; otherwise producers and sellers will discourage returns because the gain from retaining deposits and avoiding return costs would more than pay for the price of new bottles.

Observed market shares and trippage, then, are partly the manifestation of a self-reinforcing system in which declining opportunities for the purchase and return of refillables have led to reduced return rates and to

*prices of beverages in various containers under BCDLare discussed later in this chapter.

reduced refillable market shares. Distributors and retailers have become less likely to stock and accept refillables, which has further reduced opportunities for return and so on, until it is reasonable to expect refillables eventually to disappear from the marketplace.

The near disappearance of refillable bottles is already seen in some urban areas where they are not available in grocery stores, a major point of sale for beverages. * Beer in refillable bottles can only be purchased in certain liquor stores that often sell only a limited selection of brands and these only in case quantities. Some soft drink brands are not packaged in refillables at all, and the analog to the liquor store in which customers might purchase soft drinks in refillables does not usually exist.

Trippage is associated with litter. Bottles are not returned either because they are damaged and thus no longer redeemable, or because the consumer chooses to discard or litter them. Therefore, the greater the chances that a refillable is actually returned (high trippage), the lower are the chances that it will be littered. In addition, there is an incentive for scavengers to retrieve littered refillables for their deposit value. There is very little incentive to recover littered nonreturnables whose scrap value is much less than a 5-cent deposit.

Effectiveness of Beverage Container Deposit Legislation

The potential effectiveness of BCDL can be measured by the extent to which it is expected to achieve its four objectives: reduced litter, reduced use of materials and energy for beverage delivery, reduced solid waste, and establishment of a symbol of materials conservation. In this section, the potential achievement of each of these four objectives is analyzed, based on projections into the future using various quantitative and qualitative models.

Previous projections of the effectiveness of BCDL have been intensively discussed and debated. In order to assist in clarifying the arguments, this section is largely based on a review and comparison of the premises, methods, and results of several existing studies. OTA has also performed new analyses to fill gaps in the literature.

Litter Reduction

BCDL is expected to reduce littering by providing a financial incentive to return beverage containers along with their packaging (trays, six-pack cartons, paper bags) to appropriate retail outlets. BCDL would also provide a financial incentive for retrieving littered containers for their deposit refund. By using market forces, BCDL would operate without appeals to volunteerism, continuous advertising campaigns, or heavy enforcement of antilitter laws. However, BCDL would attack only the beverage container portion of litter; the remainder must be dealt with by other means.

There are two considerations in evaluating BCDL as a litter-control strategy. One is the contribution that beverage containers make to the overall litter problem, and the other is the effectiveness of a deposit system in reducing that contribution. In order to examine these questions, methods of litter measurement and their limitations are first reviewed.

LITTER PRODUCTION AND MEASUREMENT

The rate at which litter is produced varies with the season, with the type of land use (e.g., urban, suburban, residential, commercial, park, roadside), and by region. Litter begets litter: the more litter that accumulates in a place, the more likely are people to litter there. On the other hand, people tend to litter more if they know that cleanup is frequent. Thus, surveying litter at one time by collect-

*Food stamps can be used to purchase soft drinks, but until 1978 could not be used to pay refundable deposits. (43,44) The importance of this factor in stimulating growth of the nonreturnable market share is not known. Food stamps cannot be used to purchase alcoholic beverages.

ing it may affect the results of a subsequent followup survey at the same place at a later time. Not all littering is deliberate; much of it results from improper handling of waste that will be or has been collected. Wind, animals, and uncovered collection and transport vehicles all contribute to the production and redistribution of litter.

There are no agreed upon standard methods for carrying out litter surveys. All are difficult to perform and interpret. Typically, surveys evaluate physical measures such as piece count, volume, or weight. Some use a subjective measure such as esthetic impact. Photometric techniques have also been used, which measure the area of ground covered by the litter. Other approaches weight the physical measures of litter by the degree of degradability or the degree of hazardousness of various items or the cost of collecting them. In all cases, a discrimination must be made between actual litter and naturally occurring objects such as tree branches and stones. For piece count methods, a lower limit of size must be set to avoid overcounting extremely small pieces. In addition to choosing a measurement method, a representative, statistically meaningful sample of the total region to be surveyed must be chosen. Such a sample might consist of randomly selected urban blocks or mile-long highway segments. The report by Syrek for the California State Assembly discusses and illustrates a variety of approaches to litter measurement.(45)

Careful consideration must be given to the selection of a measurement method. For example, in assessing the relative importance in litter of an aluminum can and a glass bottle, each is counted as one item, and they both have about the same volume, but one weighs about 10 times more than the other. Both create the same esthetic blight on the roadside. However, if the bottle is broken, compared with the can or with an unbroken bottle it has a larger piece count, a smaller volume, the same weight, less visibility on the roadside, but is more hazardous to people, animals, and machines. Another example is the relative importance in litter of a steel can and an equivalent weight of paper gum wrappers. The wrappers have a much higher piece count, a greater physical volume, and an equal weight. At the moment of discard the wrappers are more esthetically unattractive than the can, but they degrade quickly and soon can no longer be seen. The can is much easier for litter collection crews to pick up, but if not removed can have a long lifetime in the environment. Compared with the glass bottle, both the can and the wrappers pose little hazard to health, safety, and wildlife.

The apparent significance of beverage containers in litter depends on the measurement technique chosen. Similarly, BCDL can ap pear as if it would have, or has had, a large or a small effect on litter. For example, on a piece-count basis beverage containers are usually outnumbered by pieces of paper. Therefore, using this measurement method even if BCDL were to remove all beverage containers it would appear to have little effect on the total amount of litter. However, the hazard from broken glass would be markedly reduced.

The cost of pickup is not a good measure of the total cost of litter to society. Esthetic blight, safety and health hazards, and lowered property values are all costs of litter that are excluded from pickup costs. Three cases may illustrate the point. A recreational beach may be heavily littered, yet cause little immediate esthetic loss because the people and their gear mask the litter. At the same time, collection costs may be high. Only a tiny fraction of the same litter strewn along a hiking trail may cost little to collect, yet cause considerable esthetic loss. As a third illustration, it may cost the same to collect empty paper cups or bottles from a beach, yet the social cost due to physical injury may be much higher for the bottles. In fact, there is probably little or no correlation between the total costs of litter and the costs of collection.

From these observations, it is clear that any attempt to evaluate the impact of BCDL or of any other program on litter must depend to some extent on subjective judgment. Analysis alone cannot provide an answer. These observations help explain why such differing claims can be made for the impact of BCDL on litter.

BEVERAGE CONTAINERS IN LITTER

Keeping in mind the above noted limitations of surveys and measurement methods, several published estimates of the importance of beverage containers in litter are examined here.

The Maryland State Highway Department surveyed highway litter on seven test sites of 6 miles each in 1974. On September 16 the sites were cleaned, and then resurveyed one month later on October 14. On the later date, an average of 511 beverage containers were collected per mile, or 28.6 percent of all the items collected on a piece-count basis.(46)

A report prepared for the Kentucky Legislative Research Commission in 1975 reviewed 11 surveys of highway litter by both Government agencies and private and volunteer organizations.(47) The contribution of beverage containers to litter by item count ranged from 14 to 51 percent on a "permanent accumulation" basis, and from 15 to 46 percent on areas recently cleaned. One survey in Vermont found that beverage containers account for 90 percent of all litter on a volume basis.(48)

An extensive survey for the California State Assembly on an item count basis found that beverage containers and secondary packaging (excluding pull-tops) comprised 17 percent of all littered items in open highway areas, 18 percent in agricultural areas, and 10 percent in urbanized areas.(45) These results are not comparable to the Maryland and Kentucky findings because the California survey included small items and broken glass on a piece-by-piece basis. The California group found about 200 beverage containers per week per mile of rural road, compared to the 128 per week per mile found in Maryland. A study of highway litter in Oregon found about 7 beverage containers per mile per week with the State BCDL in effect, and about 13 beverage containers per mile per week in Washington, which has a strong litter control act.(49) The California survey also examined litter in recreational areas. No data were given, however, on the portion due to beverage containers.

The EPA has estimated that a total of 4.1 billion beverage containers were littered in 1975.(50) It has been argued that this number is far too high, and that to account for it would require littering the containers for all of the beverages consumed in locations outside homes and commercial establishments. *

IMPACT OF BCDL ON ROADSIDE LITTER: OREGON AND VERMONT

The experiences in Oregon and Vermont provide two, limited data bases on which to judge the expected effect of BCDL on highway litter. Data were gathered on the beverage container content of roadside litter and on the costs of litter control before and after the passage of their deposit laws. These data have been the subject of considerable controversy due in part to sampling errors and to the lack of adequate baseline data and measurement methods. (49,52)

A survey by the Vermont State Highway Department just before and after the deposit law was implemented found a 76-percent reduction in beverage container litter and a 35-percent reduction in the volume of total litter. The same authors report a 31-percent decrease in the cost of litter pickup in Vermont from 1973 to 1977 (pro- and post- law).

In Oregon, thirty l-mile segments of State highways were surveyed by the State Highway Division. Surveys were carried out before the law took effect, during the transition

using the figuer of 150 littered containers Per mile per week based on the California and Maryland surveys and a total of 2.4 million miles of hard surfaced rural road in the United States(51) leads to an estimate of nearly 19 billion littered containers per year on rural roads alone. While this estimate is clearly too high and suggests that the California and Maryland data are not typical of all rural roads, it also suggests that the EPA estimate is not wholly unreasonable.

to the deposit system, and about 1 year after.(54) Litter rates for all items declined by 26 percent from "before" to "transition," and by 39 percent from "before" to "after."* For beverage containers, litter rates declined 72 percent to "transition" and 83 percent from "before" to "after."

Based on these two observations in Oregon and Vermont, as well as on other information, GAO projected a reduction in the beverage container portion of highway litter of 80 percent under BCDL.(56) They further estimated that total highway litter on an item count basis would decline by 7 to 37 percent, depending on whether beverage containers represent a low of 9 percent or a high of 46 percent of all litter. The latter estimate assumes that littering of other items would be unaffected by changed patterns of container littering.

In the analysis of BCDL by RCC, a reduction of total litter volume by 40 percent and a 20-percent reduction in litter item count was projected. Their 20-percent figure is roughly the average of GAO's range of 7 to 37 percent.

EPA projected that under BCDL the number of beverage containers littered in 1980 would decrease by 70 percent to 1.6 billion. Alternatively, using the GAO estimate of an 80-percent drop, and the EPA estimate of total beverage container litter without BCDL, one can estimate that 1.1 billion beverage containers would be littered in 1980.

SUMMARY OF LITTER IMPACTS

The estimates of the significance of beverage containers in litter and of the impact of BCDL on litter in Vermont and Oregon vary widely. Nevertheless, all studies agree that BCDL does or would lead to some reduction in the amount of beverage container litter found on the Nation's highways. No studies are available of the effects of BCDL on urban or recreational area litter. In view of the origins of beverage container litter, it is likely to be reduced more in urban and recreational areas than on highways. Neither estimates of the cost-effectiveness of BCDL as a litter control measure, nor comparisons of the cost-effectiveness of BCDL with alternative approaches to litter control can be made from the available data.(59)

*The Oregon data were re-evaluated by the Wharton School, which calculated declines of 23 and 36 percent respectively for the two periods.

Materials and Energy

BACKGROUND AND SCENARIOS

Several studies have projected the impacts of BCDL on the consumption of materials and energy. These results are reviewed, analyzed, and supplemented in this section.

In the overall production of beverages for market the manufacture of containers consumes the most materials. Lesser quantities are used for secondary packages (six-packs, cartons, cases) and labels as well as for constructing and maintaining capital equipment and buildings.

The use of energy is more diffused throughout the entire beverage delivery system, not only for manufacturing packaging materials and containers but also for transportation, storage, handling, cleaning, and reuse or recycling.

For a given level of beverage sales, the total consumption of materials and energy strongly depends on the market share and the return rate of each container type. In general, producing a refillable bottle requires more materials and energy than a nonreturnable glass or plastic bottle or a metal can of the same size. However, if a refillable bottle is reused a sufficient number of times, this higher resource use is spread out over several trips and the total use of materials and energy per trip is lower, even when the energy required to transport, store, and clean returned containers is included. If the refillable is not reused a sufficient number of times, however, the net consumption of energy and materials would increase under

13CDL. Producing new cans from returned cans rather than from virgin raw materials takes less energy and raw materials even when the energy required to store and return cans is included.

No one has been able to forecast with confidence container return rates and market shares under BCDL. It is the practice to estimate the energy and materials impacts for a reasonable range of these parameters. Some studies identify the critical market share and trippage values below which mandatory deposits would cause an increase in materials and energy use.

Several comprehensive analyses of the impacts of BCDL have been published in the last 5 years. The results of each have been presented in the form of one or more scenarios that describe the conditions that might exist after a law had taken effect. 1n these analyses, each scenario is a set of assumptions about the state of the system under study. (A scenario, which is neither a forecast nor a projection, usually describes a situation that is either extreme, plausible, or typical.)

Significant elements of the 12 scenarios used in 7 studies are summarized in table 63. All of the studies, except the one by the Wharton School, assume that the minimum deposit on all beverage containers is 5 cents. The Wharton School study examines a 5-cent deposit for beer and a 6-cent deposit for soft drink containers, assuming that all are refillable.

Some of the studies do not identify all the elements of the scenarios used. In addition, replication of the results of the studies requires knowledge of the scenarios used to describe the baseline conditions in the absence of legislation, and some of the reports fail to state these assumptions.

MATERIALS

Current Materials Use.—The materials used for containers and closures are glass, steel, and aluminum, with smaller amounts of plastic, paper, and wood. The annual consumption of these materials depends on market shares, return rates, recycle rates for nonreturnable containers, and the weight of materials used in each type of container.

The weights for typical beverage containers of the major types, reported in two key studies, are shown in table 64. The differences reflect the variations among containers used for different brands. Other container sizes are in use, especially for glass nonreturnables. However, it has been shown that the weight of glass required per ounce of beverage delivered is nearly the same for all container sizes .(67] For this reason, calculations of the use of energy and materials can be made with good accuracy using an average container size, In this study, each container type is assumed to have a weight equal to the average of the values in table 64.

OTA estimated the use of glass, aluminum, and steel for beverage containers and compared these results to estimates interpolated from an EPA study, as shown in table 65. Gross tons refer to the weight of all containers produced. Net tons refer to the actual materials used, assuming that various fractions of glass, aluminum, and steel containers are recycled to make new containers. It is not clear why EPA's estimates are higher than OTA'S.

The OTA estimates of gross materials consumed for the production of beverage containers in 1977 are equivalent to 30 percent of the Nation's total annual consumption of glass, 1.3 percent of steel, and 12 percent of aluminum.

The market shares and return rates used to calculate the OTA estimates of 1977 materials use are shown in table 66. According to industry sources, the total consumption of beverages in individual containers in 1977 was 734 billion ounces of soft drinks and 55o billion ounces of beer. (71,72) The total materials use is based on delivering these amounts of beverages to customers.

Future Materials Use for Beverage Containers.—Forecasting the future gross materials use for beverage containers requires forecasting future beverage consump-

Table 63.—Elements of Scenarios Used in Published Evaluations of BCDL

Source	Kind of proposal examined	Date law passed	Date law implemented	Year of scenario	Scenario designation	Return/recycle rates — %: Returnable bottle	Return/recycle rates — %: Non-returnable bottle	Return/recycle rates — %: Cans	Market shares — %: Returnable bottle	Market shares — %: NR bottle	Market shares — %: Steel can	Market shares — %: Aluminum can	Change in consumption of beverages due to law	Technology Change
Department of Commerce (60)	Mandatory deposit	1975	1978	1981	High return rate	90	NA	NA	100	0	0	0	(used 1975)	—
					Low return rate	80	NA	NA	100	0	0	0		—
Environmental Protection Agency (61)	Mandatory deposit	1975	1975	1980	N/A	90	NA	81[a]	80	0	10	0	N	Bottle weights and sizes same as 1975. No plastic bottles.
General Accounting Office (62)	Mandatory deposit	1/1/77	1/1/78	/1/81[a]	Mix I	90	NA	80[c]	48	0	[illegible]	[illegible]	No change	No plastic bottles
					Mix II	90	NA	80[c]	80	0	5	[illegible]	No change	
Hannon (63)	Mandatory deposit	—	—	1970	N/A	87.5	NA	NA	100	0	0	0	—	—
Research Triangle Institute(64)	Mandatory deposit	—	late 1970's	1982	Scenario 1	90	NA	79[d]	58	0	24	[illegible]	Reduced 0.2%	All containers to use less energy over time. No plastic bottles.
					Scenario 2	80	NA	70[e]	79	0	12		Reduced 0.2%	
Resource Conservation Committee (65)	Mandatory deposit	1980	1982		Mix I	90	80	80	40	10	[illegible]	[illegible]	No change	All containers to use less energy over time. Plastic bottle adopted.
					Mix II	92	86	86	60	5	[illegible]			
Wharton School(66)	Ban on cans & nonreturnable bottles, with deposit system.	1969	969	1974	Export bottle[g]	87.5	NA	NA	100	0	0	0	No change[h]	1974 technology used.
					Stubby bottle[g]	87.5	NA	NA	100	0	0	0		

[a]90 percent recycle of the 90 percent of cans returned.
[b]Some results are presented for 1985.
[c]Includes 10 percent reduction to account for processing losses.
[d]87.7 percent of 90 percent to account for processing losses.
[e]87.7 percent of 80 percent to account for processing losses.
[f]Plastic bottle market shares of 10 percent in both mixes.
[g]Wharton considered beer industry adoption of either export (tall-neck) or stubby (short) bottles.
[h]Wharton also examined some impacts of an arbitrary 15 percent reduction in beverage consumption.

Table 64.—Typical Beverage Container Weights in 1975

Container type	Container weight in grams: RTI (68)	Container weight in grams: Wharton School (69)
12-ounce aluminum can	20	20
12-ounce steel can (3 piece)		
Body and bottom (steel).	45	43
Top (aluminum).	5	5
Total.	50	48
12-ounce glass beer		
Refillable	283	297
Nonreturnable.	173	173
16-ounce glass soft drink		
Refillable	481	425*
Nonreturnable.	283	283
16-ounce polyester plastic.	37	—
Steel crown for glass bottles.	2.25	2.17

'Page 128 of volume II of the Wharton School report is apparently In error. To be consistent with other calculations on page 64 of that report, the 16-ounce refillable soft drink container weight should be 15, not 12 ounces

Table 65.—Materials Consumed for Beverage Container Production in 1977

Material	Annual consumption (million tons): EPA 1977' (net)	OTA 1977b (gross)	OTA 1977c (net)
Glass. , ...	7.37	6.52	6.52
Steel	1.59	1 .39d	1.26
Aluminum	0.54	0.64e	0.47

asource OTA interpolation between EPA estimates for 1975 and 1980 (70)
bBased on average container weights in table 64 and 1977 Sales mlx from table
cA~6sumlng recycle rates of Io percent for steel, 25 percent for aluminum O Per” cent for glass
dIncludes 467 billlon steel crown closures weighing 114,000 tons
eIncludes 106,000 tons of aluminum tops on 19.1 bllllon 3-piece blmetal cans

tion, container market shares, return rates, and container weights. Forecasting net materials use (gross use minus amount recycled) further requires forecasting recycle rates by container type for nonreturnable containers.

Several previous studies have addressed this forecasting problem by investigating materials use under two or more scenarios that might be typical of the future. In this study, a mode of presentation has been adopted that illustrates the future use of materials over a full range of system responses.

Table 67 shows the amounts of container materials required to deliver 1 million ounces of beer or soft drinks using containers of current design, if return and recycle rates are both zero. Figures 14 to 20 illustrate how the amounts of steel, aluminum, and glass required to deliver 1 million ounces of beverages per year depend on the market shares and on the return and recycle rates. *

Summary of Materials Impacts.—The current manufacture of beverage containers uses over 8 million tons of materials, mostly glass. Shifts from nonreturnable to refillable bottles can greatly reduce glass use. Shifts from cans to refillable glass would reduce metal and increase glass use. Since glass refillables weigh from 4 to 10 times more than steel cans and 8 to 20 times more than aluminum cans, a shift from cans to glass bottles would increase the total use of materials on a weight basis. A complete shift to refillable glass would free 1.3 percent of the Nation's steel and 12 percent of its aluminum for other uses. Similarly, total glass use would decline, with the amount depending on the trippage achieved.

ENERGY

Energy use in the beverage delivery system has been examined in a manner similar to that used for materials demand. First, detailed computations are made of the amount of energy required to deliver a certain amount of beverage, say 1 million ounces, in each type of container. Next, projections are made of beverage sales, market shares, return rates, and recycle rates, which together provide a basis for calculating the number of containers of each type. Finally, the energy requirements for each container type are totaled to arrive at the requirement for the overall system.

*G]ass use for circumstances not included in figures 17 to 20 can be estimated using these equations, which assume that no glass is recycled.

Gross glass use [tons] to deliver 1 million ounces of heer = [15.!J x [nonreturnable glass market share)] + [26.6 x (1 – return r-ate) x (refillable market share)]

Gross glass usc [tons] 10 rfeliver 1 million oonres of soft drink = [19.5 x (nonreturnable glass market share)] + [31.2 x (1 – return rate) x (refillable market share)]

Table 66.—1977 Container Market Shares and Return Rates

Beverage	Container type	Market share[a]	Ret urn/recycle rate[b]
Beer	Refillable glass	13	0.92 (12.5 trips)
	Nonreturnable glass	27	—
	Steel	19	0.10
	Aluminum	41	0.25
Soft drink	Refillable glass	40	0.90 (10 trips)
	Nonreturnable glass	22	—
	Steel	27	0.10
	Aluminum	11	0.25

apercent by by volume of al packaged beverages sold Source Industry data (71 .72.73)
bOTA estimates based on GAO (41) and RTI (39)

Table 67.—Gross Materials Required to Deliver 1 Million Ounces of Beverage in Each Type of Container

Container type	Material	Gross materials required (tons) Beer	Soft drinks
Refillable glass	Glass	26.6 12 oz.)	31.2 (16 OZ.)
	Steel crowns	0.2	0.15
Nonreturnable glass	Glass	15.9 12 oz.)	19.5 (16 OZ.)
	Steel crowns	0.2	0.15
Steel can (3 piece)	Steel	4.04	4.04
	Aluminum lids	0.46	0.46
Aluminum can	Aluminum	1.84	1.84

Basis Table 64 Assumes recycle and return rates of zero.

Summary of Previous Findings on Energy Use By Container Type.—In the study done by the Wharton School for USBA, the findings of several studies on energy use for various container types were conveniently summarized in a figure reproduced here as figure 21. Each of the studies has included energy required for material production, for container fabrication, for washing, for all forms of transportation and delivery including truck fuel, for heating and cooling of storage space including consumer refrigeration, and energy required for recycling or reuse. Such total energy analyses necessitate the synthesis of data from many sources and are always subject to considerable error. Nevertheless, figure 21 suggests that most authors are in reasonable agreement on the basic facts of beverage container energy use per unit of beverage delivered.

Return Rates and Energy Use: An Illustration.—The energy required to deliver 1 million ounces for each container type can be conveniently divided into two portions: one portion is fixed, independent of return or recycle rate; the other declines as return or recycle rate increases. The fixed portion represents the energy that must be used in every filling for container washing, filling operations, warehousing, shipping, and retailing and storage, as well as the energy used in transportation, reuse, and recycling. For refillable bottles, the variable portion represents the energy required to produce a bottle, distributed over all its trips or fillings. For a nonreturnable bottle or can, the variable portion is the energy required to produce a bottle or can, taking into account that the average energy used decreases as the recycle rate for its materials increases. Even if a con-

Figure 14.—Steel Required to Deliver a Total of 1 Million Ounces of Beer or Soft Drink Without Recycle for Various Market Shares for All Cans and Aluminum Cans

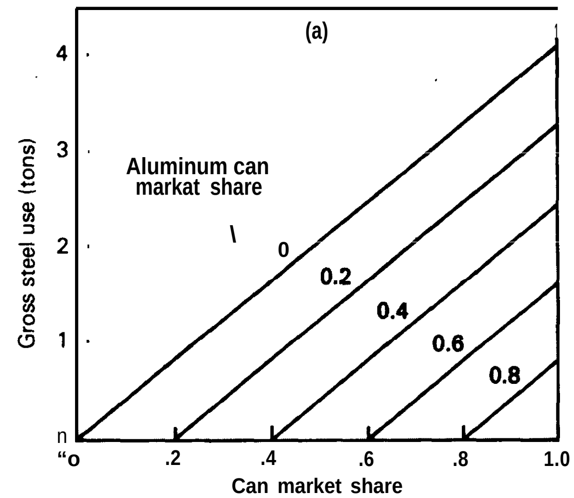
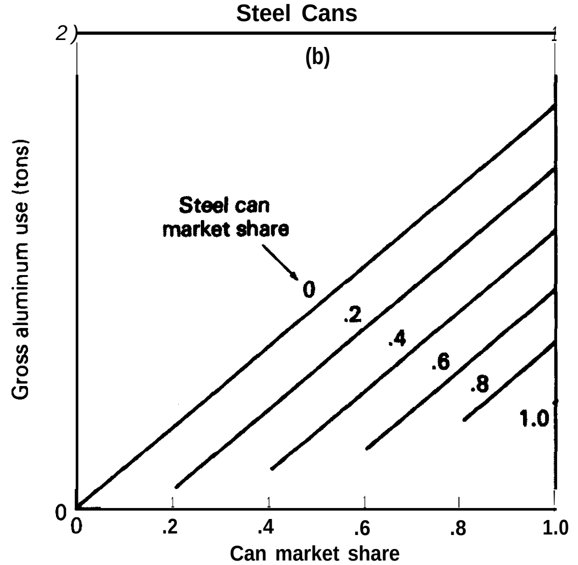


Figure 15.—Aluminum Required to Deliver a Total of 1 Million Ounces of Beer or Soft Drink Without Recycle for Various Market Shares for All Cans and Steel Cans

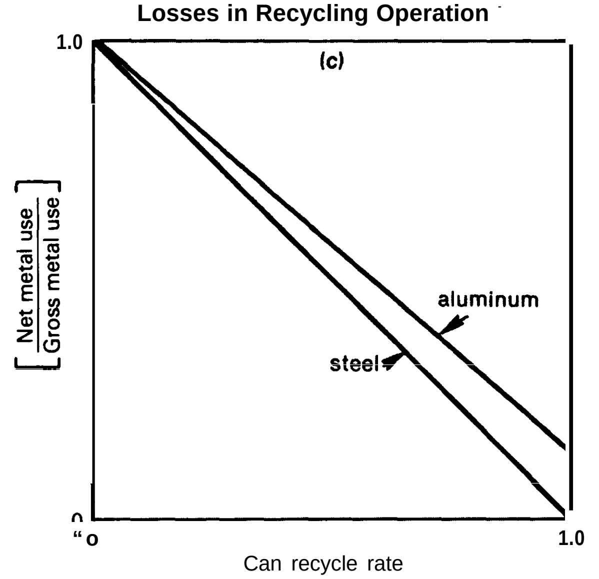


tainer were reused or recycled an indefinitely large number of times, total energy use per fill could never drop below the fixed value required in each cycle.

The following equation expresses the relationship of the energy use to the return rate for beverages in returnable containers:

Total energv use per fill – Fixed energy '[useperfill]' [',e%%%e] x [' -::::rn]

Figure 16.— Impact of Can Recycle Rate on Metal Consumption for Beverage Containers. Recycle Rate for Aluminum is Limited to 87 Percent bv Metal Losses in Recycling Operation



The equation shows that as the return rate approaches 1.0 or 100 percent, the contribution to total energy use of the energy to make a container approaches zero. For a glass refillable bottle, the energy to make a container is typically three times as great as the fixed energy use per fill. Figure 22 shows how the total energy use per fill decreases with return rate, if the fixed energy is 1 unit and the energy to make a container is 3 units.

Figure 22 can be used to help establish a rough relationship between energy use in refillable and nonreturnable bottles. According to table 64, a typical nonreturnable bottle weighs approximately 60 percent as much as a typical refillable. It is reasonable to assume that the energy to make a container is directly proportional to the weight of a glass bottle, and that for a nonreturnable it is therefore about 60 percent of 3 units or 1.8 units. Furthermore, for a nonreturnable, fixed energy use per fill is less than that for a refillable, since return, storage, and transportation energy uses are lower. It is reasonable to assume that fixed energy use per fill would be roughly 50 percent of that for a refiIlable, or 0.5 unit. Thus, total energy use per fill for a nonreturnable might be roughly 1.8 + 0.5 or

Figure 17.–Glass Required to Deliver a Total of 1 Million Ounces of Beer if the Can Market Share Is Zero and No Glass Is Recycled

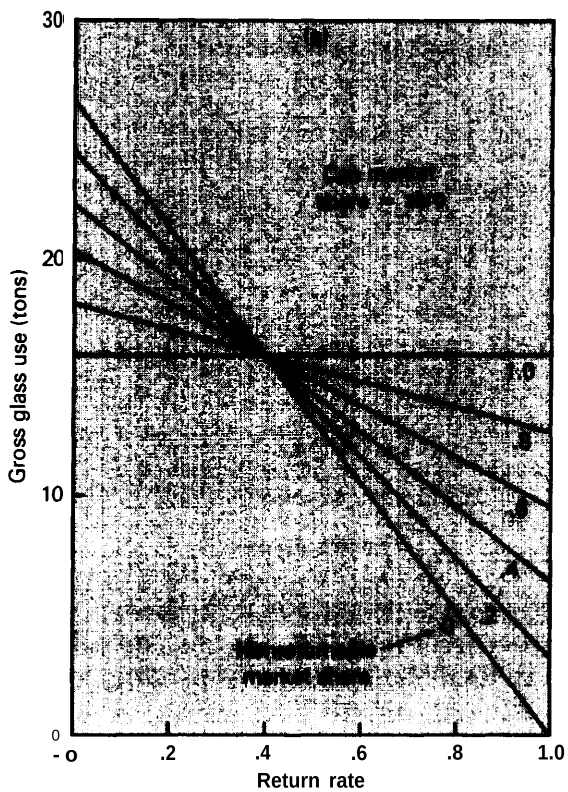
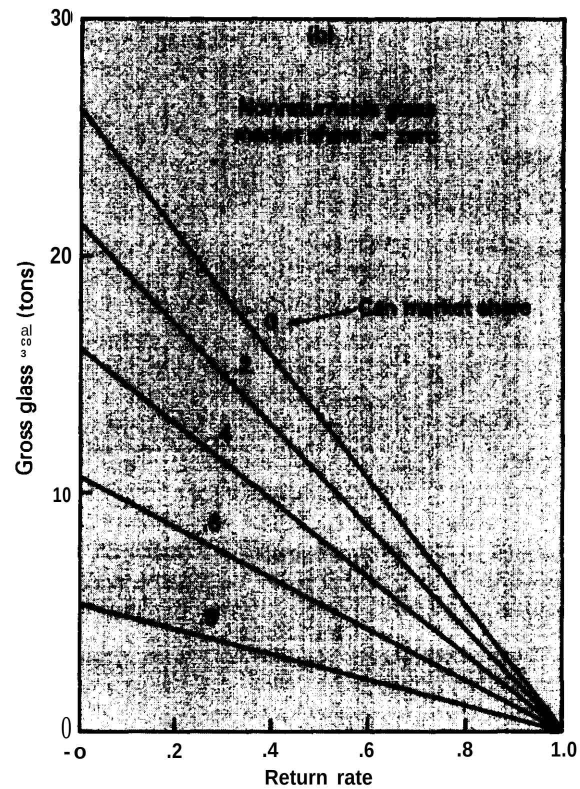


Figure 18.–Glass Required to Deliver a Total of 1 Million Ounces of Beer if the Nonreturnable Glass Market Share Is Zero and No Glass Is Recycled



2.3 units per fill. Comparison with figure 22 suggests that in this case refillable and nonreturnable bottles use the same amount of energy if the return rate is as high as 56 percent (trippage = 2.3). For return rates higher than 56 percent, refillables use less energy than nonreturnables.

Return Rates and Energy Use: The Literature.—Several previous studies have calculated the return rates, or trippages, required for energy use for refillable glass containers to "break even" with nonreturnable glass. These results are summarized in table 68. All authors place the break-even trippage between 1.5 and 3.3. While trippages between 1.5 and 3.3 represent a significant range (return rates from 33 to 70 percent), they nevertheless fall below most projections of return rates under a deposit system. Thus, an all-refillable bottle system would use less energy than an all-nonreturnable bottle system. *

The relative energy use for refillable glass bottles and for nonreturnable, but recyclable, aluminum and steel cans must also be considered. Less energy is required to produce a new can from scrap metal than from virgin ore even if the energy to return the used cans is included. Thus, as recycle rates for cans increase, average energy use per new can declines. In addition, each type of can has different values of both fixed energy use and energy to make a container. To make complete comparisons, therefore, total energy use per ~ill for refillable bottles at various

*Recycling waste glass to make new bottles saves only small amounts of energy. These studies have not taken into account this route to new bottles.

Figure 19.—Glass Required to Deliver a Total of 1 Million Ounces of Soft Drinks in a Mix of Refillable and Nonreturnable Bottles if the Can Market Share Is Zero and No Glass Is Recycled

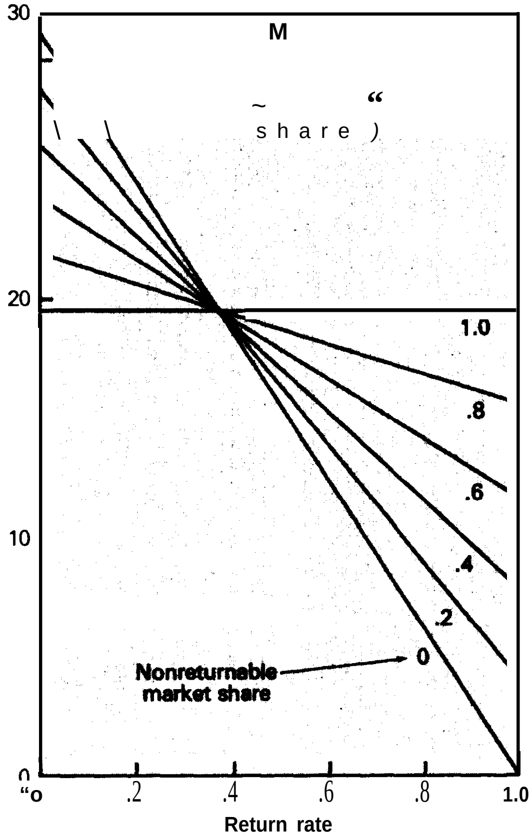
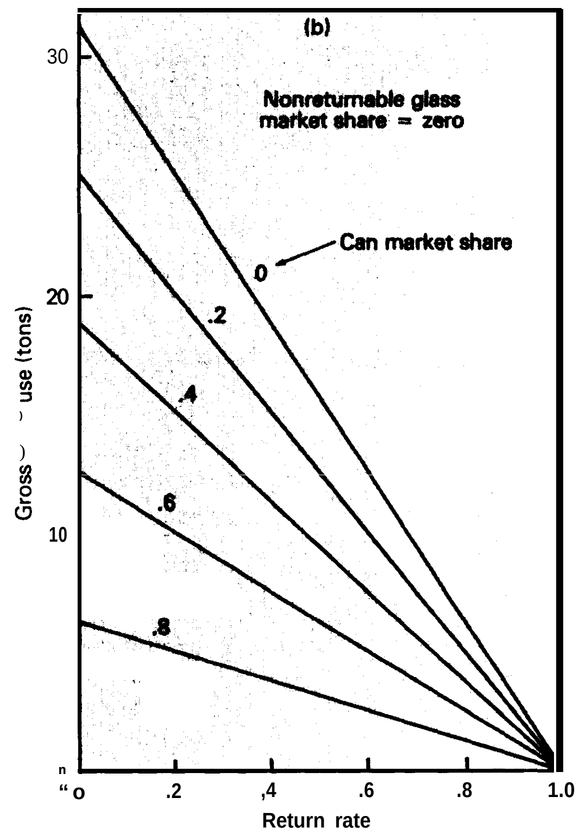


Figure 20.—Glass Required to Deliver a Total of 1 Million Ounces of Soft Drinks in a Mix of Refillable Bottles and Cans if the Nonreturnable Glass Market Share Is Zero and No Glass Is Recycled



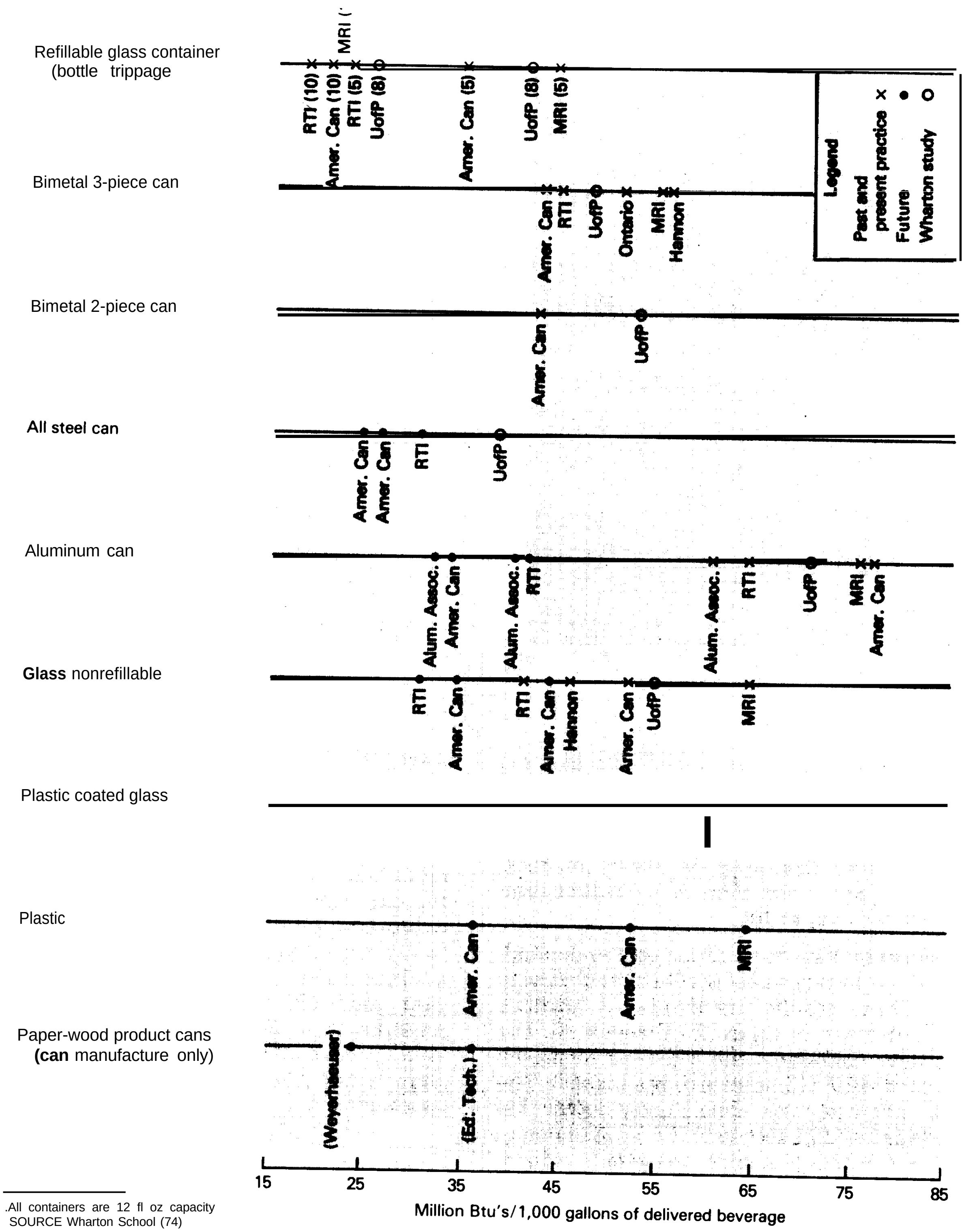
return rates must be compared with that for cans at various recycle rates. Since soft drink bottles typically contain 16 ounces while cans contain 12 ounces, the comparison can be more usefully displayed in terms of total energy use per ounce of beverage rather than total energy use per fill.

Several studies have reported the dependence of total energy use on return and recycle rates. These results are displayed together for comparison in figure 23 through 25. For each beer container, the Midwest Research Institute (MRI) estimates are the highest. The GAO estimates are consistently lower because they are based on RTI's projections to 1985, when it is assumed container technology will be improved. The RTI and GAO projections for recycled cans in 1985 differ somewhat because of GAO's treatment of a technical point in recycling. *

Figures 23 through 25 can be used to identify energy tradeoff points between pairs of containers, for each study. Table 69 shows the can recycle rates that would have to be achieved if total energy use per fill were to be lower than that for refillable bottles, at each of three bottle return rates. Table 69 means that generally aluminum-can recycle rates must be 10 to 20 percent higher than bottle return rates if cans are to use less energy than returnable bottles. Steel cans are unable to compete with glass refillables on an

*GAO assumed that an 80-percent recycle rate would translate to the production of only 70 percent of new cans from scrap due to scrap loss on remelting.

Figure 21 .—Comparison of Total Energy Requirements by Container for Off-Premise Package Beer as Presented by Various Investigations*



.All containers are 12 fl oz capacity
SOURCE Wharton School (74)

Figure 22.—Dependence of Total Energy Use Per Fill on Container Return Rate (schematic illustration)

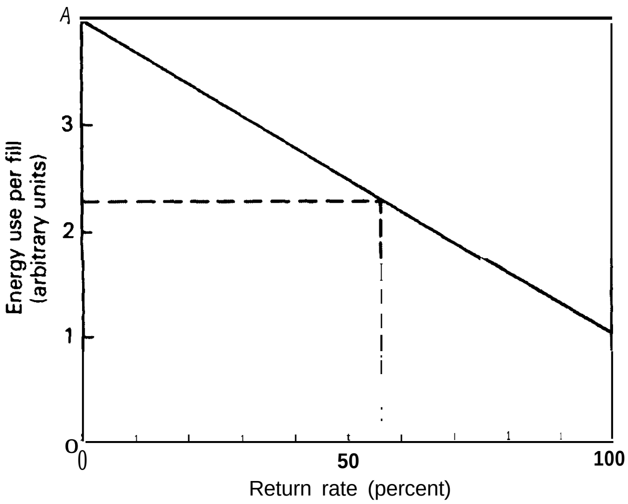


Table 68.—“Break-Even” Return Rates and Trippages for Equal Energy Use in Refillable vs. Nonreturnable Bottles

Breakeven point			
Return rate (%)	Trippage	Source	Beverage type
60	2.5	GAO (75)	—
33	1.5	RTI (76)	soft drink
50	2	RTI (76)	beer
70	3.3	DOC (77)	
62	2.5	Wharton (78)	beer
35	1.5	Wharton (78)	soft drink
50	2	Hannon (63)	soft drink
56	2.3	illustration on page 199	—

SOURCE Office of Technology Assessment

energy basis if bottle return rates exceed 65 percent (or 70 percent for soft drinks according to the Battelle study).

Total Energy Use in the Beverage Delivery System.—Using the background data on per-unit energy use described above, along with projections of beverage consumption, market shares, and return and recycle rates; seven of the BCDL studies estimated current energy use for beverage delivery and/or projected future use with and without deposit legislation. The various estimates and projections are compared in this section.

Figure 23.—Total Energy Use for Beverage Delivery in 12-Ounce Aluminum (—) and Steel (– – –) Cans in Years Noted

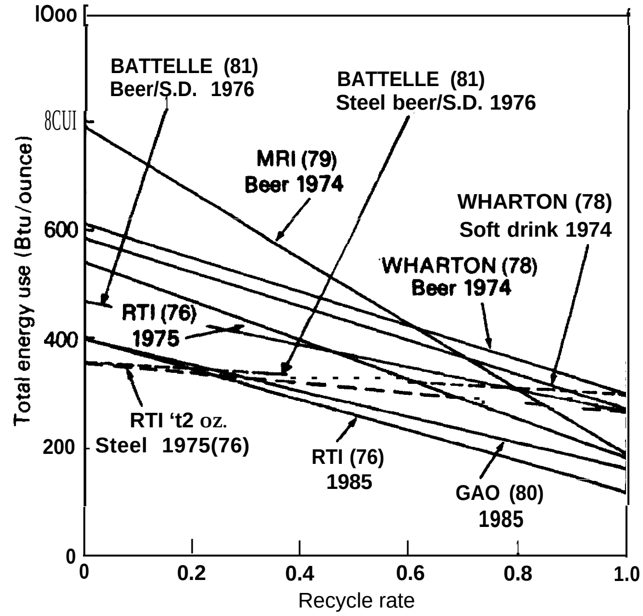
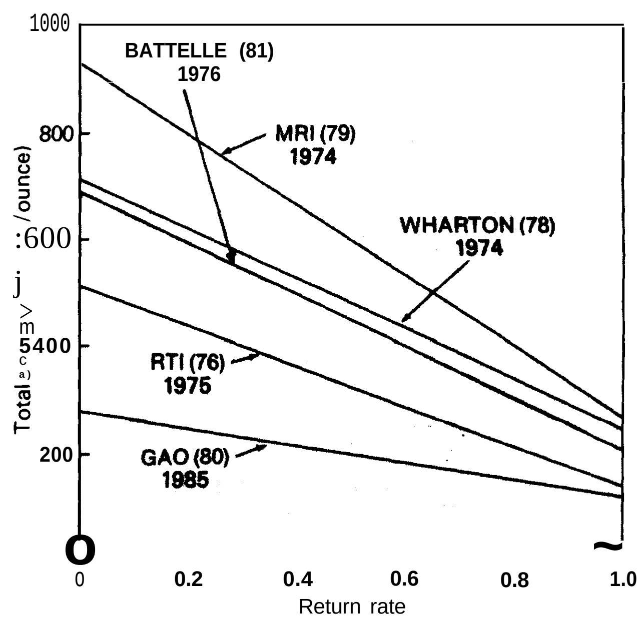


Figure 24.—Total Energy Use for Beverage Delivery in 12-Ounce Refillable Bottles for Beer



All these systemwide energy use calculations attempt to include all energy used for beverage delivery, including materials production, container production, washing, filling, transportation, wholesaling, retailing, and return and recycling. The energy con-

Figure 25.—Total Energy Use for Beverage Delivery in 16-Ounce Refillable Soft Drink Bottles

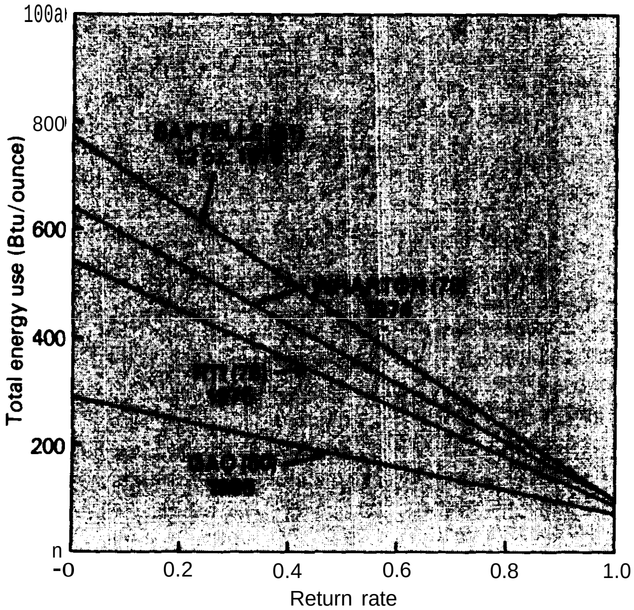


Table 69.-Typical Tradeoffs of Total Energy Use Between Refillable Bottles and Recyclable Cans Using 1974-76 Technology

Study	Bottle ret urn rate	Can rec cle rate for equal Jnergy use	
		'Aluminum	Steel
Beer			
RTI (64)	Toy.	80%	none •
Wharton (66).	70°/0	72%	—
MRI (79).	i'O°/o	!?i4°/o	—
Battelle (81)	70"A	580/0	any* •
RTI (64)	800/0	920/o	none*
Wharton (66).	80%	89%	—
MRI (79). ... , ...	800/0	65Y0	—
Battelle (81)	80Y0	85%	none •
RTI (64)	90%	100!40	none •
Wharton (66).	90Y0	100?40	—
MRI (79).	900/0	750/0	—
Battelle (81)	90?'fo	none	none •
Soft **drink**			
RTI (64)	70940	89Y0	none •
Wharton (66).	700/o	none*	—
Battelle (81)	700/0	900/0	none*
RTI (64)	800/0	100 "/0	none*
Wharton (66).	80Y0	none *	—
Battelle (81)	80Y0	none •	none •
RTI (64)	9o"A	none •	none •
Wharton (66).	90Y0	none •	—
Battelle (81)	90~0	none •	none •

"Total energy use for cans at all recycle rates is higher than that for refillable bottles at this return rate
" .Total energy use for cans at any recycle rate is less than that for refillable bottles at this or lower return rates

sumed by workers and their families in their nonworking life, the energy used by consumers who make special trips from home to retail store to return containers, and the energy consumed by alternative consumer purchases with money saved by buying lower priced beverages (the so-called "re-spending" effect, see page 205), are all specifically excluded.

Table 70 summarizes the findings of seven studies of system energy use under BCDL for various scenarios. The scenarios of the Commerce Department, Hannon, and the Wharton School all assume that only refillable bottles are used. The return rates used range from 80 to 90 percent in these three studies. The EPA, RTI, GAO, and RCC scenarios feature mixes of cans and bottles at various market shares.

The most significant feature of table 70 is the general agreement regarding potential energy savings under a deposit system. The estimates range from 21- to 61-percent savings, clustering around 40-percent savings. The high estimates of 56- and 61- percent savings by the Wharton School and the Commerce Department reflect the assumption that a highly efficient, all-glass refillable system would result from BCDL. The lowest estimate of 21-percent savings by RCC reflects a scenario based on the retention of significant market shares for cans and nonreturnable bottles, and on low estimates of return and recycle rates.

The various studies use different baseline time periods and different baseline values for beverage consumption, market shares, and returrdrecycle rates. Thus, one cannot meaningfully compare the future baseline energy requirements nor the absolute levels of energy use under a deposit law. The estimates for 1975 energy consumption are a more meaningful basis for comparing the various studies, since they are founded on actual industry data or on 1- or 2-year extrapolations

Table 70.—Total System Energy Use for Beverage Delivery: Literature Estimates of Deposit Impact Under Various Scenarios

			Future energy use			
			No deposit law baseline energy use	Energy savings under deposit law		
Source	1975 energy use (10^{12} Btu)	Year	(10^{12} Btu)	(10^{12} Btu)	(% of baseline)	Scenarios
Commerce Dept. (82)	461	?	461	280	61	90 % RR: all refillables
	461		461	181	39	80 40 RR: all refillables
EPA (70)	465	**1980**	585	245	42	90% ret. & recyc. rates: all refillables
GAO (83)	—	**1985**	363	116	32	Mix I
	—	1985	363	155	43	Mix II
Hannon (63).	—	1980	—	—	40	80% RR: all refillables
RTI (84).	358	1982	383	168	44	Scenario 1
	358	1982	383	144	38	Scenario 2
Resource Conservation Committee (85)	—	1985	334		21	Mix I
	—	1985	334	1 ; :	39	Mix II
Wharton School (86).	—	1974	407	147	36	87% RR: all export refills.
	—	1974	407	226	56	87% RR: all stuby refills.

a see table 63 for scenario details

from such data. The Wharton estimate can be included in this group because it is based on actual 1974 statistics. The differences among the studies of the total energy use by the beverage delivery system in 1974/1975 arise from the different estimates of energy used per unit of beverage delivered.

The impact of BCDL on national energy demand can be approximated using the data in table 70. The average of the estimates for energy use by the beverage delivery system in 1975 is 425 trillion Btu (including Wharton's 1974 estimate escalated to 1975 by 3 percent). This is about 0.60 percent of the total national energy use in that year. The studies suggest that 40 percent of the energy used by the beverage delivery system would be saved under BCDL. In 1975, this savings would have been 170 trillion Btu or 0.24 percent of the total national energy use. For perspective, 170 trillion Btu per year is equivalent to 80,000 barrels per day (bpd) of petroleum or to the output of ten 1,000-MWe electric powerplants, or to about one-eighth of the energy supply potential of the Nation's MSW. (See chapter 5.) However, the energy savings estimates range from 20 to 61 percent. This range translates to an overall savings of O.12 to 0.36 percent of national energy demand, or to the equivalent of 40,000 to 120,000 bpd of petroleum.

Types of Energy Saved Under BCDL.—Changes in energy use would differ for various fuel types under BCDL; in fact, use of some forms of energy might actually increase if there were a strong shift from nonreturnables to refillables. Fuel use by source for each type of container has been examined by RTI,(87) Wharton, and Battelle.(81)

RTI estimated that in 1975 the actual beverage delivery system was based on oil (37 percent); coal (29 percent); natural gas (26 percent); and nuclear, hydropower, and wood wastes (8 percent). RTI did not attempt to project the future distribution of energy use by fuel type due to the uncertain nature of future energy markets. However, from data presented on page 27 of the RTI report, the conclusion can be drawn that compared with a lo-trip refillable bottle more natural gas and more coal are used to produce nonreturnable bottles and aluminum and steel cans. Nonreturnable bottles and aluminum cans also require more oil, while bi-metal steel cans require less oil than refillable beer bottles, but more than 16-ounce refillable soft drink bottles at 10 trips. Thus, according to RTI a shift toward a lo-trip refillable system would reduce the use of coal and natural gas, but would have a small effect on oil use, which could go up or down.

Battelle's estimates of the shifts in energy use by fuel type are based on _ete replacement of all cans used in 1~76 with refillable glass bottles that achieve trippages of 4 for off-premise consumption of beer and 10 for soft drinks. (Beverage sales in nonreturnable bottles were assumed to be unchanged.) For this shift, Battelle estimated total energy savings of 67 trillion Btu per year but an increase in oil consumption of 11 trillion Btu, [~quivalent to about 5,000 bpd].(90) However, Battel!e's estimates of energy use are among the lowest for cans and the highest for refillable bottles. (See figures 23 to 25.) Thus, their estimates of fuel shifts may overstate the increase in oil use.

Wharton estimated fuel-specific energy shifts for complete conversion of all beverage containers to refillables in 1974.(88) For a system of 8-trip refillables for both beer and soft drinks, (an optimistic trippage level) they estimated savings in all forms of energy, including oil. For a system of 3-trip refillables (a pessimistic trippage level) they projected savings in all forms of fuel except oil, for which increases in use ranged from 5 to 26 trillion Btu per year (i.e., 2,000 to 12,000 bpd), and natural gas, for which a small increase might occur under a doubly pessimistic outcome,

These three studies together suggest that energy use would decrease under BCDL for each fuel form, with the possible exception of oil. For the case of oil, some of the estimates also suggest a savings. However, Wharton's pessimistic 3-trip scenario shows an increase in oil use, as does Battelle's study. In view of these findings, as well as the current emphasis on fuel switching toward coal in industry and electric power generation, and of the current trend toward more energy efficient transportation vehicles and appliances, the future consumption of energy by fuel type remains clouded at best. The available estimates do not suggest a heavy increase in oil use under BCDL, even though increased fuel use for delivery trucks is included.

Limitations of the Energy Impact Analyses.—Two limitations must be attached to the energy savings estimates presented above. First, the uncertainty in the potential for energy savings of deposit legislation is large. It is unlikely that further modeling efforts can reduce this uncertainty significantly due to the unpredictable nature of the system response in terms of beverage sales, market shares, and recycle/return rates. However, every study has found that energy use in the beverage delivery system would decrease under a deposit system.

Second, reduced consumer expenditures under a deposit system might actually increase total national energy consumption. This might take place if beverage prices decline under a deposit law. Then consumers would have additional disposable income that might be spent on goods and services having a higher energy intensity per dollar than beverage containers. Suppose, for example, that average beverage prices were to decline by I cent per 12-ounce container under a deposit law and that 40 percent of the energy use were saved on average, or about 150 Btu per ounce. The marginal energy savings would then be 12 ounces multiplied by 150 Btu per ounce and divided by 1 cent, or 180,000 Btu per dollar. If prices were to decline by 2.5 cents, the marginal energy savings would be 72,000 Btu per dollar. The average energy intensity of consumer expenditures has been estimated to be about 68,500 Btu per dollar. (91) Thus, if prices decline by as much as 2.5 cents per 12-ounce container and if that 2.5 cents is spent on average personal expenditures, the energy savings from a deposit system might be eliminated. Smaller price decreases than this, however, would not eliminate the energy savings. Of course, if prices of beverages do decline under BCDL, consumers would gain the benefit of greater disposable income. Furthermore, the very idea that beverage prices will decline under a deposit system has been challenged by its opponents. (See page 221.)

Summary of Energy Impacts.—There is broad agreement in all major studies on the amount of energy used to deliver soft drinks and beer. Furthermore, most studies agree on the break-even point for trippage or return rates required in order that refillable bottles use less energy than nonreturnables: generally 1.5 to 3.3 trips. All of these estimates of break-even trippage are on the low side of expectations for BCDL. Similarly, most studies agree that aluminum cans must achieve recycle rates that are 10 to 20 percent higher than bottle return rates in order to break even on an energy basis. Most studies find steel cans unable to compete with refillable bottles on an energy basis at any recycle rate, if bottle return rates are 70 percent or higher.

Seven major studies of BCDL estimate energy savings of 20 to 60 percent, clustered around 40 percent of total system use, or about 170 trillion Btu per year. This is equivalent to 0.24 percent of the total national energy use, or to 80,000 bpd of oil, or to the output of ten 1,000-MWe powerplants, or to the fuel content of one-eighth of the Nation's MSW. The uncertainty in this number is large—it might lie in the range of 20 to as much as 61-percent savings; i.e., from the equivalent of 40,000 to 120,000 bpd of oil.

Most estimates suggest that all forms of fuel would be saved under BCDL, but some studies suggest a small increase in oil use. In no case are large increases in oil use expected, even including truck fuel.

If consumer prices of beverages under BCDL drop by 2.5 cents or more per container, the energy saved by BCDL might be offset by increased consumer expenditures for other purposes. Smaller price decreases would offset only a part of the energy savings.

Finally, all studies project a decrease in energy use for beverage delivery under BCDL. It is unlikely that further analyses or additional studies of experiences in States having BCDL can reduce the uncertainties in these estimates.

Solid Waste Reduction

BCDL would affect the generation rate and the composition of solid waste by changing the amounts of container and secondary packaging materials that are discarded. Eventually, nearly all beverage container materials are discarded as solid waste or as permanent litter. A portion of these discards are recycled into new products. Other parts, especially refillable bottles retired by bottlers and brewers, become industrial waste that is not included in the MSW total, but that may be recycled into new bottles.

In this section, various literature estimates of the impact of BCDL on solid wastes are summarized and compared. In addition, detailed estimates are made of the impact of BCDL on MSW composition and amount under five scenarios that describe possible outcomes of BCDL. These estimates serve as a basis for evaluation of the literature estimates, and as a basis for assessing the interaction of BCDL with source separation and centralized resource recovery.

BEVERAGE CONTAINERS AND TOTAL SOLID WASTE: THE LITERATURE

Table 71 summarizes available estimates from the literature of the impacts of BCDL on the rate of solid waste generation. Estimates of reductions in total MSW due to BCDL range from 1 to 5 percent by weight. Estimates of reductions in weight of beverage container material discards range from 24 to 78 percent. As is the case with estimates of energy use, most authors caution that they present scenarios, rather than predictions of the most likely outcomes.

By any reasonable standard, a reduction of total solid waste tonnage by 1 to 5 percent can be considered as small, but not insignificant. In the near term, this tonnage reduction would be unlikely to reduce the cost of waste collection. However, disposal costs are more likely to be reduced in direct proportion to the

Table 71.—Beverage Containers in Solid Waste: Literature Estimates

Source	Year	Beverage containers in solid waste (million tons)		Percent by weight of MSW		Percent reduction due to BCDL		Comments
		No BCDL	With BCDL	No BCDL	With BCDL	Container materials	Total MSW	
Commerce Dept. (92).	?		(Reduction of 4.8 million tons with deposits)					$X)70 RR:all refill.
EPA (70)	1975	8.8	—	—	—	—	—	—
	1980	10.6	3.4	6	2	69	5	90°/0 RR:all refill.
GAO (93)	1985	10.5	2.3	5.2	1.1	78	4	Mix I
	1985	10.5	3.2	5.2	1.6	70	3.6	Mix II
RTI (94) total	1982	9.4			2.6		3.2	Scenario I
glass	1982	(6.87)	(::;7)	(::;)	(2.6)	(::)	(1.6)	Scenario I
steel	1982	(1.93)	(0.13)	(1.2)	(0.1)	(93)	(1.1)	Scenario I
aluminum	1982	(0.56)	(0.04)	(0.3)	(0.02)	(93)	(0.3)	Scenario I
Resource Conservation	1985	6.3	4.8	3.8	2.9	24	1	Mix I
Committee (95)	1985	6.3	3.1	3.8	1.9	51	2	Mix II

SOURCE: Office of Technology Assessment

reduction in waste load. At $6 per ton for disposal, a 4-percent reduction in the 135 million tons of MSW generated nationwide each year would represent a savings of $32 million annually in disposal costs. At a typical cost of $30 per ton for both collection and disposal of MSW, the maximum savings would be $160 million per year. This estimate does not depend on whether collection is done by municipal employees or by private firms.

IMPACT OF MANDATORY DEPOSITS ON WASTE COMPOSITION

BCDL would change not only the amount but also the composition of MSW because the discard rates for glass, steel, and aluminum would be altered. This alteration in composition might cause the potential revenues from the recovery of materials from waste by either source separation or centralized resource recovery to change. This section presents estimates of the range of composition changes that might be expected on a nationwide basis.

This analysis has four important limitations. First, the content of glass, steel, and aluminum in MSW varies widely from place to place, so nationwide estimates may be inadequate for evaluating local effects. Second, beverage container contributions to solid waste depend markedly on market shares and return rates, even within reasonable ranges of expectations for the future. Third, technologies for separating out marketable aluminum and glass in centralized resource recovery are still developmental at best, and the economics of separate collection of cans and glass are often marginal. For these reasons, it is optimistic to attribute any net revenues to the recovery of container materials, other than steel from resource recovery. Finally, as a first approximation, it is assumed in this analysis that all materials used to produce beverage containers eventually become solid waste discards that are either recycled or disposed of. This assumption overstates the content of each material in solid waste by a small, unknown amount, since it includes containers that are littered or otherwise lost from the system.

In this analysis the impact of BCDL on waste composition is examined as if such legislation had been in effect in 1975. Noncontainer waste materials (both "gross discards" and "net disposed of") are assumed to be the same as those reported by EPA for 1975 as shown in table 72. Beverage sales in individual containers in 1975 are assumed to be unchanged by the deposit law. They are 594 billion ounces of soft drinks and 517 bil-

Table 72.—Non.Beverage Container Contents of MSW in 1975
(million tons)

Material	Gross discards	Net waste disposed of
Paper	44.1	37.2
Glass*	7.4	7.2
Ferrous metals*	10.0	9.5
Aluminum*	0.5	0.5
Other metal	0.4	0.4
Product organics	14.9	14.7
Food and yard waste	48.8	48.8
Misc. inorganic	1.9	1.9
Total	128.0	120.2

'Does not-lnlcude beverage container portion of these materials
SOURCE Adapted from EPA data (96)

lion ounces of beer. (71,72) Individual container weights are those given in table 67. (The container portion of MSW calculated in the following paragraphs is different from the values reported by EPA.(96))

Several scenarios are examined to illustrate how the effects of deposit legislation depend on return rates and market shares. These include a baseline case with no BCDL and four scenarios with BCDL in effect. The scenarios are described in table 73. Scenario I is the baseline, designed to represent the actual situation in 1975. Scenarios II and HI, based on an all-refillable glass system, are designed to show the effects of the complete disappearance of aluminum and steel beverage containers. For these two scenarios, glass waste is estimated for both 80- and 90-percent return rates. Scenarios IV and V illustrate high and low market shares for cans. Under the high can share of Scenario IV it is further assumed that the remaining refillable bottle purchasers will be more consistent returners (RR = 90 percent) than they would be under the low can share situation (RR = 80 percent). In either case, under the deposit system, can recycle rates are assumed to be 10 percent lower than bottle return rates to account for material losses in the recycling process and for the expected tendency of can customers to make fewer returns.

Using the assumptions of the five scenarios, the beverage sales estimates, and the methods and data of pages 194 and 195, the gross discards and net disposal rates for glass, steel, and aluminum containers were calculated. These results are presented in table 74. The calculated percentage decreases in beverage container materials in MSW are in general agreement with the literature scenarios in table 73.

The composition of MSW under each of the scenarios was also estimated. These results are presented in table 75 for the "net disposed of" situation, since it is more likely to be representative of the composition of curbside MSW than is "gross discards. "

For the five scenarios, BCDL is estimated to remove at most ST percent of the aluminum, 11 percent of the ferrous metal, and 36 percent of the glass, although not all three at the same time. The impact on ferrous metal content is small because only about 11 percent of all the ferrous metal in MSW comes from beverage cans. The glass and aluminum percentages are larger because beverage containers make up about 47 percent of all the glass and 40 percent of all the aluminum in MSW. In Scenario II, for an all-refillables system with an 80-percent return rate, the glass content of waste increases by about 2 percent. For an all glass refillables system with a 70-percent return rate, glass content of waste would rise by 25 percent to 17 million tons. However, this low return rate is less likely than the 80 or 90 percent used in Scenarios IV and V.

The impacts of the change in waste composition on both source separation and resource recovery depend on projections of the efficiencies of materials recovery and on net unit revenues from materials sales. These impacts are addressed in detail in chapter A for source separation and in chapter 6 for resource recovery, based on the scenarios in table 75. It is estimated in these chapters that successful BCDL might cause a revenue loss of 4 to 5 percent for a resource recovery plant optimized before the legislation takes effect, and a maximum revenue loss of 25 percent for a residential source separation program.

Table 73.—OTA Scenarios for Estimation of the Impact of Deposits on Solid Waste Composition in 1975

		Market shares					Returnlrecycle rates				
		Scenario					Scenario				
Beverage	Container type	I	II	III	IV	V	I	II	III	IV	V
Beer	Steel	28	0	0	30	lo	0.10	—	—	0.80	0.70
	Aluminum	32	0	0	40	20	0.25	—	—	0.80	0.70
	Refillable glass	16	100	100	30	70	0.927	0,80	0.90	0.90	0.80
	Nonreturnable glass	24	0	0	0	0	0	—	—	—	—
Soft drink	Steel	27	0	0	30	10	0.10	—	—	0.80	0.70
	Aluminum	5	0	0	20	20	0.25	—	—	0.80	0.70
	Refillable glass	47	100	100	[redacted]	70	0.905	0.80	0.90	0.90	0.80
	Nonreturnable glass	21	0	0		0	0	—	—	—	—

Scenario I Baseline 1975. 0 deposit law
Scenario II All refillable glass, 80-percent return rate
Scenario III All refillable glass, 90-percent return rate
Scenario IV High can market shares
Scenario V Low can market shares

Table 74.—Beverage Containers in MSW Under Five Scenarios in 1975 (million tons)

	Gross discards [a]					Net disposed of [b]				
	Scenario					Scenario				
Material	I	II	III	IV	V	I	II	III	IV	V
Glass	6.33	6.46	3.23	1.35	4.52	6.33	6.46	3.23	1.35	4.52
Aluminum	0.46	0	0	0.69	0.42	0.33	0	0	0.13	0.12
Steel	1.28	o	0	1.33	0.44	1.15	0	0	0.27	0.13
Total	8.07	6.46	1 2 3	3.37	5.38	7.81	6.46	3.23	1.75	4.77
Percent drop in total from scenario I	—	20	60	58			17	59	78	39

a No recycle of used glass, aluminum, ors beverage containers
b includes recycle of aluminum and steel cans at the rastes shown in table 73

Table 75.–Composition of MSW in 1975 Under Five Scenarios [“Net Waste Disposed Of”]

	Amount (million tons)					Weight percent				
	Scenario					Scenario				
Material	I	II	III	IV	V	I	II	III	IV	V
Paper	37.2	n.c. •	n.c.	n.c.	n.c.	29.0	29.4	30,1	30.5	29.8
Glass	13.5	13.7	10.4	8.6	11.7	10.5	10.8	8.4	7.0	9.4
Ferrous metal	10.7	9.5	9.5	9.8	9.6	8.4	7.5	7.7	8.0	7.7
Aluminum	0.8	0.5	0.5	0.6	0.6	0.6	0.4	0.4	0.5	0.5
Other metal	0.4	n.c.	n.c.	n.c.	n.c.	0.3	0.3	0.3	0.3	0.3
Product organics	14.7	n.c.	n.c.	n.c.	n.c.	11.5	11.6	11.9	12.0	11.8
Food and yard waste	48.8	n.c.	n.c.	n.c.	n.c.	38.1	38.5	39.5	40.0	39.1
Misc. inorganic	1.9	n.c.	n.c.	n.c.	n.c.	1.5	1.5	1.5	1.6	1.5
Total*	128.0	126.7	123,4	122.0	124.9	99.9	100.0	99.8	99.9	100.1

Basis: Tables 72 and 74.
•No change
“Total percents do not add to 1000 due to rounding

BCDL AS A SYMBOL OF CONSERVATION

The fourth objective of BCDL supporters is to establish such a law as a symbol of natural resource conservation. The importance of working towards or achieving such a symbol cannot be judged objectively. Because the deposit law issue has been argued so widely at local, State, and national levels, many citizens and decisionmakers have taken strong positions pro and con.

By any objective measure of materials and energy conservation, the attention given BCDL has outweighed its potential for resource savings compared with other conservation approaches. Such measures as auto gasoline mileage standards, appliance performance labeling, and thermal performance standards for buildings can save more energy. By leading to reduced auto weight, auto mileage standards can also save more materials than can BCDL.

The symbolic importance of BCDL as a conservation measure has two identifiable subjective bases. Litter is the first of these; beverage containers make a uniquely visible and hazardous contribution to litter. The second is that to some people beer or soft drinks are unnecessary or undesirable products. For them, not only do containers create litter and waste resources, but they also symbolize a waste of money and human resources as well. Perhaps it is not surprising then, that deposit laws have received so much attention.

It is, of course, understandable that BCDL has strong opponents. If such legislation were passed, various groups expect to lose profits, income, or jobs. Reductions in the use of materials and energy mean declines in the outputs of various industries and thus job losses in them, even as jobs would be gained in beverage production and delivery. Costs of beverage distribution would increase at the wholesale and retail levels, and decline in bottling and brewing. The uncertainties about the extent and incidence of direct economic losses and gains are perhaps as important as the losses and gains themselves. Since no one has been able to demonstrate conclusively whether shelf prices will go up or down (see page 221), proponents and opponents emphasize decreases and increases respectively in order to influence voter attitudes in referenda on BCDL. The following section examines some of the impacts, losses, and gains in detail.

Unintended Effects of BCDL: Impacts, Issues, and Options

Introduction

It is widely recognized that BCDL may have unintended impacts in addition to effects on litter, energy, materials, and solid waste. 1n this section, a number of these impacts are examined in order to assist in decisions about whether the benefits of BCDL are worth the costs, and in order to identify potential actions that might be taken if BCDL were passed.

These impacts have several salient characteristics. First, since the purpose of BCDL is in part to internalize some of the external costs of container production and use, it follows that some of the impacts are redistributive in character. 1n other words, in comparison with the situation without deposits, some parties will be better off and some worse off under BCDL. This is especially true in the case of labor impacts—some new jobs are created but others are lost.

Second, assessment of many of the impacts is highly uncertain, either because their determination requires making the same somewhat arbitrary assumptions about system responses to BCDL that were made in assessing its effectiveness, or because the impacts are qualitative and predicting their nature and degree is necessarily judgmental.

Third, the impacts are largely unintended; that is, proponents of BCDL do not intend that they should occur. Thus, proponents and opponents alike presumably have a strong interest in ameliorating those impacts that adversely affect various groups. Because

BCDL represents a change in the rules of the economic game, there is reason not to penalize those whose gains under the old rules may be threatened by the new ones. On the other hand, the parameters of economic life change frequently for many reasons. It is, therefore, important to retain incentives in the economic system to motivate people to make effective adjustments to new conditions.

In the subsequent sections, impacts, issues, and options are discussed in eight areas:

1. capital costs of production and delivery of beverages,
2. employment and wages,
3. costs and prices,
4. beverage availability and consumption,
5. environment,
6. health and safety,
7. new technology, and
8. government

Existing analyses by various parties are used, where available, as a basis for the discussion. Quantitative predictions are compared with respect to assumptions and findings, following the approach used in the previous section on the effectiveness of BCDL. Six major sources of such information are studies by RTI,(64) the Wharton School, the Department of Commerce (DOC),(60) GA0,(62) EPA,(61) and RCC.(65)

Capital Costs of Beverage Delivery under BCDL

INTRODUCTION

The delivery of beer or soft drinks in refillable bottles requires a greater capital investment than delivery of the same amounts of beverage either in nonreturnable bottles or in cans. This is true for several reasons: (i) can-filling lines are less expensive, more productive, and physically smaller than are bottle-filling lines, (ii) cans and, to a less extent, nonreturnable bottles are lighter and smaller than refillables, and (iii) nonreturnables avoid the costs of plant, equipment, and vehicles required for storing and returning used containers.

Under BCDL, the expected shift toward refillables would thus require a greater capital stock* than would have been required in the absence of such a law. Calculation of this difference has proven to be conceptually and practically difficult, as has its interpretation in terms of additional annual investment and production cost per fill. There is disagreement over the correct typical price of various capital equipment and plant items such as filling lines, bottle washers, storage space, and delivery vehicles. Furthermore, the productivity of such plant and equipment is treated differently by different authors. The degree to which existing capital stock for nonreturnables can be converted to use for refillables has been disputed, as have the costs of such conversions. In addition, it has not been shown that firms in the relevant industries use minimum capital investment as a strategic objective, so calculations based on optimum utilization of capital may be unrealistic. Finally, there is disagreement over the proper bounds on the industries and the items to be included—some authors treat expenditures for refillable bottle inventory, or "float," as a capital cost, while others treat float as a recurring expense. Some authors include changes in the capital investment required for producing container materials and for fabricating containers, while others do not. In analyzing changes in the total costs of beverage delivery under BCDL, ignoring the capital requirements of the container and material producers is equivalent to assuming that the prices paid by brewers and bottlers for containers would not be affected by BCDL. Under any outcome of BCDL, the output and capital requirements of can producers would decline. Bottlemakers would suffer a large decline in output and would convert some capacity from making nonreturnables to making refillables.

*Capital stock is the undepreciated dollar value of all the plant and equipment required to put in place the capacity to deliver a given amount of products each year.

CAPITAL STOCK NEEDS PER UNIT OF OUTPUT

RTI presented the data in table 76 on the capital stock used by various industries and subindustries in order to deliver 1 million ounces per year of beer and soft drinks in each of three container types.(gT) From table 76 it can be seen that refillable bottles require more capital stock for brewers, bottlers, distributors, and retailers. On the other hand, container producers require more capital stock for nonreturnables since several times more nonreturnable containers are needed than refillables.

Industry sources have criticized RTI's unit capital requirements, but have not provided equivalent data that could be presented here. * In their review of RTI's report for USBA, R. S. Weinberg and Associates suggested that based on a survey of brewers, $17.50 to $22.50 might be a reasonable estimate of investment per annual barrel of capacity needed to convert to delivering beer in refillables. Twenty dollars per annual barrel is equivalent to $5,040 per million ounces per year, as compared with RTI's estimate of $5,422 per million ounces per year required for brewers and wholesalers to build new refillable capacity. Since it came

*The Wharton School study for USBA is based on alternative cost data, but the presentation of the data does not include an equivalent summary nor can it be easily extracted from their report. The DOC and RCC studies provide no such data, (60,65) GAO used the RTI data,(62)

Table 76.—Capital Stock Required to Deliver 1 Million Ounces of Beverage Per Year in 1982

	Capital stock (1974 dollars)		
	Refillable bottle system	Nonreturnable bottle system	Metal can system
Beer system			
Brewers and wholesalers	$5,422	$3,713	$2,974
Filling lines	(1,519)	(1,123)	(774)
Production and distribution space	(2,210)	(1,404)	(1,162)
Distribution equipment	(1,200)	(848)	(768)
Other	(492)	(338)	(270)
Retailers*	1,325	—	495
Equipment	(87)		
Space	(1,238)		(195)
Container producers	284	2,850	1,089
Total	$7,031	$6,563	$4,558
Soft drink system			
Soft drink bottlers and canners	$5,827	$4,229	$2,774
Filling lines	(2,679)	(1,993)	(940)
Distribution space	(1,188)	(836)	(704)
Distribution equipment	(1,200)	(848)	(768)
Other	(760)	(552)	(362)
Retailers*	1,325	—	495
Equipment	(87)	—	
Space	(1,238)	·	(195)
Container producers	596	1,697	1,107
Total	$7,748	$5,926	$4,376

* Retail space and equipment required for handling returned containers
SOURCE RTI (97)

from a survey of brewers who were asked how much it would cost them to convert under BCDL, there may be an upward bias in Weinberg's estimate.

CAPITAL IMPACTS OF BCDL

Four ways could be used to estimate the impact of BCDL on capital needs and costs in the beverage delivery system. In each case, the length of the transition period from the passage of BCDL to full implementation is an important parameter. With longer transition periods there is more opportunity for firms to replace or to decommission equipment as it reaches the end of its useful life, rather than prematurely.

An estimate of the lower bound on the capital costs of conversion to BCDL can be obtained by subtracting the total capital stock required without BCDL to produce the industry output in some future year from that required with BCDL. The difference is the extra capital investment required by BCDL. The total capital stocks required for each of the two cases are estimated by multiplying the unit capital stock requirements in table 76 (or their equivalent from another source) by the total beverage consumption and by market shares for each container type; followed by summing up the requirements for the three kinds of containers. The problem with this approach is that it assumes that all existing capital can be converted or liquidated at no cost. Since this is not the case, this method gives capital impacts that are too low.

A better estimate of the capital costs of conversion can be obtained by taking account of the fact that not all of the capital stock that would be used without BCDL can be converted for use with BCDL. For example, for most scenarios, the market shares of cans will decline under BCDL. Thus, some portion of capital stock in can-filling equipment will be retired from service early and be written-off as a loss, and it will have to be replaced with bottle-filling equipment. This shift makes the investment in new capital larger than the first estimate.

A third approach to estimating the capital costs of the transition to BCDL would be to ask firms what costs they anticipate. Besides the incentive for firms to overstate such costs in order to emphasize the negative effects of BCDL, it would be most difficult to obtain a clear picture of the future scenarios implicit in such estimates. The Wharton School used this approach in cooperation with R. S. Weinberg and USBA.(99) Their task was simplified by the stated assumption that all cans and nonreturnable bottles would be banned under the proposal they studied.

An even better estimate might be made by taking into account the uncertainties that industrial managers would face during a transition to BCDL. Since they cannot foresee with confidence what the market shares and beverage sales will be under BCDL, managers are unlikely to make perfect investment decisions. To ensure their ability to meet demands, they might overinvest in new equipment. On the other hand, in the face of an uncertain future they may choose to underinvest, and to meet changed demands by operating with higher utilization of existing refillable capacity until the nature of the new sales pattern is clarified. Other factors that might be taken into account include abnormal increases in capital equipment prices in the face of a surge of demand caused by BCDL, as well as the possibility that less expensive conversion technologies might be developed to facilitate the transition. It is not clear whether this improved estimate would be higher or lower than any of the first three.

Table 77 presents a summary of estimates of the capital cost impacts of BCDL from the literature. This table also shows the length of the transition period, the year the transition would be completed, the method used for the estimate, and indications of the scenarios used.

The range of estimates in table 77 is so wide as to preclude any suggestion that there is a consensus. The Wharton School and Department of Commerce estimates are obviously too high for BCDL because they are based

Table 77.—Estimated Additional Capital Costs Due to BCDL: Literature Values[a]

Source	Additional capital costs of BCDL (million dollars) Total	Beer	soft drinks	Other	Estimating method	Transition time (years)	Year of cost estimates	Scenario[b]
Deparment of Commerce (100).	1,970-2,990	1,700-2,610	270-380	15-20[f]	industry testimony	3-4	1975	all refillables
	–	—	600-1,000'	—		—	—	—
EPA (101)	1,780d	1,235e	545'	—	gross costs	several	1975	800/0 refillables
	1,915	254	272	1,376	early writeoffs	several	1975	800/0 refillables
RTI (102).	824	604	897	-6769	lower bound	4	1974	Scenario I
	2,006	1,067	1,314	– 3749	lower bound	4	1974	Scenario II
GAO (103)	818	342	476	– 5g9	adjusted	3	1974	Mix I
	2,448	1,387	1,061	– 1139	lower bound	3	1974	Mix II
Wharton School (104)	3,500	2,252'	1,248'	—	lower bound &	5	1971-73	Export bottle
	3,165	1,952'	1,213e	—	industry survey	5	1971-73	Stubby bottle

[a]All estimates exlude cost of assitional refillable Container inventory, or float
[b]see table 63 for details of scenarios
[c]Industry critique of Department of Commerce estimate (100)
'Includes "float "
[e]Retall costs divided equally between beer and soft drinks
'Vending machines
9Container producers

on a transition to an all-refillable bottle system. On the other hand, the RTI and GAO* estimates are too low since they are "lower-bound" values that overstate the degree to which existing capita] can be converted to different uses. More realistic estimates might be derived from the RTI data by adding the costs for the beer and soft drink industries without subtracting the negative capital costs they attributed to the decrease in output in the container industries. This calculation gives total costs of $1,501 million and $2,381 million for RTI's Scenarios I and 11 respectively,

Table 77 suggests that the capital costs of BCDL to brewers, bottlers, distributors, and retailers might range from $2 to $3 billion, distributed over 3 to 5 years. This implies an annual rate of additional capital investment due to BCDL of $0.4 to $1.0 billion per year. By contrast, EPA reports that these industries were investing in new capital at the rate of $0.4 to $0.6 billion per year during the period I970-75.(1o1) Assuming that this rate would have prevailed without deposit legislation, then as a rough estimate, BCDL might require a doubling of the rate of capital investment in these industries for a 3- to 5-year period. Beyond the transition period, capital costs per unit of output would continue to be larger due to the higher investment per unit required to support industry growth.

*GAO did make some unspecified adjustments to account for limits on the conversion of existing equipment.(105)

A further consideration related to capital stock impacts is the cost of additional refillable container inventory, or float, necessary to support the system under BCDL. Estimates of the additional cost of float during the transition to BCDL range from $1.0 to $1.6 billion. As GAO notes, however, this cost is very much lower than the savings from not purchasing nonreturnables during the same period.

The energy saved by BCDL will reduce the need for new capital equipment for energy supply, conversion, and distribution. A previous section estimated energy savings under BCDL in 1975 equivalent to 40,000 to 120,000 bpd of oil. Recent estimates for the capital investment needed to produce a new supply of energy range up to $3,000 for coal, up to $10,000 for oil and gas, and up to $100,000 for electric power per bpd of oil equivalent.(106) At $10,000 per bpd, the 40,000- to

120,000 bpd” equivalent saved by BCDL translates to capital cost savings in the energy supply industries of $400 million to $1.2 billion. While this estimate could be carefully refined to reflect the fuel mixes needed under different scenarios, this approximation suggests that capital savings in the energy supply industries could be a significant fraction of the additional capital costs in the beverage delivery industries.

POLICY OPTIONS FOR CAPITAL IMPACTS

The two major kinds of capital-related impacts that might occur under BCDL require different kinds of policy responses. The can- and bottle-making firms may undergo considerable dislocations; some would cease growing and some would suffer very large, and perhaps fatal, sales decreases. Labor contracts in the container industry could put a heavy burden on firms for income maintenance in the face of plant shutdowns or layoffs. At the same time, the beverage delivery industries may be faced with the problem of raising large sums for new investment in an uncertain business environment.

For the container-making industries, policy options include financial assistance through direct grants, Government purchase of plant and equipment, accelerated capital depreciation, or assistance for plant modification to produce new products. (Complementary assistance to employees is discussed in a later section.)

The problems of the container industries could also be ameliorated by insuring that the transition to BCDL is gradual by providing for an implementation period of 2 to 4 years. This strategy would allow a more orderly redirection of company effort. However, it maybe ineffective if firms choose to delay the changeover in the hope that BCDL would be repealed prior to its implementation.

Policy responses to the investment problems of the beverage delivery industries (brewers, bottlers, wholesalers) would be somewhat different from those for the container industries. The uncertainties of both the regulatory environment and the response of the delivery system to BCDL might make investors wary. For example, if a firm were to purchase expensive bottle-filling equipment for refillables under BCDL, and if the new law were subsequently modified in response to political pressure, that firm would be left holding costly, unused equipment. Thus, such investments might appear to be imprudent if the political climate seems uncertain.

Under these conditions, some form of risk sharing by the Federal Government might be appropriate through, for example, loan guarantees, interest subsidies, or cost sharing. Such programs must be designed and administered in a way that avoids stimulating overinvestment while remaining fair and not overburdensome for participating firms.

The needs of small retail stores that depend heavily on beverage sales must be given careful consideration, since they often lack adequate storage space. Some State laws have allowed special beverage container redemption centers to be setup to help relieve the storage problem of small stores. The difficulty with this approach is that it may create a new barrier to the convenience of container return for purchasers, while at the same time weakening the sales base of small stores. In view of these drawbacks and the administrative costs of certifying official redemption centers, it maybe more desirable to let such centers emerge, if they will, as responses to market needs rather than through legislation.

Impacts on Employment and Labor Costs

BCDL would increase both the size of the labor force and the labor costs associated with beverage delivery, while redistributing jobs away from container manufacture toward container handling. Jobs would be shifted geographically from regions where containers are manufactured to regions where beverages are produced and sold. This section summarizes and compares the published evidence of BCDL’S impacts on labor and wages, and discusses related policy issues and options.

UNIT LABOR REQUIREMENTS FOR BEVERAGE DELIVERY

RTI estimates (107) of labor requirements to deliver 1 million ounces of beverages in each of four container systems are reproduced in table 78. Like their unit capital stock estimates, these labor needs have been challenged; however, equivalent alternative estimates have not been made available.

The RTI estimates contain some unexplained omissions; in particular no retail labor is attributed to nonreturnable bottles and cans. In the RTI study, the retail labor for refillable bottles is the extra labor required to manage returns. To be consistent, however, some extra labor should also have been attributed to the recycling of cans. Because of these omissions RTI probably underestimated the number of new jobs that would be created in the retail sector under BCDL.

Within the limitations noted above, the RTI estimates suggest that beverage delivery in refillable containers requires 47 to 86 percent more labor than delivery in nonreturnable bottles and cans. Furthermore, they show that the increased use of refillables would lead to a gain in jobs in all phases of beverage production and distribution. Job losses would occur in the materials and container manufacturing industries.

JOB SHIFTS, GAINS, AND LOSSES UNDER BCDL

Several studies have estimated the size of job shifts, gains, and losses that might occur under BCDL for various scenarios. It is important to differentiate between a job shift and a job gain or loss. A job shift represents a net change in the total number of persons employed in an industry or a sector over a period of time. An estimate of the number of jobs shifted does not account for the actual number of jobs gained or lost in specific trades or industries, or for the difference between a gradual reduction in employment through attrition and retirement, and one that occurs suddenly through layoffs and termination. The actual number of persons who might lose their jobs due to BCDL would be smaller if the transition period is long enough that the labor force is reduced through attrition and retirement.

Table 78.—Average Unit Labor Requirements in the Beverage Delivery System in 1982

	Jobs Der million ounces per year							
	B				Soft drinks			
			Metal can system				Metal can system	
	Refillable bottle system	Non-returnable bottle system	Steel	Aluminum	Refillable bottle system	Non-returnable bottle system	Steel	Aluminum
Container manufacturing								
Glass containers.	0.010	0.094		—	0.021	0.071	—	—
Metal cans.	—	—	0.062	0.062	—	—	*0.062*	0.062
Metal manufacturing . . .	—	—	0.022	0.025	—	—	*0.023*	0.040
Beverage producers and distributors	0.209	0.149	0.139	0.139	0.197	0.095	*0.146*	0.146
Production.	(0.031)	(0.031)	(0.031)	(0.031)	(0.039)	(0.039)	(0.039)	(0.039)
Distribution.	(0.178)	(0.1 18)	(0.107)	(0.107)	(0.158)	(0.056)	(0.107)	(0.107)
Retailers	0.108	—	—	—	0.089	—	—	—
Total.	0.327	0.243	0.223	0.226	*0.308*	0.166	0.231	*0.249*

SOURCE: Research Triangle Inst te (107)

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Table 79 summarizes estimates from the literature on net total job shifts for all industries under BCDL. All the studies project a net increase in total employment. However, as in the case of capital investment requirements, it is difficult to discern a consensus among these studies on anticipated net job additions. The Wharton School estimates are the largest by far; if extrapolated to the 1980-85 period they would approach 200,000. Wharton's estimates are expected to be high since they are based on an all-refillable bottle system. On the other hand, the DOC estimates were made on the same basis and are the lowest. The GAO and RCC scenarios represent less change in the total beverage system than the other studies, and they give generally lower net job additions.

The six studies summarized in table 79 all present estimates of job gains and losses in each of the affected industries. In each case, job gains would occur in beverage distribution and job losses would occur in metal and container production. These results are summarized in table 80 (job gains) and table 81 (job losses). Jobs lost are divided among metal production, canmaking, and bottlemaking. The highest losses in metal production and in canmaking would occur for situations in which bottles capture all or most of the market. Similarly, bottlemaking losses would be smallest for the all-refillable bottle case; even then, however, the labor needed for the production of refillable bottles would be somewhat less than that for the production of a mix of refillables and nonreturnables without BCDL.

As shown in table 80, estimates of job gains by sector differ widely. In general, with BCDL bottlers would need more additional labor than brewers. However, the combination of brewers and wholesale beer distributors would require labor force increases roughly equivalent to those for bottlers, because the bottler data include the soft drink distribution labor. Estimates of job gains in retail trade vary widely, largely because of the poor quality of the data base on labor requirements in retail trade for handling refillables. Finally, Wharton's full simulation of the economy identified another 93,000 new jobs in other industries. Inclusion of these jobs helps to explain why Wharton's estimates of net new jobs in table 79 are so much higher than the others.

Three points stand out in this review of labor impacts of BCDL. First, there is general agreement that under BCDL jobs would be lost in metals production and in container manufacture and that jobs would be gained in beverage distribution, especially in retail trade. Second, studies differ widely on the actual numbers of job gains and losses. Third,

Table 79.—Total Job Shifts Due to BCDL: Summary of Literature Estimates

Source	Scenario [a]	Date	Net number of new jobs [b]
Department of-Commerce (108) . . .	All refillable	1980	13,000-33,000
EPA (109).	800/0 refillable	1980	82,000
GAO (1 10)	Mix I	1981	20,300
	Mix II	1981	41,300
Research Triangle Institute (1 11). . .	Scenario 1	1982	117,700
	Scenario 2	1982	116,900
Resource Conservation Committee (1 12)	Mix I	1985	54,000
	Mix II	1985	53,300
Wharton School (1 13)	Export bottle	1974	137,950C
	Stubby bottle	1974	131 ,150C

[a] see table 63 for scenario details
bFull.time job equivalents in materials, container, brewing, bottling, wholesaling, and retalling Industries (total gains minus total losses)
[c] Includes job shifts in entire economy

Table 80.—Job Gains in Beverage Distribution Under BCDL: Summary of Literature Estimates

			Total number of new jobs gained				
Source	Scenario[a]	Date	Brewers	Bottlers	Beer Wholesalers	Retailers	Other
Department of Commerce (108)	All refillable	1980	~ 60,000-75,000			“35,000-40,000	—
EPA (109) .	80% refillable	1980	8,300	35,000	23,100	97,900	—
GAO (1 10)	Mix I	1981	700	11,300	10,400	27,700	—
	Mix II	1981	7,400	28,000	37,500	29,700	—
Research Triangle Institute (11 1). . . .	Scenario 1	1982	– 100(loss)	25,800	14,100	115,700	—
	Scenario 2	1982	– 100(loss)	32,500	26,600	100,500	—
Resource Conservation Committee (1 12). .	Mix I	1985	19,500			59,200	—
	Mix II	1985	38,300			64,300	—
Wharton School (1 13)	Export bottle	1974	12,370	30,100	16,750	33,600	93,000b
	Stubby bottle	1974	12,370	30,100	12,870	32,740	—

a see table 63 for scenario details
b Based on simulation of the entire economy

Table 81 .—Job Losses in Container Production Under BCDL: Summary of Literature Estimates

			Total number of jobs lost		
Source	Scenario*	Date	Metal product ion	Can making	Bottle making
Department of Commerce (108)	All refillable	1980	25,000	35,000	22,000
EPA (109)	80°10 refillable	1980	18,500	34,000	29,700
GAO (1 10). ., ...	Mix I	1981	30,700		
	Mix II	1981	61,400		
Research Triangle Institute (1 11). ...	Scenario 1	1982	6,500	15,800	15,500
	Scenario 2	1982	14,300	35,000	– 6,700 (gain)
Resource Conservation Committee (1 12),	Mix I	1985	5.600	14,200	4,900
	Mix II	1985	10,900	28,000	10,400
Wharton School (1 13)	Export bottle	1974	10,000	33,000	4,870
	Stubby bottle	1974	—	33,000	6,940

“ See table 63 for scenario details

there would be a shift from high-skill, high-wage jobs in the metals and container industries, to low-skill, low-wage jobs in distribution and retailing.

The preceding observations suggest that BCDL would create entry-level positions at the expense of established, skilled workers. Two factors might help to alleviate the job loss problems in metals production. First, only a small part (a maximum of 1.3 percent) of steel production would be affected. Second, automobile companies are currently expressing concern about limited future aluminum supplies and they might absorb any aluminum output made available by BCDL.

The job loss situation in can and bottle production would be considerably more serious. Beverage containers now account for over 40 percent of all steel cans, 96 percent of all aluminum cans, and 50 percent of glass bottles. Obviously, large declines in the output of beverage containers would create serious problems for both workers and firms in these industries,

WAGE IMPACTS OF BCDL

It was shown above that under BCDL the total number of jobs is likely to increase, but that the average skill level would decline. Table 82 shows literature estimates of the im-

Table 82.—Total Employee Compensation Impacts of BCDL: Summary of Literature Estimates

Source	Scenario[a]	Date	Current dollar year[b]	Annual wage changes (million dollars): Net for all industries	Total gains	Total losses
EPA (114)	80°/0 refillable	1980	1976(?)	+ 403	+ 1,292	– 889
GAO (115)	Mix I	1981	1974	+ 201	+ 493	– 292
	Mix II	1981	1974	+ 503	+ 1,164	– 661
Research Triangle Institute (116)	Scenario 1	1982	1974	+ 879	+ 1,285	– 406
	Scenario 2	1982	1974	+ 936	+ 1,505	– 569
Wharton School (113)	Export bottle	1974	1974	+ 649	+ 1,150	– 501
	Stubby bottle	1974	1974	+ 559	+ 1,082	– 523

[a] see table 63 for scenario detail.
[b] Base year in which dollars are measured

pact of the job shifts on the total wages paid annually, as well as on the total gains and the total losses in wages. In each study, the wage losses would occur in metal production and container manufacture and the gains would occur in the beverage production and delivery industries. All sources agree that the net wages paid would increase and that total gains would outweigh total losses by a ratio of approximately 2 to 1.

OTHER LABOR IMPACTS OF BCDL

This section discusses two additional aspects of the labor impacts of BCDL. First, the changes in employee earnings discussed above following the adoption of BCDL do not capture all the employee-related costs to firms. They do not include the costs of employee fringe benefits or of training programs for new employees. In addition, estimates of earnings costs do not include costs of severance pay or income maintenance for discharged employees in the materials and container industries. For example, the contracts of the United Steel Workers with aluminum and steel producers call for extra unemployment benefits, special pensions for plant shutdowns, and other income security provisions. The Steel Workers also represent workers in can-manufacturing plants, and such severance benefits have been extended to that industry .(117) In the event of a layoff of employees both in metals and in metal can production, employees would be eligible for substantial financial assistance. This would aid affected workers but would be an added expense for firms.

A second important aspect of labor impacts is the fact that job losses in the glass container industry might be seriously localized. RCC has made a preliminary analysis of this problem and has identified 10 counties in the United States in which 14 glass container plants that might be especially hard hit by BCDL are located. (118) They were unable, however, to determine whether the manufacture of beverage containers is a large fraction of the production of each of these plants, in order to determine whether, in fact, special problems would be created. RCC is working with the Glass Packaging Institute to learn more about the situation in these plants.

POLICY OPTIONS FOR LABOR IMPACTS

On balance, the creation of more jobs and higher total earnings as a consequence of BCDL would contribute in a small way toward easing the Nation's unemployment problem. But, a very serious unemployment problem would be faced by workers in container manufacturing, and to a lesser extent, in the metals production industries. As noted in table 81, various studies have projected losses of 25,000 to 82,000 existing jobs due to BCDL. Since these jobs would be lost over a period of several years, some of them could be accounted for by normal attrition and retirement. Thus the number of workers now employed who might lose their jobs as a result of BCDL could be substantially smaller than 25,000 to 82,000. This might be especially true in metals production, where beverage-container related jobs are a small part of the total.

Nevertheless, while total employment would increase, a substantial number of workers with specialized skills would lose jobs, many in regions where unemployment is already high or economic growth is slow. Thus, if BCDL were instituted, some kind of Federal assistance for affected workers might be considered. Options include retraining and relocation assistance and direct grants-in-aid. Reconversion assistance to firms might also assist workers indirectly, but it cannot be viewed as a substitute for direct assistance to workers and their families. Such assistance efforts need to be designed and administered so that they would not provide incentives for firms to accelerate or expand their layoff programs. Furthermore, container firms have been routinely reducing their labor force over the last several years by taking advantage of new, more-productive technology. Thus, it might prove to be difficult for program administrators to determine whether layoffs can, in fact, be attributed to BCDL.

Impacts of BCDL on Beverage Costs and Prices

BCDL would cause increases in some costs of beverage delivery (filling, distribution, transportation, storage, retailing) and decreases in others (principally the cost of containers per fill). Various authors differ as to whether the net cost change is an increase or a decrease. They also differ as to whether prices paid by consumers would go up or down. This section reviews some of the analyses of changes in costs and prices, including some empirical observations on the relative prices of beverages in refillable and nonreturnable containers.

Unless otherwise noted, in this section as in the rest of this report, price refers to the shelf price of a beverage excluding any container deposit or local sales taxes. A purchaser of beverages in containers that bear a deposit, who does not intend to claim that deposit, pays a price equal to the shelf price plus the deposit.

REDUCED COSTS OF CONTAINERS UNDER BCDL

The beverage delivery system includes three parties for beer (brewer, distributor, and retailer) and two parties for soft drinks (bottler and retailer). For distributors and retailers, the direct costs of doing business are higher with beverages in refillables than in nonreturnables. Handling refillables entails a larger number of tasks, and the unit costs of most of the tasks are higher, because refillables weigh more and take up more space than nonreturnables. Sorting refillables adds an additional costly task.

Brewers and bottlers also face higher costs for washing, filling, and handling refillables than they do for nonreturnables. However, their costs for refillable containers per fill are less than the costs for nonreturnable containers. The costs of producing the beverage per se are not affected by packaging type. Thus, the net impact of BCDL on total costs for brewers and bottlers depends on the net of the various cost differences in buying and handling containers.

Typical prices paid by brewers in 1976 for new 12-ounce containers in large lots were: refillable bottles, 7 cents; nonreturnable bottles, 4 cents; and metal cans, 6 cents. (119) Typical prices paid by soft drink bottlers in late-1978 were about 17 cents for 16-ounce refillables, 8 to 9 cents for all-aluminum cans, and 8 cents for 3-piece steel cans with aluminum tops. (120) (These prices vary widely with container design, quantity purchased, and special sales arrangements). If a refillable is used an average of N times (N = trippage), its cost per fill is its price divided by N.

The total cost per fill of a container is reduced by its net scrap value if it is returned to the brewer or bottler under a deposit system.

Typically, as scrap, aluminum cans are worth 1 cent, steel cans are worth 0.2 to 0.4 cent, and bottles are worth about I cent each. If a deposit-bearing container is not returned, the brewer or bottler can retain its deposit as a cost offset. For an average return or recycle rate of R, the retained deposit per fill is equal to (l-R) multiplied by the deposit. For refillable bottles, the cost per fill is offset by both retained deposits and a very small scrap income from refillables rejected in the plant.

The following example compares the net costs of beverage containers per fill under three hypothetical situations:

Case I: A beverage is sold in 12-ounce nonreturnable containers that cost 8 cents each and do not carry a deposit. No containers are recycled.

Case II: A beverage is sold in 12-ounce, nonreturnable containers that cost 8 cents each, carry a 5-cent deposit, and have a scrap value of 1 cent each. Eighty percent of the containers are recycled.

Case III: A beverage is sold in 12-ounce refillable bottles that cost 12 cents each and carry a 5-cent deposit. The return rate for the container is 80 percent (trippage = 5).

Question: What is the net cost of the container per fill of beverage in each case?

Case 1: Container cost per fill = 8 cents.

Case II: Container cost per fill = 6.2 cents. Since for every container filled, 0.8 container is returned with a scrap value of I cent each, a scrap credit of 0.8 x 1 cent or 0.8 cent is earned per fill. For each container shipped a deposit of 5 cents is collected but on average only 0.8 container is recycled requiring an average refund of 0.8 x 5 cents or 4 cents per fill. Thus, 1 cent of the deposit per fill is retained by the producer. The direct container cost is then [8 cents – 0.8 cent – 1 cent] or 6.2 cents per fill.

Case 111: Container cost per fill = 1.4 cents. Since a bottle that costs 12 cents is used an average of 5 times, its cost per fill is 2.4 cents. Furthermore, for every container shipped a deposit of 5 cents is collected. However, on average only 0.8 container is returned, so an average of 20 percent of the deposit, or 1.0 cent is retained by the producer per fill. Therefore, the net direct container costs are (2.4 - 1.0) or 1.4 cents per fill.

In the above cases, the direct container costs per fill are 8 cents for the nonreturnable, 6.2 cents for the recycled nonreturnable with deposit, and 1.4 cents for the refillable. Thus, the refillable system will have the lowest total beverage delivery cost if the additional costs of handling refillable bottles as compared with nonreturnables are equal to or less than (8 cents – 1.4 cents) or 6.6 cents; and if the additional costs of handling refillable bottles as compared with recycled nonreturnables are equal to or less than (6.2 cents – 1.4 cents) or 4.8 cents. In other words, the production and distribution cost differential per fill with refillables over nonreturnables should not exceed 4.8 cents if BCDL is to result in lower total costs and prices. Conversely, if the extra costs of producing and distributing beverages in refillables are greater than 4.8 cents per fill, the total costs and the shelf prices of beverages can be expected to increase in this hypothetical example.

The container cost data and return/recycle rates used in this hypothetical comparison are intended to be reasonably representative of actual situations. They suggest that direct container costs are about 5 to 7 cents less for refillables than for nonreturnables. Only 0.5 cent of this cost advantage arises from retained deposits; the rest comes from differences in prices paid for containers per fill and from scrap income.

INCREASED COSTS OF BOTTLING BREWING, WHOLESALING, AND RETAILING UNDER BCDL

Data on the costs of brewing, bottling, wholesaling and retailing beverages in various kinds of containers, with or without BCDL, are scant. Weinberg (121,122) has given detailed accounts of these costs on a hypothetical basis for delivery of malt beverages. The Central Investment Corporation, which has interests in soft drink bottling, has provided data on the costs of bottling in 12-ounce cans and in 16-ounce refillable botties.(123) However, neither set of data is adequate for addressing the actual cost differences among the container types. Weinberg's data, for example, show that off-premise retailers' margins (costs plus profits) are lower for beer in refillables, but he gives no breakdown between costs and profits. Nor does he explain why these margins are lower for refillables in view of: (i) the wide agreement that retailers' costs are higher with refillables, and (ii) the fact that consumer prices are lower in refillables than in nonreturnables. Also, no basis is given for his calculations of profits at each stage. (122)

PRICE IMPACTS OF BCDL

Models of Pricing Behavior.-The change in total costs of beverage production and delivery is the sum of: (i) savings on container purchase, (ii) earnings from the sale of recycled containers, and (iii) unclaimed deposits; less the sum of: (i) additional costs of capital including a reasonable return on investment, (ii) additional labor costs, and (iii) additional operating costs for maintenance, utilities, and insurance. The changes in prices of beer and soft drinks under BCDL would depend on the net change in the total cost of beverage delivery and on the degree to which that cost change would be passed on to consumers.

Whether cost changes would be passed on to consumers depends on the competitiveness of the various industries and on the degree to which consumer demand for beverages is affected by price and availability.

If the beverage industries are competitive, market forces will cause them to pass on changes in total beverage costs due to BCDL as changes in prices. The amount of the price change would depend on the sensitivity of beverage demand to price. If beverage demand is sensitive to price, firms would not be able to raise prices by the full amount of a cost increase. If there is a cost decrease they might take advantage of economies of scale in production and actually be able to lower prices by an amount greater than the decrease. * Conversely, if demand is not very sensitive to price, firms would pass on nearly the full amount of any cost change as a price change.

If some parts of the beverage delivery industries are not competitive, that is to say, if at least some firms or sectors possess a degree of monopoly power, a different set of price changes might take place. If BCDL were adopted, it is clear that brewers and bottlers (excluding distribution activities) would experience cost decreases, while wholesalers and retailers would experience operating cost increases. If brewers or bottlers have a degree of monopoly power, they would not be disciplined by market forces to pass their cost decreases on as lower prices for goods sold to wholesalers or retailers. Thus, the total costs of wholesalers and retailers would increase and they would raise prices to consumers, with the price increase being greater if consumer demand is not sensitive to price and vice versa.

Evidence was presented earlier in this chapter that the demand for beer is fairly price sensitive while the demand for soft drinks is not very price sensitive. The preceding theoretical discussion then leads to the following projections about the prices of each product if BCDL were adopted.

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*The Wharton School study considered the effect of changes in beverage sales on container costs and prices, They found that the second-order price changes were very small .(1 24)

If the soft drink industry is competitive, any cost changes caused by BCDL would be passed on to consumers as price changes, either as increases or decreases depending on the net cost change. If the soft drink industry is not competitive to some degree, prices might increase under BCDL regardless of changes in the total costs of beverage delivery.

If the beer industry is competitive, cost changes caused by BCDL would be passed on to consumers, but prices would increase by less than a cost increase and might decline by more than a cost decrease (reflecting price sensitivity of demand and possible economies of scale). If the brewing industry possesses a degree of market power, retail prices to consumers might actually increase even if the total costs are reduced under BCDL; however, the increase would be less than the amount of distributor and retailer cost increases and smaller than in the case of soft drinks, since demand is more sensitive to price.

Unfortunately, it is not known for certain whether the beer and soft drink industries are competitive or possess a degree of market power. Thus, one cannot make reliable forecasts of the price effects of BCDL, even if unequivocal estimates of its effects on costs in each industry could be made. Part of the disagreement in the literature about the price effects of BCDL thus stems from a disagreement over the degree to which the industries are competitive.

Literature Forecasts of Beverage Prices Under BCDL.—TWO approaches have been used to forecast changes in future beverage shelf prices under BCDL. One is based on analytical cost/price models of the beverage industries. The other is based on extrapolations from the existing data on the relative prices of beverages in various kinds of containers and on the behavior of prices in Oregon and Vermont under BCDL.

Table 83 summarizes forecasts from the literature of changes in prices based on the analytical model approach. The figures from RTI and RCC suggest price changes in the range of –4.o to + 1.6 percent, depending on beverage, container type, and scenario. These estimates assume that retained deposits are used to offset increased costs. The Wharton School estimated increases of 3.1 percent for soft drinks and 4.7 or 13.1 percent for beer, depending on which type of beer bottle is used. These estimates are based on an all-refillable system and higher conversion costs than those of RTI and RCC. Furthermore, the Wharton School treated retained deposits as a direct consumer cost. When the shelf prices are adjusted to reflect the offset of a producer's costs by retained deposits, Wharton's shelf prices in the off-premise market increase by only 0.5 percent for soft drinks and 0.8 to 9.1 percent for beer. In all cases, of course, customers who discard deposit containers pay, in effect, 5 cents over shelf price (Wharton used a 6-cent deposit for soft drinks).

Evidence on Current Prices of Beverages.—Most reports of the relative prices of beverages in various types of containers have been based on informal price surveys. However, a comprehensive set of data gathered by the Majers Corporation provides information on feature prices* for soft drinks in 106 major U.S. retail markets. (129) For the 12 months ending November 1977, Majers reported the average feature prices for soft drinks shown in table 84. Table 84 shows that soft drinks in 16-ounce refillable bottles were priced 41 percent below 12-ounce cans and 33 percent below 16-ounce nonreturnable bottles on a price-per-ounce basis. Similar ratios hold for individual major brands and in specific marketing areas.

The results of several price surveys are summarized in the EPA Fourth Report. EPA summarized these surveys by concluding that savings are often in the range of 3 to 8 cents per 12 ounces of beverage in refillable containers.(lol) This is equivalent to a price dif-

*Feature prices are advertised prices in supermarkets, which often offer soft drinks in special promotional campaigns.

Table 83.—Beverage Shelf Prices Under BCDL: Summary of Literature Estimates Based on Analytical Methods

		Percent change in shelf price							
		Beer				Soft drinks			
		Bottles		Cans		Bottles		Cans	
Source	Scenario[a]	Ref.	N.R.	Alum.	Steel	Ref.	N.R.	Alum.	Steel
Department of Commerce (125) . .	All-refillable bottles	Increase	—	—	—	Increase	—	—	—
Research Triangle Institute (126).	Scenario 1	– 0.05	–	– 1.9	+ 1.5	– 0.8	–	– 2.0	+ 1.6
	Scenario 2	– 0.05	–	– 3.9	-0.8	+ 0.7	—	– 4.0	– 0.8
Resource Conservation Committee (127)	Mix I	0.0	– 0.7	– 3.1	– 0.7	0.0	– 0.9	– 3.2	+ 0.8
	Mix II	0.0	+ 0.8	– 1.5	+ 0.8	0.0	+ 0.4	– 2.0	+ 0.8
Wharton School[b] (128).	Export	+ 13.1	—	—	—	+ 3.1	—	—	—
	Stubby	+ 4.7	—	—	—	+ 3.1	—	—	—
Wharton School adjusted[c].	Export	+ 9.1	—	—	—	+ 0.5	—	—	—
	Stubby	+ 0.8	—	—	—	+ 0.5	—	—	—

a see table 63 for scenario details.
b Baseline prices were not provided. Percentage changes were estamated assuming 1974 baseline prices of $5.00 and $4.00 Per case for beer and Soft drinks in 12" oz containers respectively Off-premise prices are reflected In these changes
c OTA adjusted Wharton's shelf price increases by subtracting retained deposits as an offset against cost increases

Table 84.—Feature Prices of Soft Drinks in Various Container Types

Container size and type	Average price a (ounce)
12 oz cans . . .	1.33¢
16 oz refillable bottles	0.78
16 oz nonreturnable bottles. . .	1.16
32 OZ refillable bottles	0.73
32 oz nonreturnable bottles.	1.13
64 oz refillable bottles	0.90
64 oz nonreturnable bottles. .	1.12

a for 12 months ending November 1977
SOURCE Majers Corporation (129)

ference per ounce of 0.25 to 0.67 cent which is consistent with Majers' findings of a 0.38 to 0.55 cent per ounce difference.

Weinberg's estimates for typical shelf prices for 12-ounce containers of beer in 1976 were: metal cans, 25.6 cents; nonreturnable bottles, 25.5 cents; and refillable bottles, 23.0 cents.(1 22) The price advantage of refillables of 2.5 cents per serving is equivalent to 0.2 cent per ounce; i.e., to the low end of the EPA estimate.

There is broad agreement, then, that the current shelf prices consumers pay for beverages in refillable bottles are lower than for nonreturnables, generally in the range of 2 to 8 cents lower per 12-ounce container. (This is equivalent to price differences of about 10 to 30 percent.)

However, there is some disagreement about whether this difference would persist if BCDL were implemented. For example, Weinberg has argued that refillables for beer are currently being subsidized by nonreturnables, and that wholesalers actually lose money on refillables. (122) If this is true, then current prices for refillables are too low to cover all their costs, and under BCDL their prices would have to increase. What is not clear from this argument is why this cross subsidy should persist, since by the same argument there is a strong incentive for wholesalers and retailers to raise the prices of allegedly unprofitable refillables, both to drive them out of the market and to earn some profit on those that might remain.

One factor that would tend to reduce shelf price differences for various container types as compared with the current situation, is that under BCDL industries would find it necessary to make rapid changes in their capital equipment. These changes would add to the average costs of beverage delivery, at least during the transition period. Prices of nonreturnables might increase if equipment is used at a lower capacity than before BCDL, and the cost of additional equipment to handle increased sales with refillables might add to their average prices.

Finally, from a long run point of view, it is argued that the competition among different types of bottles and cans has served to keep all container prices low. If the nonreturnable bottle or can were to disappear from the marketplace under BCDL this competition might be eroded, and all container prices might rise over a period of time. None of the analyses of price/cost behavior has taken this possibility into account, and there is probably no way to do so other than by making arbitrary assumptions about relative prices in the future.

Beverage Availability and Consumption

Opponents of BCDL say that it would reduce the availability of beverages to consumers. Some stores would discontinue beverage sales, the number of brands sold in various market areas would decline, and fewer vending machines would be used due to the difficulty of refunding deposits. The net effect would be a drop in beverage sales. Proponents of BCDL argue the opposite—that availability would improve, especially the availability of a variety of brands of both beer and soft drinks in refillable containers. Both sides agree that the number of available container sizes and designs would decrease. *

A related argument is made about the convenience aspects of beverage purchase and consumption under BCDL. Opponents, who equate convenience with the availability of nonreturnable containers without deposits, say it would decline. Proponents argue that BCDL does not eliminate nonreturnable containers and would not affect this aspect of convenience. They further argue that customers who value the convenience of discarding used containers can continue to do so; they would simply forfeit the deposit. Proponents also point out that refillables would become more convenient to purchase and that convenience of return would improve for those who prefer refillables or find it economically worthwhile to recover deposits.

Another related argument centers on the phrase "freedom of choice. " Opponents have used this phrase to suggest that BCDL would infringe on the rights of customers to purchase, use, and discard the containers of their choice in the manner of their own choosing. Proponents of BCDL argue that these choices would remain available to those who wish to exercise them, but that they should pay the costs associated with those choices through the deposit system. The "freedom of choice" argument is relevant in a discussion of a ban on nonreturnables. It does not apply to proposals for BCDL.

The consumption of beverages under BCDL would be affected by the change in shelf price, by the addition of the deposit on formerly nondeposit containers, and by a change in the availability of beverage brands, sales, and return outlets.

Some analysts have argued that consumption will be affected by the value that former consumers of nonreturnables attach to the time and effort required to make returns. If such customers are, in fact, rational, they will not make such returns if that value exceeds the potential 5-cent refund. Thus, the maximum decrease in purchases by these kinds of customers can be estimated by assuming that the price they would have to pay would be equal to the shelf price plus the deposit. On the other hand, sales to current purchasers of refillables might increase if the number and convenience of return points were to increase under BCDL.

An estimate of the impacts of price changes on consumption can be obtained by multiplying projected price changes from table 83 by the estimated price elasticities of demand. As noted in an earlier section, RTI

*The analysis in this chapter is concerned exclusively with containers for beer and soft drinks. However, the impact of BCDL on availability might be greatest for other beverages such as iced tea and mineral water. Since these are currently sold in much smaller volumes, the adoption of BCDL might make them unmarketable in many locations due to the relatively high overhead costs of operating a deposit system for small numbers of containers, On the other hand, omission of these beverages from BCDL coverage could lead to their rapid substitution for beer and soft drinks in the kinds of markets where the litter problem is most serious.

found price elasticities of demand of 0.6 for beer and 0.13 for soft drinks. Using & 2 percent as rough estimates of shelf price changes, one can estimate changes in beer sales of around & 1 percent, and around 0.25 percent for soft drinks.

The effective percentage price changes faced by customers who continue to discard deposit containers would be higher. A 5-cent deposit might add 25 percent to the effective price per container of soft drinks and 20 percent for beer. For these customers, maximum decreases in consumption might be expected of 20 percent x 0.6 or 12 percent for beer, and 25 percent x 0.13 or 3 percent for soft drinks.

RTI estimated that overall beverage demand would drop by only a fraction of 1 percent under BCDL.(130) For one of its calculations, the Wharton School assumed that beverage consumption would decline by 15 percent, based on their interpretation of events in Oregon and Vermont. (131) Using an elasticity of demand approach on the other hand, Wharton estimated maximum consumption decreases of 7.64 percent for beer and 4.43 percent for soft drinks, assuming that nonreturnable containers were banned. (132) The discrepancies originate in the different analyses of the price elasticity of beverage demand discussed earlier. Neither Wharton nor RTI was able to account for the quantitative effect of the availability/convenience argument.

Impacts on the Environment

Every stage of the production, use, reuse, and recycling of beverage containers creates air and water pollution and solid waste, over and above that due to disposal or littering. Such wastes are a function not only of container material, type, and return/recycle rate but also of the type and degree of environmental control technology employed at each stage. Furthermore, the true social cost of each kind of emission also depends on the location of the activity in question: air pollution may be more significant in a major urban area or near a pristine wilderness than in a small-town manufacturing center.

For these reasons, any estimation of the pollution impacts of various container systems is necessarily somewhat arbitrary. It usually reflects the current technology in place or to be adopted in the near term. It is also likely to reflect average industrial pollution control practice, rather than a "best-plant, " ''worst-plant, " "marginal plant, " or "compliance" practice. As such, the results of the analysis can be expected to change over time as industrial technology and pollution control methods change.

The standard reference work in this area is a study done for EPA by MRI in 1974 entitled "Resource and Environmental Profile Analysis of Nine Beverage Container Alternatives. ''(133) Environmental impacts were included for materials extraction and processing, container manufacture, transportation, container cleaning and filling, and distribution. Impacts of consumer activities including transportation from point-of-purchase to point-of-consumption were not included.

Table 85 summarizes the air and water pollution, industrial solid waste, and total water use impacts for the nine container systems studied by MRI. Each data point represents the impacts of delivering 1,000 gallons of beer in each type of container. In nearly every case the 19- and lo-trip refillable glass bottles rank lowest on these measures of environmental impact. The only major exception is the all-steel can, which ranks lowest on waterborne wastes. The five trip glass refillable (return rate = 80 percent) has a mixed advantage over the other containers. It ranks better than the others on industrial solid wastes and on atmospheric emissions (except for the all-steel can). It has the greatest amount of waterborne waste of any system (tied with ABS plastic) and is tied with several other systems in terms of total water use. From these data, it is concluded that a shift to a system featuring refillable bottles and recycled cans would reduce the environmental impact of beverage delivery.

Table 85.—Environmental Impacts of Delivering 1,000 Gallons of Beer in Various Containers

Container type	Air emissions (pounds)	Waterborne wastes (pounds)	Total water use (1,000 gallons)	Industrial solid waste (cubic feet)
Glass refillable				
19 trip	71	27	11	7
10 trip	94	35	15	9
5 trip	200	69	33	
Glass nonreturnable	261	56	37	15
Three-piece bimetal	222	34	34	93
Aluminum can a	323	59	15	36
All steel can	146			108
Plastic coated nonreturnable glass	246	: :		30
Plastic b	241	69	42	7

a 15 percent of cans recycled
b Acrylonitrile- butaidiene-styrene (ABS) plastic Was used for illustration This material is not now. nor is it likely to be used for beverage containers. drink containers now on the market are made from polyethylene terephthalate (polyester)
SOURCE Midwest Research Institute (133)

These results have some important limitations. As noted above, they are based on actual industrial pollution control performance rather than on a best-practice basis. Perhaps more importantly, the air, water, and solid waste measures are in terms of total pounds of emissions. No attempt was made to rate the degree of hazard per pound of the waste components to public health or to the environment. Thus, fluoride emissions from aluminum production and oxides of nitrogen from gas combustion in glass production are compared on a weight basis, when, in fact, the former poses a considerably greater hazard than the latter.

In its recent report, RCC reported estimates of the impact of BCDL on industrial solid wastes, atmospheric emissions, and waterborne waste in 1985. As shown in table 86, substantial improvements are forecast under BCDL for all three waste categories. Waste loads are reduced by 44 to 52 percent under Mix I and by 69 to 86 percent under Mix II. These reductions occur because reusing and recycling containers create much less pollution than do extracting and processing materials to make new containers.

Health and Safety Impacts

BCDL might affect health and safety in such areas as pest and hazard control in unwashed, used containers; worker injury when handling returned glass containers and when carrying heavier glass refillables; and injuries due to glass litter and to bottle explosions and breakage. In principle, one could estimate these impacts for various scenarios under BCDL. Unfortunately, the necessary data are not generally available by container type.

HEALTH IMPACTS

Unwashed empty beer and soft drink containers are favorable environments for the growth of insects and vermin. However, observers of the long-established voluntary deposit system have not identified this as a major problem. Likewise, authorities in both Oregon (135) and Vermont (136) report that no special pest control problems have arisen in the programs of those States. The Vermont law allows a retailer to refuse to accept dirty containers for deposit, a provision that can help to manage potential sanitation problems.

Other types of container contamination such as gasoline, solvents, or solid materials can be a problem with refillable containers. Glass containers can be adequately washed, but plastics would absorb such foreign materials and be unacceptable for reuse or even for recycling into new food or beverage containers. Solid contaminants not removed by washing can be detected prior to refilling in bottle inspection systems. It is probable, however, that refillable containers pose a

Table 86.—Resource Conservation Committee Estimates of the Impact of BCDL on Industrial Pollution in 1985*

		Mix I		Mix II	
	Baseline	Total	reduction from baseline	Total	Reduction from baseline
Industrial solid wastes (million cubic feet)	524	250	52 "/0	71	860/0
Atmospheric emissions (mllllon pounds)	1,717	968	44%	521	700/o
Waterborne wastes. (million pounds)	308	173	44°/0	94	690/0

'The numbers in this table represent industrial effluents from the extraction, fabrication, and recycling sectors of beverage container production See table 63 for definition of the market shares and return rates for Mix I and Mix II
SOURCE RCC staff estimates (134)

higher risk of product contamination—the extent of that risk is unknown.

FDA has jurisdiction over the health aspects of materials used for food packaging, including beverage containers, under the Food, Drug, and Cosmetic Act. In recent years, beverage containers made of certain plastics have become a matter of concern and policy debate.

On March 11, 1977', the Commissioner of FDA stayed certain parts of the food additive regulations that permitted beverage containers to be made of acrylonitrile copolymer plastics. This action had the effect of prohibiting the sale of such bottles. FDA's concern was that residual acrylonitrile monomer from the plastic container would migrate into the beverage with toxic effects. The Commissioner's order was appealed by Monsanto, the company that developed and began to market the bottle in 1975, and a Federal appeals court ruled that FDA had to undertake administrative proceedings on the safety of the bottle. In September 1977, FDA, after investigating its safety in public hearings and additional laboratory testing, issued a final order banning the use of beverage containers made from acrylonitrile-based plastics. Monsanto was given go days, to December 22, 1977, to remove the bottles from the market.(13g) The company has since filed an appeal of FDA's ban on the use of acrylonitrile copolymer in plastic soft drink bottles in the U.S. Court of Appeals in Washington, D.C.(138) A review of the case is expected in 1979. Monsanto has removed bottles made from acrylonitrile copolymer from the market, pending review by the U.S. Court.

The Bureau of Alcohol, Tobacco, and Firearms also regulates alcoholic beverage containers. In conjunction with FDA it licensed, and then terminated, an experiment to market alcoholic beverages in polyvinylchloride (PVC) containers after potentially hazardous levels of vinylchloride were found to have leached into the contents from the containers.(13g) While two companies soon developed bottles with monomer levels below 25 parts per million, authorization for their use was not granted and PVC liquor bottle development has ceased in the United States.

FDA has approved plastic beverage containers made from polyethylene terephthalate, a polyester. Several companies are using this polyester as a material for lightweight, energy-efficient, breakage-resistant containers. The bottles are being aggressively marketed by soft drink manufacturers in both 32- and 64-ounce sizes.

WORKER INJURY

No statistics are available on the nature, frequency, or severity of worker injury from different types of beverage containers. Heavier refillables may be associated with a higher incidence of skeletomuscular injuries in delivery and stock workers. However, it is likely that workers move more containers of nonreturnables at a time and thus the weight and consequent injury risk remain the same for both container types. Handling glass refillables might be more hazardous than handling cans. Furthermore, a refillable container will be handled more times per trip than a nonreturnable; which should increase the probability of injury per unit sold, even if the probability of injury is the same for each handling operation. However, data are not available to provide a basis for assessing the relative frequency of such injuries.

LITTER INJURY

Under BCDL, litter-related injuries due to broken glass on highways, city streets, and recreational areas should decline as the beverage container litter rate declines.

Studies of litter injuries have been made in California and Kentucky .(140,141) Both the California and Kentucky litter surveys indicated that the large majority of reported injuries were caused by broken glass and pull tabs. In California, approximately 25 percent of the persons interviewed reported that someone in their immediate family had been injured by litter, and 5.3 percent knew of someone who had swallowed, or almost swallowed, a pull tab they had put into a drink. Both the California and Kentucky studies on litter indicate that littered soft drink and beer containers, pull tabs, and plastic six-pack binders also cause injury to livestock and wildlife.

OTHER INJURY

Under BCDL the fraction and number of beverages sold in refillable glass bottles is likely to increase, while those in nonreturnable bottles would decrease. Under these conditions, it is not clear whether the consumer and worker injury rate due to broken or exploding beverage containers might increase or decrease. There are no data on the frequency of such events according to type of bottle.

The Consumer Product Safety Commission has jurisdiction over the safety of containers under the Consumer Product Safety Act. Injuries resulting from metal soft drink and beer cans, glass soft drink and beer bottles, and self-contained openers (pull-tops) are collected and categorized in the Commission's National Electronic Injury Surveillance System. Information is gathered from a sample of hospital emergency rooms throughout the country in order to monitor the occurrence and seriousness of consumer product safety problems. From these data, estimates of the incidence of product-related injuries can be made for the entire United States.

The Commission categorizes injuries related to carbonated soft drink and beer containers into four classifications: Code 1103—self-contained openers, pop-top cans, zip-open cans, etc.: Code 1112—containers, metal (cans); Code 11 20—glass soft drink bottles for carbonated beverages; and Code 1122—glass containers, malt beverages (beer, ale, malt liquor). Analysis of data for 1974 by the Commission found that more than 32,000 persons were treated in hospital emergency rooms for injuries related to carbonated soft drink bottles. (142) These injuries occurred as a result of passive exploding bottles, bottles exploding on impact, propulsion of bottle caps, breakage resulting from impact, and accidental contact with broken glass. The available data does not differentiate between refillable and nonreturnable glass bottles.

The estimate for 1,377 is approximately 34,000 injuries related to glass soft drink bottles. Self-contained openers (pop-tops) caused around 2,200 injuries. Injuries resulting from glass beer and related containers were estimated at around 11,000.(143)

Manufacturers and distributors have taken steps to improve the quality of the production and handling of beverage bottles in order to reduce the risk of injury. In cooperation with the National Bureau of Standards, two voluntary product standards (VPS) are being developed. (144) One is completed and one is in the initial stage. The completed VPS recommends standards for the manufacturers of carbonated soft drink bottles, while the second VPS would establish guidelines for distributors of bottled carbonated soft drinks. The purpose of these standards is to reduce the number of injuries resulting from carbonated soft drink bottles. The standards are concerned only with refillable and nonreturnable glass bottles manufactured from soda-lime-silica glass. They are not applicable to plastic-clad or encapsulated bottles.

Impacts on New Technology

BCDL would provide a stimulus for development of new technologies in such areas as container materials, designs, and types; new beverages; and new delivery system elements including secondary packaging, vehicles, vending machines with capability to refund deposits, and container-sorting devices. One might also expect novel advertising and marketing techniques designed to take advantage of the new situation with minimum disruption.

The recent history of experience with Government regulatory programs suggests that industry is capable of adjusting to new market conditions with new or redesigned technologies, often at a lower cost than was projected prior to the implementation of such regulation. (145) Furthermore, when major technical advances are not required on short notice, firms can adjust best on their own. For this to happen, however, requires a stable, well-defined, and relatively certain business and regulatory environment. Firms from outside the established industries can sometimes take advantage of the new environment to provide innovative replacements for older technologies. Under these conditions, direct Government involvement in developing new technologies is not needed.

On the negative side, BCDL might establish a barrier to the private development and adoption of improved "standard" refillable containers that can be used by two or more bottlers or brewers for different brands. This would be an undesirable impact of BCDL, since refillable containers have not changed in recent years and they could be improved. Under BCDL the incentive for a firm to incur the costs of R&D to develop a better standard container would be weakened, because it could not take advantage of its competition through exclusive use of a lower cost container. The situation would be even worse if the new standard container were one that cost more to produce but that cost less to fill and distribute. In this case the innovator would be directly subsidizing his competitors if he were to distribute higher cost containers for general reuse. Because antitrust regulations would probably prevent firms from agreeing to develop new standard containers, the administrator of the BCDL program might be given authority to fund the necessary research, to set guidelines for standard container design, or to coordinate cooperative industry activity in this area.

Government Impacts

BCDL would affect Government by its requirements for administering the deposit program; by affecting tax revenues from beverage-related industries; and by reducing the costs of litter control, solid waste management, and materials and energy supply. The latter cost reductions were discussed earlier and will not be examined here.

Administrative costs of BCDL would be small. Fundamentally, BCDL uses a market mechanism rather than a regulatory approach. Unlike Government regulatory programs with respect to public health and the environment, BCDL requires no research, standards-setting, or monitoring programs, and enforcement would be limited to acting on violations reported by consumers or by other parties to the beverage transaction. Under BCDL, the increased trade in returned containers might lead to an increase in illegal activity, such as the fraudulent return for deposit of containers destined for recycling, which have already been returned. This problem is inherent in the fact that the refund value of a nonreturnable is 5 to 10 times its value for recycling. Some additional law enforcement effort might be required to deal with this problem.

Jeffords and Webster (146) report that Government administrative costs for the first 5 years of the Vermont law totaled between $1,000 and $1,500. Most of this expense was for duplication of the law and for advertising to notify the public of proposed regulations. Given the nature of Federal programs, and in view of the likelihood of numerous legal challenges to Federal BCDL, it is unrealistic to expect that this $200 to $300 per year cost could be extrapolated to the national level. Nevertheless, the Vermont experience suggests that administrative costs would not be large.

Under BCDL certain Federal, State, and local tax revenues might be affected. Federal and State excise taxes on beer would change in proportion to sales changes. State and local sales taxes on beer and soft drinks would change in proportion to sales as well. Local property tax revenues might increase as total plant investment increases. Corporate income taxes might decline substantially from the can and bottle industries and increase from the beverage production and delivery industries. Personal income taxes on the higher total earnings would probably increase, although the shift to lower average wages paid would tend to offset some of this increase.

Estimates of Government revenue change are sensitive to several parameters whose values are not well established, such as sales, prices, investment, and wages. In their study of a ban on nonreturnables, the Wharton School estimated increases in total Government revenues of $273 million to $472 million. (147) Corporate and personal income taxes accounted for most of the increase, with corporate tax increases about twice as large as those for personal income taxes. Sales tax increases were only about 10 percent of the total. Property tax changes were not examined. It is likely that these estimates are on the high side, since the Wharton study features the greatest increase in investment and employment of any of the major analyses.

Emerging Influences on Beverage Container Choice

The analysis of BCDL in this chapter uses a number of assumptions that are based on a continuation of historic trends in the structure of the beverage industries and in beverage container technology. This section discusses two emerging trends that may heavily influence the performance of the beverage delivery system for soft drinks: the plastic softdrink container and the recent Federal Trade Commission (FTC) decision regarding territorial franchises for soft drinks.

The Plastic Soft Drink Bottle

Recently, plastic soft drink bottles manufactured from a polyester (polyethylene terephthalate or PET) have made very rapid gains in market share in the large 1- and 2-liter sizes (approximately 1 and 2 quarts). First marketed in 1976, PET bottles appear to have gained about one-fourth of the market for 2-liter containers by 1978.*(148) The National Soft Drink Association reports that I.5- to 2-liter containers held 6.3 percent of the total market in 1977, up from 2.5 percent in 1974. Securities analysts are projecting rapid penetration of plastics into soft drink markets in the next few years. (137, 148) At least four major firms now produce PET beverage containers.(149)

In an earlier venture, Monsanto had introduced a beverage container based on a polyacrylonitrile resin that was ordered off the market by FDA on health grounds. (See earlier section on health and safety aspects of containers). PET has not encountered any health- or safety-related problems.

*Authoritative data on plastic containers for soft drinks are not yet available in standard industry or Government sources. Most of such data now come from business and trade publications, All of the plastic beverage containers currently in use are intended to be nonreturnable. In principle, a plastic container could be made refillable. However, this would require much heavier container construction, which would defeat their major advantage—light weight. Furthermore, plastics are liable to partial degradation under heat and light and can absorb foreign substances, such as solvents or fuels, that might be stored in empties. These characteristics make refilling plastic bottles a doubtful possibility. For these reasons, if plastic bottles are returned for deposit under BCDL, they are more likely to be recycled into noncontainer plastic articles than to be reused or made into new beverage bottles.

On first consideration, nonreturnable plastic containers made from oil and natural gas would seem to be very energy intensive. However, plastics are so much lighter than glass and require so much less energy for production than do aluminum or steel that the nonreturnable 2-liter PET bottle uses less energy per ounce of soft drink delivered than any other container but the refillable glass bottle. (150) The PET system also uses less natural gas than any alternative except refillable glass, but it uses more petroleum than any container-type except aluminum cans and nonreturnable glass. When compared to a 2-liter plastic-coated glass bottle, the 2-liter PET bottle uses considerably less total energy, including much less natural gas and about the same amount of petroleum.

Should the plastic container displace significant numbers of cans or glass bottles in smaller sizes (10 to 16 ounces), it could have more serious negative consequences for current container producers than would BCDL. They would sustain a loss in both production volume and jobs. In fact, the projected negative consequences of BCDL for the industries and workers now producing containers may occur as a result of the use of plastic bottles, regardless of whether BCDL is adopted. In any future analyses of the effectiveness and impacts of the possible adoption of BCDL the role of the plastic bottle must be given serious consideration.

The FTC Decision on Soft Drink Territorial Franchises

BACKGROUND OF THE DECISION

On April 7, 1978, FTC ordered the Coca-Cola Company and others, and PepsiCo to cease and desist from enforcing contracts that allocate or restrict the territories of franchised bottlers. (151) It ordered the end of all such marketing agreements, except for beverages in refillable containers which can continue to be sold in restricted territories under exclusive franchises. The FTC's orders in these cases have been appealed in the U.S. Court of Appeals in Washington, D. C., and a decision of the Court is pending. (152)

Some opponents of the FTC decision, arguing in part by analogy to the evolution of the beer industry since World War II, say that if the FTC decision is upheld, small bottlers will be driven out of the market. (153) National companies that operate from large, high-speed regional plants using nonreturnable containers will be responsible for the rapid demise of the refillable bottle under these circumstances. According to this view, the exclusive franchise agreements protect the refillable container.

The contrary point of view is that the franchise system has protected small bottlers who are operating with technology that fails to take advantage of the enhanced productivity of larger, more modern equipment. Furthermore, it is argued that franchise bottlers are not disciplined by intrabrand market forces to compete on the grounds of price, quality, or service. According to this view, consumers are injured by the franchise system, and the fact that refillables are maintained by it is evidence of the use of inefficient technology by franchisees.

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INTERACTION OF BCDL AND THE FTC DECISION

It is not the purpose of this study to examine the legal arguments regarding the FTC decision and the status of the territorial franchise system. * However, it is useful to examine how the decision, if it stands, would interact with or affect BCDL.

First, if passed, BCDL could help reduce any trend to regional bottling stimulated by the FTC decision. By helping to preserve the role of the refillable in the marketplace, BCDL would undercut the economic advantage of centralized bottling, which is limited to nonreturnable containers. (The heavier weight of refillables and the need to back haul empties discourages their centralized bottling.) Thus, BCDL might slow any trend toward elimination of local bottlers.

Second, BCDL could continue to discourage litter, reduce solid waste, and reduce the use of virgin materials, regardless of whether territorial franchises stand. The deposits under BCDL would continue to provide an incentive to return all containers for recycling and/or reuse rather than to litter them or put them in the trash.

Third, the energy use for soft drink delivery would be lower under BCDL if the FTC decision is upheld, than if it stands without BCDL. In a recent study, Franklin Associates has shown that assuming the FTC decision causes a rapid decline in the use of refillables for soft drinks, energy use for the delivery of soft drinks in 1982 could range from 17 to 36 percent higher than if the decision is overturned and BCDL is not passed. (154) BCDL would help preserve the refillable bottle and lessen the impact of the FTC decision on energy use. The quantitative effect, however, has not been estimated.

*Several bills have been introduced in the 96th Congress that would permit the maintenance of the territorial franchise system for carbonated soft drinks by exempting soft drinks from the antitrust laws for this purpose. See, for example, H.R, 596, 1512, 1669, 1693, and 1868 and S. 268 and 598.

Finally, it is noteworthy that both the beer and soft drink industries are complex, and are characterized by a mix of small and large firms, regional and national markets, and extensive use of packaging alternatives as marketing and competitive devices.(155 to 158] None of the major analyses of the effects of BCDL assessed in this chapter has taken these structural complexities into account. In part, this reflects the limits of the art of policy analysis. But, it also contributes to the inherent uncertainty regarding the ultimate outcomes of either BCDL or antitrust action taken against the industries.

Findings on BCDL

During the past 30 years, the beer and soft drink industries have shifted heavily from sales in refillable glass bottles to the use of nonreturnable glass bottles and metal cans. At the same time, the sales of both beverages in individual packages have grown dramatically. One result of these trends has been that discarded beverage containers have become important parts both of litter and of MSW. Beverage delivery has become more energy- and materials-intensive, while employing fewer people and using less capital per unit delivered. Economies of scale in brewing, bottling, and transportation, especially in lightweight nonreturnables, have favored a trend toward the centralization of bottling and brewing with fewer producers and fewer brands available. Packaging has become an important part of beverage marketing strategy, with a wide variety of package sizes and types available.

Legislation has been proposed whose purpose is to slow the declining market share of beverages in refillable bottles by imposing a mandatory, uniform, refundable deposit on each individual container. Beverage container deposit legislation, or BCDL, would not ban any type of container—can or bottle. Unlike a ban on nonreturnable containers, this legislation would preserve the right of producers and consumers to use the package of their choice. Moreover, it would ensure that users of nonreturnables pay the full cost of their disposal, and would provide incentives for recycling and against littering.

Considerable uncertainty exists regarding the ultimate effects of BCDL on container market shares and on return and recycle rates. No one has devised a method for predicting these outcomes, which depend on market decisions by consumers and on the exercise of at least limited market power by producers and distributors. Nevertheless, experience in the several States that have implemented BCDL, as well as the judgments of informed observers, indicate that BCDL would lead to a greater use of refillable bottles and to higher rates of container return for reuse and recycling.

A review of seven major and several minor studies of BCDL sponsored by proponents, opponents, and neutral parties finds them all in agreement that BCDL would accomplish all of its major goals to some degree. It would lead to a reduction in litter, in MSW, and in consumption of energy and raw materials. It would also serve as a symbol of a commitment to resource conservation, even though it would not save as much energy or materials as such measures as energy efficiency standards for buildings and automobiles.

BCDL would have a number of important side effects that are not intended by its proponents and which should be considered. It would increase the capital needs of brewers, bottlers, wholesalers, and retailers. At the same time, it would severely disrupt the metal can and glass bottle industries. Overall employment in beverage delivery would increase, along with total compensation to workers in the affected industries. However, existing skilled jobs would be lost in materials and container production, while relatively unskilled jobs would be gained in wholesaling, transportation, and retailing of beverages.

Under BCDL, the costs of containers per fill would decline due to the enhanced use of multitrip refillables, while other costs of delivery might increase. Available data do not permit a consensus judgment of the net effect of BCDL on total costs, nor on the shelf prices of beer and soft drinks. Some authors project a decrease in costs and prices, others an increase. Data on current prices show that beverages are cheaper in refillables, but there is some reason to believe that this might not be the case under BCDL.

The availability of beverages in refillable containers is expected to improve under BCDL, whereas the number of types of containers might decline. Depending on how consumers value the convenience of refillables and nonreturnables, as well as on the uncertain price changes, beverage consumption might decline by at most a few percent under BCDL.

Refillable containers generally cause less air and water pollution and less industrial solid wastes than other container types on a per-fill basis. Litter-related injury from improperly discarded glass bottles would probably decline under BCDL. It is not possible to say with the data currently available whether injuries to workers and consumers would increase or decrease. No evidence was found that refillable glass bottles pose additional health or sanitation hazards.

If BCDL were passed, new technology is expected to emerge for managing refillable containers and for recycling nonreturnables. Government action might be needed to spur development of new, more efficient standard refillable containers for use industrywide.

BCDL would cause some shift in tax revenues at and among the local, State, and Federal levels because it would change the mix of capital, labor, and incomes for the beverage-related industries and for their employees. While BCDL uses the market approach to regulation and is nearly self-administering, some additional Government resources would be needed to administer and police a deposit system.

The growing popularity of the plastic bottle could drastically alter the soft drink package mix, whether or not BCDL is adopted. If made available in smaller sizes (10 to 16 ounces), plastic containers would markedly alter the projections of system performance, effectiveness, and impacts under BCDL that are discussed in this chapter. If upheld by the courts and not amended by the Congress, the recent FTC decision, which outlaws territorial franchise restrictions for trademarked soft drinks in nonreturnable containers, could lead to rapid concentration of that industry. The outcomes would be an industry with only a few firms having a few large plants, as well as the rapid disappearance of the refillable bottle for soft drinks. BCDL could help retard or limit these consequences.

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