

Michigan Bottle Bill

**A Final Report to:
Michigan Great Lakes Protection Fund**

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July 10, 2000

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1. INTRODUCTION

The Michigan Beverage Container Act ("the Bottle Bill") was enacted in a statewide referendum on November 2, 1976, and was implemented on December 3, 1978. The stated purpose of the Bottle Bill was to reduce roadside litter, clean up the environment, and conserve energy and natural resources. The Bottle Bill put a 10-cent deposit on beer, carbonated soft drinks, and mineral water. In addition the Bottle Bill put a 5-cent deposit on refillable beverage containers, spawning the development of the squat 12 oz. "Michigan Bottle". In 1988 it was amended to include wine coolers and canned cocktails. In 1989 Michigan passed a law giving retailers 25 percent of the unclaimed deposits. The other 75 percent is deposited in the state's environmental fund.

The Bottle Bill is over 20 years old. Michigan may now wish to consider a range of options, including the Bottle Bill and alternatives to it, based on clearly stated and publicly available data. This report provides such data. It addresses the Bottle Bill as well as a range of alternatives, focusing on the level of container recovery which might be achieved, the cost of recovery, and the environmental and other benefits which container recovery provided. Redemption of containers purchased outside Michigan is also considered.

Alternatives Considered

States in the U.S. and provinces in Canada take a wide range of approaches to the management of used beverage containers. The following approaches provide the basis for alternatives to Michigan's current system:

- Most states have **no bottle bill**. Instead, used beverage containers are addressed by existing recycling and waste disposal systems.
- Bottle bills divert aluminum, as well as plastic and glass, from recycling programs. Aluminum is the most valuable material that recycling programs collect. Because most recycling programs were not in place when the bottle bill was first implemented, recycling programs in Michigan were not planned with revenue from aluminum in mind. However, revenue from the sale of aluminum containers could significantly offset the cost of recycling in Michigan. Delaware has a bottle bill which **places no deposits on aluminum cans**. This allows recycling programs to recover aluminum, while glass and plastic are captured by the bottle bill.
- In Massachusetts, the distributors pay a **handling fee** to the retailers. This does not affect the overall system cost of the bottle bill. It simply shifts costs from retailers to distributors.
- In the past 20 years, consumption of beverages other than beer and soda has increased dramatically. Today these items make up a significant portion of the beverage market. Maine has **expanded its bottle bill** to cover containers for these beverages. California also recently added some of these containers to its system.
- In Alberta, **depots** supported by the beverage industry and not the retailers accept empty containers and refund deposits to the consumers. In addition, several states such as Maine and Massachusetts

have hybrid systems where consumers can return containers to both retailers and dedicated redemption centers.

The Bottle Bill itself and the approaches cited above provide the basis for development of six of the seven options considered in this report. The seventh option has a somewhat different source:

- Many beverages other than beer and soda sold in single-service containers are consumed away from home. Massachusetts Department of Environmental Protection engaged Tellus to design a non-residential **Alternate Recycling System (ARS)** to recover these beverage containers. The term "alternative" is used because, in the Massachusetts work, this recycling system was developed as an alternative to the expansion of the Massachusetts bottle bill.

Table 1 below summarizes the options analyzed in this report. As shown in the table, the options are divided into two groups based on the (used beverage) container stream they address.

Table 1: Bottle Bill Options Analyzed

Containers Covered Currently by the Bottle Bill ("The Current Container Stream")

1. The Bottle Bill Without Any Changes
2. No Bottle Bill
3. No Deposit on Aluminum Cans
4. The Bottle Bill with Distributors Paying Retailers a Handling Fee

Containers Covered Currently Plus Containers for Fruit Beverages, Bottle Water, Tea, Wine and Spirits ("The Expanded Container Stream")

- An Expanded Bottle Bill
- A Depot System, to Replace the Bottle Bill and Expand Coverage
- An Alternative Recycling System, to Capture a Portion of the Expanded Stream

The options discussed in this report do not provide an exhaustive treatment of the possible modifications of the Bottle Bill or of the alternatives to it. For example, there is no discussion of modifying the Bottle Bill to foster or require additional use of **refillable containers**. While the options discussed here provide a reasonable basis for consideration of the Bottle Bill, some may wish to extend the range of options to be considered.

Scope and Organization of this Report

In the body of this report, the size (i.e., number of containers and tonnage) and composition (e.g., fraction of glass, aluminum, and plastic) is estimated for the current and expanded container streams. For each option, the energy saved and greenhouse gas emissions avoided, and the costs and benefits for the option, are also estimated. For the costs and benefits, in addition to aggregate data, **unit data** on impacts per deposit-bearing container sold, per ton recovered, and per household are presented.

Information on the container streams, and on the Bottle Bill and the alternatives, is developed in Chapters 2

through 4.

- **Chapter 2** addresses the current container stream and the Bottle Bill.
- **Chapter 3** considers Alternatives 2, 3, and 4, which address the same container stream as the Bottle Bill.
- **Chapter 4** considers Alternatives 5, 6, and 7, which are relevant to the expanded container stream.

Chapters 2 through 4 explain the basis for the results obtained concerning the physical and economic impacts of the options considered. Chapter 5 summarizes the results obtained in Chapters 2 to 4, and discusses various ways in which these results might be used to consider the seven options. Chapter 5 can be read separately from the remainder of the report. However, those doing so will have to rely on a variety of results from the preceding chapters.

The purpose of this report is **solely** to provide information. It makes no recommendation concerning retention or change for the Bottle Bill. Nor do the numbers "speak for themselves" on these points. It is up to the reader to decide what conclusions, if any, to draw from the analyses and results presented.

2. THE CURRENT BOTTLE BILL

This chapter provides a detailed analysis of the current container stream and of the Bottle Bill. Methods used in this chapter are applied throughout this report. Many of the results obtained in this chapter are applied, directly or with simple modifications, in the following chapters.

The Current Container Stream

As the first step in the analysis of the Bottle Bill, the size and composition of the container stream currently subject to deposits was determined. The total number of deposit-bearing containers sold and redeemed was determined from Treasury Department figures for 1995 on the total deposits collected and refunded. The Container Recycling Institute provided data on the composition of the Michigan container stream. This data divides the containers by material (aluminum, plastic and glass). The tons of containers covered by the Bottle Bill were calculated, based on Tellus estimates of the average weight for each type of container. The results of this analysis are shown below in Table 2.

Table 2: Container Stream Covered by the Bottle Bill

	Material			Total
	Glass	Aluminum	Plastic	
Number of Containers (millions)	676	2,609	633	3,919
Containers per Ton	3,593	59,473	16,216	
Tons (thousands)	188	44	39	271

Container and Deposit Flows

Figure 1 below shows the flow of containers covered by the Bottle Bill. The solid lines represent sales of full containers and the dotted lines represent empty container returns. As shown in the figure, distributors sell full containers to retailers who, in turn, sell them to the consumers. Empty containers are returned to the retailers by consumers who purchased beverages in-state, and those engaged in fraudulent redemption; (e.g., those redeeming containers on which no deposit was paid).

Figure 1: Flow of Containers

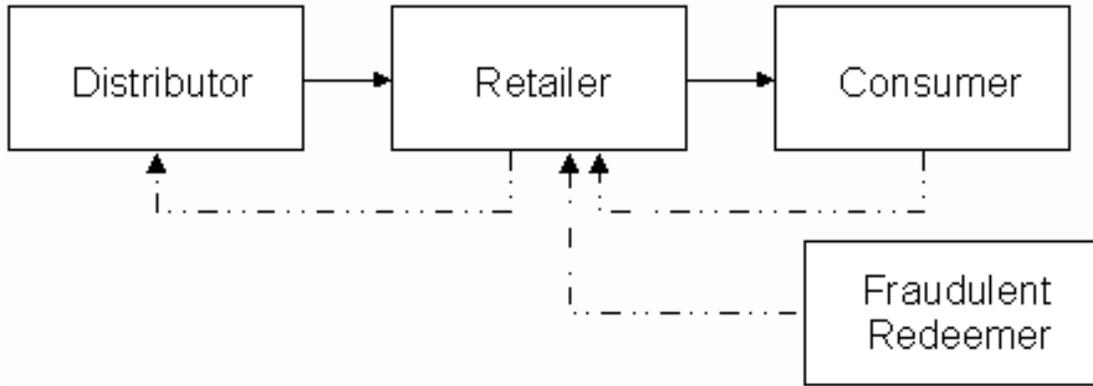
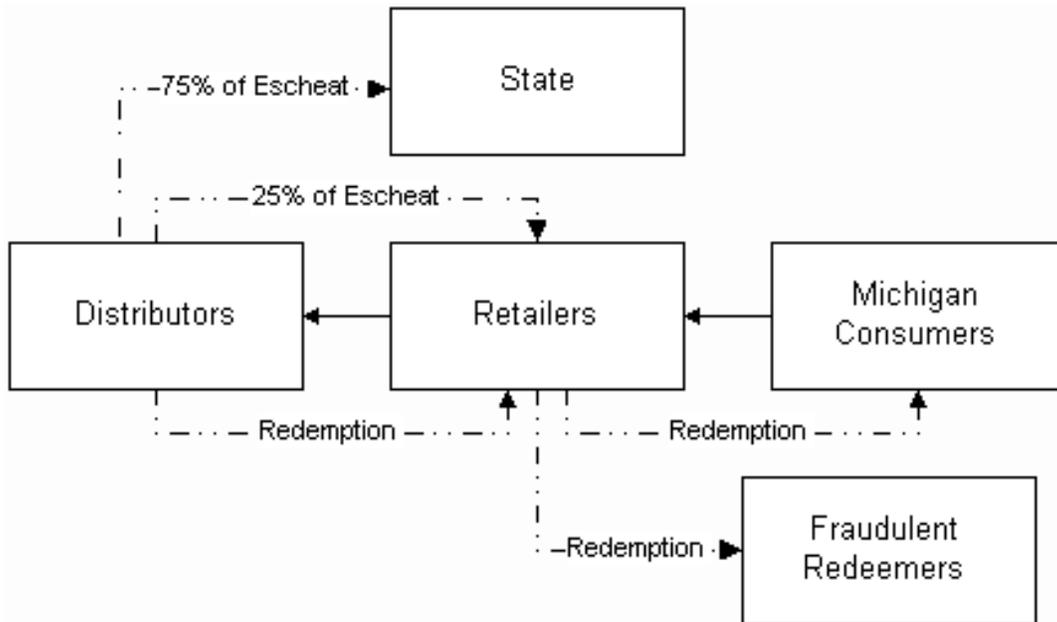


Figure 2 below shows the flow of deposits that results from the flow of containers shown in Figure 1. The solid lines represent the payment of deposits associated with the sale of beverages, and the dotted lines represent the return of deposits when the containers are redeemed. Because not all used beverage containers are returned to the distributor from which they originate, some distributors refund less than the deposits they receive from retailers, others refund more. Unrefunded deposits are shared 25 percent by retailers and 75 percent by the State of Michigan.

Figure 2: Flow of Deposits



Deposit Costs

Deposit costs are the results of the flows shown in Figure 2. Data from the Treasury Department was used to determine the magnitude of the container stream. This data included the deposits collected, deposits refunded and the amount paid to the state of Michigan. The total deposits collected were \$391.9 million in 1995. The total deposits refunded were \$387.1 million. One might expect that the amount paid to the state would be roughly the difference between the deposits collected and the deposits refunded or \$4.8 million. However, the Treasury department figures show the escheat to be \$8.7 million. The difference can be explained by the under and over redemption mentioned above.

Fraudulent redemption has been estimated at \$10 million. This number reflects the mid-range of the figures that might be justified given available estimates. The only available fraud estimate comes from the *Analysis of Foreign Containers in the Michigan Deposit Stream*. This report estimates that there are about 150 million fraudulently redeemed containers. However, this estimate extrapolates survey data collected at only certain types of redemption locations in a limited portion of the state. The types of redemption locales and areas actually surveyed only account for about 50 million fraudulent redemptions. For this report a figure of 100 million fraudulent redemptions was used.

Given the \$10.0 million in fraud and the \$4.8 million difference between deposits collected and refunded, \$14.8 million of deposits on containers purchased in Michigan were never returned. This information can be used to determine deposit-related costs and benefits experienced by beverage distributors, retailers, Michigan residents, and the state of Michigan due to the flows shown in Figure 2. Table 3 presents these impacts. In Table 3 costs to each party are entered as positive numbers, and benefits (i.e., returns or payments) to each party are entered as negative numbers.

**Table 3: Annual Deposit Costs
(Millions of Dollars)**

Sector	Cost
Distributors	
Deposits Collected	-\$391.90
Deposits Refunded	\$387.10
Escheat	\$8.70
Subtotal	\$3.90
Retailers	
Deposits Paid to Distributor	\$391.90
Deposits Received from Customers	-\$391.90
Deposits Refunded to Customers	\$387.10
Deposits Refunded by Distributor	-\$387.10
25% of Escheat	-\$2.18
Subtotal	-\$2.18
Residents	
Deposits Paid	\$391.90
Deposits Refunded to Residents	-\$377.10
Subtotal	\$14.80
State	
75% Escheat	-\$6.53

Subtotal	-\$6.53
Total	\$10.00

As shown in Table 3, while the \$8.7 million in escheat comes from the distributors, the distributors pay only \$3.9 million in deposit-related costs in the aggregate. By choosing not to return containers, residents pay \$14.8 million through unclaimed deposits. Retailers and the State of Michigan share \$8.7 from the unclaimed deposits. Thus, the impact on the State of Michigan of the deposit system is simply the \$10 million due to fraudulent redemption.

Operating Costs

Operating costs for the Bottle Bill are incurred by the retailers and distributors. Retailers are responsible for accepting empty containers and sorting them for pick-up by the distributors or their representatives. Distributors pick up the empty containers from the retailers, process the containers as required, and sell the materials into the recycling market.

Retailers' costs vary with the use of reverse vending machines or manual sorting. For this reason, two estimates of retailers' costs were developed. The cost per container using a reverse vending machine was estimated by spreading the purchase cost of the machine over its lifetime and then adding the costs associated with the operation of the machine. The assumptions and calculations are shown below in Table 4. Data on the cost and capacity of the machine comes from the Environmental Products Corporation in Chantilly, VA, a manufacturer of reverse vending machines. Data on the operating expenses and pest control comes from the *Commonwealth of Massachusetts Bottle Bill Redemption Fee Study*.

Table 4: Monthly Cost of Reverse Vending Machine

	Aluminum	Plastic	Glass
Cost of Machine	\$11,000	\$11,000	\$11,000
Lifetime (years)	7	7	7
Interest Rate	8%	8%	8%
Monthly Capital Cost of RVM	\$171.45	\$171.45	\$171.45
Container Capacity	1,900	470	600
Containers per Month	15,000	15,000	15,000
Time to Empty Machine (hours)	.25	.25	.25
Cost of Labor (emptying machine assuming \$10.80/hour)	\$21.32	\$86.17	\$67.50
Electricity	\$5.00	\$5.00	\$5.00
Pest Control (from DSM Report page 22)	\$20.00	\$20.00	\$20.00
Other Operating Expenses (\$.005 per container)	\$75.00	\$75.00	\$75.00

Total Monthly Costs	\$292.76	\$357.62	\$338.95
Cost Per Container	\$0.020	\$0.024	\$0.023

The cost of processing containers without the use of reverse vending machines—\$.025 per container for all types of containers—was estimated based on the labor required to handle the containers plus overhead, as determined in an earlier Tellus bottle bill report for the State of Massachusetts, which, in turn, built on a nationwide study of bottle bill economics, conducted by Tellus with EPA funding.

Costs to distributors vary depending on whether a retailer uses reverse vending machines. Reverse vending machines crush or shred the containers, eliminating or reducing the need (and cost) for distributors to collect and process the material recovered. The collection and processing cost estimates used in this analysis are based on data developed for the State of Massachusetts. These estimates are shown below in Table 5.

Table 5: Collection and Processing Costs per Container

	Reverse Vending Machines	Manual Sorting at Retailer
Glass	\$0.011	\$0.023
Aluminum	\$0.006	\$0.016
Plastic	\$0.014	\$0.044

Table 6 shows the total operating costs. In developing Table 6 it was assumed that 40 percent of aluminum and plastic containers are handled in reverse vending machines based on the Foreign Container Report. No glass containers are assumed to be handled in reverse vending machines because, in Michigan, reverse vending machines do not crush glass containers. This means that the retailers still have to sort and store the containers, negating the advantages of the reverse vending machine. Costs to Michigan consumers in terms of time spent returning containers have not been included in this analysis as containers are assumed to be returned as part of regular shopping trips.

Table 6: Total Annual Operation Costs

	Containers Handled (in millions)	Cost (in millions)
Distributors		
RVMs used	1,281	\$9.69
RVMs not used	2,590	\$56.63
Total	3,871	\$66.32
Retailers		
RVMs used	1,281	\$29.46

RVMs not used	2,590	\$65.52
Total	3,871	\$94.99

Benefits of the Bottle Bill

Broadly speaking, there are two groups of benefits associated with the operation of the Bottle Bill:

- **Recycling Benefits.** Redeemed containers provide recycled glass, aluminum, and plastic to replace virgin feedstocks, leading to reduced energy consumption and emissions, including greenhouse gases (GHGs).
- **Litter Reduction Benefits.** Container deposits reduce used container litter, resulting in lower litter clean-up costs, and avoiding injuries to humans and damages to farm equipment and animals.

On the basis of available information, this study quantifies both groups of benefits and attaches "market values" to them. It is important to note that these benefits accrue to different groups. Because container manufacturing and its associated activities may occur outside of Michigan these benefits accrue to people in general. Litter reduction as a result of the bottle bill will occur within the state, therefore litter reduction benefits will accrue to the residents of Michigan.

One benefit of recycling containers is the revenue earned from selling the containers. Aluminum is especially valuable. Using data on material prices from *Waste News*, the revenue generated by selling the containers was calculated. The per-ton material prices and revenue generated for each material are shown below in Table 7.

When materials are recycled, they become feedstock for production. Less greenhouse gases are emitted when use is made from recycled rather than virgin feedstocks. A recent EPA report gives per-ton greenhouse gas emissions reductions in metric tons of carbon equivalent (MTCE) per ton recycled. MTCE is a standard unit of measurement that adds together the emissions of different greenhouse gases (i.e., CO₂, methane, etc.), weighted according to their warming potential. These values were used to determine the total greenhouse gas benefit of the Bottle Bill recycling in Michigan. The results of this calculation as well as the per-ton values are shown below in Table 7. There is currently no market value for avoided GHG emissions. However, based on available information concerning the cost to achieve GHG emissions reductions, a value of \$50 per MTCE of avoided emissions is reasonable.

The energy required for production from virgin feedstocks generally is greater than the energy required for production using recycled materials. Thus, recycling produces net energy savings. These savings were estimated using data from the EPA report on GHG emissions cited earlier. It provides life-cycle energy requirements for products, produced from both virgin and recycled materials. Using this data, energy savings were calculated. The energy saved per ton recycled and the total energy savings are shown below in Table 7. To avoid double counting, energy savings are not assigned a dollar value. The value of the energy savings is at least partially reflected in the sale prices for the recycled commodities.

Table 7: Annual Recycling Benefits

	Tons (1,000)	Sales Revenue		Greenhouse Gas				Energy	
		\$/ton	Value (Millions)	MTCE/ton	MTCE	\$ per MTCE	Value (Millions)	MMBtu/Ton	MMBtu
Glass	185.9	\$21.00	\$3.90	0.08	14,875	\$ 50	\$ 0.74	2.49	462,993

Aluminum	43.3	\$600.00	\$26.00	3.88	168,137	\$ 50	\$ 8.41	190.59	8,259,091
Plastic	38.6	\$140.00	\$5.40	0.62	23,924	\$ 50	\$ 1.20	30.17	1,164,173
Total	267.9		\$35.31		206,936		\$ 10.35		9,886,256

An important effect of the Bottle Bill is litter reduction. For example, studies conducted by the Michigan Department of Transportation (MDOT) have shown that there was a dramatic decline in used beverage containers littered along roads when the Bottle Bill came into effect. During a 30-day period in late August and early September of 1978, about 230 empty bottles and cans per mile accumulated along Michigan state highways. During the same period in 1979 the figure was 45 per mile. Data from other sources, such as beach clean-up efforts, support the view that bottle bills reduce littering substantially.

Litter reduction reduces litter clean-up costs. It also leads to reduced injuries to children and others who might otherwise come in contact with old or broken containers. In the year after Massachusetts enacted the bottle bill, outdoor glass-related injuries to children treated at Children's Hospital in Boston dropped by 60 percent, while other childhood accidents remained steady or increased slightly. Littered containers also cause problems for farmers. Litter can cause flat tires on farm tractors. Tires have to be replaced, putting equipment off line. In addition, litter can contaminate feed for cows. If the farmer does not realize the feed has been contaminated, the cows may die after eating the litter. For these reasons, farmers and farm associations have testified before Congress in support of bottle bills.

The Tellus report to the EPA provides estimates of the per-capita monetary benefit of reduced litter for the three areas discussed above. The data in the Tellus report span a wide range, as shown in per-capita in Table 8 below. The midrange values were used to develop the litter-related, total benefits for Michigan shown in Table 8. However, the high and low values are available so that readers can test the effects of more "cautious" or "aggressive" assumptions concerning the valuation of these benefits.

Table 8: Annual Litter-Related Benefits

Benefit	Benefit Per Capita			Total Benefit (Millions)
	Low	High	Average	
Litter Clean-up	\$.15	\$.50	\$ 0.28	\$ 2.7
Injury Prevention	\$.34	\$ 3.52	\$ 1.32	\$ 12.8
Farm Damage	\$.40	\$ 4.38	\$ 1.63	\$ 15.7
Total Litter Benefit	\$.89	\$ 8.40	\$ 3.23	\$ 31.2

Net Impacts

Drawing on the results developed thus far, Table 9 summarizes the deposit and operating costs, and value of benefits experienced by beverage distributors, retailers, residents, and the state of Michigan. In the table, farms

are included with residents. Sales revenue is allocated to the distributors. Avoided injury and farm costs as well as the avoided emissions are allocated to residents. While avoided emissions do create benefits beyond Michigan, the full value of this benefit has been included in the table. Michigan consumers are entitled to the full value of the emissions avoided through their returns of used beverage containers.

**Table 9: Summary of Bottle Bill Costs and Benefits
(Millions of Dollars)**

	Costs
Distributors	
Deposit Cost	\$3.90
Collection and Processing	\$66.32
Material Revenue	-\$35.31
Total Distributors Cost	\$34.91
Retailers	
25% of Escheat	-\$2.18
Sorting	\$94.99
Total Retailers Costs	\$92.81
Residents	
Unclaimed Deposits	\$14.80
Injury Prevention	-\$12.79
Farm Damage Prevention	-\$15.71
Avoided GHG Emissions	-\$10.35
Total Residents Costs	-\$24.04
State Costs	
75% of Escheat	-\$6.53
Litter Clean-Up Prevention	-\$2.69
Total State Costs	-\$9.22
Total	\$94.46

Table 10 below converts the aggregate costs and benefits in Table 9 to unit values.

Table 10: Unit Values - Bottle Bill

	Units (Millions)	Values (Dollars per Unit)		
		Costs	Benefits	Impacts
Containers Covered	3,919	\$0.044	-\$0.020	\$0.024

Tonnage Recycled	0.27	\$640	-\$287	\$353
Households	3.50	\$48.94	-\$21.96	\$26.99

Fraud and the Bottle Bill

The methods used in the previous sections can be used to analyze the impacts of fraudulent redemption associated with the Bottle Bill. As discussed earlier, we have assumed that 100 million containers are redeemed fraudulently each year. In addition to deposit costs, fraudulent redemption creates additional operating costs for the retailers and distributors who must handle the fraudulently redeemed containers. However, fraudulent redemption also results in increased container recycling, producing additional litter reduction and increasing the recycled feedstock. Fraudulent redemption avoids disposal of 6,900 tons of containers—reducing greenhouse gas emissions by 5,300 MTCE and energy consumption by 255,400 MMBtus. Using the same per-container costs as discussed in the earlier sections, Table 11 shows that fraudulent redemption of 100 million containers has an impact of \$12.99 million. Table 11 does not include benefits associated with litter reduction because those benefits are local in nature and are assumed to occur outside Michigan. Note that there probably is some litter reduction benefit from fraudulent redemption. For example, containers brought into the state by tourists and then redeemed might have become part of the litter stream without the bottle bill. Because of the uncertainty involved, this benefit has not been quantified.

**Table 11: Cost and Benefits of Fraudulent Redemption
(in Millions)**

Lost Deposits	\$10.00
Collection and Processing	\$1.71
Sorting	\$2.45
Material Revenues	-\$0.91
Avoided Emissions	-\$0.27
Total	\$12.99

3. Alternatives to the Current Bottle Bill

This chapter focuses on three alternatives to the Bottle Bill which address the same container stream as the Bottle Bill:

- No Bottle Bill – recovery through the existing recycling systems;
- The Bottle Bill with no deposit on aluminum cans;
- The Bottle Bill with distributors paying retailers a handling fee.

For each of these alternatives the containers recovered, energy saved and GHG emissions avoided, as well as the associated monetary costs and benefits are developed, using the same general methods employed for the Bottle Bill in Chapter 2.

No Bottle Bill

Without the Bottle Bill, managing used beverage containers would be the responsibility of municipal solid waste programs. Empty containers would be recycled through existing programs, disposed of as trash, or littered. While Michigan does not have recycling data for specific materials, recycling rates for glass, aluminum and plastic in the absence of the Bottle Bill can be estimated by taking the recycling rate for each material from the *Characterization of Municipal Solid Waste in the United States: 1997 Update* and adjusting it to account for the lower recycling rates in non-bottle bill states as well as the overall recycling rate in Michigan. The results of this calculation are shown in the second line of Table 12 below. Table 12 shows that in the absence of the bottle bill, 2,455 million fewer containers would be recycled. Indeed, these containers would enter either the litter or disposal streams.

Table 12: Recycling in the Absence of the Bottle Bill

	Glass	Aluminum	Plastic	Total
Recycling Rate w/ Bottle Bill	99%	99%	99%	
Recycling Rate w/o Bottle Bill	12%	46%	20%	
Containers Generated	676	2,609	634	3,919
Containers Recycled w/Bottle Bill	668	2,577	626	3,871
Containers Recycled w/o Bottle Bill	78	1,209	128	1,416

Table 13 summarizes the monetary costs and benefits of eliminating the Bottle Bill. Costs to retailers and distributors are replaced by costs to local solid waste managers who handle the containers recycled or disposed. Recycling costs have been estimated to be \$143 per ton, based on data from a recent study of the U.S. solid waste management system. Disposal costs include a landfill tipping fee of \$35 per ton, as well as a collection cost of \$29 per ton. Without the Bottle Bill there would be recycling-related benefits. These have been calculated as in Table 7. The corresponding physical benefits are 85,547 MTCE of avoided GHG emissions and 4,168,543 MMBtu of reduced energy use. Without the Bottle Bill, there is no financial incentive to avoid littering, so all litter-related benefits resulting from the Bottle Bill are eliminated.

**Table 13: Costs and Benefits in the No Bottle Bill Scenario
(In Millions)**

	Costs
Recycling Costs	\$7.16
Trash Collection	\$6.41
Tip Fees	\$7.74
Material Revenue	-\$13.77
Avoided GHG Emissions	-\$4.28
Total	\$3.27

In developing Table 13 it was assumed that all of the used containers not recycled are disposed of as trash. In fact, a portion will end up as litter. The portion littered is very difficult to quantify. However, the available evidence suggests that it is small, on the order of a few percent of the container stream, or less. Given its small and uncertain size, no adjustment was made. Readers who wish to include this effect could simply reduce the trash collection and tip fees in Table 13 by 3 percent. This assumes 118 million containers are littered. It would reduce the total impact in Table 13 to \$2.85 million.

Table 14 below converts the aggregate costs and benefits in Table 13: to unit figures.

Table 14: Unit Values – No Bottle Bill Alternative

	Units (Millions)	Values (Dollars per Unit)		
		Costs	Benefits	Impacts
Containers Covered	3,919	\$0.005	-\$0.005	\$0.001
Tonnage Recycled	0.05	\$426	-\$361	\$65
Households	3.50	\$6.09	-\$5.16	\$0.93

No Deposit on Aluminum

Instead of exempting all containers from deposits as in the No Bottle Bill alternative, one could simply exempt the aluminum containers. This alternative, in effect, combines the Bottle Bill for plastic and aluminum containers with the No Bottle Bill alternative for aluminum. In this scenario recycling of aluminum would drop from 2,609 to 1,209 million containers as shown in Table 12, while recycling of glass and plastic remains at the Bottle Bill levels shown in Table 2. This produces 5.5 million MMBtu of avoided energy use and 117.7 thousand MTCE of avoided GHG emissions. With the exception of the litter-related benefits, the dollar costs and benefits are simply the corresponding "aluminum-related" items from the No Bottle Bill alternative, and the "glass- and plastic-related" items from the Bottle Bill analysis. The litter-related benefits developed for the Bottle Bill have simply been scaled by the number of plastic and glass containers sold with deposits divided by the total number of containers sold with deposits. The resulting costs and benefits are shown in Table 15.

Note that this analysis assumes there will be no shift in container material type with this policy. Some reviewers feel that this policy would result in a shift to more aluminum containers. Shifting to more aluminum containers would reduce the total number of containers handled by the bottle bill and increase the number of containers handled by municipal recycling programs. This would result in a lower recycling rate, lower costs to the beverage industry, greater municipal collection costs, greater municipal material revenue and reduced benefits compared to the costs and benefits shown in Table 15. The authors have seen no evidence of this effect. In fact, PET bottles are rapidly replacing aluminum can in soda and beer container applications.

**Table 15: Costs and Benefits – No Deposit on Aluminum
(In Millions)**

	Costs
Distributors	
Deposit Costs	\$1.30
Collection and Processing	\$35.39
Material Revenue	-\$9.31
Total Distributors Cost	\$27.39
Retailers	
25% of Escheat	-\$0.73
Sorting	\$31.29
Total Retailers Costs	\$30.56
Residents	
Unclaimed Deposits	\$4.95
Injury Prevention	-\$4.27
Farm Damage Prevention	-\$5.25
Avoided GHG Emissions	-\$5.88
Total Residents Costs	-\$10.46
Municipal	
Recycling Costs	\$2.91
Trash Collection	\$0.68
Tip Fees	\$0.82
Material Revenue	-\$12.20
Total Municipal Costs	-\$7.79
State Costs	
75% of Escheat	-\$2.18
Litter Clean-Up Prevention	-\$0.90
Total State Costs	-\$3.08
Total	\$36.61

Table 16 below converts the aggregate costs and benefits in Table 15 to unit values.

Table 16: Unit Values – No Deposit on Aluminum

	Units (Millions)	Values (Dollars per Unit)		
		Costs	Benefits	Impacts

Containers Covered	3,919	\$0.015	-\$0.006	\$0.009
Tonnage Recycled	0.24	\$239	-\$101	\$138
Households	3.50	\$16.71	-\$7.08	\$9.63

Handling Fee

As shown in Table 9, under the Bottle Bill retailers incur a much higher cost than the distributors. The 25 percent of escheat that goes to retailers helps to offset their costs, but does not come close to covering them. In six states distributors currently pay retailers a per-container handling fees. These states are: Connecticut, Iowa, Maine, Massachusetts, New York and Vermont. The handling fees range from one cent in Iowa to three cents in Maine and Vermont. A two-cent handling fee in Michigan would cover most of the retailers' costs. It would cost the distributors \$77.4 million. Instituting a handling fee would not change the overall cost of the bottle bill; it simply transfers the cost from the retailer to the distributor. A summary of the costs and benefits is shown below in Table 17. Table 18 shows the associated unit costs. As one would expect, the unit values are the same as those in Table 10 for the Bottle Bill.

Table 17: Costs and Benefits – 2-Cent Handling Fee

	Costs
Distributors	
Deposit Costs	\$3.90
Handling Fee	\$77.42
Collection and Processing	\$66.32
Material Revenue	-\$35.31
Total Distributors Cost	\$112.33
Retailers	
25% of Escheat	-\$2.18
Handling Fee	-\$77.42
Sorting	\$94.99
Total Retailers Costs	\$15.39
Residents	
Unclaimed Deposits	\$14.80
Injury Prevention	-\$12.79
Farm Damage Prevention	-\$15.71
Avoided GHG Benefit	-\$10.35
Total Residents Costs	-\$24.04

State Costs	
75% of Escheat	-\$6.53
Litter Clean-Up Prevention	-\$2.69
Total State Costs	-\$9.22
Total	\$94.46

Table 18: Unit Values – 2-Cent Handling Fee

	Units (Millions)	Values (Dollars per Unit)		
		Costs	Benefits	Impacts
Containers Covered	3,919	\$0.044	-\$0.020	\$0.024
Tonnage Recycled	0.27	\$640	-\$287	\$353
Households	3.50	\$48.94	-\$21.96	\$26.99

4. EXPANDING DEPOSIT COVERAGE

Since the Bottle Bill was enacted 20 years ago, the container stream has changed significantly. In response to these changes, California and Maine have expanded their systems beyond the containers initially covered. This chapter will consider three alternatives which address containers not currently covered by the Bottle Bill:

- An Expanded Bottle Bill in which there is no change beyond the extension of deposits to an expanded container stream;
- A Depot System to handle the same container stream as the Expanded Bottle Bill;
- A New, Non-Residential Alternative Recycling System ("The ARS"), to cover some containers currently without deposits.

The recycling levels, costs and benefits associated with each of these alternatives will be discussed below. First, however, some information on the expanded container stream needs to be developed.

The Expanded Container Stream

The expanded container stream consists of the containers covered by the Bottle Bill, plus additional containers not covered by the Bottle Bill. The Container Recycling Institute (CRI) provided Tellus with data on the size and composition of Michigan's container stream. The data provided by CRI for beer and soft drinks were adjusted to be consistent with the Treasury Department figures. The adjusted CRI data are shown below in Table 19. The organization of Table 19 by "beverage type" does not precisely match the coverage of the Bottle Bill and the alternatives. For example, the Bottle Bill covers more than soft drinks and beer. However, the current and expanded container streams shown in Table 19 are sufficiently close to the streams covered by the Bottle Bill and

the alternatives, to provide a reasonable basis for analysis.

**Table 19: Expanded Container Stream
(Containers in Millions)**

	Materials			Total
	Glass	Aluminum	Plastic	
Beer	649	844	0	1,493
Soft Drink	27	1,765	633	2,426
Total Current Stream	676	2,609	633	3,919
Fruit Beverages	121	139	95	355
Wine	42	0	0	42
Spirits	34	0	13	47
Bottled Water	12	1	94	107
Tea	42	38	19	100
Total "New" Containers	252	179	221	651
Total Expanded Stream	928	2,788	854	4,570
Containers per Ton	3,593	59,473	16,216	
Tonnage-Expanded Stream (Thousands)	258	47	53	358

The figures shown in Table 19 are only sufficient to determine the deposits paid for containers purchased in Michigan. For purposes of analysis, it is also necessary to know the numbers of containers purchased in Michigan that are redeemed, the level of fraudulent redemption, and the number of containers giving rise to the escheat. For purposes of analysis, the figures developed for the current container stream are all assumed to increase by the same percentage as the increase from the current to the expanded container stream.

The Expanded Bottle Bill

Analytically, the Expanded Bottle Bill alternative was dealt with by "scaling up" the results developed for the Bottle Bill. Operating costs and recycling-related benefits were determined by applying the methods described in Chapter 2 with the current container stream replaced by the expanded container stream. Deposit costs and litter-related benefits were increased by the percentage increase in the number of deposit containers sold. The resulting Expanded Bottle Bill costs and benefits are shown in Table 20. The corresponding unit values are provided in Table 21. Note that in this scenario, wholesalers of new age beverages such as juice, water and sports drinks may not currently have the infrastructure in place to deal with a deposit system. These wholesalers may experience higher initial costs with this system than those wholesalers already set up to deal with the bottle bill.

**Table 20: Costs and Benefits – Expanded Bottle Bill
(Millions of Dollars)**

	Costs
--	--------------

Distributors	
Deposit Costs	\$4.55
Collection and Processing	\$81.12
Material Revenue	-\$40.42
Total Distributors Cost	\$45.25
Retailers	\$0.00
25% of Escheat	-\$2.54
Sorting	\$110.65
Total Retailers Costs	\$108.11
Residents	\$0.00
Unclaimed Deposits	\$17.26
Injury Prevention	-\$14.91
Farm Damage Prevention	-\$18.32
Avoided GHG Emissions	-\$11.62
Total Residents Costs	-\$27.59
State Costs	\$0.00
75% of Escheat	-\$7.61
Litter Clean-Up Prevention	-\$3.14
Total State Costs	-\$10.75
Total	\$115.02

Table 21: Unit Values for the Expanded Bottle Bill

	Units (Millions)	Values (Dollars per Unit)		
		Costs	Benefits	Impacts
Containers Covered	4,570	\$0.045	-\$0.019	\$0.025
Tonnage Recycled	0.35	\$575	-\$250	\$325
Households	3.50	\$58.12	-\$25.26	\$32.86

The Depot Alternative

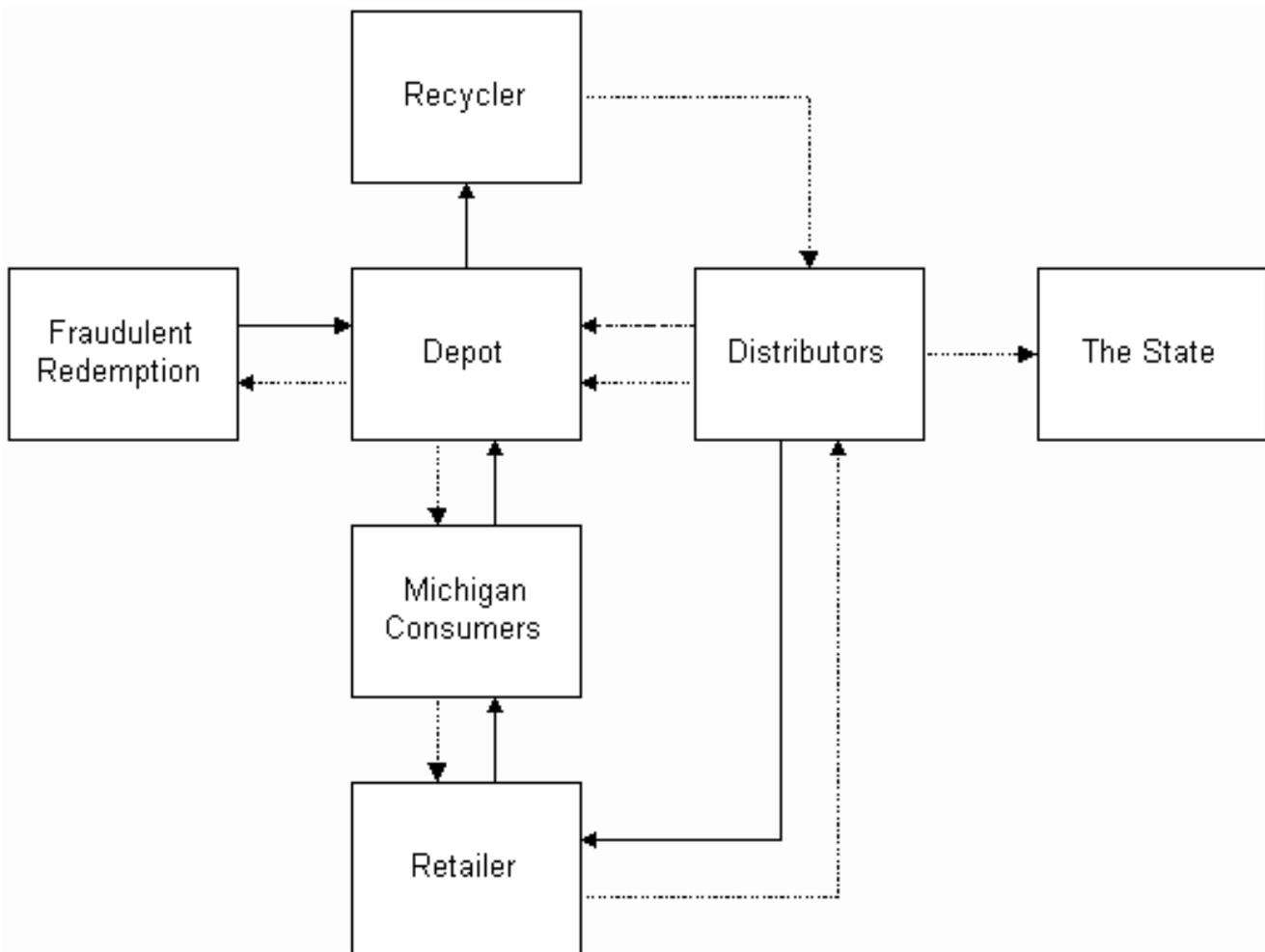
Depots are businesses that replace retailers as the entities that redeem used beverage containers. In large urban areas, depots are usually stand-alone operations. In rural areas where the used container stream is not large

enough to warrant a stand-alone operation, they often share physical space with other businesses. To lower costs and increase efficiency, depots do not separate used containers by brand or return them to individual distributors. Instead, the containers are simply separated by material type and processed (i.e., washed if need be, crushed, etc.) and shipped for recycling.

Alberta, Canada, has a depot system. It achieves about an 80 percent redemption rate for used containers for all beverages except milk products. Consumers pay a 5-cent Canadian deposit on containers smaller than one liter, and a 20-cent Canadian deposit on containers larger than one liter. The depots receive a 3-cent Canadian handling fee from the beverage industry for the smaller containers, and a 5-cent Canadian fee for the large containers. The industry is also responsible for the transport of containers from the depot to the recycler, and receive the revenues from the sale of the recycled materials. In Alberta, the unclaimed deposits are retained by the industry to offset the cost of the depot system. However, that is not an essential feature of the depot system.

Based on the Alberta depot system, a Depot alternative for Michigan was "designed". In this Depot alternative the distributors play the role of the beverage industry. The physical and financial flows associated with the system are shown in Figure 3 below. As shown by the solid lines, beverage containers flow from distributors to retailers, Michigan consumers, depots and recyclers. Fraudulent redeemers also return containers to the depots as shown. Financial flows are shown as dashed lines. Deposits paid by Michigan consumers flow through retailers to the distributors, who reimburse the depots for redemptions by Michigan consumers and fraudulent redeemers. The distributors also forward 75 percent of the unclaimed deposits to the state, retaining 25 percent to defray their costs. Finally, the distributors pay the deposit expenses (the second dashed line from distributors to depots) and receive the revenues from the sale of recyclables.

Figure 3: Depot System Container and Financial Flows



The costs and benefits associated with the Depot alternative were analyzed based on the following assumptions:

- Costs per container processed for the Alberta depot system were converted to U.S. dollars at \$.70 US per \$1.00 Canadian.
- Depot operating costs, which are largely labor-related, were increased by 5 percent to account for the fact that wages are about 5 percent lower in Canada than in the U.S.
- Michigan’s \$.10 deposit is twice the typical U.S. figure. Michigan has a 99 percent redemption rate for deposit containers, compared to the 85 percent average for U.S. states with bottle bills. The Depot system currently in place in Alberta achieves an 80 percent recovery rate with an average deposit of \$.07 Canadian or about \$.05 American. A high redemption rate for the Michigan Depot system is expected due to the \$.10 deposit. The recovery rate for the Depot alternative is assumed to increase by the difference in recovery rates between Michigan and states with a \$.05 deposit. Therefore the recovery rate for the depot system was set at 80% + (99% - 85%), or 94%.
- Deposit costs as well as recycling- and litter-related benefits were scaled as in the Expanded Bottle Bill alternative.

Based on these assumptions, the costs and benefits of the Deposit alternative are as shown in Table 22 below. Table 23 provides the corresponding unit values.

**Table 22: Costs and Benefits—Depot Alternative
(Millions of Dollars)**

	Costs
Distributors	
25% of Escheat	-\$6.85
Material Revenue	-\$38.47
Handling Commission	\$114.36
Other Expenses (Transportation etc)	\$27.61
Total Manufacturers Costs	\$96.65
Depots	
Handling Commission	-\$114.36
Operating Costs	\$114.36
Total Depot Costs	\$0.00
Residents	
Unclaimed Deposits	\$27.42
Injury Prevention	-\$13.51
Farm Damage Prevention	-\$16.59
Avoided GHG Emissions	-\$11.05
Total Residents Costs	-\$13.73
State Costs	
75% of Escheat	-\$20.56
Litter Clean-up Savings	-\$2.84
Total States Cost	-\$23.41
Total	\$59.51

Table 23: Unit Values for the Depot Alternative

	Units (Millions)	Values (Dollars per Unit)		
		Costs	Benefits	Impacts
Containers Covered	4,570	\$0.031	-\$0.018	\$0.013
Tonnage Recycled	0.34	\$422	-\$245	\$177
Households	3.50	\$40.56	-\$23.56	\$17.00

Alternative Recycling System

The Bottle Bill leaves many single-service beverage containers without an easily accessible recycling option. With this in mind, Tellus was retained in 1998 by the Massachusetts Department of Environmental Protection to design an Alternative Recycling System (ARS) that would make beverage container recycling—for single-serve juices, teas, sports drinks, and bottled water—readily available in every workplace in Massachusetts, as well as in public, outdoor places throughout the Commonwealth. Tellus research showed that the costs of such a system would be driven by two factors: the need for intensive education and promotion, and the logistics of collecting the used beverage containers. These two cost centers were analyzed using an extensive database and a spreadsheet model.

The Tellus base case estimates of the cost of an ARS for Massachusetts are shown in Table 24. The first three rows of Table 24 show the components of the base case collection costs; the next three rows show the components of the education costs. The total cost is \$97.6 million per year. Estimates of the cost of ARS will vary, depending on a number of assumptions, including the number of employees who will share one recycling bin and cost per pick-up. Analysis of a range of assumptions produced a range of \$67 million to \$210 million for a Massachusetts ARS.

Table 24: Base Case Estimate of ARS Cost in Massachusetts
(in Millions)

Collection Costs	Cost of Workplace Pick-Ups Per Year	\$53.6
	Cost of Public Space Pick-Ups Per Year	\$3.2
	Cost of Bin Consolidation Within Workplaces	\$10.6
Education Costs	Education/Outreach Costs to State for General Campaign to Promote ARS	\$1.1
	Cost of Promotion at Workplaces	\$10.5
	Cost of Employee Time to Learn about ARS	\$18.6
Total Cost		\$97.6

The Massachusetts ARS was designed to recover 85 percent of the targeted containers, to match the 85 percent recovery rate achieved by the Massachusetts bottle bill. Designing to achieve this rate was costly. For the 205 million containers covered by the Massachusetts ARS, the cost was \$.48 per container covered. While designing an ARS for Michigan was beyond the scope of this report, the approximate cost of a Michigan ARS was determined based on the size of the relevant Michigan container stream (the 561 million "new" containers for beverages other than wine and spirits shown in Table 19, and the Massachusetts unit ARS costs. The cost for the Michigan ARS is \$258.54 million. If the ARS were designed to produce the nearly 99 percent recovery rate achieved by the Michigan Bottle Bill, rather than the 85 percent achieved in Massachusetts, the cost would likely be even higher.

A Michigan ARS would extend the recycling opportunities for containers not currently covered by the Bottle

Bill. The ARS design also includes placing recycling containers in public places where littering might otherwise occur. Thus, both recycling and litter reduction benefits accompany an ARS. An analysis of the costs and benefits of the Michigan ARS based on these assumptions is shown in Table 25. The physical benefits of the ARS are 918 thousand MMBtu of energy saved, and 20 thousand MTCE of GHG emissions avoided.

**Table 25: Costs and Benefits – Michigan ARS
(in millions)**

	Costs
Cost of Alternative Recycling System	\$267.31
Material Revenue	-\$3.93
Avoided GHG Emissions	-\$1.00
Litter Clean-up	-\$0.33
Injury Prevention	-\$1.58
Avoided Farm Damage	-\$1.94
Total	\$258.54

Unit values for the Michigan ARS are shown in Table 26. In developing the unit values only the container stream covered by the ARS was considered.

Table 26: Unit Values for the ARS

	Units (Millions)	Values (Dollars per Unit)		
		Costs	Benefits	Impacts
Containers Covered	561.45	\$0.476	-\$0.016	\$0.460
Tonnage Recycled	0.05	\$4,875	-\$160	\$4,715
Households	3.50	\$76.37	-\$2.51	\$73.87

The ARS could be used in combination with any alternative for the existing container stream. Thus, for example, an expanded "No Bottle Bill" alternative could be created by combining the results from the No Bottle Bill alternative considered earlier with the results from this section.

5. CONSIDERING THE OPTIONS

The preceding three chapters provide a good deal of information about the Bottle Bill and six alternatives to it. These seven options differ considerably in the size of the used container stream they cover, the number of containers they capture for recycling, and the net financial impact (i.e., costs minus benefits) they entail. Table 27 below provides a summary of this information for each of the options considered. The table also shows the physical benefits—avoided greenhouse gas (GHG) and energy use—each option provides.

Table 27: Summary of Results

Alternatives	Containers			Net Financial Impact (\$ Millions)	Physical Benefits	
	Covered (Millions)	Recycled (Millions)	Recycling Rate		GHG (Thousands MTCE)	Energy (Millions MMBtu)
The Bottle Bill	3,919	3,871	98.8%	\$94.46	206.9	9.9
No Bottle Bill	3,919	1,416	36.1%	\$3.27	85.5	4.2
No Deposit on Aluminum Cans	3,919	2,503	63.9%	\$36.61	117.7	5.5
Bottle Bill with Handling Fee	3,919	3,871	98.8%	\$94.46	206.9	9.9
Expanded Bottle Bill	4,570	4,514	98.8%	\$115.02	232.3	11.0
Depot System	4,570	4,296	94.0%	\$59.51	221.1	10.5
Alternative Recycling System	561	477	85.0%	\$267.31	20.0	0.9

In addition to the total impact, the preceding chapters provide three unit values for the impact associated with each option: cents per container addressed, dollars per ton of material recycled, and dollars per Michigan household per year. These unit values are summarized in Table 28

Table 28: Summary of Unit Impacts

Alternatives	Cents per Container Covered	\$/Ton Recycled	\$/Household per Year
The Bottle Bill	2.4	\$353	\$26.99
No Bottle Bill	0.1	\$65	\$0.93
No Deposit on Aluminum Cans	0.9	\$138	\$9.63
Bottle Bill with Handling Fee	2.4	\$353	\$26.99
Expanded Bottle Bill	2.5	\$325	\$32.86
Depot System	1.3	\$177	\$17.00
Alternative Recycling System	46.0	\$4,715	\$73.87

The analyses supporting the results summarized in Table 27 and Table 28 are complex. Data choices and methodological assumptions underlying the results for each alternative are described in the body of the report. There are, however, three general points that affect all the results:

- Each alternative is considered on a stand-alone basis, as if it and not the Bottle Bill were currently in operation. The costs considered for each alternative are the **average costs** of implementing that alternative. Use of average costs throughout the report allows for "apples-to-apples" comparisons: all options are addressed and analyzed on the same basis.
- Differences in average costs provide an indication of the incremental effect of replacing the Bottle Bill by one of the alternatives. However, such a change could introduce additional considerations. For example, eliminating the Bottle Bill might allow recycling and disposal collection programs to make more efficient use of existing capacity. On the other hand, for a curbside recycling program, increases in the weight of the recycled material collected may impose hidden costs due to the need to lift heavier loads at each collection stop. Research conducted by Tellus for the EPA has shown that such costs can be quite "significant."
- The results presented in Table 27 and Table 28 are based on sound analytical methods applied using the best data available. However, users of the report should be aware that data are limited and of uneven quality. Results provide an indication of magnitudes, not a precise estimate.

The data in Table 27 and Table 28 highlight what might be called the **basic trade-off** between container recycling achieved and financial impact. The alternatives with "low" financial impacts—No Bottle Bill and No Deposit on Aluminum—have the lowest recycling levels. At the other end of the spectrum, the Expanded Bottle Bill and Depot System provide the highest levels of recycling, but have the highest financial impacts. Below, different ways of addressing the trade-off will be discussed, based on the different types of unit impacts presented. This discussion is intended to help readers understand how the report’s results can be used. However, the report will not, explicitly or implicitly, identify the "best" option. That choice is left to the reader.

Cents per Container Covered

The data in Table 28 provide a measure of financial impact per container covered. The figures range from 0.1 cents to 46.0 cents. Some may be interested in the relationships between these impacts and the purchase of the deposit-bearing items. To make this connection, one must identify the portion of the impact that might influence prices. Depending on how competitive the market is, price may reflect distributors’ and retailers’ costs net of revenues from the sale of recyclables and the 25 percent of the escheat paid to retailers. Table 29 below shows the unit impacts together with per-container prices. In a very competitive market, price will not be as affected by the costs to the retailers and distributors as is shown in Table 29.

**Table 29: Unit Impact and Price Effect
(Cents per Container)**

Alternatives`	Unit Impacts	Price Effect
The Bottle Bill	2.4	3.3
No Bottle Bill	0.1	0.0
No Deposit on Aluminum Cans	0.9	4.4

Bottle Bill with Handling Fee	2.4	3.3
Expanded Bottle Bill	2.5	3.4
Depot System	1.3	2.1
Alternative Recycling System	46.0	0.0

In order to translate price increases into changes in purchasing one must identify the **price elasticity**; that is, the percentage change in purchases due to a one percent change in price. The price elasticity for beer and soda is not well known. However, Tellus' review of the available data, conducted as part of the work sponsored by the EPA, is likely close to zero. However, some studies suggest it is quite large. A value of -.5 is at the mid-range of the values in the literature. This value means that one percent increase in price results in half a percent reduction in purchases. Using a \$.60 average per-container purchase price for purposes of illustration, the impact on purchases of the Bottle Bill can be computed as follows:

$$\text{Percent change in purchase} = \$.033 \div \$.60 \times (-.5) = -.028$$

The illustration indicates 2.8 percent reduction in purchases.

Readers concerned about price effects may wish to take note of the Depot alternative. The Depot alternative covers the expanded container stream with per-container impacts and prices below those for the current Bottle Bill. Repeating the calculation of percent change in purchasing with the \$.021 per container price for the Depot alternative in place of the \$.033 from the Bottle Bill, changes the decrease in purchases from 2.8 percent to 1.4 percent. A Depot system limited to the current container stream might have even lower price impacts and so less effect on purchases. Whether the reduced impacts on purchases associated with the Depot alternative would justify a major change in Michigan's deposit-return system is, of course, a matter of judgment.

Dollars Per Ton

The Bottle Bill, as well as other deposit-return options, can be considered as waste management and, in particular, recycling programs. Some argue that, from this perspective, the Bottle Bill and the other deposit-return options considered in this report are too limited in scope and effect to justify the level of effort and financial impact they entail. Based on data published in *Biocycle*, total municipal solid waste generated in Michigan in 1995 was about 13.5 million tons. The Bottle Bill recovers only about 271 thousand tons at a cost of \$353 per ton. One can certainly think of recycling options other than deposit-return systems for containers for which equivalent expenditures **might** result in more tons of material recycled. However, in considering this line of argument, it is useful to keep the following points in mind:

- The Bottle Bill (and the other deposit-return alternatives) provide a continuously operating litter control system. As will be discussed in the "per-household" section, the benefits of this litter reduction may exceed those quantified in this report.
- The Bottle Bill has a funding mechanism in place as well as a track record of success in providing recycling. "Alternative recycling investments" may require adoption of a new funding mechanism and may not have a track record of success.
- Deposit-return systems make "producers" (i.e., distributors and retailers) responsible for product-related waste. In many countries other than the U.S., such producer responsibility is a fundamental principle of waste management.

How to balance these points against the limited scope of the deposit-return options is a matter of judgment.

Consideration of deposit-return systems from a solid waste management perspective is often motivated by a concern about the impact of such systems on municipal recycling programs. The results in this report provide some insight into this concern.

- Absent the Bottle Bill, sales of recycled containers could provide substantial revenues to recycling programs. In the No Bottle Bill alternative, the value of such sales amounts to \$13.8 million. However, with the Bottle Bill, the revenue from sales of recyclables is \$35.3 million. This provides an off-set to the distributors’ operating costs. Thus, with the Bottle Bill, sales of recyclables contribute more revenue in total to support recycling than they would without the Bottle Bill.
- There are a variety of ways to modify the relationship between the Bottle Bill and recycling program revenues. All or part of the \$13.8 million in revenue recycling programs might have received from the sale of used beverage containers could be provided to those programs through a **transfer payment**. Methods for financing such a payment include use of all or part of the 75 percent of the Escheat currently reverting to the state, or imposition of an additional charge on distributors, or Michigan consumers. Such a transfer payment would cause no change in the level of recycling achieved, or in the Bottle Bill’s aggregate costs and benefits.

Finally, those interested in the use of recycling programs to recover used beverage containers should take note of the dramatic difference in costs per ton recycled between the No Bottle Bill and ARS alternatives. These costs differ because, in the No Bottle Bill alternative, recycling of used beverage containers takes place through **existing recycling programs**. In contrast, to recover single-serve containers which are often consumed away from home, a new non-residential recycling program such as the ARS would need to be put in place. Any dedicated program such as the ARS is likely to be costly. The costs could be reduced if the program were not designed to achieve recycling rates comparable to those of the Bottle Bill, or if it were part of a comprehensive, non-residential recycling program.

Dollars Per Household

All of the options considered in this report impose costs and provide benefits. The costs and benefits per household, as well as the financial impact due to their differences, is shown in Table 30 below.

Table 30: Summary of Per Household Impacts

Alternatives	Cost	Benefit	Impact
The Bottle Bill	\$48.94	-\$21.96	\$26.99
No Bottle Bill	\$6.09	-\$5.16	\$0.93
No Deposit on Aluminum Cans	\$16.71	-\$7.08	\$9.63
Bottle Bill with Handling Fee	\$48.94	-\$21.96	\$26.99
Expanded Bottle Bill	\$58.12	-\$25.26	\$32.86
Depot System	\$40.56	-\$23.56	\$17.00
Alternative Recycling System	\$76.37	-\$2.51	\$73.87

The costs associated with the options considered in this report directly affect a number of parties. However, the net deposit and operating costs which underlie the data shown in Table 30 are, ultimately, likely to flow to Michigan’s households:

- As shown in Table 3, net of transfers, the deposit cost is simply the cost of fraudulent redemption.

This is a part of the unclaimed deposit on containers purchased in Michigan.

- Operating costs, initially incurred by distributors, retailers, and solid waste management service providers, are all likely to be transferred to Michigan's households through the price of beverages and services to Michigan households.

In addition, under all of the options, households may have some involvement in container recycling: with the deposit-return options there is the modest effort to return containers. With the No Bottle Bill and No Deposit on Aluminum alternatives, greater care and effort is required for recycling. The obvious question is "Is it worth it?" Here, the information of benefits developed in this report provides a start, but only a start, at an answer.

The benefits shown in Table 30 reflect **market prices** for a range of physical effects of container recycling, reduced GHG emissions, and avoided litter-related injuries to humans and farm animals. For example, the cost of the Bottle Bill to households is offset by the value of the medical payments avoided due to reduced litter-related injuries. In Table 30, the impacts are simply the difference between the cost of the option and the cost of purchasing benefits provided, such as GHG emissions avoided, or not paying for "damages," such as litter-related injuries which are avoided.

If one relies on the market valuation of benefits, then one might say that the choice to have the Bottle Bill rather than No Bottle Bill imposes an "extra" cost of \$26.03 per year, or \$.50 per week per household. Using the same logic, one could say that adoption of the Depot System would reduce these costs by \$10 per year, while expanding the containers covered and recycled substantially. How important differences of \$10 or \$26 per year are to an average Michigan household is a matter of judgment.

Market prices are often used to value environmental benefits. However, from the standpoint of environmental economics, it is more appropriate to consider what households in Michigan might be **willing to pay** to obtain these benefits. Willingness to pay puts the benefits considered in this report, as well as the options considered, in a rather different light:

- Would society be willing to pay more or less than the average cost of medical treatment to avoid a litter-related injury?
- Would society be willing to pay more or less than the market value of a farm animal, such as a dairy cow, to avoid what farms describe as a slow, painful death due to eating a littered container?
- Each used aluminum container returned during a trip to the supermarket avoids about four times the container weight in GHG emissions, with little or no inconvenience. Would consumers concerned about global warming be willing to pay more or less than the \$50 per MTCE avoided used in this report?
- Knowing the value of these benefits would consumers be willing to go out of their way to redeem containers? Michigan's high redemption rate shows that consumers are willing to return containers to retailers. Would they also be willing to return containers to a depot?

Consideration of willingness to pay could also reduce the value of the benefits quantified in this report. For example, those who doubt the importance of global warming may not be willing to pay \$50 per MTCE of avoided GHG emissions.

Based on these considerations, it may be useful to focus on the per-household cost data shown in Table 30. For the cost data, the relevant question would be whether Michigan households, as a group, are willing to pay the level of annual costs shown to obtain the benefits associated with any particular option shown. In considering this point it may be useful to note that, in 1995, the median income of Michigan households was approximately \$36,400 per year. One indication that Michigan residents are willing to pay the current level of costs is the popularity of the bottle bill.

Deposit-return systems such as the Bottle Bill, allow Michigan residents to make a contribution to a better

environment. For some consumers, the ability to take **personal action** (i.e., returning used beverage containers) to address global warming and other environmental concerns, may be a benefit, not a burden. Others may simply resent the bit of extra time it takes to return used containers, or the deposits they lose if they choose not to return them. Consumers can decide how, and to what extent, the satisfactions or burdens associated with the various options might offset or add to the costs associated with the options, as shown in Table 30.

Fraudulent Redemption

The amount of fraudulent redemption occurring in Michigan is uncertain. As noted in Chapter 2, the only source on the amount of fraud is a recent report prepared for the Michigan Beer and Wine Wholesalers Association which put the figure at about 150 million containers per year. However, as explained in Chapter 2, review of that report suggested that a range of 50 to 150 million was reasonable, so a midrange figure of 100 million was used. To determine the level of fraud associated with other alternatives, this report assumes that the amount of fraud scales with the number of containers subject to deposit. Fraud associated with each option is shown in Table 31 below.

The principal effect of fraudulent redemption is to return deposits to parties who have not paid a deposit. Fraudulent redemption also creates additional operating costs for the retailers and distributors who must handle the fraudulently redeemed containers. Fraudulent redemption has certain positive effects. It increases container recycling, producing additional litter reduction and increasing the recycled feedstock, reducing greenhouse gas emissions and energy consumption. The methods used in the body of this report can be applied to analyze the impacts of fraudulent redemption. Table 14 in Chapter 3 shows the details of such an analysis for fraud associated with the Bottle Bill. Table 31 below shows the impact (i.e., costs minus benefits) associated with fraud for each of the options considered in this report. This impact is not an addition to the impact shown in Table 28. Rather, it is included in the impact shown there. In thinking about fraudulent redemption, it is useful to know how fraud contributes to the unit impacts developed for each option. That information is also provided in Table 31.

Table 31: Information on Fraud

Alternatives	Containers (Millions)		Net Impact (\$ Millions)	Unit Impacts		
	Recycled	Fraudulently Redeemed		Cents Per Container Recovered	\$/Ton Recovered	\$/Household Per Year
The Bottle Bill	3,919	100	\$12.99	0.33	\$48.49	\$3.71
No Bottle Bill	3,919	0	\$0.00	0.00	\$0.00	\$0.00
No Deposit on Aluminum Cans	3,919	33	\$4.77	0.12	\$19.50	\$1.36
Bottle Bill with Handling Fee	3,919	100	\$12.99	0.33	\$48.49	\$3.71
Expanded Bottle Bill	4,570	117	\$15.27	0.33	\$43.20	\$4.36
Depot System	4,570	111	\$14.06	0.31	\$41.78	\$4.02

Alternative Recycling System	561	0	\$0.00	0.00	\$0.00	\$0.00
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As the data in Table 31 show, whether one sees fraudulent redemption as a "large" or "small" problem depends on one's frame of reference: the absolute numbers of containers and dollar value of impacts are both in the millions, but the share of fraudulently redeemed containers in those recycled, as well as the unit impacts, are all "small."

There are a variety of things that could be done to thwart fraudulent redemption. However, all have drawbacks:

- One could impose large fines for substantial fraudulent redemption, and target for enforcement locales where substantial fraudulent redemption is likely to occur (i.e., large stores with reverse vending machines and easy access to out-of-state parties). However, one must ask if this is the best use of law-enforcement resources.
- One could limit the number of containers that can be returned by a single party on one day. However, this could inconvenience Michigan households who choose to return their used containers in bulk, and could discourage the poor who collect littered containers.
- One could change the markings on containers to make redemption of containers purchased outside Michigan more difficult. However, this could upset current distribution systems and impose additional costs.

While some progress in each of the directions noted should be possible, there is little prospect for wiping out fraud entirely.

APPENDIX A: PUBLIC INPUT AND COMMENTS ON THE DRAFT REPORT

In order to obtain public input to this report, meetings were held in Lansing, Michigan on November 8, 1999. Representatives from government, the recycling industry, non-governmental organizations, and industry groups interested in the Bottle Bill and related matters were invited to attend. Once a draft was available it was circulated to those attending the November 8 meeting, as well as to others interested in reviewing it. Complete texts of all the comments received are enclosed in this appendix. The comments received have been addressed to the fullest extent possible given the scope of the project and the resources available.

APPENDIX B: PRESENTATION OF STUDY RESULTS

The results of this report were presented at the 18th Annual Conference of the Michigan Recycling Coalition, held at the Crown Plaza Hotel in Grand Rapids on May 24 and 25, 2000. This appendix contains copies of the overheads used in this presentation. They are included in this report because they provide a useful brief summary and overviews of much of the information presented in the report.