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GRAY DAVIS
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April 14, 2003

To: Interested Parties

In 1986, the Legislature passed Assembly Bill 2020 creating the current system of recycling beverage containers in California. This unique program -- a coordinated effort by environmentalists, the grocery industry, container manufacturers and government -- is the only one of its kind in the nation.

In 1999, the Legislature and all interested parties again worked together to update and improve California's recycling program resulting in the passage of Senate Bill 332, and the companion bill, Assembly Bill 1244 (AB 1244). These efforts resulted in an expansion of beverage containers included in the recycling program. AB 1244 also included a requirement to evaluate the recycling program's effectiveness and the impact to recycling rates for the containers added to the recycling program. The attached closed study conducted by the University of California, Berkeley provides an excellent review of this innovative recycling program.

I am pleased to report the recycling program continues to be a resounding success. Recycling beverage containers continues to be convenient and cost effective and forms the foundation upon which we can build a more resourceful California.

In reviewing the performance record of the program to date, California continuously strives to achieve its established goals and serves as a model for recycling throughout the nation.

The study conducted by the University of California, Berkeley identifies possible ways of enhancing the existing program. I look forward to working with all interested parties to further California's beverage container recycling goals.

Sincerely,

Darryl Young
Director

Attachment

California
Beverage Container Recycling & Litter Reduction Study

CRV

A REPORT
TO THE CALIFORNIA LEGISLATURE

Mary D. Nichols
Secretary for Resources
The Resources Agency

Darryl Young
Director
Department of Conservation

CALIFORNIA BEVERAGE CONTAINER RECYCLING AND LITTER REDUCTION STUDY

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EXECUTIVE SUMMARY

The Legislature requested that six issues concerning the California Beverage Container Recycling and Litter Reduction Act (Act) be examined.[1] This report examines those six questions and this summary provides a short answer to each of those questions.

The Act provides for the recycling of beverage containers by offering a California Redemption Value (CRV) to consumers and certain recycling entities for the return of those containers. The Act also provides for the payment by beverage distributors of a redemption payment. These payments are used both to fund the CRV claimed by those who redeem containers and for other costs of the recycling program. The major questions concerning the Act are the level of the CRV and redemption payment, the type of containers covered by the Act, the use of a state-run, rather than a distributor run, fund, the costs of the Act, and the relation between the Act and the curbside pickup programs. These questions underlie the queries (a) – (f) that the Legislature posed and are discussed below. In order to answer many of these questions, we carried out a regression analysis that predicts redemption of containers as a function of CRV and demographic characteristics.

Our regression model shows that the most effective way to increase the recycling of containers is to raise the California refund value (CRV) for containers of less than 24 ounces to 5 cents and of larger containers to 10 cents. The CRV is the smallest redemption payment of any state or Canadian Province. Recycling responds strongly to a change in the CRV. Doubling the CRV, which would make it somewhat higher than other "bottle-bill" states, will result in a California recycling rate for aluminum of 90 percent, for glass of 81 percent, and for PET of 61 percent. The overall recycling would be 82 percent. Increasing the CRV for container of less than 24 ounces to 5 cents, while leaving the CRV for larger containers to 5 cents would result in recycling rates of 90 per cent for

[1] Section 9, Chapter 817, Statutes of 1999 (AB 1244). Amended Section 15, Statutes of 2001(SB528)

aluminum, 80 percent for glass, and 58 percent for PET.[2] The overall recycling would be 81 percent.[3]

One set of questions concerning the Act is the efficacy of the Act in promoting the return of containers. These questions were approached in two ways. (1) The comparison of recycling rates before and after inclusion in the Act. We made these calculations for a subset of PET containers that first were covered in the Act in January 2000. (2) Change in the recycling rate once included in the Act.

(a) *Review whether the inclusion of plastic beverage containers made of resins other than PET has substantially increased the recycling rate of those containers. (In order to perform this and other aspects of the study, the investigators may need to develop a model for estimating food and drink container sales volumes by material and product type.)*

(b) *Compare the recycling rates for like types of beverage containers covered by the Act with like types of beverage containers not covered by the Act.*

The Department of Conservation (DOC), Division of Recycling (DOR) has comprehensive records of the quantities of material recycled by type of container (e.g. aluminum) but not by contents (e.g. juice). Their records also contain the sales by container type of containers covered by the Act, but no such records for containers not covered by the Act. In order to approximate the recycling rates of containers not covered by the Act, it is necessary to estimate their sales. Our model of beverage sales depended upon three sources of information: a survey of sales of beverages based on scanner data compiled by AC Nielsen, industry supplied figures on volume by category of beverage, and a custom audit of stores to determine the exact packaging of covered beverages. Using these three sources we were able to estimate the sales, by container type and contents, of beverages both covered and not covered by the Act.

[2] Within this regression framework, there is no way to predict recycling rates from other than proportional increases in the small and large container CRV.
[3] The overall recycling rates are calculated using July-December 2000 sales as the weighting factor.

Although containers with covered beverages in resins #2 - #7 are included in the Act, only one of those resins, HDPE (#2) has sufficient redemption and sales volume to analyze its recycling rate. Since being covered under the Act, HDPE's recycling rate increased from 18 percent at introduction to 38 percent at the end of the second year after introduction. While this is evidence of the efficacy of the Act, predominant use of curbside programs to return this material suggests that factors other than inclusion in the Act were also partially responsible for the increase in recycling rate.

In 2000, PET-packaged coffee and tea-based drinks, juice blends, and 100-percent fruit juice in containers less than 46 ounces became covered by the Act. We used these PET-packaged beverages before and after their inclusion as like containers. We used supermarket scanner data and industry data to estimate the sales of these PET packaged items before their inclusion in the Act. We used estimates from DOC of PET that was returned but was not covered in the Act to estimate returns. From these numbers we constructed the recycling rate in 1999, before these containers were covered by the Act. By looking at the change in recycling rate for PET between 1999 and 2000, we were able to infer the rate for the newly covered containers in 2000. We found that, before inclusion, they were recycled at a rate of 12 percent and, after inclusion, at a rate of 17 percent.

We also examined by statistical methods whether the sales of these containers decreased because of their inclusion in the Act. In our event study, we did not find any decrease in sales incident upon inclusion in the Act.

Our conclusion is that the recycling rates of HDPE increased upon being included in the Act and that like containers (in this case PET containers) have an increased recycling rate upon being included in the Act. Section 2 covers these matters in greater detail.

(c) *Compare the net cost of recycling containers covered by the Act at recycling centers, supermarkets, and curbside recycling programs and estimate the cost of collection and disposal of those containers not covered by the Act and not recycled.*

From data held by DOC/DOR and our own survey, we determined the costs of recycling containers covered in the Act. The net costs to California are costs incurred by the indicated programs, less the scrap value of the material recycled. For recycling to be the correct social decision these net costs need exceed the unknown environmental costs and the estimated monetary costs of the alternate disposal, landfilling. We compared these net costs to the monetary costs of landfilling. If the net monetary costs are less than the costs of landfilling, then recycling is the correct social decision. If the net costs are more than the costs of landfilling, then one would need to know the environmental cost of landfilling in order to determine the correct social decision. The net costs of recycling aluminum in all programs, of recycling glass in non-supermarket sited recycling centers are less than the monetary costs of landfilling. The supermarket sited recycling centers have the highest net costs in all cases.

The benefit to recycling programs is the scrap value plus the Act's program payments, less the costs of recycling. The benefits to non-supermarket-sited recycling centers were $111 per ton. Supermarket-sited recycling centers had benefits of -$35 per ton. Curbside benefits were $243 per ton of redeemable material. Section 3 provides more detail.

(d) *Compare the economic benefit and impact on the state's economy of the Act with an "Oregon-style" nickel-deposit law and with the situation if the Act were repealed.*

We used our net cost estimates described above and the Dynamic Revenue Analysis Model of the California economy to find the impact on the state's economy. The analysis excludes environmental benefits or other reasons why the price of landfilling does not represent the total social cost. It includes the effect of recycling on the demand for transportation, supply of basic metals, demand for landfilling services and all possible secondary effects on the economy. The effect of the Act was a gain of $42 million in California personal income, slightly less than the amount by which the value of the materials collected under the Act exceeds the direct costs incurred under the Act.

Because of the need to sort containers, the Oregon deposit system is estimated to have costs six times those of the Act. An Oregon deposit system is estimated to lead to losses of $1.5 billion in personal income. If the costs of an Oregon deposit system are only twice that of the Act, then the loss of personal income would be $500 million. This compares very unfavorably to the gain of $42 million under the Act. Section 5 provides more detail.

In order to determine the quantities that would be recycled by program if the Act were repealed or if there were a different CRV structure, such as the Oregon nickel for all containers structure, we performed a regression analysis. From DOC/DOR records and other sources we assembled a data set of returns, by program, by county, by calendar quarter. The data set also included CRV, adjusted for inflation, median family income, temperature, and many other demographic and recycling variables. The estimated equation was then used to estimate the return by program with a zero CRV (for cessation of the program), a nickel CRV (for the Oregon case), and a nickel and dime CRV structure. It is these predictions that underlie our recommendation for a doubling of the CRV to a nickel and dime structure and also that provide the material for evaluating the impact of the Act on curbside.

(e) *Report the scope of curbside recycling in California along with an evaluation of the benefits and cost impact of the Act on curbside recycling programs.*

During the year 2001, curbside programs provided collection to 72 percent of single-family households, 58 percent of multifamily units, and 28 percent of apartment units. We used the regression methodology described above to predict the returns, by program, if there were no Act and then constructed two other scenarios as a sensitivity analysis. Total curbside recyclers' net revenue is higher by $35 to $40 million because of the Act.

Curbside recycling would not be a sufficient substitute for the Act. We found that, without the Act, recycling rates would be less than half their current rates. Section 4 provides more detail.

(f) *Recommend any modifications to the Act, including, but not limited to, the fiscal and recycling impact of repealing the Act; the fiscal and recycling impact of expanding the Act; the impact of switching to a container basis rather than continuing the current content basis; and any products or materials that should be included or excluded from the coverage of the Act.*

We have one recommendation: The CRV should be doubled to a nickel for containers less than 24 ounces and a dime for larger containers. Based upon our regression results and our analysis of the PET additions in the year 2000, we believe that this change in CRV is the most efficacious way to increase the quantity of material returned. Our recommendation is specific to doubling the CRV as compared to a CRV structure of a nickel for all sizes of containers because the latter would not provide sufficient additional incentive for the return of PET containers. The addition to the program of milk, wine, and liquor are all potentially feasible, but only with a higher CRV. Section 5 provides more detail.

A container basis will not be as useful as including the major excluded beverages: milk, juice in large containers, liquor, and wine. Section 5.3 provides more detail.

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CALIFORNIA BEVERAGE CONTAINER RECYCLING AND LITTER REDUCTION STUDY

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1. INTRODUCTION

The California Beverage Container Recycling and Litter Reduction Act (Act) was enacted in 1986 to promote recycling of empty beverage containers, commonly known as California Redemption Value (CRV) containers. The State's Department of Conservation (DOC) administers the Act, which established the California Beverage Container Recycling Fund (CBCRF) in the State Treasury. The CBCRF consists of redemption payments collected from beverage distributors. All beverage distributors must deposit a redemption payment for every covered container sold or offered for sale in the state: 2.5 cents for every container smaller than 24 ounces and 5 cents for every container equal to or greater than 24 ounces.[4]

The CBCRF is a unitary state fund, with all distributors paying into the same fund. In contrast, no other bottle-bill state[5] has a state fund and each bottler is responsible for the deposits and refunds of their own bottles. The other states' systems are inherently less efficient in that stores must sort bottles for return to that bottle's original distributor. California's unitary fund makes it possible to pay the refund for return bottles without regard to who sold or distributed the bottle.

The CBCRF finances payments to consumers and others for the return of the beverage containers. The balance created in the CBCRF from the payment of redemption payments by distributors that is in excess of the refunds claimed by those who return the bottles is available for paying the costs of recycling and such other uses as the legislature directs. Other states differ in their treatment of the fund balances, with Hawaii, Massachusetts and Michigan claiming the balance as state property, and other states permitting the distributor/bottler to keep these funds. California uses the CBCRF for the payment of administrative fees, handling fees, part of the processing payment, supplemental curbside payments, and various community and educational programs. In

[4] CA DOC/DOR, 2001, Section 14560.
[5] There are 11 bottle bill states: California, Connecticut, Delaware, Hawaii, Iowa, Maine, Massachusetts, Michigan, New York, Oregon, and Vermont.

addition to these payments, beverage manufacturers pay processing fees that vary by container type and by year.[6]

The Act has broad coverage of beverage containers. However, it does not include wine, milk, or juice in containers greater than 46 ounces, vegetable juice in containers greater than 16 ounces,[7] and liquor. No other state covers milk, but coverage of wine and liquor differs among the states with Hawaii, Iowa, Maine, and Vermont covering wine and liquor.

The Act is unique among programs for the return of beverage containers in calculating the payments for return on a weight basis. All other bottle bill states and the Canadian provinces pay redeemers of containers by counting the containers and paying a fixed price per container (often varying with size and type.) Under the Act, prices are set on a per pound basis for each material type. Within a material type, e.g. aluminum cans, there is no segregation by brand or size at the time of redemption, nor does the Act require such segregation at any later point.[8] The payment made in California to the agent who returns a container is called a California Refund Value (CRV) and is distinguished from a deposit in its payment by weight.

The Act requires redemption facilities be available proximate to major supermarkets and fixes the minimum number of hours that such sites must be open. Other states with bottle bills require all sellers to redeem and redemption hours generally to follow store hours. In addition to the redemption facilities mandated by the Act, California has recycling centers that are not sited at supermarkets, curbside collection, and drop off and other programs.

California's CRV is about half of the deposit levied by most other bottle-bill states. With the exception of Michigan that has a deposit of 10 cents, all other states charge 5 cents for the great majority of their returned containers.[9] California achieves a

[6] CA DOC/DOR, 2001.
[7] Vegetable juice in containers greater than 16 ounces was excluded as of January 1, 2001.
[8] Processors or handlers may elect to sort materials (e.g. colors of glass) to maximize the value of the recovered product, but the Act does not require it.
[9] For instance, Maine and Vermont have a deposit of 15 cents for wine and liquors

published recycling rate on the low end of what other bottle-bill states report, though the other states generally include fewer types of containers in their published statistics.

There is also a mandate for municipalities to reduce their waste by 50 percent, which creates incentives for these entities to fund curbside collection and otherwise support recycling. End user demand for the material collected by recycling is increased by recycled content laws.

1.1. The Sections

This report is in seven substantive sections, the first of which is this introduction. Section 2 describes the effects of a container's inclusion in the Act. In 2000, PET-packaged coffee and tea-based drinks, juice blends, and 100-percent fruit juice in containers less than 46 ounces became covered by the Act. We used these PET-packaged beverages before and after their inclusion as like containers and calculated their recycling rates before and after their inclusion in the Act. To calculate their recycling rates before inclusion in the Act required both sales and return data. Sales estimates were based upon supermarket scanner data and industry data, while the return data came from DOC data on the return of PET on which CRV was not paid. From these numbers we constructed the recycling rate in 1999, before these containers were covered by the Act. By looking at the change in recycling rate for PET between 1999 and 2000, we were able to infer the rate for the newly covered containers in 2000. Section 2 also includes evidence that HDPE containers were recycled at a higher rate after inclusion in the Act and a statistical event study that shows that inclusion of containers within the Act does not decrease their sales.

Section 3 contains information on the net costs of recycling and on payments by the DOC. While the cost estimates are drawn both from a survey completed for this report and from information collected by the DOC, information on payments is only from information collected by the DOC. In this section, CRV payments by material type, administrative fees, processing payments, handling fees, and curbside supplemental payments are discussed. Costs, by type of recycling program and type of material, are set out. The net costs to California of recycling material are compared to the physical, though not environmental costs, of alternative disposal of the material.

Section 4 contains a discussion of the scope of curbside recycling and the effect of the Act on curbside programs. The scope of curbside programs is illustrated with maps showing the percent of each county that is served by the program. The effects of the Act on curbside are both financial and on the quantity of material that would be collected in the curbside program. A regression model, described in section 5 below, is used to predict the changes in quantity collected at curbside if the Act were not in effect. This estimate is supplemented by a sensitivity analysis based upon one recycler's study of the amount of material that is moved from curbside to for-CRV return modes.

Section 5 begins with the discussion of a regression model that predicts the amounts returned in each major category of program as a function of the CRV and demographic variables such as income. The model is then used to predict the effect of changing the CRV. Changing the CRV to zero approximates the no act outcome, while increasing the CRV to a nickel for all types of containers approximates the Oregon incentives for container return. The effects of expanding the Act and defining the Act on a container basis are also discussed.

Section 6 uses a model of the California economy, together with the costs estimates from section 3, to produce estimates of the benefits of the Act to the California economy. In contrast an Oregon-style system is estimated to have substantial economic cost.

Section 7 presents the effects of different demographics on the recycling rate.

1.2. Recommendation

We have one recommendation: The CRV should be doubled to a nickel for containers less than 24 ounces and a dime for larger containers. Based upon our regression results and our analysis of the PET additions in the year 2000, we believe that this change in CRV is the most efficacious way to increase the quantity of material returned. Our recommendation is specific to doubling the CRV as compared to a CRV structure of a nickel for all sizes of containers because the latter would not provide sufficient additional incentive for the return of PET containers. The addition to the program of milk, wine, and liquor are all potentially feasible, but only with a higher CRV.

2. THE EFFECT ON A CONTAINER'S RECYCLING RATE OF BEING INCLUDED IN THE ACT

In order to investigate whether the inclusion of plastic resin beverage containers in resins other than PET have substantially increased the recycling rate of those containers, and to investigate the recycling rate of like containers covered and not covered by the Act, we made an estimate of the types of beverage containers sold in California by content and by container type.

These estimates depend upon three data sources. First, AC Nielsen[10] supplied data taken from scanners at stores (later referred to as Nielsen, 2002, or scanner data). The data are representative of grocery, drug, and mass-merchandiser sales in California and covers types of stores accounting for about 90 percent of sales. These data give quantity of product by type of product but do not include the exact type of packaging. The second set of data was a custom audit to determine exact packaging and DOC codes of the products listed in the scanner data. The final data source was *Beverage World* (2001). The *Beverage World* data were used to scale up the scanner data to account for the market segments not included in the scanner data sample. By using these three sources of data, we produced the estimates of containers sold by packaging type and content.

There are very few containers covered by the Act in resins other than PET. The only other resins reported in the scanner data are #2, #4, and #7. The reported numbers of containers sold for beverages covered by the Act made of resins #4 and #7 are so small that these recycling rates cannot be accurately estimated. The recycling rates for the half year beginning January 2000, was 18 percent for HDPE. The succeeding half years had recycling rates of 24, 40, and 38 percent, respectively.[11] Since HDPE was first included in the Act in 2000, this upward trend is indicative of the effectiveness of the Act. However, 73 percent of the material for which CRV was refunded was collected in the curbside program in year 2000 and 65 percent was collected in curbside in 2001.[12] Thus, while the percent returned by consumers (or scavengers, i.e., people who have no legal

[10] AC Nielsen Market Decision, 2002. These data are not publicly available.
[11] Biannual Report, Table 1, May 23, 2001.
[12] CA DOC/DOR unpublished data.

rights to the materials left at curbsides) for CRV is quite low, it is increasing, and the percent returned has increased markedly over the time that HDPE containers have been included in the Act.

In the year 2000, there were substantial introductions of types of beverages into the Act. We compared the recycling rate of these beverages before and after their introduction to the Act. Most of the introductions were packaged in PET, so we chose PET-packaged coffee and tea-based drinks, juice blends, 100-percent fruit juice in containers less than 46 ounces, non-carbonated water, noncarbonated soft drinks, and sport drinks as our like containers. The same beverages were sold in the same containers before and after they were added to the Act and serve as their own control group. We estimated the recycling rate for PET containers for 1999 and for 2000. These rates are representative of the rates for the same containers and same beverages before and after inclusion in the Act.

In order to estimate the recycling rate of PET containers not in the program in 1999, we used data from DOC on the return, by weight, of non-program PET. We apportioned that PET into that attributable to the subject containers (e.g., still water) and to other containers (e.g., juice in containers greater than 46 ounces, which was not added to the beverages in the Act). We used those numbers to make an estimate of the number of containers sold. These numbers were then used to calculate a recycling rate of 12 percent for PET containers not covered by the Act in 1999.

The recycling rate for PET containers covered by the Act was computed as follows. The containers covered in 1999 were assumed to have their recycling rate fall by the same proportion that the recycling rate of aluminum containers fell. The recycling rate for all PET returned in 2000 was taken from DOC records. The recycling rate of the 2000 introduced PET can then be found since the weighted average recycling rate of the 2000 introductions and the PET that was in the program prior to 2000 is the recycling rate of all PET for 2000. This rate for containers introduced in 2000 was 17 percent.

We conclude that PET containers for juice (in containers less than 46 ounces), still water, juice blends, and sport drinks had a recycling rate of 12 percent when not covered by the Act and 17 percent when covered by the Act.

3. NET COSTS OF RECYCLING CENTERS, SUPERMARKET SITES, AND CURBSIDE PROGRAMS AND COSTS OF DISPOSAL OF NON-CRV CONTAINERS

3.1. Introduction

The purposes of the study are to estimate and compare the net recycling costs of the CRV containers for different recycling programs and to estimate the costs of collection and disposal of non-CRV containers for the calendar year 1999. Recycling programs considered in the study include non-supermarket-sited recycling centers, supermarket sites, and curbside programs. Other recycling programs (such as drop-off and collection centers and community-service programs) are excluded from the study due to relatively small volumes of collection at these programs and wide variations in methods and costs of operations.

3.2. Material Flows

Most CRV containers are recovered for recycling at recycling centers and through curbside programs as well as through drop-off, collection, and community-service programs. The containers can also be salvaged at transfer stations and other disposal facilities. Recycling centers are categorized into two groups: 1) certified recycling centers located at supermarket sites located in convenience zones, [13] including sites receiving or not receiving handling fees (referred to as "supermarket sites"), and 2) any certified recycling center not supermarket sited or receiving handling fees (referred to as "non-supermarket sited recycling centers"). Under the Act, at least one supermarket site is placed in every convenience zone, which provides consumers with convenience in recycling and helps increase recycling rates of all types of beverage containers. Non-supermarket sited recycling centers and supermarket sites sell the returned CRV containers to processors who buy the containers and process the materials by densification, such as bailing and crushing. The containers are then sold for scrap values to end users.

[13] A convenience zone is defined as the area within a one-half mile radius around a full-line grocery store with $2 million or more in gross annual sales (CA DOC/DOR, 2001, Section 14509.4; 14526.5).

Curbside and drop-off collection and community-service programs receive CRV containers as mixed or source-separated recyclables. The containers are sometimes poached from residential and commercial collection sites and delivered to non-supermarket sited recycling centers and supermarket sites for CRV. The rest of the collected containers are brought to material-recovery facilities (MRFs) and transfer stations for sorting, compacting, and baling or are sent directly to processors. Of the two types of MRFs, clean MRFs accept mixed recyclables and dirty MRFs accept municipal solid waste (MSW) as well. Materials collected through curbside programs by definition are not mixed with MSW when collected from the curb and thus are brought to a clean MRF. A dirty MRF, where MSW is delivered and recyclables are sorted out, serves collection or community-service programs. Both types of MRFs then sort out the mixtures into individual types of recyclable materials, and all separated CRV containers are then brought to processors.

3.3. DOC Roles

The DOC plays a central role in the state's recycling system by certifying all recycling programs and processors under the Act and managing the CBCRF. All certified recycling programs are categorized into non-supermarket sited recycling centers, supermarket sites, curbside programs, collection and drop-off programs, and community-service programs. The DOC uses the CBCRF to pay all certified programs the CRVs for returned containers based on the redemption weight. Because not all containers are returned for refund values, the non-refunded portion of the CBCRF becomes available for other uses. Certified recycling programs become eligible to receive different payments specific to the type of program.

Besides CRVs, the DOC pays administrative fees, processing payments, handling fees, and curbside supplemental payments. All programs and processors, in general, receive administrative fees and processing payments (which pass on to recyclers). But handling fees are paid only to eligible supermarket sites, and curbside supplemental payments are paid to eligible curbside programs. Curbside programs are also supported with general-waste (garbage) collection fees and other income from local government.

3.3.1. CRV Payments by Material Type

There are three major types of beverage containers that have CRV values: aluminum, glass, and PET. DOC reports that more than 99 percent of CRV containers received in 1999 were of these three material types. Of all plastic containers, only PET containers had CRVs until January, 2000. Thus, CRV plastic containers were all PET containers in 1999.

In 1999, California consumers recycled 124,056 tons of CRV aluminum, 428,533 tons of CRV glass, and 42,224 tons of CRV PET containers.[14] Aluminum containers were recycled most heavily at non-supermarket sited recycling centers and supermarket sites while larger percentages of glass and PET containers were recycled through curbside and collection programs. Of the aluminum containers, 69 percent and 25 percent were recycled at non-supermarket sited recycling centers and supermarket sites, respectively, while only 5 percent and 1 percent were recycled through curbsides and collection programs, respectively. But curbside programs received 19 percent each of total glass CRV and PET CRV containers, and collection programs received 4 percent of glass CRV and 3 percent of PET CRV containers. These differences in recycling methods by container type reflect the differences in ease of recycling and scrap values, with aluminum easier to handle and more likely to be valuable to consumers for scrap values and CRV per pound.

3.3.2. Administrative Fees

Administrative fees are paid to all recycling programs based on the amount of CRVs claimed by them. Certified programs and processors divide the administrative fees according to a predetermined ratio. In 1999, processors received a 1.75 percent administrative fee, of which 0.50 percent was passed on to all other certified programs, including curbside programs, and processors retained the 1.25 percent difference. Beginning in 2000, the administrative fee was 2.5 percent. The processor's share became 1.75 percent and the certified recycler's share, 0.75 percent.[15]

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[14] CA DOC/DOR, 1999c.
[15] CA DOC/DOR, 2001, Sections 14573(a)(2) and 14753.5(a)(2).

3.3.3. Processing Payments

Processing payments are financed from processing fees paid by beverage manufacturers and processing fee offsets procured from the CBCRF fund surplus. Processing payments are determined for each container type and are calculated as the difference between the recycling costs, which are adjusted for reasonable financial return, and scrap values.[16] The reasonable financial returns, as defined in the California Code of Regulations, Section 2975, are equal to the statewide average recycling costs multiplied by the average returns on costs for the scrap and waste materials industry as determined from the data contained in the most recent Dun & Bradstreet Standard Three-Year Norm Report (Dun & Bradstreet Credit Services).

3.3.4. Handling Fees

Of the payments made specifically to certain types of recycling programs, handling fees are payments allocated to supermarket sites, which become eligible to receive such fees when they collect between 60,000 to 500,000 containers in a given month.[17] Handling fees were 1.7 cents per eligible container in 1999 (raised to 1.8 cents in 2000) and were paid based on the number of containers redeemed per month.[18] Containers smaller than 24 ounces are considered single containers while containers equal to or greater than 24 ounces are counted as two containers.[19] Each supermarket site could receive up to $2,000 per month[20] and, from the year 2000 onwards, they could receive up to $2,300 per month.[21]

3.3.5. Curbside Supplemental Payments

Curbside supplemental payments are other DOC payments allocated specifically to certain program types. They are paid for each container collected by all curbside and certain collection programs, namely, neighborhood programs,[22] based on the number of

[16] CA DOC/DOR, 2001, Section 14575.
[17] CA DOC/DOR, 2001, Section 14585(a)(2); other requirements are specified in Section 14585(a)-(e).
[18] CA DOC/DOR, 2001, Section 14585(a)(5) and CA DOC/DOR, 1999a, Section 14585(a)(5).
[19] CA DOC/DOR, 2001, Section 14585(b)(5), 14585(a)(3).
[20] CA DOC/DOR, 1999a, Section 14585(a)(6).
[21] CA DOC/DOR, 2001, Section 14585(c)(6).
[22] A program that provides recycling opportunity to residential neighborhood can be designated as a neighborhood program by a government entity (CA DOC/DOR, 1999a, Section 14514.4.1). No neighborhood program has qualified for the payment as of 2000.

containers collected by curbside programs.[23] In 1999, all curbside programs were eligible to receive the payments even if they did not collect all types of beverage containers.[24] From July 1, 2002, however, the program operators must collect all types of empty beverage containers to receive the payment.[25]

3.4. Recycling Cost Data

This section describes the sources of cost and payment data that are related to CRV container recycling. Most of the cost data for non-supermarket sited recycling centers and supermarket sites were obtained from the DOC while the cost data for curbside programs came from various sources, including DOC, a survey, and other secondary data sources.

3.5. Facility Operation Costs

Table 1 summarizes cost and payment data at non-supermarket sited recycling centers and supermarket sites for the study year 1999. Costs presented in the table represent the typical facility operation costs of recycling a ton of aluminum, glass, and plastic (PET) CRV containers. For our analysis, we determined costs to recycle for all non-supermarket sited recycling centers and for all supermarket sites (including handling-fee and non-handling-fee sites). At non-supermarket sited recycling centers, they were \$361.83 per ton of aluminum, \$86.75 per ton of glass, and \$588.14 per ton of PET containers.[26] The 1999 non-supermarket sited recycling center cost figures received from the DOC/Division of Recycling (DOR) were \$354.30 for aluminum, \$86.25 for glass, and \$584.14 for PET, but we adjusted them to remove administrative fees. In the survey, administrative fees are deducted. As few supermarket sites were included in the 1999 cost survey sample, the best reflection of actual costs for non-supermarket sites was the 1999 cost of recycling, excluding centers receiving handling fees, with the administrative fees

[23] CA DOC/DOR, 2001, Section 14549.6.
[24] CA DOC/DOR, 1999a, Section 14549.6.
[25] CA DOC/DOR, 2001, Section 14549.6(a).
[26] Facility operating costs derived from data provided by CA DOC/DOR

not deducted. At supermarket sites, they were \$553.06 per ton of aluminum, \$418.35 per ton of glass, and \$901.35 per ton of PET containers.[27]

Table 1. Costs and Payments (\$/ton) by CRV Container Type, 1999

	Aluminum	**Glass**	**PET**
Costs			
Non-supermarket Sited Recycling Center	361.83	86.75	588.14
Supermarket Site	553.06	418.35	901.35
Processors	73.81	22.29	133.57
Revenues			
CRVs[1]	1505.00	100.00	840.00
Processing Payments	0	71.56	298.72
Scrap Values[2]	923.64	17.62	493.42

[1]Based on fully segregated CRV per pound.
[2]Average scrap values paid to recyclers for the period between October, 1998, to September 30, 1999, for glass and PET containers.
Source: State of California, Department of Conservation, Division of Recycling (CA DOC/DOR) 2000, 1999d, 1999e, and 1998a; and derived from data provided by CA DOC/DOR.

For our analysis, we determined costs to recycle for all supermarket sites (including handling-fee and non-handling-fee sites). For the cost of supermarket sited recycling centers, costs were determined from data representing the few supermarket sited recycling centers in the 1999 cost survey along with data from handling fee sites with the costs weighted based on volume redeemed from these two populations. It was more expensive to recycle all container types at supermarket sites because the law determines the locations of these sites and the collection volume by each supermarket site was small. Processor’s costs in 1999 were estimated based on 1998 data as \$73.81 per ton

[27] Facility operating costs derived from data provided by CA DOC/DOR.

for aluminum, $22.29 per ton for glass, and $133.57 per ton for PET containers.[28] Glass beneficiation and plastic reclamation processes are not included in the processor cost figures.

Table 1 also presents the payments made to different container types, which were not reflective of recycling program type. According to the DOC, the total CRVs received for a ton of fully segregated containers in 1999 were $1,505 for aluminum, $100 for glass, and $840 for PET containers.[29] Processing payments were $71.56 per ton for glass and $298.72 for PET containers in 1999, and no processing payments were made for aluminum.[30] Manufacturers paid processing fees of $19.66 per ton for glass containers in 1999, but they did not pay any processing fees for PET containers in the same year because scrap values were artificially high. In 2000, the processing payments were $67.57 per ton for glass and $581.51 per ton for PET containers[31] and processing fees were $10.14 per ton for glass and $87.32 per ton for PET containers.

In 1999, recyclers other than curbside programs, on average, received scrap values of $923.64 per ton of aluminum, $17.62 per ton of glass, and $493.42 per ton of PET containers.[32] Note that 1999 processing payments were calculated using the average scrap values and recycling costs of 1998. The 1998 scrap values were $1,022.14 per ton for aluminum, $30.00 per ton for glass, and $518.24 per ton for PET containers.[33] The 1998 recycling costs were $99.41 per ton for glass and $799.68 per ton for PET containers.[34]

[28] CA DOC/DOR, 2000. When these calculations were completed, processor costs for the year 1999 were unavailable at the DOC/DOR. They were estimated from 1998 data with the manufacturer index of intermediate materials, supplies and components (US BLS 1999).
[29] CA DOC/DOR, 1998a.
[30] CA DOC/DOR, 1999d.
[31] CA DOC/DOR, 1999e.
[32] CA DOC/DOR, 1999e; In 1999, the actual scrap value for PET was $493.42 which was artificially inflated to avoid imposition of a processing fee. The $61.18 noted on the 2000 processing fee notice removed the influence of the artificial scrap value.
[33] CA DOC/DOR, 1999d.
[34] CA DOC/DOR, 1999d.

3.5.1. DOC Cost Data

The average cost of curbside collection in 1992 (measured in 1994) was $142 per ton as estimated by the DOC.[35] Total labor and general overhead costs represented most of the costs, namely, about 61 percent combined when the midpoints of cost ranges in the report were used to calculate the cost share. The study, however, examined only eight recycling programs. In order to update and improve data accuracy, a mail survey was conducted.

3.5.2. Survey Cost Data

A survey was sent to approximately 200 curbside recyclers in California. Due to the nature of a survey that inquired about sensitive cost information, the response rate was 15 percent. Because the survey does not depict an accurate picture of statewide curbside recycling, the results from this survey were used only to update the costs of curbside operations and redefine the flow of recyclables collected at the curbside.

In general it was difficult to summarize the data, since there were great variations in curbside recycling methods, with their costs ranging anywhere from $14 to $700 per ton. Overall, labor costs were about 61 percent of the total costs and the labor costs represented the majority of the general overhead, which were similar to the DOC's 1994 study data. Depreciation was higher than that of the DOC study, partially reflecting the curbside collection's trend toward more machine-intensive operations. Most containers collected at the curbside were first shipped to MRFs before being recycled by processors. According to our survey, costs to operate MRFs were about $30 per ton. The California Integrated Waste Management Board finds that MRFs charge $40 per ton on average at the gate.[36] Large-volume recyclers are likely to get a discount from that $40 per ton charge, and we have decided to use the survey figure of $30 per ton for MRF charges.

3.5.3. Curbside Collection Costs

Curbside collection costs were estimated by updating the $142 figure in the 1994 DOC report[37] by inflating to get a 1999 figure of $168.53 per ton. This figure may be

[35] CA DOC/DOR, 1994.
[36] CIWMB, 1999.
[37] CA DOC/DOR, 1994.

high because of the increase in single-stream curbside recycling since the time of that report.

3.5.4. Net Costs of Recycling

This section presents the net recycling costs (recycling costs net of scrap value) for the study year 1999. Net recycler costs are defined as the total operation costs of recycling programs minus their scrap values. Tables 2 through 4 summarize these costs by CRV material type and by recycling program type. Net costs per container are presented along with the costs per ton, calculated based on the DOC's conversion ratios. These are the actual costs, less the scrap value received, and do not include the program payments including CRV, which are transfer payments from government to recycling programs. The net costs in tables 2 through 4 reflect the costs to California of recycling beverage containers. These costs are to be compared to the costs of alternate disposal means for these containers, such as the physical and environmental costs of landfilling. These costs do not include program payments because those payments are income to recycling programs in exactly the same amount that they are a cost to consumers and hence would have no effect in the comparison of alternative methods of container disposal.

Table 5 includes the program payments to recycling programs, and shows the financial situation of these programs and is not a measure of the costs borne by society as a whole of the recycling programs.

Table 2. Net Costs of Recycling CRV Aluminum Containers, 1999

Recycler Type[1]	Costs ($/Ton)			Revenue ($/Ton)	Net Costs ($/Ton)	Net Costs ($/Container)
	Recycler Costs	MRF Costs	Processor Costs	Scrap Value		
RC	361.83	0.00	73.81	923.64	-488.00	-0.0082
SS	553.06	0.00	73.81	923.64	-296.77	-0.0050
CS	168.53	30.00	73.81	923.64	-651.30	-0.0110

[1]RC: non-supermarket sited recycling centers; SS: supermarket sites; CS: curbside programs.

Table 3. Net Costs of Recycling CRV Glass Containers, 1999

Recycler Type[1]	Costs ($/Ton)			Revenue ($/Ton)	Net Costs/ ($/Ton)	Net Costs ($/Container)
	Recycler Costs	MRF Costs	Processor Costs	Scrap Value		
RC	86.75	0.00	22.29	17.62	86.38	0.0237
SS	418.35	0.00	22.29	17.62	417.98	0.1148
CS	168.53	30.00	22.29	17.62	203.20	0.0551

[1]RC: non-supermarket sited recycling centers; SS: supermarket sites; CS: curbside programs.

Table 4. Net Costs of Recycling CRV PET Containers, 1999

Recycler Type[1]	Costs ($/Ton)			Revenue ($/Ton)	Net Costs/ ($/Ton)	Net Costs ($/Container)
	Recycler Costs	MRF Costs	Processor Costs	Scrap Value		
RC	588.14	0.00	133.57	493.42	228.29	0.0116
SS	901.35	0.00	133.57	493.42	541.50	0.0276
CS	168.53	30.00	133.57	191.62	140.48	0.0072

[1]RC: non-supermarket sited recycling centers; SS: supermarket sites; CS: curbside programs.

Table 5. Net Recycler Costs of Recycling CRV Containers by Recycler, Weighted Average, 1999

Recycler Type[1]	Costs ($/Ton)			Revenue ($/Ton)	Net Costs/ ($/Ton)	Program Payments ($/Ton)	Net Costs-Program Payments ($\Ton)
	Recycler Costs	MRF Costs	Processor Costs	Scrap Value			
RC	186.34	0.00	42.09	267.95	-39.52	71.72	-111.24
SS	486.93	0.00	43.12	275.17	254.88	219.73	35.15
CS	168.53	30.00	34.85	87.93	145.45	388.87	-243.42

[1]RC: non-supermarket sited recycling centers; SS: supermarket sites; CS: curbside programs.

3.6. Estimation of Net Curbside Recycler Costs

Using the numbers in section 3.5.3 and 3.5.2, for all containers, collection costs of $168.53 and MRF costs of $30.00 were used for our impact analysis. Revenues for recyclers come from scrap values for sales of CRV containers, which are presented in Table 1.

3.7. Costs Analysis and Comparison

This subsection presents cost analysis and comparison for different recycling programs and different CRV containers based on recycling costs presented in the previous two subsections.

As shown in tables 2-4, the recycling costs of CRV aluminum containers were -$488.00 per ton and -$0.0082 per container at non-supermarket sited recycling centers, -$296.77 per ton and -$0.0050 per container at supermarket sites, and -$651.30 per ton and -$0.0110 per container at curbside programs. In addition there were avoided costs of $140 per ton for each recycler type for not having to take the material to landfill. We can subtract these avoided disposal costs of $140 per ton to get -$628.00 per ton at non-supermarket sited recycling centers, -$436.77 per ton at supermarket sites, and -$791.30 per ton at curbside programs. All of these recycler costs were negative since the aluminum scrap value was higher than the recycler cost. Net recycler costs of CRV PET and glass containers were much higher than those of aluminum containers at all recycling programs. For PET containers, they were about $228.29 per ton and $0.0116 per container at non-supermarket sited recycling centers, $541.50 per ton and $0.0276 per container at supermarket sites, and $140.48 per ton and $0.0072 per container at curbside programs. We can subtract the avoided disposal cost of $140 per ton (see section 3.9) from these figures to get $88.29 at non-supermarket sited recycling centers, $401.50 at supermarket sites, and $.48 at curbside programs. Net recycler costs for CRV glass containers were $86.38 per ton and $0.0237 per container when recycled at non-supermarket sited recycling centers, $417.98 per ton and $0.1148 per container at supermarket sites, and $203.20 per ton and $0.0551 per container at curbside programs. Again, subtracting the avoided disposal costs, we get costs of -$53.62 per ton for non-supermarket sited recycling centers, $277.98 per ton for supermarket sites, and $63.20 per ton for curbside programs. The cost of disposal of $140 per ton does not include the environmental costs and the long-run maintenance costs for landfills.

3.8. Weighted Average by Recycler Type

Table 5 presents the weighted averages of net recycler costs per ton by recycling program and these costs minus program payments. As shown in the sixth column of the table, non-supermarket sited recycling centers had the lowest and supermarket sites had the highest costs net of scrap value. The final column of the table shows the net costs less program payments, a measure of profitability. The net costs minus program payments are $111.24 in revenue for non-supermarket sited recycling centers, $35.15 in costs for supermarket sites, and $243.42 in revenue for curbside recycling. With these payments added in, curbside programs and non-supermarket sited recycling centers have positive revenues per ton.

3.9. Disposal Costs

Disposal costs vary depending on when containers are sorted out and shipped to landfills. According to the CIWMB, average tipping fees at California landfills were $35 per ton in 1999.[38] Because it is estimated that the tipping fees were about 25 percent of all collection costs in 1999,[39] disposal costs were estimated at about $140 per ton. When containers are sorted out as non-recyclables at the MRFs, marginal costs of disposal would be higher since containers are collected as recyclables and transportation costs and tipping fees are added to the recycling costs.

3.10. Summary

This study estimates and compares the net recycling costs in the study year 1999 by different recycling programs and also estimates the costs of disposal. As shown in

[38] CIWMB, 1999.
[39] Alder, Green & Hasson, 1997.

table 5, overall, non-supermarket sited recycling centers were found to have the lowest net cost. Both non-supermarket sited recycling centers and curbside operations have greater receipts from program payments and scrap value than they have costs.

4. SCOPE OF CURBSIDE RECYCLING AND THE IMPACT OF THE ACT ON CURBSIDE RECYCLING

4.1. Introduction

The first curbside program originated in Berkeley in the 1970s. The Act provides payments to curbside programs and is a major reason for the expansion of curbside recycling programs since its introduction in 1986. The California Integrated Waste Management Act, requiring California's cities and counties to reduce waste by 50 percent in terms of weight before the close of 2000, also provided major impetus for the expansion of curbside programs.

In what follows, we first look at the scope of curbside recycling programs in California, emphasizing the recycling of glass, aluminum, and PET containers.

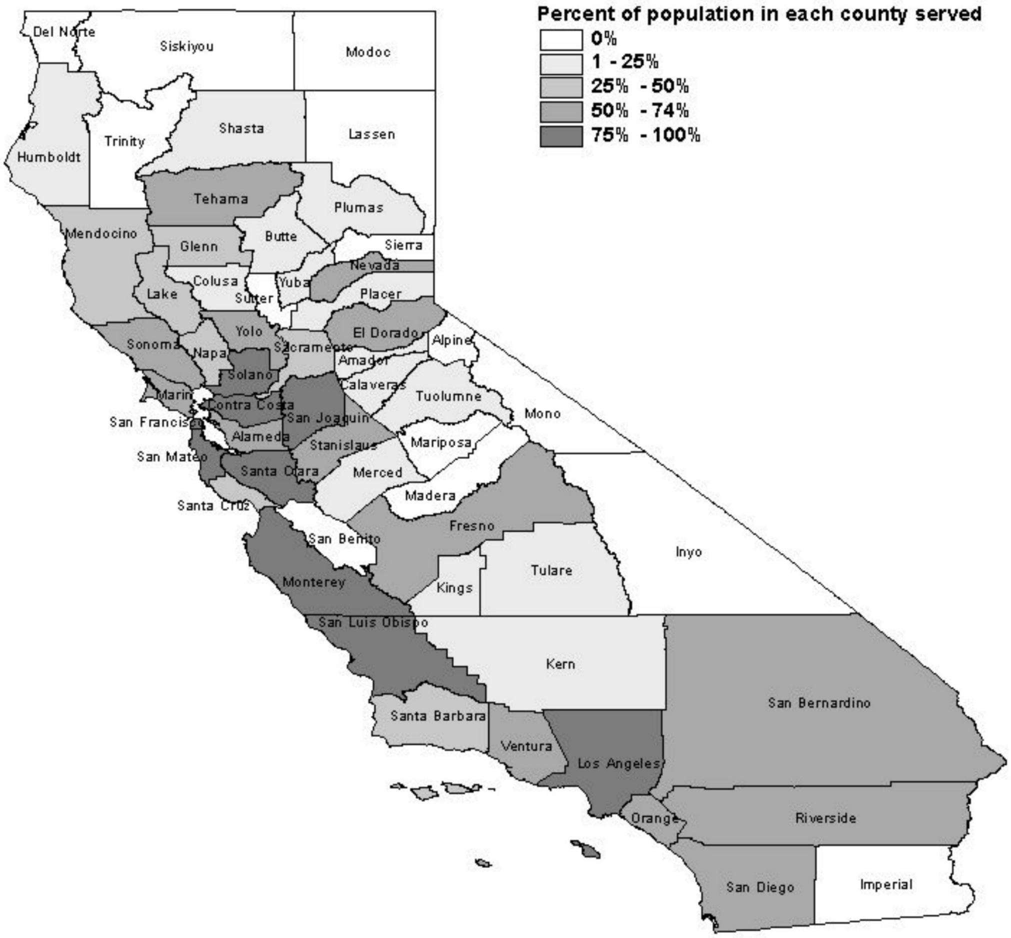
The scope discussions are followed by an analysis of the impact of the Act on curbside recycling. We first discuss various ways the Act can impact curbside recycling and then do an economic analysis of the benefits and costs of the Act on curbside recycling. In particular, this analysis compares the existing situation (with the Act) with a hypothetical situation in which there is no Act.

4.1.1. Curbside Recycling Coverage

Map 1, derived from data, up to and including 1999, from DOC/DOR and Department of Finance (DOF), shows the coverage as a percentage of the population of curbside recycling programs throughout California. The highest covered counties are San Luis Obispo, Contra Costa, San Francisco, Santa Clara, and Monterey. Other counties around the state also have high curbside coverage.

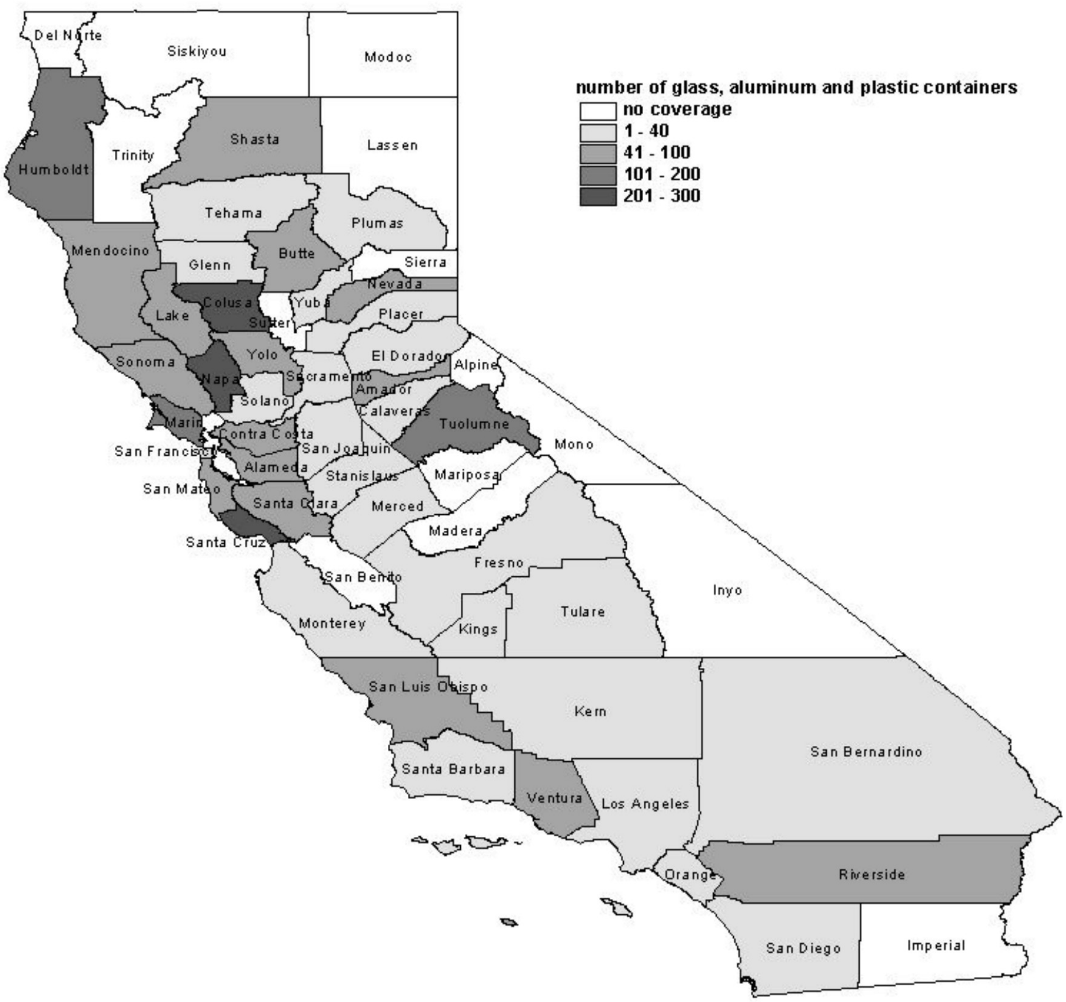
Fourteen of California's 58 counties are not covered by curbside recycling at all. These counties are rural. The other counties with less than 25 percent coverage also generally have low populations and are rural.

Map 1: Curbside recycling coverage, 1999



Source: Computed from DOC/DOR and DOF data.

Map 2: Number of aluminum, glass and plastic CRV containers collected person served by curbside recycling, 1999



Source: Computed from DOC/DOR and DOF data.

4.1.2. Containers Collected through Curbside Recycling

Map 2 is derived from DOR/DOC data up to and including 1999. It shows the average number of CRV containers collected per person served by the curbside recycling programs in different counties. The highest per-person container collection rates are in Colusa, Santa Cruz, Napa, and Marin. Among many factors that can impact the level of collection, the number of CRV containers collected depends positively on the level of household participation in curbside recycling as well as household consumption of products that use containers and is negatively related to the level of illegal scavenging of curbside containers.

4.1.3. Expansion of Curbside Recycling

The proliferation of curbside programs that occurred in the early 1990s has continued during the latter part of the decade, albeit at a much slower pace. As a consequence of the Act and the California Integrated Waste Management Act, the number of programs in operation increased from 181 in June, 1990, to 459 in June, 1993. This 154 percent increase in less than three years could not be sustained in the ensuing years. In the seven years that followed, the number of programs rose to 540—an increase of about 18 percent. The slowdown in the expansion of the number of programs may indicate that coverage in the state is coming closer to a saturation point.

While the number of programs increased by about 28 percent from 1992 to 1999, the total volume weight of containers recycled by these households increased by around 32 percent for glass, 28 percent for aluminum, and 278 percent for PET over the same period. By weight, much more glass than PET or aluminum is recycled, reflecting the heavy weight of glass containers relative to aluminum and PET.

4.1.4. Types of Households Served

During the year 2001, curbside programs provided collection to 5.5 million single-family households, or 72 percent of all single-family households in California. Meanwhile, coverage of multifamily units (defined as units with two to four households) and apartment units is not as pervasive; 58 percent of multifamily units and 28 percent of apartment units are served by curbside recycling.

4.1.5. Curbside Collection Services

Curbside recycling programs can vary in the type and convenience of services offered. Here, we examine three features that characterize curbside collection of containers: frequency of collection, material-separation requirements, and collection method. The vast majority (81 percent) of the curbside recycling programs collects weekly, and most of the others collect less frequently. More frequent collection tends to increase household participation—a figure that is reported by curbside recycling program operators when their registration is renewed to the DOC.

In addition, curbside collection programs typically collect materials on the same day as regular garbage collection. Coordinating collection days makes recycling more convenient and easier to remember, again encouraging greater participation.

Material-separation requirements refer to the amount of separation of containers by materials households must do when they put materials out for recycling. Some curbside haulers pick up containers that are mixed together while others require that containers be sorted by material (glass, aluminum, and PET) or by even finer characteristics. Allowing customers to mix their recyclables probably increases household participation rates by making recycling easier. It also reduces the amount of scavenging by increasing the amount of sorting scavengers need to do. On the other hand, customer-sorted recycling reduces the processing costs to the hauler and usually results in cleaner recyclable materials.

4.2. Impact of the Act on Curbside Recycling

This section of the study focuses on the impact of the Act on curbside recycling. The collection and recycling of glass, aluminum, and PET are affected by various provisions of the Act.

First, the Act imposes a CRV for beverage containers containing certain products. This value is given to anyone returning containers with CRV to a certified recycling operation that pays redemption value. The payment of CRV may reduce the number of containers curbside picks up because the CRV provides an incentive for return to recycling centers. This reduction in materials collected reduces the revenues from sales of the materials as scrap and reduces the costs of pickup. However, the curbside recyclers gain additional revenue from the CRV containers they do collect.

A second provision of the Act that affects curbside programs is the mandate that provides processing payments for recycling containers whose scrap value is insufficient to cover the costs of recycling. Curbside programs, recycling centers, and drop-off and collection programs are all eligible to receive these payments. This provision supports the recycling of PET and glass containers. The processing payments are calculated based on the total cost of recycling containers at recycling centers, plus a reasonable financial return (defined in the regulations), minus their scrap value. This provision increases the feasibility of collecting and recycling glass and PET and thus benefits curbside recycling programs.

A third provision affecting curbside program required that, in 1999, each beverage container manufacturer in the state use a minimum of 35 percent of post-filled glass in the manufacturing of glass containers. This provision has since been changed so that if the manufacturer is using 75 percent mixed-color cullet, the minimum has been reduced to 25 percent total use of cullet. This provision increases the demand for scrap materials for all modes, including curbside, of recycling.

A fourth provision of the Act provides supplemental payments to curbside programs. These payments are funded by CRV payments that have gone unredeemed. The supplemental payments to curbside recyclers were $5,000,000 per year in 1999. These types of payments have been issued since 1996 and were increased to $15,000,000 in 2000. The total sum is divided annually among the curbside recycling programs throughout the state in proportion to the number of containers each program recycles. The estimated supplemental payment per container for 1999 is $0.006. This number is derived by taking the total number of CRV containers collected by curbside for 1999 and dividing it into $5 million—the supplemental payments in 1999.[40] Clearly, this provision benefits

[40] CA DOC/DOR 1999a, Section 14549.6.

curbside recycling programs since they receive additional payment for the containers they receive.

A fifth provision is that in 2000 there was also a quality glass incentive payment program that provided up to $25/ton for curbside program generated color-sorted glass or mixed color cullet that later was color sorted.

To sum up, there are five channels through which the Act affects curbside recycling:

- CRV
- Processing payments
- Minimum recycled contents for glass containers
- Supplemental payments
- Quality Glass Incentive Payment Program.

This completes our discussion of the various aspects of the Act that affect curbside recycling. We now do a formal analysis of the total impact of the Act on curbside recycling.

4.3. Impact Analysis: Methodology and Assumptions

In this section we examine the effect of the Act on the costs and revenues of curbside recycling given existing conditions, such as the existing total potential materials in curbside, existing costs for picking up curbside materials, and existing scrap values. The differences between the "with-Act" and "no-Act" scenarios arise from eliminating support from the state in the no-Act scenario and reducing the amount of CRV materials being taken to recycling centers.

This section estimates the financial effects of removing the Act on curbside programs. Our focus in this section is solely on the curbside programs, ignoring the effect of the Act on consumer consumption or the total quantity recycled.

One consequence of eliminating the Act is that curbside recycling program revenues will decline as they lose the payments they are currently receiving for CRV, processing payments, administrative fee, and supplemental payments. In 1999, processors received 1.75 percent of the refund value as an administrative fee,[41] of which 0.50 percent was passed on to all other certified programs, including curbside recycling programs; processors retained the 1.25 percent difference. The administrative fee increased beginning in the year 2000 to 2.5 percent, with processors receiving a 1.75 percent and all other certified programs taking a 0.75 percent share. For the purposes of this study, it is a reasonable approximation to assume that the net effect of taking away the administrative fee as a result of repealing the Act will be negligible. Since the fee reimburses the processors and certified programs for actual administrative costs incurred as a result of the Act, repeal of the Act would not only take away the administrative fee but also relieve the programs of the administrative costs.

The amount of revenue received for CRV depends not on the total number of containers recycled but on the total number of recycled containers covered by the Act. In 1999, total CRV payments to curbside recycling programs were almost $24 million, so this amount would be the CRV loss without the Act. Processing payments are only provided for recycled glass and PET and, again, only for containers covered by the Act. To evaluate the scrap value of PET in these scenarios, we use the market value of scrap PET which was $61.18 per ton. In that case the processing payment for PET would have been $755.78 per ton since the recycling programs were guaranteed a payment of $816.96 per ton for PET. Therefore, in 1999, total processing payments to curbside recycling programs, using our assumptions about scrap values and processing payments for PET, were estimated to be $11.9 million This amount would be the processing payment loss without the Act. The supplemental payments are based on the state fiscal year, and payments are generally made in June—the last month of the fiscal year. Supplemental payments were $5 million in 1999[42] and are independent of the total quantity recycled by all curbside recycling programs. Therefore, $5 million would represent the loss in supplemental payments to curbside recycling programs without the Act.

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41 CA DOC/DOR 1999a, Section 14573(a)(2),14573.5(a)(2).

42 CA DOC/DOR, 1999a, Section 14549.6.

We assume that if the Act were removed, there would be an increase in the amount of glass, PET, and aluminum containers recycled by curbside programs. This arises since eliminating the CRV and convenience zones would reduce the incentives and increase the costs of other disposal modes. As material collection increases, revenues from sales of glass, PET, and aluminum as scrap would increase proportionally. The 1999 market scrap values per ton were $17.62 for glass, $61.18 for PET, and $923.64 for aluminum[43]. The processing costs would also increase proportionally to the quantity collected. These costs are the variable recycling costs (processor and MRF costs) of $52 per ton for glass, $164 for PET, and $104 per ton for aluminum in 1999 plus fixed collection costs. However, the cost of curbside collection would change very little since these costs are related to the fixed costs of paying crews to go from house to house, and are almost unaffected by the relatively small change in the quantity they collect. For simplicity, we assume zero change in collection costs.

A summary of the assumptions of the two scenarios is given in Table 6.

The question is by how much the quantity of glass, PET, and aluminum collected by curbside recycling would increase if there is no Act.

There are two methods of estimating the increase in collections that would be incident on the repeal of the Act. One method is to use the regression methodology described in section 5 and the other is to use estimates derived from estimates of the diversion of curbside materials by scavengers.

The regression framework predicts that without the Act the pickups at curbside would increase from 5.7 percent to 8.5 percent of CRV bearing aluminum sold while the collection of CRV glass and CRV PET would decrease. We doubt that without CRV, less glass and PET would be deposited at curbside and take these estimates as no change in these two materials. Thus, we take scenario one as an increase in CRV aluminum

[43] CA DOC/DOR 1999e and derived from data from CA DOC/DOR.

Table 6. Summary of the Common Assumptions of the Three Scenarios

Assumptions	Current Situation	Hypothetical No-Act Scenario
CA Recycling Act	Yes	No
Number of curbside programs	No change	No change
Amounts recyclable material available	No change	No change
Scrap values	No change	No change
CRV, administrative, processing and supplemental payments to curbside programs	CRV — $ 24 million Administrative — negligible Processing — $ 11.9 million Supplemental — $ 5 million	No CRV — loss of $ 24 million Administrative — negligible Processing — loss of $11.9 million Supplemental — loss of $5 million
Amount of aluminum, glass and PET collected by curbside	No change	Increase (No change in collection costs)

returned of 49 percent (which is 42 percent of total aluminum returned) and no change in PET or glass returned.

Two further scenarios were developed to examine the sensitivity of the effects of the Act on curbside to changes in Act induced changes in curbside volume. These scenarios were based upon one estimate of the quantity diverted by scavengers. Without the Act, some of the material currently diverted by scavengers would remain for curbside collection. In addition, without the requirement for recycling centers in convenience zones, households would have fewer opportunities to take their recyclable material to recycling centers and some of that material, too, would be placed in curbside containers. Thus an estimate of scavenging is a lower bound estimate on the quantity of additional material that would be available for curbside pickup without the Act.

We know of one study of the scavenging rate and it is for San Francisco. In San Francisco previous research has estimated the extent of revenue loss to the curbside recycling company that arose from scavengers taking curbside materials. That research provides the recycling company a basis for estimating the percent of CRV container diversion in the city—estimated as 25 percent for glass, 30 percent for PET, and 50 percent for aluminum (Sunset Scavenging Company)[44]. In other cities, such as Riverside, diversion by scavengers was considered to be negligible while a very large proportion of the glass, PET, and aluminum were being returned by households themselves for CRV reimbursement rather than being put on the curbside for recycling collection. Thus, we use these numbers as a base to produce two further scenarios that show the effects of potential changes in volume to curbside in a no Act scenario.

We base our two further scenarios on a range of numbers spanning the current San Francisco scavenging estimates. We assume that even without the Act, half of the aluminum (and no glass or PET) that is currently available to curbside programs but diverted for consumer redemption would continue to be diverted. Thus we chose the following three scenarios, stated in terms of the additional material (CRV and non-CRV) returned to curbside programs if there is no Act.

[44] Personal communication, Sunset Scavenging Company, San Francisco

- Scenario one. 49 percent more CRV aluminum and no more glass or PET are returned in curbside. This is the regression-based scenario.
- Scenario two. 25 percent more CRV PET, 18 percent more CRV glass and 33 percent more CRV aluminum are returned in curbside. This scenario brackets the San Francisco diversion estimates from below.
- Scenario three. 67 percent more CRV PET, 43 percent more CRV glass and 150 percent more CRV aluminum are returned in curbside. This scenario brackets the San Francisco diversion estimates from above.

Table 7A shows the results of the impact analysis using the regression-predicted changes in the volume of material collected in curbside programs.

In this case, collection of CRV glass and PET remain the same and CRV aluminum collection goes up by 49%. The increase in scrap revenues from the additional aluminum in the no-Act scenario is $2.7 million and the total revenue loss is $38.1 million. The change in cost is $0.3 million from processing and MRF costs. The total loss of net revenue to curbside operations is $38.4 million for this regression-based scenario.

Table 7B shows the results of the impact analysis using the lower of the scavenging-based scenarios. It differs in volume from the regression-predicted scenario in having less aluminum but more glass and plastic collected.

In this case, collection of CRV glass, PET, and aluminum are projected to increase by 18 percent, 25 percent, and 33 percent, respectively, if the Act were removed. The change in CRV payments is calculated by taking the volume collected under the Act (which is the current tons collected) and multiplying that by the value of CRV per ton of material. The processing payments, which are the total cost of recycling containers at recycling centers plus financial return minus scrap values, are calculated by multiplying the current tons collected with processing payments per ton ($71.56 for glass and $755.78 for PET). The change in supplemental payments is the difference between supplemental payments under the Act ($5 million), which are not dependent on the amount of CRV material collected, minus supplemental payments under the no-Act scenario ($0).

Table 7A. Impact of Removing Act—Regression Scenario

	Glass	Aluminum	PET	Total
Additional CRV material returned without Act.	0	49%	0%	
Cost/revenue per ton				
Processing and MRF costs	$52	$104	$164	
Scrap value	$18	$924	$61	
Volume collected				
Tons collected in 1999	214,491	6,692	18,820	240,003
Change in tons collected under no Act	0	2,875	0	2,875
Percent Change in Total Material	0 %	+ 43.0%	0 %	+ 1.2%
Revenue changes				
Change in CRV	$(8,158,766)	$(8,831,438)	$(6,781,575)	$(23,771,778)
Change in processing payments	$(5,838,413)	$0	$(6,101,641)	$(11,940,054)
Change in supplemental payments				$(5,000,000)
Change in scrap revenue	$0	$2,655,790	$0	$2,655,790
Change in total revenue				$(38,056,042)
Change in total cost	$0	$298,490	$0	$ 298,490
Change in net revenue				$(38,354,533)
Total number of households served				7,473,004
Change in payments/household/year				$(5.13)
Change in payments/household/month				$(0.43)

Table 7B. Impact of Removing Act–Low Additional Material Scenario

	Glass	Aluminum	PET	Total
Additional CRV material returned without Act	18%	33%	25%	
Cost/revenue per Ton				
Processing and MRF costs	$52	$104	$164	
Scrap value	$18	$924	$61	
Volume Collected				
Tons collected in 1999	214,491	6,692	18,820	240,003
Change in tons collected under no Act	14,398	1,956	2,018	18,372
Percent Change in Total Material	+ 6.7%	+ 29.2%	+ 10.7%	+ 7.7%
Revenue Changes				
Change in CRV	$(8,158,766)	$(8,831,438)	$(6,781,575)	$(23,771,778)
Change in processing payments	$(5,838,413)	$0	$(6,101,641)	$(11,940,054)
Change in supplemental payments				$(5,000,000)
Change in scrap revenue	$253,546	$1,806,660	$123,481	$2,183,687
Change in total revenue				$(38,528,146)
Change in total cost	$752,862	$203,055	$330,339	$1,286,256
Change in net revenue				$(39,814,420)
Total number of households served				7,473,004
Change in payments/household/year				$ (5.33)
Change in payments/household/month				$ (0.44)

Table 7C. Impact of Removing Act–High Additional Material Scenario

	Glass	Aluminum	PET	Total
Additional CRV material returned without Act	43%	150%	67%	
Cost/revenue per Ton				
Processing and MRF costs	$52	$104	$164	
Scrap value	$18	$924	$61	
Volume Collected				
Tons collected in 1999	214,491	6,692	18,820	240,003
Change in tons collected under no Act	34,966	8,802	5,382	49,150
Percent Change in Total Material	+ 16.3%	+ 131.5%	+ 28.6%	+ 20.5%
Revenue Changes				
Change in CRV	$(8,158,766)	$(8,831,438)	$(6,781,575)	$(23,771,778)
Change in processing payments	$(5,838,413)	$0	$(6,101,641)	$(11,940,054)
Change in supplemental payments				$(5,000,000)
Change in scrap revenue	615,754	8,129,969	$329,283	$ 9,075,006
Change in total revenue				($31,636,826)
Change in total cost	$1,828,379	$913,746	$880,367	$3,622,4921
Change in net revenue				$(35,259,318)
Total number of households served				7,473,004
Change in payments/household/year				$(4.72)
Change in payments/household/month				$(0.39)

The increase in net scrap revenue of $2.2 million is due to the increased quantities collected under the no-Act scenario and is calculated by taking the change in tons collected under no-Act and multiplying it by the scrap prices. This allows us to calculate the total revenue change of $38.5 million as the sum of the changes in CRV, processing and supplemental payments, and scrap revenues. The change in total cost is the change in quantity collected times the variable cost per ton (glass $52 per ton, PET $164 per ton, and aluminum $104 per ton). Total costs under the low-diversion subscenario increase by $1.3 million. Therefore, curbside recyclers lose $39.8 million in this scenario relative to the present.

Table 7C shows the results from the large increase in collection scenario. In this case, the projected increases in total CRV collection of glass, PET, and aluminum are by 43 percent, 67 percent, and 150 percent, respectively. The revenue loss from no longer collecting CRV receipts, processing payments, and supplemental payments are $23.8 million, $11.9 million, and $5 million, respectively. On the other hand, there is a net increase in scrap revenue because of the increased amount collected. This increase is projected to be $9.1 million. Total costs will increase by $3.6 million because of the high amount of additional material that requires handling. The total loss of net revenue to curbside operations is $35.3 million compared to the present.

4.3.1. Discussion

Our regression-based model predicts that total container collection by curbside recycling would increase by 1.2% if there were no Act. The lower of the two diversion-based scenarios predicts a 7.7% increase and we believe that the correct order of magnitude for increased curbside collection is likely somewhere between these two.

In terms of revenue for curbside, the three scenarios all predict losses to the curbside program of between $35 and $40 million, so the financial loss to the curbside programs is large and not at all sensitive to the estimate of how much additional material would come to curbside if there were no Act.

Neither evidence from the regression analysis or the consideration of the scavenging-based scenarios lends credence to the hypothesis that curbside alone will collect the material now covered by the Act.

5. THE IMPACT OF THE ACT RELATIVE TO NO ACT OR TO AN OREGON-STYLE RECYCLING LAW

The Act differs from the Oregon recycling system in at least the following respects: (1) Oregon has a 5-cent deposit (paid by count) while the Act has a CRV (paid by weight) for less than 24-ounce containers that is 2.5 cents; (2) Oregon requires redemption at all points of sale while the Act requires redemption only at recycling centers certified by the state including required recycling centers located within one-half mile of larger stores; (3) Oregon requires that bottles go back to their original distributors and that the private sector handle the redemption system while the Act establishes a government-held fund and uses other methods to assure the transit of empty containers to their point of reuse. This section begins by describing a statistical estimation of the effects of changing the CRV value—a key difference between an Oregon-style bill and the Act. It discusses the costs of an Oregon-type system relative to the California system and then provides an estimate of recycling without the Act. Finally, it provides several estimates of the impact on the California economy of repeal or of an Oregon-style law.

In order to find the effects of a change in the CRV on returns, we collected data on returns by program type, county, CRV (adjusted for inflation), scrap value, and date. We matched this data set to demographic data on the counties. By using regression techniques that were constrained to predict recycling rates between zero and 100 percent, we developed an equation that relates returns to CRV and the other variables.

5.1. Response of Recycling to Change in Container Value

Recycling responds strongly to a change in the CRV. Doubling the CRV, which would make it somewhat higher than other "bottle-bill" states, will result in a California recycling rate for aluminum of 90 percent, for glass of 81 percent, and for PET of 61 percent. The numbers for plastic are calculated with less data and should be treated with caution. Further increasing the CRV by 50 percent to 7.5 cents for small and 15 cents for larger containers would bring glass up to a rate of 84 percent, aluminum to 92 percent and PET to 63 percent. Increasing the CRV for containers of less than 24 ounces to 5 cents, while leaving the CRV for larger containers to 5 cents would result in recycling rates of 90 per cent for aluminum, 80 percent for glass, and 58 percent for PET.

The two projections for higher CRVs (5 cents for all containers and 5 cents for small and 10 cents for large) have very similar recycling rates with the largest difference being for PET. Since 97 percent of aluminum and 94 percent of glass containers returned are in sizes less than 24 ounces, it is not surprising that the recycling rate for these two materials is not very sensitive to whether the CRV for containers of 24 ounces and larger is 5 cents or 10 cents. However, 37 percent of PET containers are larger than 24 ounces; so this category is sensitive to the rate charged for larger containers. Redemption of containers is on a weight basis—containers are not counted or sorted into sizes. A load of containers that was representative of the containers in the PET population would currently be redeemed at an average rate (across larger and smaller containers) of 3.4 cents per container. The 5 cents for all containers proposal would increase the CRV for these containers by a factor of 1.5 while the nickel and dime proposal would increase the CRV by a factor of 2. Given that it is exactly the PET containers that are potentially returnable in great numbers, the proposal to double the CRV to a nickel and a dime stands a much better chance of significantly increasing returns for these containers.

Increasing the CRV provides incentives both for consumers to return their own containers and for scavengers to remove containers from curbside and return them for the CRV. For aluminum, with an increase of CRV to a nickel per small container, the volumes in drop-off and in curbside programs both decrease and curbside volumes are predicted to become de-minimus. For glass, curbside programs collect substantially less with an increase in CRV. Collections of plastic increase in all three program segments with an increase in the CRV.

Increasing the CRV to the level used in Oregon and many other bottle-bill states is very likely to increase the amount of material recycled.

Changing the CRV also changes the flow of materials and funds to the major types of recycling programs. Table 8 shows the processing payments, and administrative fees paid to each of the major receivers of beverage containers. The table shows that all three segments of the recycling industry handle more containers and therefore receive higher payments with the higher CRVs.[45]

According to a report by Business and Environmentalists Allied for Recycling, the collecting and processing costs per container of the Oregon-style Act (all sales points redeem and containers go back to their original source) is more than 6 times the cost of California system.[46] This result seems extremely likely since the Oregon-type system requires separation of materials by original source and requires many more establishments to participate in the recycling endeavor. The design of the Act does seem to minimize the cost of returning containers within the confines of a deposit return or CRV system.

5.2. Expanding Act Coverage

Expansion to other products is possible. Our research using the scanner data shows that wine, liquor, and milk have substantial volumes of containers. Of the beverage containers in our scanner data sample, 5.6 percent are milk packed in #2 resin and 2.2 percent are wine packed in glass. Wine packed in glass is in a deposit program in Iowa and Maine. Maine charges a deposit of 15 cents for these bottles while Iowa charges 5 cents. In Canada, Saskatchewan has a deposit of 20 Canadian cents for wine bottles. In Iowa, it is not legal to place deposit containers in a landfill, so recycling is guaranteed independent of the deposit. Wine bottles are heavier than beer bottles and much of the wine in bottles that is not currently in the program (classified as barley drinks) is consumed by those with higher incomes. Both of these circumstances make return by consumers for CRV less likely. Since most Californians already have the option of recycling wine bottles at curbside, the CRV necessary to induce additional return by Californians through recycling centers might be more than 10 cents per bottle envisioned

[45] The processing payments are funded by a charge leveled on container manufacturers and from the State Fund. Hence, the recycling programs receive more in processing payments than the Fund pays out. The administrative cost payment of 2.5 percent is split between processors (who are not shown) and recycling programs who receive .75 percent. Hence, the Fund pays out more than the recycling programs receive.
[46] See Beck, 2002.

Table 8. Financial Payments by Program Type for Three CRVs

.025/.05 CRV				
	Recycling Centers	Other Programs	Curbside	Total
CRV		$9,590	$40,856	$50,446
Processing Payment glass	$25,038	$1,611	$9,144	$35,793
Process Payment PET	$17,168	$1,520	$8,067	$26,755
Admin fee (.75% of CRV)	$1,760	$72	$306	$2,138
Total Payment	$43,966	$12,793	$58,373	$115,132
.05/.10 CRV				
	Recycling Centers	Other Programs	Curbside	Total
CRV		$20,096	$58,128	$78,224
Processing Payment glass	$44,023	$3,685	$5,477	$53,186
Process Payment PET	$ 32,705	$1,212	$11,106	$45,024
Admin fee (.75% of CRV)	$ 5,025	$151	$436	$5,611
Total Payment	$81,574	$25,144	$75,147	$182,045
.05/.05 CRV				
	Recycling Centers	Other Programs	Curbside	Total
CRV		$18,227	$46,726	$64,953
Processing Payment glass	$43,469	$3,641	$5,587	$52,697
Process Payment PET	$30,295	$1,267	$10,912	$42,474
Admin fee (.75% of CRV)	$4,572	$137	$350	$5,059
Total Payment	$78,336	$23,272	$63,575	$165,184

Note: All dollar figures in thousands. Figures may not add because of rounding.

Table 9

Effects of Repealing the Program: Recycling Rates by Material and Program Type

	Recycling Center	**Drop-Off**	**Curbside**	**Total**
Plastic	9%	0%	1%	10%
Glass	11%	0%	5%	16%
Aluminum	19%	0%	8%	28%

Source: Calculated.

in the nickel and dime CRV scenario. Liquor bottles are both glass and PET and could also be considered for inclusion at the time that wine is considered.

Milk, like juice in containers over 46 ounces, is included in the Women Infants Children (WIC) program, which appears to be an impediment to inclusion. Milk containers are generally not included in redemption programs in other states or in Canada. With a higher CRV, such as 10 cents, inclusion could bring back substantial amounts of milk and juice in containers greater than 46 ounces for CRV, some of it currently land filled and some currently returned to curbside programs.

We would not recommend any of these expansions until the recycling rate on existing materials, particularly PET, is more on a par with glass. An increase in the CRV is a preferable alternative.

5.3. Container Basis

The attraction of a container rather than content basis for inclusion in the program is that it might be simpler and therefore easier to explain to consumers. In practice, exactly the same forces that exclude milk, liquor, wine, and juice in containers of 46 ounces and greater would continue to operate. Excluding all PET and HDPE containers over 46 ounces is no easier to understand than excluding milk and juice in large containers. Since coverage has now been defined as nearly all categories of beverage and the exceptions would stay the exceptions, there is no point in rewriting the statute in another way. If the intent were to encompass non-beverage containers, the Act would then require participation of a whole new and large universe of distributors. Continued consumer education, more prominent CRV symbols, and higher CRVs are all potential ways to make consumers more aware of what has a CRV.

5.4. Recycling without the Act

Without the Act, voluntary drop-off, some (mostly non-supermarket sited) recycling centers and curbside would be the remaining modalities for the collection of recyclables. The regression model discussed above was used to make an estimate of increased use of the non-CRV modalities if the CRV was reduced.[47] The increase in curbside recycling does not make up for the decrease in the use of centers. Table 9 provides our estimates of recycling rates without the Act.

For aluminum, curbside program recycling increases from 6 to 8 percent, while recycling center recycling falls to 19 percent in this simulation. The simulation is well outside of the data on which the regression is based, so it is not surprising that it does not predict no recycling center recycling at all. This is also reasonable considering that there was a mature recycling infrastructure for some materials prior to the Act, and that this infrastructure would likely continue to be used to recycle materials. However, the regression does not support the theory that all volume will be picked up by curbside; much to the contrary, the evidence is that a great deal of the volume will be lost. For glass, all programs decrease with a cessation of the CRV payments and total recycling goes from 55 percent to 16 percent.[48] Because data on plastic was collected for fewer years than for other materials, the plastic numbers need be treated with caution. However, cessation of the program is predicted to result in a decrease in the recycling rate for PET from 36 percent to 10 percent. Based upon the experience of the last several years, reducing the CRV and eliminating the requirement for certified recycling centers would severely reduce the level of recycling

A second and independent set of estimates was made based upon the likely changes in the rate of scavenging should the CRV be eliminated. This exercise concludes that the collections of all three materials by curbside would likely increase but not by enough to offset the loss of the material collected by the current CRV system.

5.5. Comparison to Other Localities

A survey of the recycling programs of other states and of Canada reinforces the conclusion that a deposit program, with a deposit twice that of California's redemption payment, is needed to achieve a high recycling rate. Figure 1 shows the rates for several

[47] To find the situation without the Act, we used our regression to predict recycling rates with a CRV of zero, an average of no hours open for convenience sited centers, and a zero density of these centers.
[48] These recycling rates are all regression predicted to maintain their comparability.

bottle-bill states and for the United States as a whole. Bottle-bill states have higher recycling rates than the U.S. average. Michigan, with a 10-cent deposit has the highest rate. The other states (except California) are nickel-deposit states. It is only after the additions to the program in 2000 that California performed very differently from the nickel-deposit states. Apparently, both the erosion of the deposit value by inflation and the addition of new categories contributed to the decrease in the stated rates of recycling. (In the case of California, the actual recycling rate increased between 1999 and 2000. The chart is an artifact of the reporting of the rates for in-program containers only.)

New York City has both its state's deposit law and a curbside collection system that includes all households and is operated by the City. In New York City the separation of recyclables is required by law and fines of up to $150 are issued for violation.

In the European Union, there are no deposit systems, and curbside collection is ubiquitous. Industries, in some countries jointly with municipalities, are responsible for the recycling of the collected material.

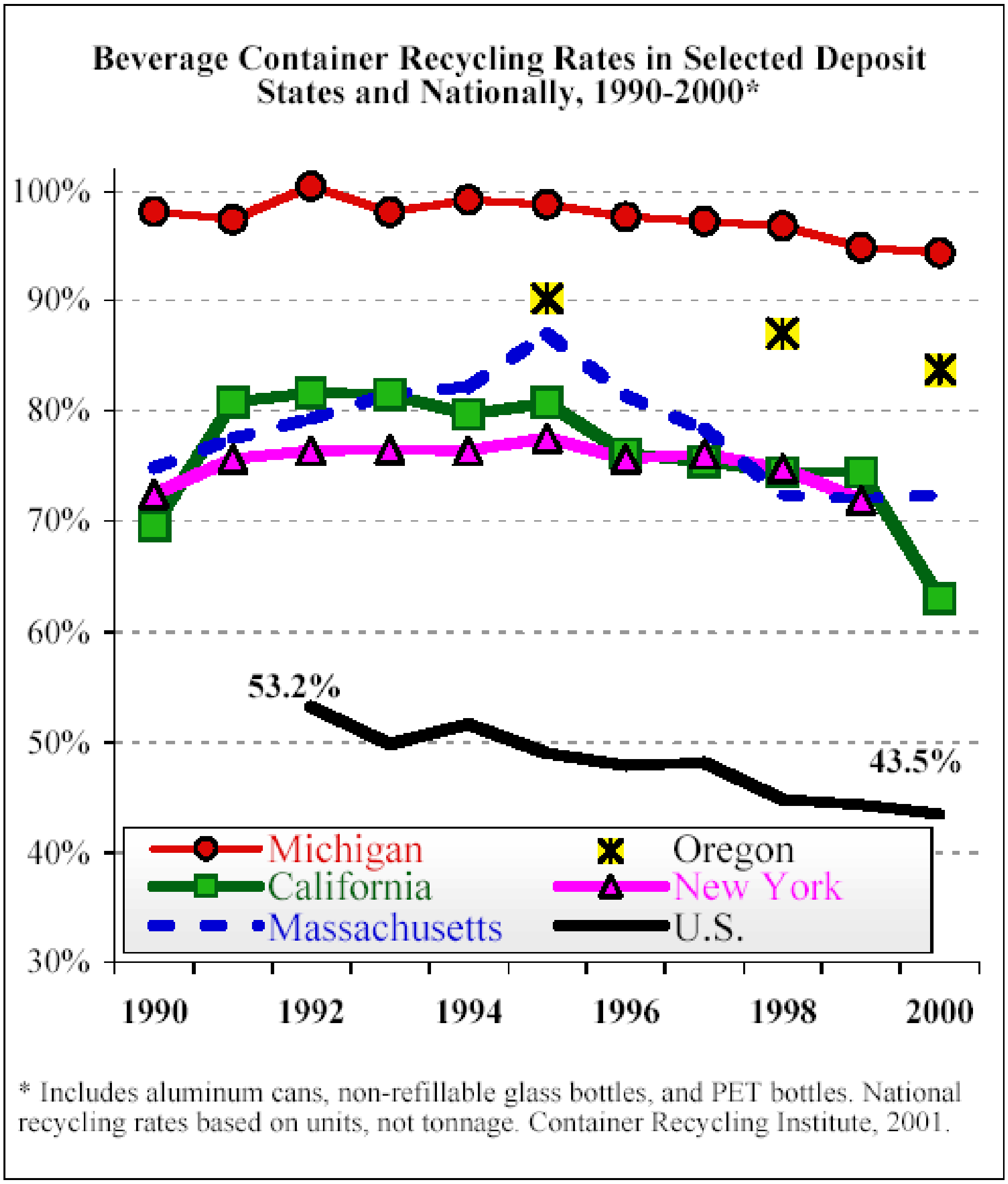

Figure 1. Beverage Container Recycling Rates in Selected Bottle-bill States

Source: Association of Oregon Recyclers Conference, Oregon, 2001.

Perhaps the best evidence from other countries on the efficacy of a deposit return system is from the Canadian Provinces of Manitoba and Saskatchewan. For other than beer bottles, Manitoba uses only curbside and collects 34 percent of the glass while Saskatchewan uses a deposit system and collects 83 percent.

6. ECONOMIC IMPACT ON THE STATE

In order to determine the economic effect of eliminating the Act or adopting an Oregon-style deposit system on the State of California, as a whole, we used the cost estimates developed earlier in this report and a model of the California economy.

The comparison is limited to the economic costs and does not include environmental benefits of the recycling program. The no-program alternative does not consider alternate measures to reduce land filling to meet statutory requirements. In order to find the total economic effect upon California's economy, the costs and economic benefits or recycling are evaluated using a computable general equilibrium model of the State of California, the Dynamic Revenue Analysis Model (DRAM).

DRAM captures the fundamental economic relationships among producers, consumers, and government by modeling the financial flows within California, including the markets for all goods, services, and factors of production. For modeling purposes, the economy is represented as having 29 industrial sectors, each of which produces a single aggregate good, such as agriculture. DRAM is an equilibrium model, so the prices of goods and service are modeled as changing in response to policy measures, such as discontinuing the CRV system. The purpose of DRAM is to be able to trace the changes caused by policy on macro aggregates, such as income, taking into account how all other markets will adjust to the change. In DRAM, when the demand for an industry is reduced by a change in regulation, the model accounts for the possibility that the workers in that industry will be employed by other industries and it also accounts for the reduced demand for the goods of other industries caused by the decrease in demand for the subject industry. All economic impacts, both those induced by the change and stemming from the change, are accounted for.

DRAM was developed jointly by the DOF and Berkeley researchers to perform dynamic revenue analyses of proposed legislation as mandated by California State Senate bill 1837 in 1994.[49]

[49] A fuller description of DRAM can be found in Berck*, et. al*., 1996.

In order to evaluate the economic effects of the Act and its alternatives, we first found the direct economic costs and benefits of the Act relative to the situation that would obtain without the Act. The costs of recycling were enumerated previously in this report. The benefits of recycling were the availability of the recycled material as a raw input for industry. Absent recycling, there would also be costs incurred for disposal of the previously recycled material.

The state of affairs in 1999, which includes the Act, was the baseline from which our analysis begins. The elimination of the Act would change the economy in three major ways: First, the wholesale sector of the economy would be required to spend substantially less on transportation of material because landfilling requires less transportation services than the return of recyclables for reuse. The amount saved by the wholesaling industry from eliminating the Act is $108 million. Second, landfilling necessitated by abandoning the recycling program would cost $21 million. These additional costs would fall upon the wholesaling sector. Third, $144 million worth of recyclables would no longer be available to the economy for re-use. These revenues would no longer accrue to the wholesaling sector. In net the recycling program has direct economic benefits in excess of direct economic costs of $57 million, exclusive of the costs to administer the program.

In order to use DRAM, we model the change in policy as causing the wholesaling sector to require proportionately less transport, more landfilling (classified as utilities within the model's broad sectoralization) and supply less material to manufacturing sectors. The proportions are calculated as the ratio of the amount used in the no-Act case to the amount used in the base case.

The model was then solved twice—once with the current program and once with the changes described above. The difference was $42 million in California personal income, which would be the loss to California personal income from the repeal of the Act. The reason for the change in personal income being different from the direct economic benefits is that, on a dollar basis, a decrease in the need for raw material, such as aluminum, does not have as much effect of the state's economy as an increase in the costs of wholesaling.

An Oregon-style program would have a much larger impact on statewide personal income than the Act does. As we discussed above, the direct costs of an Oregon-type program were estimated as being six times the California costs. The direct costs of the Act are $170 million so, on the belief that the Oregon system is six times as expensive, the direct costs of an Oregon-style system would be $1.022 billion. Using the DRAM model, we estimate that an Oregon-style program would lead to a loss of personal income of more than $1.5 billion. If the Oregon-style program were only twice as expensive as the Act, the loss of personal income under an Oregon-style program would be $500 million.

Since the Act leads to a gain in personal income and the Oregon-style program leads to a large loss of personal income, the California program is preferred.

7. DEMOGRAPHIC OBSERVATIONS

The regression analysis described in section 5 also allows prediction of the circumstances in which there will be more recycling, sales held constant. For a 10-percent increase in mean family income, the recycling rate at recycling centers decreases by 1 percent while the recycling rate at curbside increases by 1.6 percent. The unemployment rate has a trivial effect on recycling. When income increases, time is more expensive, which leads to people choosing to recycle in a time efficient method, curbside, rather than a time-intensive method, return for CRV. Higher family income also coincides with less scavenging effort. Counties with higher population have higher recycling rates as do counties with a greater percentage of apartment units. The implication of these demographic factors for designing recycling programs is that recycling for CRV is likely to be the most successful in areas with lower income while curbside will be most effective in areas of higher income. The response to income also suggests that return for CRV will be encouraged by minimizing the time commitment needed to recycle. Although earlier versions of this regression model did show a positive relation between hours open and recycling rate, the final regression does not show an economically significant effect to increasing hours open for recycling centers.

Another piece of evidence on regional recycling habits is available from the regional scanner data. The greater Sacramento region accounts for 8 percent of the sales of beer, water, and carbonated beverages in California. It accounts for 10 percent of returns. The region has lower income and higher unemployment, which should increase recycling rate, but lower density, which should lead to lower recycling rates.

The coverage of multi-unit dwellings by curbside is lower than for other dwellings. Since these dwellings have a higher density of population, they should provide more material per pickup. However, since the average income is lower, the material should include fewer CRV bearing containers.

The overall conclusion of examining the demographics of recycling is that economic conditions, such as unemployment, are important for recycling for CRV but that recycling is the least of the reasons to be concerned with these demographics.

8. REFERENCES

Alder, Green & Hasson, LLP. 1997. *1997 California Waste Industry Survey*. Los Angeles, California.

American Metals Market. Data provided by DOC/DOR.

Beck, R.W. 2002. *Understanding Beverage Container Recycling.* Business and Environmentalists Allied for Recycling, a project of Global Green, January.

Berck *et al.* 1996. DRAM Report, "Dynamic Revenue Analysis for California," is available at www.dof.ca.gov/HTML/FS_DATA/dyna-rev/dynrev.htm.

Beverage World. 2001. Industry magazine at www.beverageworld.com.

California Beverage Container Recycling and Litter Reduction Act. 2002. Paragraph 14549.6. Downloaded from www.consrv.ca.gov/dor/Act-2002.pdf on 05/13/2002.

CA DOC/DOR. 2002. *The California Beverage Container Recycling Act: Flow of Payments Under the Beverage Container Recycling Program*, February.

———. 2001. *California Beverage Container Recycling and Litter Reduction Act*. Revised, October

———. 2000. *California Beverage Container Recycling and Litter Reduction Program Fact Sheet.*

———. 1999a. *California Beverage Container Recycling and Litter Reduction Act*. Revised, October.

———. 1999b. "Curbside Volumes: CRV Type Material."

———. 1999c. "Participant Share Analysis."

———. 1999d. "Notice: SB1 Changes to the Beverage Container Recycling Program," Sacramento, California, January 29.

———. 1999e. Notice: "2000 Processing Payments and Processing Fees." Sacramento, California, December 16.

———. 1998a." Notice: Segregated and Commingled Refund Value per pound and Number of Containers per Pound Rates," December 1.

———. 1997. "Curbside Collection Survey Results." Sacramento, California.

———. 1994. “Curbside Recycling Cost and Funding Study.” Sacramento, California, April.

CA DOF 2000. *2000 California Statistical Abstract*.

CIWMB. 1999. “Tipping Fees at California Solid Waste Disposal Facilities.”

DOR web site. 2002. Obtained from www.consrv.ca.gov/dor/faqsB332.htm on 05/13/02.