Bottled Up:

Beverage Container Recycling Stagnates (2000-2010)

U.S. Container Recycling Rates & Trends, 2013

CRI
CONTAINER RECYCLING INSTITUTE

Jenny Gitlitz, Principal Author

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October 2013

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Dedication

This 10th anniversary edition of the CRI's beverage container recycling analysis is dedicated to CRI founder and former Executive Director Pat Franklin (1941-2012).

Pat founded the Container Recycling Institute in 1992, and grew it from a shoestring operation in her basement to the internationally recognized source of beverage container information and analysis that it is today. For 15 years, Pat networked with hundreds of activists and legislators in dozens of states, sharing information critical to campaigns to promote deposit legislation. She recruited executives from secondary-materials industries to serve on CRI's board, and was tenacious in spreading the message of producer responsibility—long before that term gained widespread usage.

Pat spearheaded a series of Container Deposit Summits, spoke at scores of recycling conferences, and was interviewed hundreds of times by members of the mainstream media as well as the trade press in both the solid waste and recycling industries.

Pat was instrumental in getting then-Senator Jim Jeffords of Vermont to sponsor a National Bottle Bill initiative, and she spoke before the Committee on the Environment and Public Works on Capitol Hill. Over the years, Pat presented expert legislative testimony to dozens of state committees where deposits were being debated. Pat took on the tough challenges within the beverage and grocery industries with fearless determination. Undaunted by the obstacles in her path, she was a force to be reckoned with.

She wrote the first edition of "The 10-cent Incentive to Recycle" and numerous other CRI reports and articles. Never to shy away from innovation, Pat developed CRI's two websites—www.container-recycling.org, and www.bottlebill.org—when the web was still in its infancy. Finally, Pat conceived of and helped execute CRI's first beverage container recycling analysis in 2002—and helped this study evolve into the powerful tool it is for researchers, state agencies, industry leaders and activists.

Pat left an indelible mark on the beverage container recycling movement. Her work lives on in the passage of a bottle bill in Hawaii; in bottle bill expansions in Connecticut, New York and Oregon; and in the countless interns and colleagues whose work she supported over the years.

About the Container Recycling Institute

Founded in 1991, the nonprofit Container Recycling Institute is a leading authority on the economic and environmental impacts of used beverage containers and other consumer-product packaging. Its mission is to make North America a global model for the collection and quality recycling of packaging materials. We do this by producing authoritative research and education on policies and practices that increase recovery and reuse; by creating and maintaining a database of information on containers and packaging; by studying container and packaging reuse and recycling options, including deposit systems; and by creating and sponsoring national networks for mutual progress. CRI envisions a world where no material is wasted and the environment is protected. It succeeds because companies and people collaborate to create a strong, sustainable domestic economy.

Please visit CRI at www.container-recycling.org and www.bottlebill.org

About the Principal Author

Jenny Gitlitz became an environmental professional in 1985 when she founded a course at the University of California at Berkeley called "The Joy of Garbage"—a course that was still being taught 26 years later. She has an M.A. in geography from Clark University and an M.S. from the UC Berkeley Energy and Resources Group. Her master's theses examined the global environmental and social effects of the primary aluminum and hydroelectric industries. She has implemented curbside recycling programs in two California cities, organized several major recycling conferences, and has spoken and published widely.

Jenny served as the Container Recycling Institute's Research Director from 2000 to 2007. In addition to co-authoring four editions of the Beverage Market Data Analysis (BMDA) with CRI founder Pat Franklin, she authored the 2002 "Trashed Cans" report and co-authored two editions of the "Ten-Cent Incentive to Recycle" report. More recently, Jenny served as the Director of Environmental Assessment for Green Depot. She currently works as an enviornmental consultant.

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Special thanks to CRI consultant Shea Cunningham and CRI board members Tex Corley and Marge Davis for their editorial assistance; CRI programs manager Sue Herrschaft for her meticulous proofing of data tables; and CRI intern Candace Lee for her adept data-gathering assistance.

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Sponsors

This project was made possible by the many generous supporters of the Container Recycling Institute, especially:

Introduction

It has been a decade since the publication of the Container Recycling Institute's (CRI) first beverage container recycling analysis report, which tracks U.S. sales, recycling and wasting[1] rates of carbonated beverages;[2] non-carbonated, non-alcoholic beverages;[3] and non-carbonated, alcoholic beverages.[4] Three pronounced trends in American beverage consumption and recycling patterns have emerged since CRI's first BMDA looked at year 2000 data: overall sales growth, non-carbonated sales growth, and stagnating recycling rates—all of which are resulting in higher rates of landfilling, incineration and littering, and other negative environmental impacts.[5]

History of Beverage Container Recycling in the U.S.

Prior to 1935, beverages were sold in glass refillable containers. Bottles were washed and refilled as many as 20-50 times, and when they became too scuffed up for use, they were recycled. Glass refillables are still popular throughout the world, but are rare in the United States today.

The steel can was introduced for beer in 1935 and was rapidly adopted, rising to 31% of beer packaging by 1945, and extending to carbonated soft drinks by 1953.

Coors pioneered the aluminum beverage can in 1959, according to the Aluminum Association. By 1963, 11% of all carbonated beverages were sold in one-way aluminum cans, and in 1967, the first consumer-level aluminum recycling program was introduced.[6]

The PET (polyethylene terephthalate) plastic bottle was patented in 1973, and according to the National Association for PET Container Resources (NAPCOR), was first recycled in 1977.

Prior to the 1950s and 1960s, refillable bottles that carried a deposit had a 96% return rate, so littering of these items had not been much of an issue. Beginning in the 1950s, however, there arose a consumer backlash to the littering of "one-way" containers. In 1953, a bill was proposed in Maryland (but never put into law) that would have required a deposit-return system for beverage containers, and in that same year Vermont "passed a law that prohibited the use of nonreturnable glass beer bottles."[7] That Vermont law was repealed in 1957.

The first U.S. beverage container deposit laws (CDLs) were passed in 1971 and 1972 in Oregon and Vermont, respectively, and are the first examples of "Extended Producer Responsibility" in the United States.[8] These laws required a refundable deposit to be placed on certain beverage containers sold in these states, and required beverage manufacturers to take back the empty containers for recycling. These laws generated vast quantities of all container types for beverage manufacturers, but there was no recycling process for PET bottles until 1977, when a small program was piloted by St. Jude Polymers. In 1978, Wellman Plastics began recycling PET soda bottles into carpet fiber.[9]

Container deposit-refund laws have been introduced in nearly every U.S. state. Today, CDLs exist in 10 U.S. states and more than 30 foreign countries, provinces and territories.

Economic and Environmental Importance of Recycling Beverage Containers

In 2009, the U.S. Environmental Protection Agency (EPA) used a systems-based approach to modeling to compile a report on total greenhouse gas production in the United States. In this report, "each system represents and comprises all the parts of the economy working together to fulfill a particular need." The report found that "provision of goods" is associated with an estimated 29%[10]—nearly a third—of total U.S. greenhouse gas emissions. Most of these goods are used and become waste, sooner or later. Separately, the EPA estimates annual U.S. municipal solid waste generation and recycling.[11] While beverage containers represent nearly 6%[12] of municipal solid waste (MSW) by weight, they represent approximately one-fifth of greenhouse gases that could potentially be saved through MSW recycling.[13]

On an economic scale, the annual scrap value of beverage containers (including glass, aluminum, PET and HDPE, or high-density polyethylene, is nearly $3.8 billion, yet only $1.6 billion worth of this material was recycled in 2010, meaning that Americans sent beverage containers worth more than $2 billion to landfills in 2010.[14] In the decade from 2001 to 2010, the value of wasted beverage container materials exceeded $22 billion.

As the subject of packaging recycling receives increased attention in the U.S., it is important to note that beverage containers are 17% of packaging materials by weight, per the EPA statistics for 2011. Furthermore, beverage containers are 25% of curbside recyclables by weight, and a slightly greater amount by volume.[15]

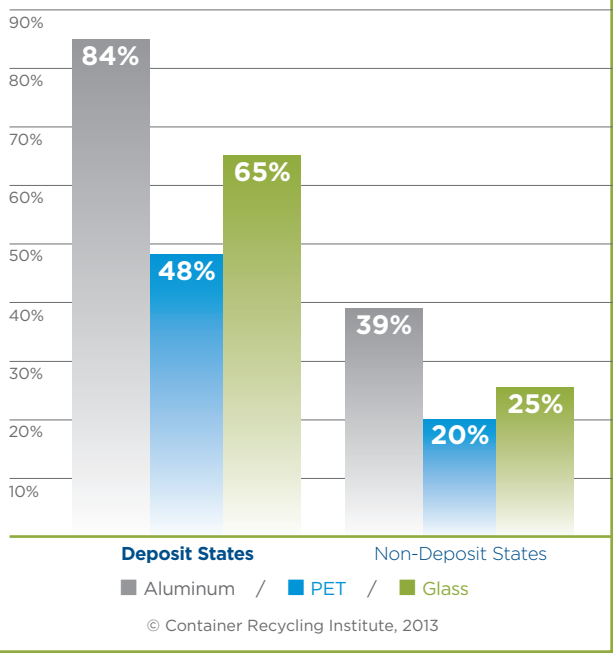
2000 – 2010: Key Findings

U.S. Beverage Container Recycling Rates for 2010 and 2000

The overall beverage container recycling rate for 2010 was 36.9%, and this includes all material types and all major beverage types. When we consider traditional material types only,[16] the national beverage container recycling rate in 2010 was higher, at 39.6%. Traditional material types include aluminum beverage cans (recycled at the rate of 49.7%), glass beverage bottles (recycled at 36.9%) and PET beverage bottles (recycled at 29.1%). (See Appendix A.)

Compared to the year 2000, the recycling rate for traditional containers was virtually unchanged; it was 39% in 2000, and 39.6% in 2010. When non-traditional containers and milk are added to the statistics, the trend is slightly more positive, increasing from a 33% recycling rate in 2000 to a 36.9% recycling rate in 2010.

Figure 1: Deposit States Have Higher Beverage Container Recycling Rates



But the national rates do not tell the whole story. The 11 U.S. states that had active container deposit laws in 2010[17] consistently recycled covered containers at rates of 66%-96%, while the overall recycling rate for beverage containers in non-deposit states was 30% in 2010. As shown in Figure 1, recycling rates for traditional beverage container types were more than twice as high in deposit states in 2010 compared to non-deposit states. PET has a lower recycling rate than aluminum and glass in deposit states because only three states include most PET beverages in their deposit laws (California, Hawaii and Maine). Some of the deposit states include only carbonated beverages in their laws (Michigan, Iowa, Massachusetts, Vermont) while others (Oregon, New York and Connecticut) also include water, but exclude other non-carbonated beverages.

> "In the decade of 2001-2010, Americans landfilled, incinerated or littered enough aluminum cans to reproduce the world's entire commercial air fleet 25 times."

If all of the bottles and cans that were wasted in 2010 were instead recycled, it would save the energy equivalent of 203 trillion BTUs of energy, an amount sufficient to supply the energy needs of 2.3 million homes—nearly enough to power all the homes in the cities of Los Angeles and Chicago combined. This level of recycling would also avoid the production of 11.6 million tons of greenhouse gas emissions (CO_2E)—equivalent to taking nearly 2.3 million cars off the road.

Robust Growth in Sales of Non-Carbonated Beverages

Sales of traditional bottles and cans have grown 22% in the decade from 2000 to 2010, partly due to U.S. population growth of 9.6% during that period. Also, per capita consumption is now three times higher than it was 40 years ago. Non-carbonated beverages accounted for all of the non-alcoholic sales growth over the last decade, while soft drink sales dropped by 10%. Bottled water sales increased by more than 400%, from 8 billion units in 2000 to 45 billion units in 2010. In 2010, the market share of beverage types was as follows: soft drinks 33%, beer 26%, bottled water 18%, milk 7%, fruit beverages 6%, and energy drinks, sports drinks, wine, spirits, flavored and enhanced waters, all at 3% or less.

Market Share by Container Type

From 2000 to 2010, sales quantities of most container types were roughly unchanged, with the exception of PET bottle sales, which nearly doubled. In 2010, beverages were sold in the following container types: 41% in aluminum cans, 33% in PET plastic bottles, 14% in glass bottles, 4% in HDPE plastic bottles, and the remainder in paper gable-top cartons, aseptic multi-material drink cartons, foil pouches, bi-metal (steel) cans, and refillable glass bottles.

A decade of environmental and economic impacts

In the decade of 2001-2010, Americans landfilled, incinerated or littered enough aluminum cans to reproduce the world's entire commercial air fleet 25 times.

More than 100 million tons of beverage containers have been wasted in the last decade--or about one-and-a-half-trillion individual bottles and cans. Two-thirds of the weight is from glass bottles, while aluminum cans and plastic bottles account for only 7% and 28% of the weight, respectively. Valued at 2012 prices, the scrap value of ten years of wasted containers is *more than $22 billion* (more than $12 billion in aluminum, $8.9 billion in PET, and $1.3 billion in glass.)

Aluminum and plastic are also the most energy intensive of the three leading container types, each accounting for 47% of the total energy lost when containers are landfilled or burned. Over the last ten years, 2.5 quads (quadrillion BTUs) of energy were consumed in making new "replacement" containers: enough to supply the

annual residential energy needs of almost 28 million American homes—or the populations of the states of New York, Texas, Florida and Virginia combined.

Aluminum cans account for 58% of the greenhouse gases (GHGs) emitted during replacement production, or 67 million metric tons of carbon dioxide equivalent ($MTCO_2E$). Plastic wasting accounted for 28% of the replacement GHGs during the last decade (30 million $MTCO_2E$), while glass wasting accounted for 16% of the GHG impacts (about 19 million $MTCO_2E$). Cumulatively, the 116 million tons of greenhouse gases emitted during the decade were equivalent to the annual carbon dioxide emissions from almost 23 million cars.

It is these environmental impacts that persist year in and year out as the recycling rates for the major container materials essentially stagnate. Minor percentage changes in the recycling rates for cans and bottles will not stem the tide of these impacts, nor will they have any measurable impact on other "upstream" consequences of extracting, processing, shipping and manufacturing billions of short-lived containers: water quality degradation, local air pollution, soil erosion, habitat loss and the disruption of native human communities. Recycling rates for all major materials must edge above 90% to be considered "sustainable;" rates in the 20s and 30s will not cut it.

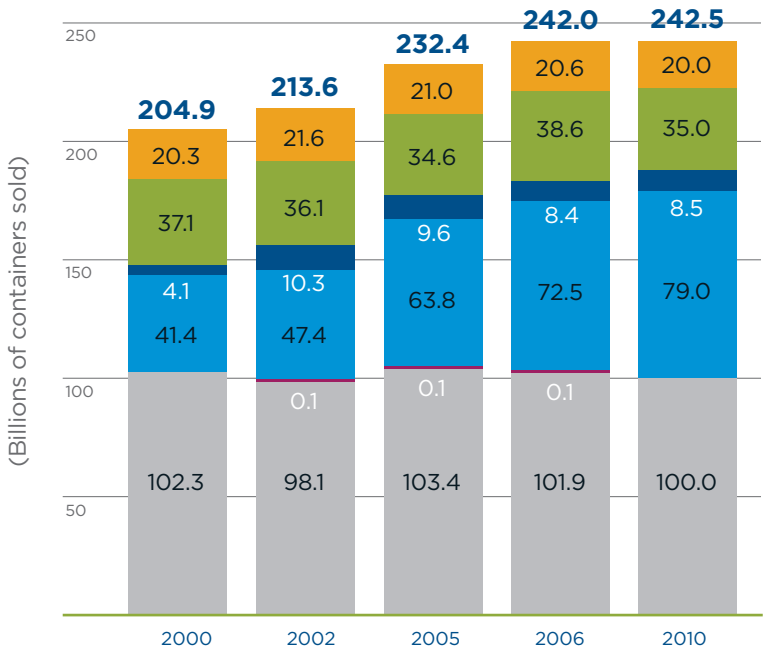
Beverage Sales Trends, 2000 to 2010

Growth of One-Way Packaged Beverage Sales[18]

Sales of traditional bottles and cans have grown dramatically: from approximately 178 billion units sold in 2000 to 216 billion sold in 2010, a 22% increase in just one decade. When non-traditional containers (drink boxes, cartons and foil pouches) are added in, and when milk is included, total sales rose by 36.5 billion units: from 205 billion in 2000 to 243 billion in 2010 (see Figure 2).

Part of this increase is due to population growth. The U.S. population rose 9.6% from 282 million in 2000 to 309 million in 2010: an addition of 27 million people, each of whom now consumes almost 800 packaged beverages a year.[19]

Figure 2: U.S. Growth in Packaged Beverage Sales, 2000–2010



Excludes flavored, enhanced and sweetened waters, wine coolers, champagne, sparkling wine, frozen fruit concentrates and soy, almond and rice beverages.

Non-traditional beverage containers include aseptic boxes, gable-top cartons and foil pouches.

Until recently, total sales growth could also be attributed to a long trend of **increasing per capita consumption**. CRI historical figures show per capita sales of an estimated 254 bottles and cans in 1970, rising to 319 in 1980, and 549 in 1990 (see Figure 3). By 2000, the average American drained the contents of 629 bottles and cans each year, and 730 beverage packages overall (including milk, and non-traditional containers such as cartons, drink boxes and pouches). By 2006, per capita bottles and cans had risen to 722, and 811 beverage packages overall, including milk and flexible packages: more than 2 per person per day.

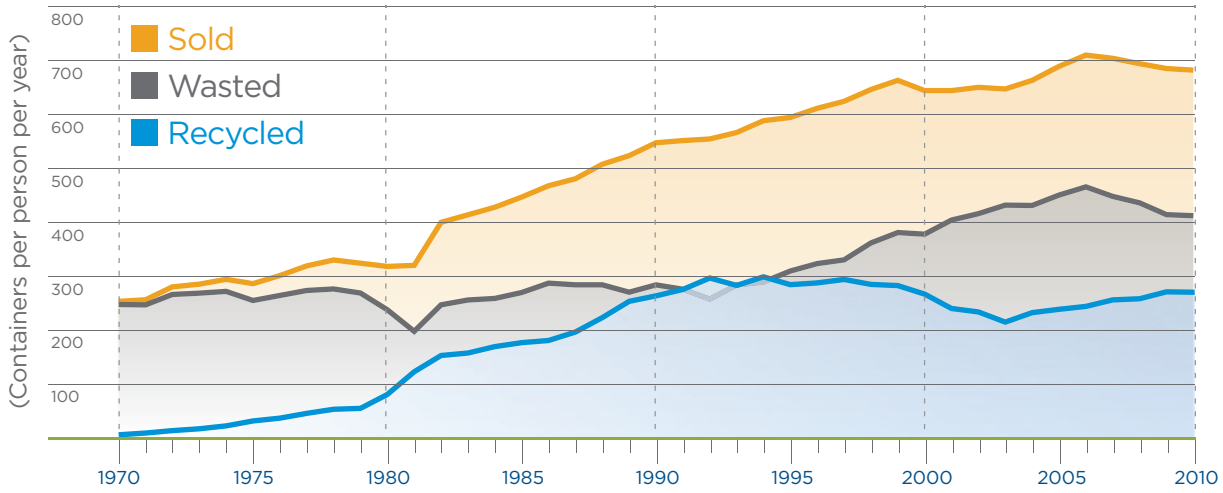
By 2010, however, the growth trend in total sales had leveled off, and had even begun to decline slightly on the individual level, with 784 beverage containers being consumed per person annually (includes milk and all container types). Nonetheless, this level is 8% above the per capita rate of a decade ago, and three times the amount consumed by the average American 40 years ago.

> "Non-carbonated beverages accounted for all of the non-alcoholic sales growth over the last decade, while carbonated beverage sales dropped by 7.3 billion units."

The Rise in Non-Carbonated Beverages

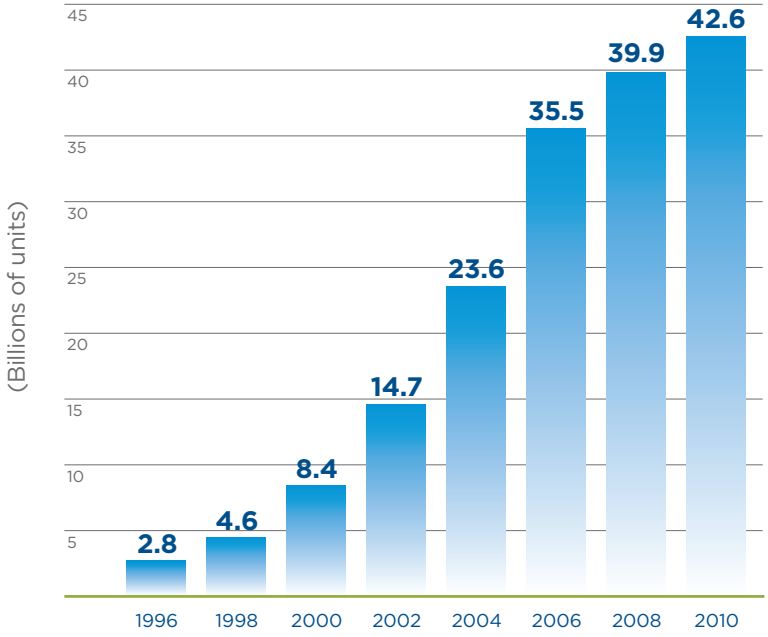
Non-carbonated beverages accounted for all of the non-alcoholic sales growth over the last decade, while carbonated beverage sales dropped by 7.3 billion units. In addition, non-carbonated drinks are increasingly marketed in convenience stores, vending machines, big-box retailers and drug, office supply, sporting goods and home improvement stores, and many other public places.

Figure 3: Per Capita Beverage Sales, Recycling & Wasting 1970–2010



Excludes aseptic boxes, gable-top cartons and foil pouches. Excludes flavored, enhanced and sweetened waters; wine coolers, mixed liquor drinks, champagne and sparkling wine; frozen fruit concentrates; milk and non-dairy "milk" beverages.

Figure 4: U.S. Plastic Bottled Water Sales, 1996–2010



Defined as domestic, bottled water packaged in plastic, ≤ 1 gallon.
Derived from Beverage Marketing Corporation data, 1996–2010.

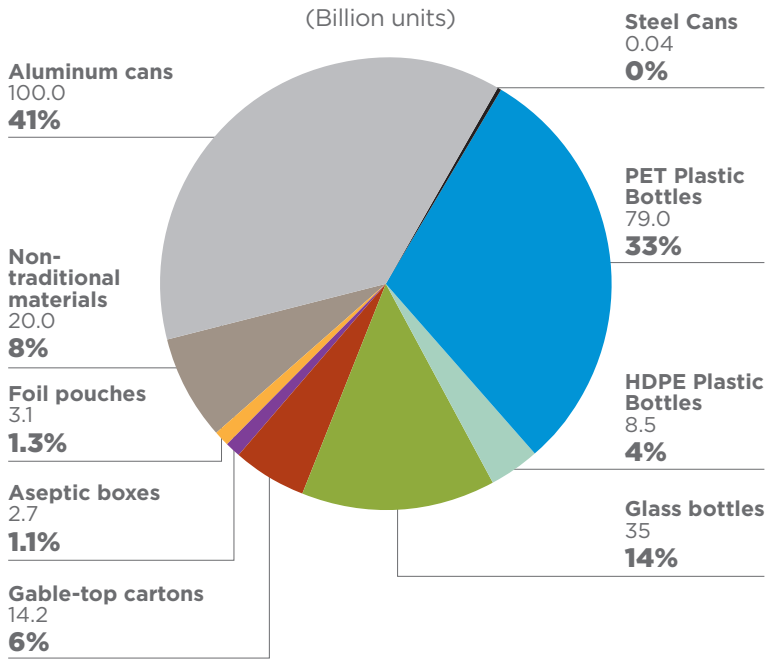
The lion's share of the non-carbonated sales increase comes from **bottled water** packaged in PET (polyethylene terephthalate) plastic. As Figure 4 shows, sales have skyrocketed from 8.4 billion single-serve plastic water bottles in 2000 to 42.6 billion in 2010, a four-fold increase. Excluded from this data set are 3.6 billion units of flavored, sweetened and enhanced non-carbonated water, of which 87% are packaged in PET.

Fruit beverage sales have remained roughly level over the past decade, with 15 billion units sold in 2010. "New age" beverages, however, have experienced steady sales growth: **ready-to-drink tea** sales rose from 4.8 billion in 2000 to 7.9 billion in 2010 (a 64% increase); and **sports drinks** sales more than doubled, to 5.4 billion in 2010. Finally, **energy drinks**—little more than a novelty in 2000 (163 million sold)—are almost neck-and-neck with sports drinks now, with 2010 sales of 4.2 billion.

Market Share by Container Type

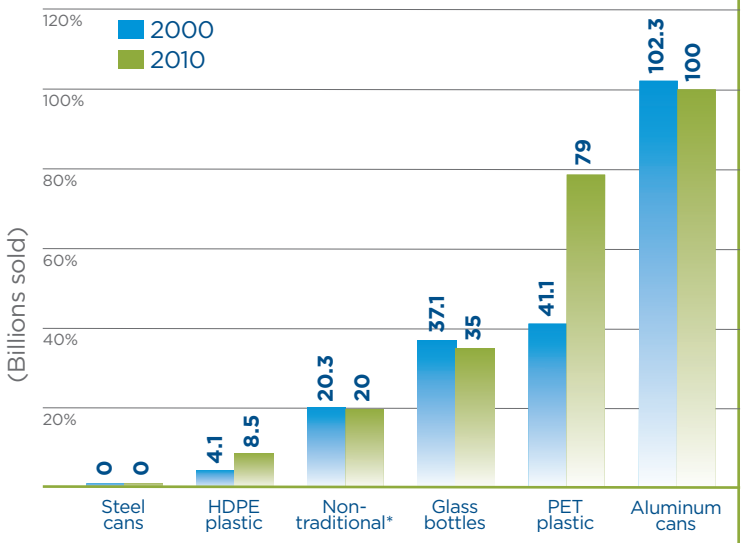
Of the 243 billion beverage containers sold in 2010, the vast majority (92%, or 222.6 billion units) were traditional bottles and cans: glass, metal and plastic. As Figure 5 shows, an estimated 41% (100 billion) were packaged in aluminum cans; 14% (35 billion) were sold in glass bottles; 33% (79 billion) were sold in PET plastic bottles; and 4% (8.5 billion) were sold in HDPE (high-density polyethylene) plastic bottles. Eight percent (20 billion) were sold in non-traditional packages: paper gable-top cartons, aseptic multi-material drink boxes, and foil pouches. Bi-metal (steel) cans and refillable glass bottles together comprise less than one half of 1% of the total beverage market.

Figure 5: Sales and Market Share by Container Type, 2010



As Figure 6 shows, sales growth of PET plastic bottles since 2000 dwarfs the changes in the other package types. Aluminum cans remain the largest single package type, holding strong due to beer sales, and to a slowing of the substitution of PET for aluminum cans in the carbonated soft drink market.

Figure 6: Container Sales by Material, 2000 and 2010



* Non-Traditional containers include aseptic boxes, gable-top cartons, and foil pouches.

Market Share by Beverage Type

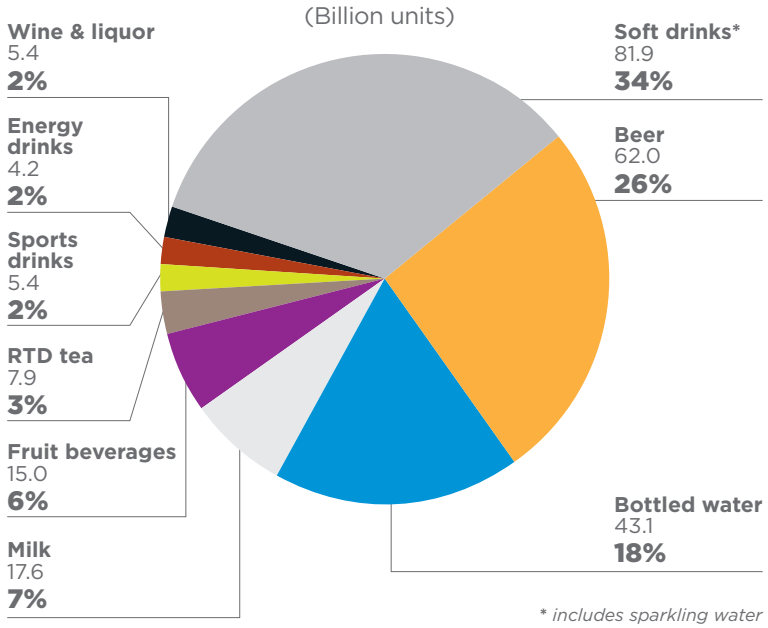
As Figure 7 reveals, of the 243 billion units sold in 2010, 59% (144 billion) contained carbonated beverages, down from 74% (151 billion) in 2000. Market shares by beverage type are:

- **Soft drinks:** both sales and market share are down since 2000. Annual sales have dropped by almost 9 billion units, while market share is down 10 points (from 43% to 34%).
- **Beer:** while total sales have grown by 3% since 2000 (from about 60 billion to 62 billion), in terms of market share, beer is down 4 percentage points: from about 30% to 26%.

All three beverages suffered market share losses to **non-carbonated beverages**. Total sales of non-carbonated beverages in all container types have nearly doubled: from 55.4 billion in 2000 (27% of the market) to 98.6 billion sold in 2010 (41% of the market). While substantially all non-carbonated beverages saw some increase, the explosion in packaged beverage growth is in bottled water. In 2010, sales of bottled water exceeded the combined sales of sports and energy drinks, juices and iced teas, and non-carbonated alcoholic beverages.

- **Bottled water** sales in sizes of 1 gallon and under went from 4% of the total market in 2000 (8.8 billion) to 18% of the market in 2010 (43.1 billion sold). Again, 3.6 billion units of flavored water are excluded from this data set.
- **Sports drinks** comprised 1% of the market in 2000 (2.5 billion sold). In 2010, sales were more than doubled: 2% of the market (5.4 billion).

Figure 7: Sales and Market Share by Beverage Type, 2010



** includes sparkling water*

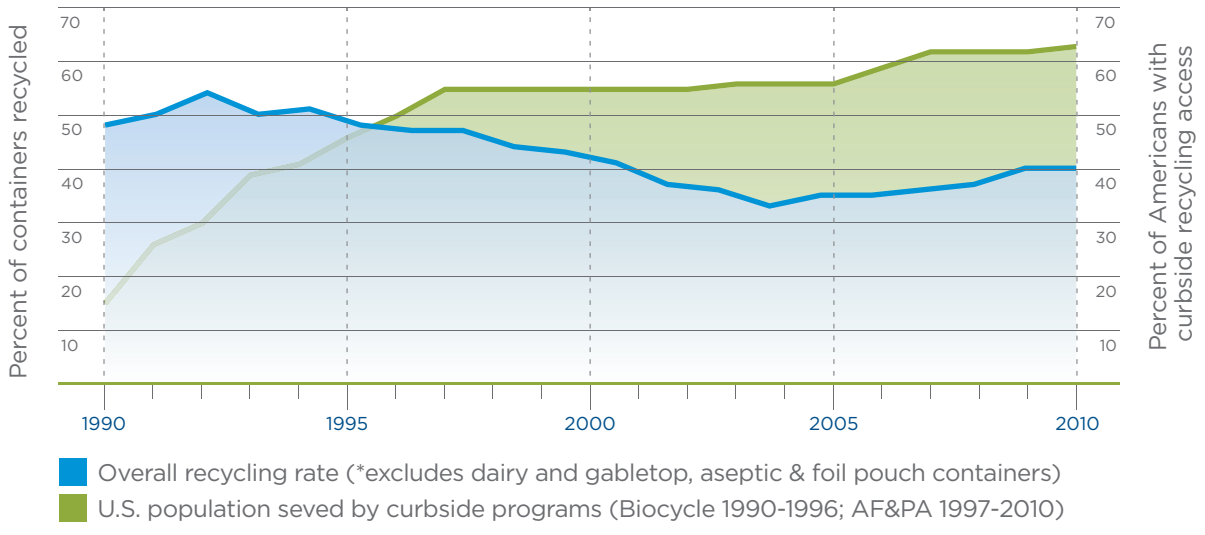
- **Fruit beverages** had a net sales decrease (15.6 billion sold in 2000, 15.0 billion in 2010), and also declined from 8% to 6% in total market share.
- **Ready-to-drink tea** saw sharp sales gains (4.8 billion in 2000, 7.9 billion in 2010), while its market share increased by one percentage point to 3%.
- **Energy drinks** had just been introduced on the scene in 2000, with sales of only 163 million units. By 2010 sales had reached 4.2 billion—putting energy drinks almost on a par with sports drinks, and comprising 2% of the total beverage market.
- **Wine & liquor** sales grew at a strong pace (4.4 billion in 2000, 5.4 billion in 2010), holding steady at 2% of the total beverage market.
- **Milk** sales were 17.6 billion sold in 2010, or 7% of the total beverage market.

Recycling and Wasting Trends, and Environmental Impacts

In 2010, Americans wasted (i.e., landfilled, incinerated or littered) almost two out of every three beverage bottles and cans sold (excluding milk and flexible packaging), as Figure 8 shows. The 39.6% bottle and can recycling rate for traditional beverage containers was nearly identical to the overall recycling rate of 39% in 2000, and down 14 percentage points from the all-time high of 54% in 1992. When non-traditional containers and milk are included, the overall recycling rate was 33% in 2000, and 36.8% in 2010.

From the late 1980s until the mid-1990s, the national recycling rate for all materials rose as various recycling programs were instituted. By the year 2000, there were almost 10,000 curbside collection programs across the United States[20]; the number has since plateaued as local budgetary pressures constrained the adoption of additional programs. The reliance on local fees or local property taxes to fund materials recovery has stagnated recycling infrastructure investments. **Even as access to curbside collection increased throughout the late 1990s, recycling rates for all three major beverage container materials began to decline, and have not recovered.** This decline is due in part to the increase in consumption of beverages away from home,

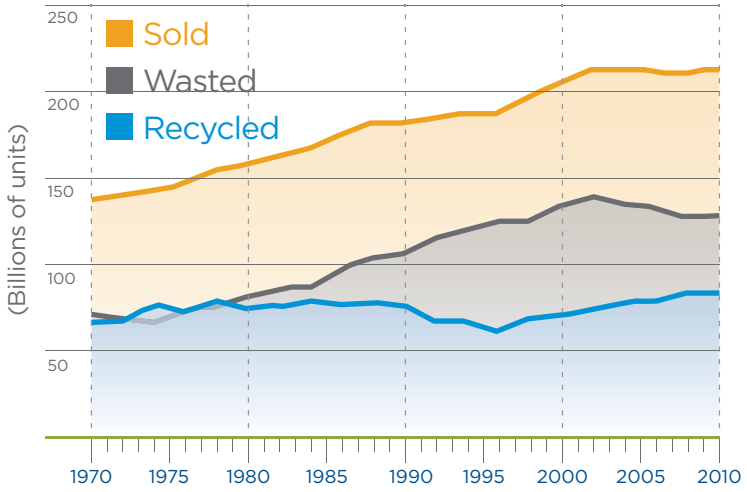
Figure 8: Comparing Curbside Recycling Access and Beverage Container Recycling Rates*, 1990–2010



and in public places where there are few available collection outlets for recycling. The drop in the recycling rate is also due to the shift away from aluminum to PET, which has a lower recycling rate.

Since 2000, there have been changes to the nation's container deposit laws that have also helped increase beverage container recycling rates. California's law was expanded in 2000 to include most non-carbonated beverages, and California's recycling rate has steadily increased for the last several years. Hawaii launched a new CDL in 2005, and Oregon, Connecticut and New York added bottled water to their laws in 2008 and 2009. All of these changes in laws have resulted in dramatically higher recycling rates for affected containers in those states.

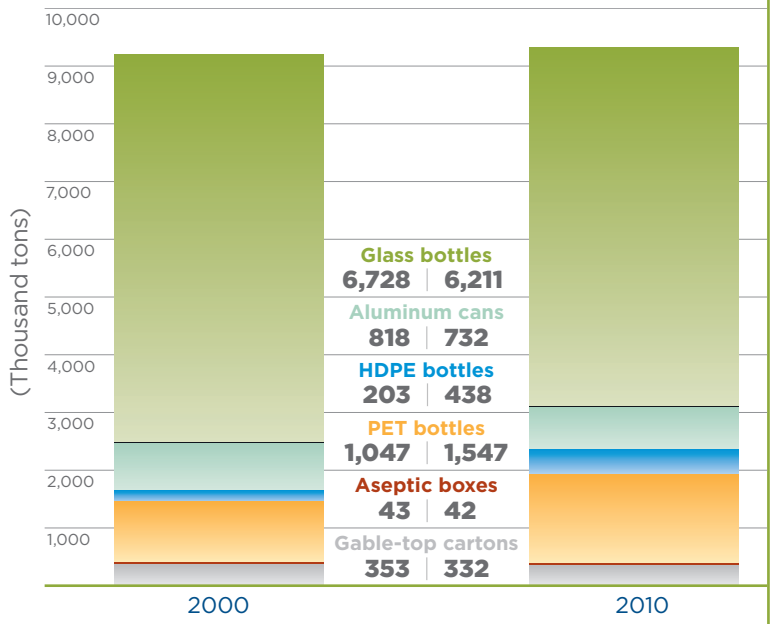
Figure 9: U.S. Beverage Sales, Recycling & Wasting, 1990–2010



Excludes aseptic boxes, gable-top cartons and foil pouches. Excludes wine coolers, champagne, sparkling wine, frozen fruit concentrates and milk.

In 2010, 153 billion of all 243 billion beverage packages sold were wasted in the United States, up from 137 billion wasted in 2000, and from approximately 85 billion wasted in 1990; this includes both traditional and non-traditional containers.[21] For 2010, this amounts to more than 9 million tons of aluminum, plastic, glass, paper and multi-material packaging wasted. (Tables B-1 and B-2, Appendix B) Similarly, of the 223 billion beverage packages sold in 2010 excluding milk and all non-traditional containers, 134 billion were wasted while only 88 billion were recycled. As Figure 9 illustrates, for traditional containers only, sales and wasting rates grew steadily between 1990-2010 while recycling rates remained flat. Figure 10 shows the tonnage of containers wasted in 2000 and 2010, by material.

Figure 10: Beverage Containers Wasted, 2000 and 2010



Milk is included. Steel can wasting is negligible.

But once again, the national overall figures do not tell the whole story. There are significant differences in recycling rates among packaging types, and recycling rates vary by collection method. The 11 U.S. states with container deposit laws in 2010 consistently recycled containers covered under their laws at rates of 66%-96% (Delaware deposit law was discontinued after 2010.) Although these states make up only 28% of the U.S. population, together they recycled 46% of the

> "The 11 U.S. states with container deposit laws in 2010 consistently recycled containers covered under their laws at rates of 66%-96%. Although these states make up only 28% of the U.S. population, together they recycled 46% of the containers that were recycled in 2010."

containers that were recycled in 2010. The remaining 39 states without deposit programs collectively recycled the remaining 54% of the bottles and cans–although these states comprised 72% of the U.S. population. By material, average 2010 recycling rates in non-deposit states were 39% for aluminum cans, 20% for PET plastic, 30% for HDPE, and 25% for glass bottles.

Among all the deposit states only three cover most non-carbonated beverages in their laws (California, Maine and Hawaii); three others have updated their CDLs to include water bottles (Oregon, New York and Connecticut). Recycling rates for non-carbonated drinks are consequently lower than the recycling rates for carbonated drinks (see Appendix A).

Per capita beverage container recycling, in terms of units of bottles and cans, also varies tremendously from state to state. The key factors that lead to high unit counts of beverage container recycling are:

- High per capita beverage container sales.
- High recycling rates.
- Container deposit laws that cover the majority of beverage container types.

As an example, in Figure 11, Maine has the highest per capita number of beverage containers recycled because its per capita beverage consumption is high, its container deposit law covers all beverage types, and its recycling rate is among the highest in the nation. Michigan, with the nation's highest beverage container recycling rate, at 97%, ranks lower in the per capita chart because the Michigan law covers only carbonated beverages, and therefore non-carbonated beverages are recycled at a much lower rate.

In addition to the tables and charts in this report, many more charts are available, on a state-by-state basis and for the U.S. as a whole, from the Container Recycling Institute. Each state's Excel data file contains 42 tables.[22]

Figure 11: Per Capita Containers Recycled in Deposit and Non-Deposit States – All Container Types, 2010

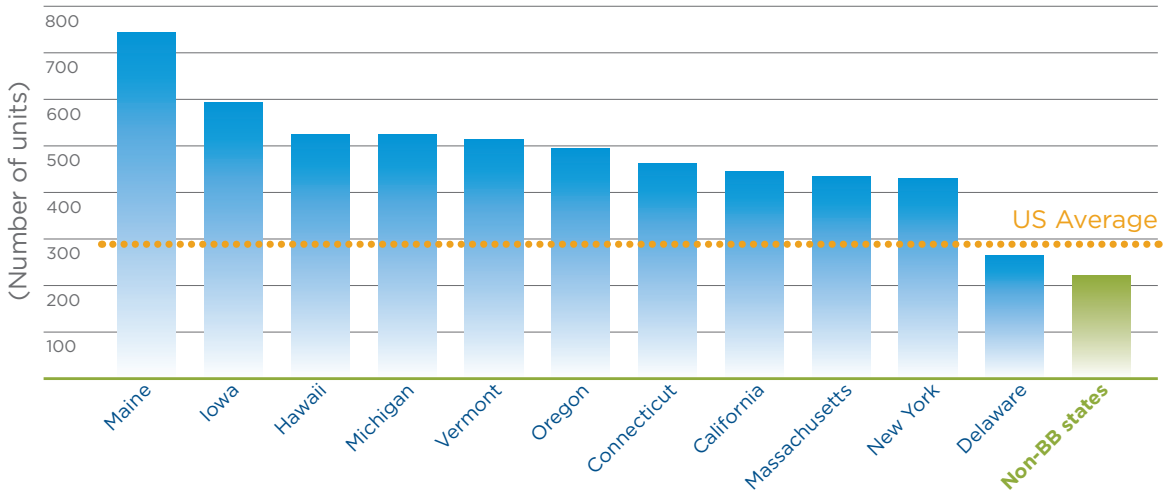
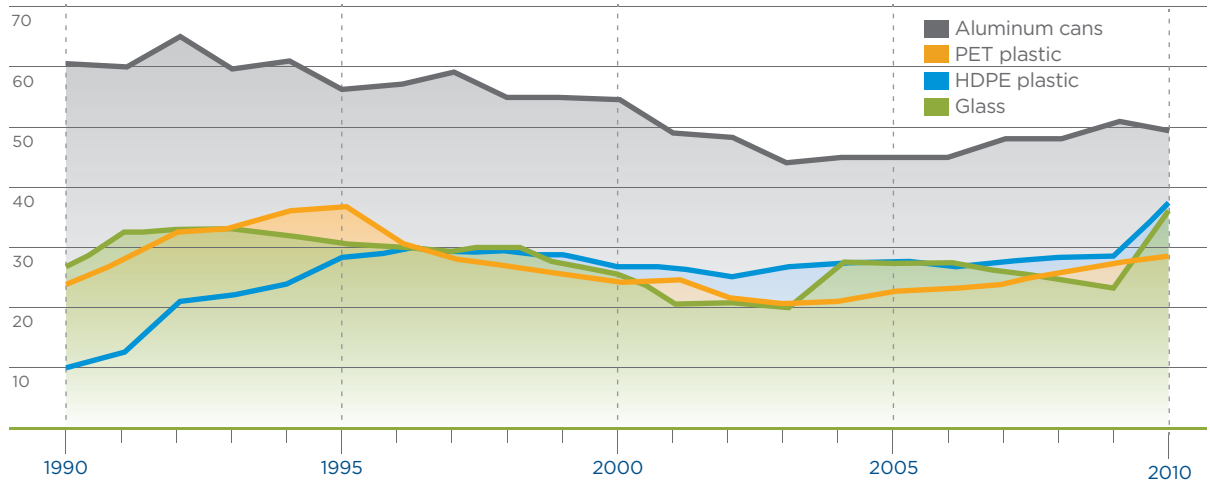


Figure 12: Recycling Rates for Aluminum, Plastic and Glass, 1990-2010



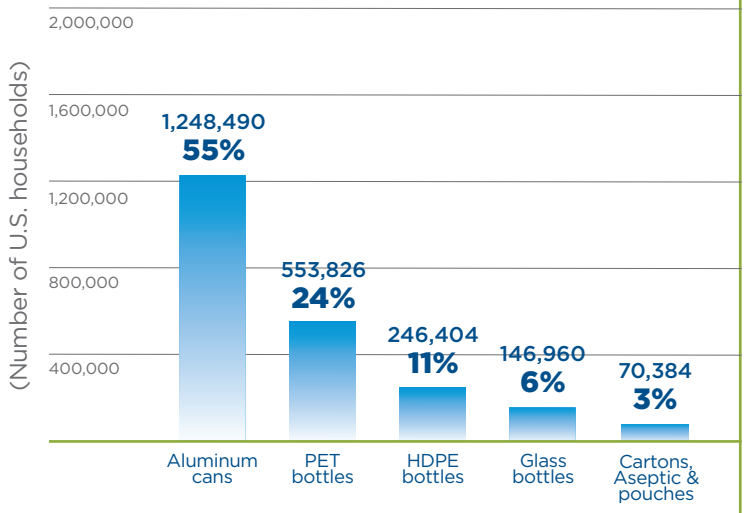
Excludes aseptic boxes, gable-top cartons and foil pouches. Excludes wine coolers, champagne, sparkling wine, frozen fruit concentrates and milk.

Energy and Greenhouse Gas Impacts of Failing to Recycle More Beverage Containers

Aluminum Cans are the most-recycled container type in the United States, with a 49.7% U.S. recycling rate in 2010 (Figure 12). This rate is down 5 percentage points from the 54.5% aluminum can recycling rate in 2000, and it is down 15 percentage points from the peak of 65% in 1992. Using redemption data reported by deposit states, CRI estimates that the average aluminum can recycling rate in the nation's 11 states with deposit systems in 2010 was 84%, and less than half that in the non-deposit states, at only 39%.

Figure 13: Energy Required to Replace Wasted Beverage Containers, 2010

(in U.S. household equivalents)



Assumes 89.6 MBtu per household per year. See further notes and sources in Appendix B.

Using electricity to process primary aluminum from bauxite ore is extremely energy-intensive, and also results in significant greenhouse gas emissions. When cans are recycled, a 95% energy savings is realized, while greenhouse gas emissions are dramatically reduced. In 2010, 724 thousand tons of aluminum cans were recycled nationwide, saving 111 trillion BTUs of energy: an amount equivalent to the total residential energy consumption of approximately 1.2 million American homes (Tables B-2 and B-3, Appendix B). This recycling also avoided the emission of 6.4 million metric tons of carbon dioxide equivalent ($MTCO_2E$) of greenhouse gases (Tables D-1 and D-2, Appendix D).

> When cans are recycled, a 95% energy savings is realized, while greenhouse gas emissions are dramatically reduced. In 2010, 724 thousand tons of aluminum cans were recycled nationwide, saving 111 trillion BTUs of energy: an amount equivalent to the total residential energy consumption of approximately 1.2 million American homes.

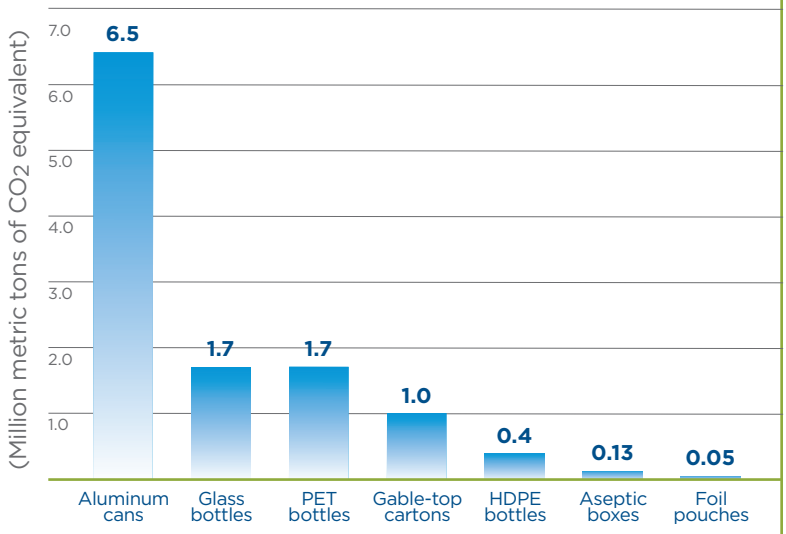
The other side of the coin is the environmental impact from wasting 50% of the cans sold. Had the 732 thousand tons of wasted aluminum cans been recovered and made into new cans, the energy saved by using recycled vs. virgin aluminum would have been equivalent to 112 trillion BTUs (Appendix B, Table B-4). This amount is sufficient to supply the total energy needs of 1.25 million American homes for a year (Figure 13 and Table B-3, Appendix B). Had these 732 thousand tons of cans been recycled, an estimated 6.5 million metric tons of carbon dioxide equivalent ($MTCO_2E$) in greenhouse gas emissions would have been avoided—which would be like taking 1.3 million cars off the road each year. For a comparison of annual greenhouse gas impacts of the different container materials, see Figure 14 and Table D-2, Appendix D.

PET Bottles had a reported 29.1% recycling rate in 2010 , compared to 24.8% in 2000. While this rate is up a few points over the 2006 rate, it is down from a peak of 37.3% in 1995. Using this national average, along with available deposit state data, CRI has estimated that the average PET recycling rate in the 11 deposit states in 2010 was 47.9% while the rate in the 39 non-deposit states was 19.9% (Appendix A). It is important to note that these recycling rates pertain only to the *collection* of PET bottles in recycling programs, not to their use in secondary production (to make new bottles, fiber, strapping, etc.). **Because a quarter of the weight of *collected* PET bottles consists of caps, labels, glue, base cups and other contaminants—and is therefore unusable as reclaimed PET feedstock—the actual *utilization rate* for PET bottles at the national level is actually only 20.8%.**

An estimated 647 thousand tons of PET beverage bottles were collected for recycling nationwide in 2010, saving the energy equivalent of 21 trillion BTUs (Tables B-2 and B-3, Appendix B), and avoiding almost three quarters of a million tons of greenhouse gas emissions ($MTCO_2E$) (Table D-1, Appendix D). More than 1.5 million tons of PET bottles were wasted, however. This is more than twice the tonnage of aluminum cans wasted—and it's up from one million tons of PET wasted in 2000. Recycling instead of wasting these PET bottles would have saved the energy equivalent of almost 50 trillion BTUs—an amount sufficient to supply the total energy needs of more than half a million American homes for a year (Table B-4, Appendix B). Had the 1.5 million tons of wasted PET bottles been recycled, an estimated 1.7 million tons of annual greenhouse gas emissions ($MTCO_2E$) would have been avoided—equivalent to taking more than 336 thousand cars off the road each year (Table D-2, Appendix D.)[24]

Figure 14: Greenhouse Gas Emissions from Replacing Wasted Containers, 2010

(million $MTCO_2E$)



See notes and sources in Appendix F.

HDPE Bottles were collected for recycling at a reported 29.9% rate nationwide in 2010[25]. This rate includes pigmented and natural resin, and beverage and non-beverage containers. An estimated 187 thousand tons of HDPE beverage bottles (including milk) were recycled in 2010, saving the energy equivalent of 9.4 trillion BTUs (Table B-3, Appendix B), and avoiding 161 thousand tons of greenhouse gas emissions ($MTCO_2E$) (Table D-1, Appendix D). Like PET, the national HDPE recycling rate includes non-HDPE material that cannot be recycled.

Yet, almost two and a half times as much HDPE was wasted: 438 thousand tons or 6 billion containers. Recycling these tons instead would have saved the energy equivalent of 22 trillion BTUs: an amount sufficient to supply the total energy needs of almost 250 thousand American homes for a year (Table B-4, Appendix B). Almost 400 thousand tons of greenhouse gas emissions ($MTCO_2E$) were associated with replacing wasted HDPE bottles and jugs with new ones (Table D-2, Appendix D).

"CRI has calculated that more than 6 million tons of glass were wasted in 2010—or 22 billion bottles—squandering the energy equivalent of about 13 trillion BTUs: enough to supply the needs of almost 150 thousand American homes for a year."

Glass Bottles were recycled at an average rate of 37% in 2010[26]. According to the U.S. EPA. 41% of beer and carbonated soft drinks bottles were recovered, and 25% of wine and liquor bottles were recovered, while 18% of "other" glass bottles and jars were recovered. This recycling saved the energy equivalent of 7.5 trillion BTUs (Table B-3, Appendix B), and avoided 1 million tons of greenhouse gas emissions ($MTCO_2E$) (Table D-1, Appendix D).

CRI has calculated that more than 6 million tons of glass were wasted in 2010—or 22 billion bottles—squandering the energy equivalent of about 13 trillion BTUs: enough to supply the needs of almost 150 thousand American homes for a year (Table B-4, Appendix B). For the last twenty-five years, glass bottle wasting has fluctuated between 6 and 7 million tons per year. About 1.7 million tons of greenhouse gases ($MTCO_2E$) are associated with replacing these wasted bottles annually (Table D-2, Appendix D).

Other, "Non-Traditional" Containers

In addition to the "traditional" bottles and cans discussed above (metal, glass and plastic), CRI estimated recycling rates and environmental impacts for cartons, drink boxes and pouches—the three most common types of so-called non-traditional beverage containers. In 2010, 20 billion of these containers were sold, but only 1.1 billion or 5.5% were recycled. According to available industry data, the recycling rates for paper gable-top cartons and paper-plastic laminated aseptic drink boxes—those historically used for milk, but now also common for fruit juices and other foods and beverages—was 6.5%. The paper recycling industry values the long, strong fibers in these packages, but the infrastructure to collect and process the used containers is still being developed throughout the country. As for foil pouches (laminates of plastic and aluminum), there is no U.S. infrastructure to recycle these containers. Various entities have made efforts to collect the pouches and reuse them in art projects (sewn into tote bags, for example), but these do not make an appreciable dent in the amount disposed, so the recycling rate is effectively zero.

Had the 18.9 billion non-traditional containers been recycled instead, they would have saved the energy equivalent of 7 trillion BTUs—enough to supply the needs of 70 thousand American homes for a year (Table B-4, Appendix B)—and avoided the emissions of 1.1 tons of annual greenhouse gases ($MTCO_2E$): equivalent to taking almost 240 thousand cars off the road each year (Table D-2, Appendix D).

Energy Impacts of Lightweighting and Recycling

Lightweighting is the process of improving container design and production techniques to enable manufacturers to produce more bottles and cans from a given amount of material resulting in reduced weight per container. Great strides have been made in the last 20 years in the lightweighting of beverage containers of all material types. For example, the weight of an average 2-liter PET bottle has dropped from 72.3 g (including an HDPE base cup) in 1972 to 53.8 g (without a base cup) in 1987[27] to 45.1 g in 2011.[28] Similarly, a 12-oz aluminum can has been cut from 20.4 g in 1972 to 15.3 g in 1992[29] down to 13.1 g in 2011.[30] And a 16-oz. glass bottle has seen a weight reduction of more than 50% since 1970.[31]

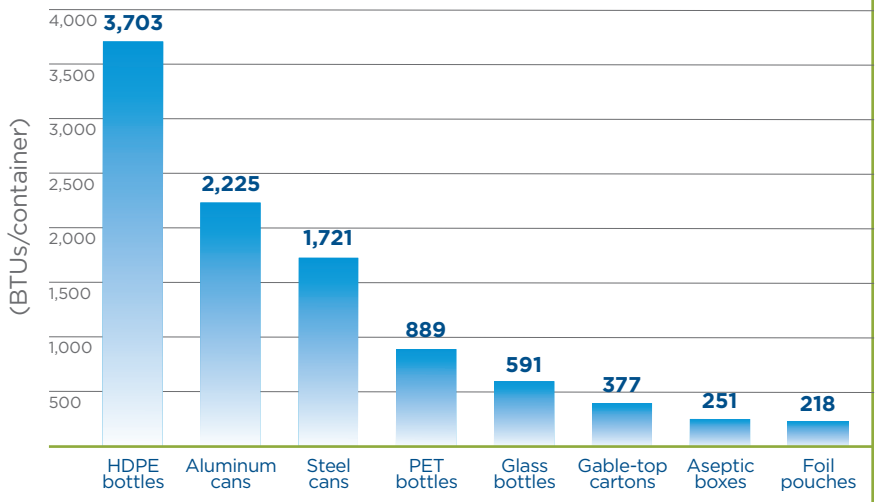
Although lightweighting gains have been made for all containers as a result of these technological efficiencies, these gains are overshadowed by huge increases in per capita consumption and total beverage sales (especially for bottled water and other new-age beverages like ready-to-drink tea, sports drinks and energy drinks) as well as stagnant or shrinking recycling rates. All of these factors lead to vastly more container material being wasted than ever before (Figure 9).

Almost 10 million tons of beverage containers were "wasted" (i.e., landfilled, incinerated or littered) in 2010. In replacing the 153 billion bottles and cans that were wasted with new containers made from virgin materials, the energy equivalent of 203 trillion BTUs were consumed, which is enough to meet the total residential energy needs of more than 2.3 million American homes, or more than the total number of occupied housing units and apartments in the cities of Los Angeles and Chicago combined (Table B-4, Appendix B). Almost 12 million tons of greenhouse gases (MTCO2E) were emitted in the process of replacing these 153 billion wasted bottles and cans with new ones: a quantity equivalent to the emissions generated by 2.3 million cars in one year (Table D-2, Appendix D).

Although glass dwarfs the other container materials in terms of *tons* wasted, it accounted for only 6% of the total energy impact of wasting beverage containers in the U.S. in 2010. Aluminum cans accounted for 55% of the total energy used to replace wasted containers. Wasted PET bottles accounted for 24% of the energy impacts, and HDPE bottles and jugs wasting accounted for 11% of the total energy impacts (Table B-4, Appendix B). Gable-top carton wasting accounted for 2% of the energy impacts, while the relative impacts of steel can, aseptic box and foil pouch wasting was negligible.

Aluminum can waste also accounted for 56% of the total greenhouse gas impacts of 2010 container wasting, compared to 15% for both PET and glass, 9% for paper cartons, and 3% for HDPE. The proportional impact of steel, aseptics and pouches was negligible (Table D-2, Appendix D).

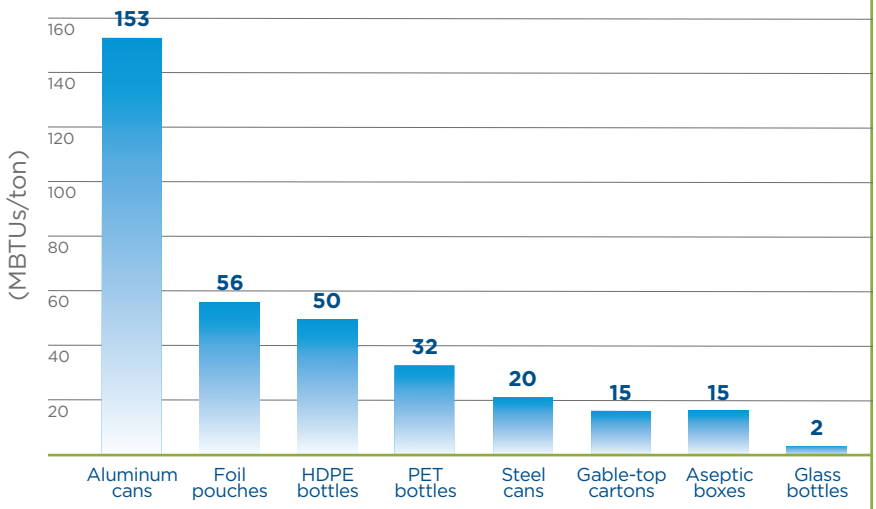
Figure 15: Comparative Energy Requirements for Replacing Wasted Beverage Containers



See notes and sources in Appendix B.

Although aluminum cans are the lightest of the container types,[33] they are also very energy-intensive to produce: a close second per container (just behind heavy HDPE jugs, Figure 15), and per ton (dwarfing all other material types, Figure 16).[34] **Since the energy required to produce aluminum from virgin resources is so high, and the recycling rate remains around 50%, aluminum beverage can wasting continues to exact a high environmental toll.** Much the same can be said for PET bottles: the benefits of producing a relatively lightweight container have been offset by skyrocketing sales, very low recycling rates, and high energy requirements.

Figure 16: Energy Required to Replace Beverage Containers, 2010



See notes and sources in Appendix B.

To realize meaningful energy savings and to reduce greenhouse gas emissions associated with beverage consumption, beverage container recycling must dramatically increase across the country. Assuming that American beverage consumption continues to follow current growth trends, and that the beverage industry maintains something close to its current packaging mix, including its marketing of single-serve packages, it is increasingly important to implement systems to recover and recycle beverage containers. Beverage sales are forecast to increase, which necessarily translates to increasing harmful environmental impacts, without dramatic increases in recycling.

Benefits from Implementing Deposit and Return Systems Across the United States

Since 1991, CRI has documented that container deposit legislation is the most effective form of recovering containers for recycling.[35] In 2010, 28% of the U.S. population lived in the nation's 11 deposit states where container recycling rates ranged between 66% and 96% for covered containers, compared to the 39.6% overall national average recycling rate. Without these 11 deposit programs, the overall container recycling rate for 2010 might have been as low as 15%-20% for PET, HDPE and glass, and 35%-40% for aluminum cans.

CRI has estimated that if a very modest 5-cent deposit were placed on all carbonated and non-carbonated beverages[36] throughout the United States, a 75% recycling rate would be achieved across the board. If the deposit were 10 cents or higher, 80%-90% recycling rates would be achieved.

> "CRI has estimated that if a very modest five-cent deposit were placed on all carbonated and non-carbonated beverages throughout the United States, a 75% recycling rate would be achieved across the board."

With a hypothetical national CDL in place with a nickel deposit, achieving a 75% recycling rate across the board for virtually all containers and all beverage types, significant energy savings and greenhouse gas emissions reductions could be realized. Assuming recycling rates of 75% for bottles and cans, 69% for cartons, 60% for aseptic boxes, and 50% for pouches (as is currently achieved in British Columbia, Canada), the additional quantities of material recovered (over and above containers recovered in 2010) would be as follows:

- Aluminum: 368 thousand tons
- Steel: 264 tons
- PET: 1 million tons
- HDPE: 282 thousand tons
- Glass: 3.8 million tons
- Gable-top cartons: 222 thousand tons
- Aseptic boxes: 24 thousand tons
- Foil pouches: 6 thousand tons

Combined, the 5.7 million tons of *additional recycling* resulting from a nationwide nickel deposit would save the energy equivalent of more than 114 trillion BTUs—an amount equivalent to the annual residential energy consumption of 1.3 million American homes. Increased recycling of aluminum, PET and HDPE would account for 49%, 28% and 12% of the total energy savings, respectively (Table C-4, Appendix C).

This additional recycling would also prevent an estimated 6.5 million tons ($MTCO_2E$) of annual greenhouse gas emissions that now result from replacing wasted containers with brand new containers made from virgin materials—an amount equivalent to taking about 1.3 million cars off the road each year (Table E-2, Appendix E).

A national CDL would support nearly 90,000 jobs in beverage container recycling. Container deposit-return creates more jobs than other forms of recycling in all stages of collection, processing and manufacturing. The higher quality and higher quantity of recyclables collected translates to more jobs in the manufacturing sector and fewer recyclables being shipped overseas for processing, as documented in CRI's 2011 study, "Returning to Work: Understanding the Domestic Jobs Impacts from Different Methods of Recycling Beverage Containers."

Historically, litter reduction was a primary reason for implementation of deposit-return programs: container deposit systems can cut beverage container litter in half, as documented by the Great Lakes Alliance, and as shown in data from Hawaii, Canada and Australia. In recent years, concern about the impacts of litter on waterways and aquatic life has been especially pronounced. Underwater cleanups show that beverage container litter makes up approximately 20% of marine debris (on a unit basis.) More recently, stormwater cleanup costs and preventative measures to keep bottles and other litter from floating into waterways are revealing higher costs being borne by municipalities and states.[37]

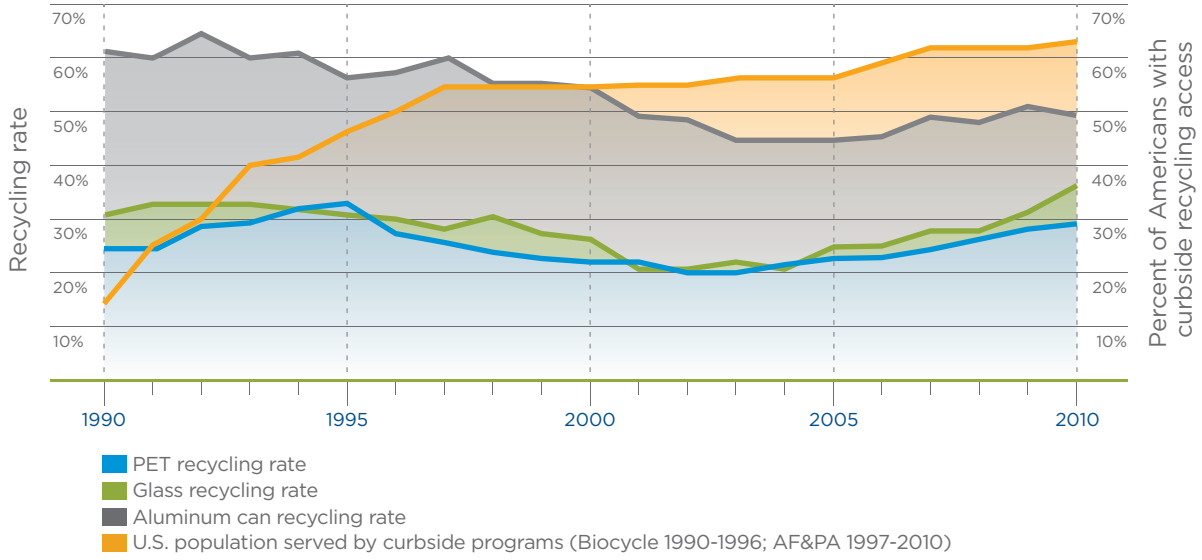
Obstacles to Creating Container Deposit-Return Systems

Deposit legislation has the added benefit of transferring the cost of end-of-life container management (i.e., recycling or landfilling/incineration) from taxpayers and ratepayers in cities and towns to the producers and consumers of these beverages. Since 1971 when Oregon enacted the nation's first container deposit law, the 11 deposit states have saved billions of dollars in the avoided costs of collecting, transporting and recycling the ***2 trillion*** bottles and cans that have been recovered through container deposit programs. Deposit programs also reduce litter, because there is a financial incentive to save or collect bottles and cans consumed away from home.

One might wonder, with all of these benefits, why have only 11 states passed container deposit legislation? The answer lies in the beverage industry's longstanding opposition to CDLs. Since anti-litter activists began organizing the beverage and grocery industries have spent millions of dollars lobbying against these laws. This continues today. In the state of New York alone, NYPIRG found that their CDL campaign's beverage industry opponents contributed more than $1.2 million dollars to state legislators, state political parties and statewide officeholders between 2002 and 2003.[38] In 2005, Common Cause Connecticut pointed to $700,000 in campaign contributions by beverage industry opponents that year to successfully (if temporarily) halt the expansion of that state's container deposit law.[39]

Beverage industry lobbyists claim that voluntary curbside recycling programs—and scattered drop-off and public-space recycling programs—recycle more effectively than deposit programs, but the evidence does not support this. From 1990 to 2000, the number of curbside recycling programs more than tripled in the United States, and went from serving 15% to 49% of the U.S. population.[40] Despite this tremendous increase in access, and the public education that accompanied it, recycling rates for beverage container materials dropped during this same period: aluminum can recycling went from a high of 65% in 1992 to 49.7% in 2010 and PET bottle recycling went from 37% in 1995 to 29.1% in 2010[41] (see Figure 17).

Figure 17: Comparing Curbside Recycling Access and Beverage Container Recycling Rates*, 1990–2010



Disadvantages of Single-Stream Curbside Programs for Beverage Container Recycling

Despite the alarming lack of supporting data, the beverage industry still clings to the ideology that curbside—and in recent years, single-stream curbside (where all recyclables are commingled in one cart)—is more effective and economical for beverage container recycling than deposits. In a 2009 report, CRI found that single-stream recycling was both more expensive overall—due to the extensive sorting that materials recovery facilities (MRFs) are forced to undertake—and produces lower quality material due to the higher rates of contamination and residue.[42] The net effect is lower quality recyclables, and considerably lower recycling rates. For example, the report found that only 60% of single-stream curbside glass was recycled into new glass bottles or even fiberglass, while 40% was "downcycled" into lower-value sandblasting base, roadbed aggregate, or landfill cover. In comparison, 98% of deposit glass can be made into new bottles. The effect is similar for PET. According to NAPCOR's 2011 report, curbside PET has a 65% yield rate, in contrast to a 75% yield rate for deposit PET bottles.

Not only do single-stream curbside programs produce a lower quality and quantity of material, but they also place the financial burden for recycling on cash-strapped municipalities with many other programmatic priorities, rather than on the beverage producers and consumers. Producer responsibility was standard practice 40 years ago, when the average American consumed 250-300 containers per year and many containers were returned to be refilled (about 50 billion units were sold in 1970). Recycling costs represent a much larger burden today, with 310 million people consuming 800 non-refillable containers per year. An estimated 250 billion beverage packages will be sold in 2013, a five-fold increase from 1970. Deposit programs relieve municipalities of this collection burden. An early example of "extended producer responsibility," deposit programs are more relevant today than ever. In 2012-2013, there were proposals for new or expanded deposit programs in 14 states across the country. *For a primer on extended producer responsibility, see CRI's website* ***http://www.container-recycling.org/index.php/issues/extended-producer-responsibility****, and for the latest information on deposit-related legislative efforts in various states, see CRI's companion website* ***www.bottlebill.org****.*

Methodology

The report methodology is described in a separate document titled "Methodological Brief," which is available on the Container Recycling Institute's website, www.container-recycling.org. The report calculations were created using data purchased or obtained from more than two dozen sources, including the Beverage Marketing Corporation, the Wine Institute, the Beer Institute, the Distilled Spirits Council of the U.S., the Aluminum Association, Can Manufacturers Institute, the Glass Packaging Institute, the National Association for PET Container Resources (NAPCOR), the Association of Post-consumer Plastics Recyclers (APR), the U.S. Environmental Protection Agency (EPA), the Energy Information Administration of the U.S. Department of Energy, the Census Bureau of the U.S. Department of Commerce, the American Chemistry Council, Verallia, and the Carton Council, as well as previous CRI research and publications. We also obtained beverage sales and/or recycling rate data from state agencies in California, Connecticut, Delaware, Hawaii, Iowa, Maine, Massachusetts, Michigan, New York, Oregon and Vermont. For consistency's sake, we used national recycling rates as reported by the EPA for glass and aluminum beverage containers. Through our research, we have found that the EPA's reported aluminum recycling rate is likely correct, or very nearly so. However, we have

found that the EPA's PET and HDPE recycling rates are overstated, while our research on the glass recycling rate is inconclusive, due to the lack of transparency in the EPA's explanation of the glass recycling rate calculation methodology. We have submitted written comments to the EPA regarding potential improvements to the recycling rate calculations for each of these material types.

> "In 2010, 732 thousand tons of aluminum cans, 2 million tons of plastic bottles, more than 6 million tons of glass bottles, and almost 400 thousand tons of carton and pouches were landfilled, incinerated or littered."

Conclusions

Americans' thirst for single-serve beverages appears to be unquenched, as sales growth has steadily increased over the past four decades. In recent years, packaged beverage sales rose from 205 billion units in 2000 to 243 billion in 2010. The widespread popularity of bottled water beginning in the mid-1990s has contributed most to rising per capita and total sales. While this sales growth has been underway, the overall national container recycling rate declined from a peak of 54% in 1992, to 36.9% in 2010. Together, these trends have contributed to the unabated waste of energy-intensive aluminum, plastic and glass. In 2010, 732 thousand tons of aluminum cans, 2 million tons of plastic bottles, more than 6 million tons of glass bottles, and almost 400 thousand tons of cartons and pouches were landfilled, incinerated or littered.

The failure to recycle nearly two out of every three containers sold in the United States has monumental environmental impacts, because bottles, cans and non-traditional beverage containers that are landfilled, incinerated or littered must be replaced with new containers made from virgin materials whose extraction and processing require more energy—and generate more pollutants—than making containers from recycled material. Replacing the 153 billion containers wasted in 2010 (more than 9 million tons of wasted material) with new containers made from virgin materials required the energy equivalent of more than 200 trillion BTUs, and generated about 12 million tons of greenhouse gas emissions ($MTCO_2E$).

Were a modest 5-cent container deposit adopted across the United States, the overall recycling rate would likely increase from 36.9% to at least 75%, resulting in the additional recycling of more than five-and-a-half million tons of bottles, cans, cartons and other containers. A national deposit system would also shift the burden of paying to recycle ever-increasing quantities of discarded containers away from the municipal taxpayers and ratepayers, and onto beverage producers and consumers. Moreover, an additional 114 trillion BTUs of energy would be saved and an additional 6.5 million tons of GHG would be avoided, over and above what's currently being achieved by existing recycling efforts. This additional recycling would have the same impact as taking some 1.3 million cars off the road each year, and saving the annual energy needs of 1.3 million American homes.

And finally there are many quantifiable but just as important benefits of increased container recycling: the cleaner roadways, the healthier waterways, the growth in local jobs and green businesses and the satisfaction that we are doing what's right not only for the planet but for future generations.

Appendix A.
Recycling Rates by Class

2010 Recycling Rates in the United States

	Beverage/ Package	Aluminum cans	Steel cans	PET bottles	HDPE bottles	Glass bottles	Total, Bottles & Cans
11 Deposit states	Carbonated	86.7%	67.1%	77.2%	65.6%	83.6%	**84.5%**
	Non-carbonated	70.7%	67.1%	49.9%	54.3%	50.5%	**52.0%**
	Average	85.2%	67.1%	55.7%	54.3%	74.6%	**70.2%**
39 Non-deposit states	Carbonated	38.3%	67.1%	16.1%	20.2%	21.4%	**27.6%**
	Non-carbonated	38.3%	67.1%	16.1%	20.2%	21.4%	**27.6%**
	Average	38.3%	67.1%	16.1%	20.2%	21.4%	**27.6%**
U.S. Total/Average	Carbonated	49.8%	67.1%	30.4%	38.0%	38.6%	**41.5%**
	Non-carbonated	49.0%	67.1%	28.5%	29.9%	31.3%	**36.2%**
	Average	49.7%	67.1%	29.1%	29.9%	36.9%	**39.6%**

Methodology: To derive recycling rates for carbonated and non-carbonated beverages in the two classes of states (those with and without container deposit laws), CRI used sales as derived in this report, reported national recycling rates for the beverage container types as described below, national and state population data, and reported and estimated recycling rates in the 11 states with deposit systems in 2010. We also assumed that recycling rates for containers that were not covered by deposit programs (regardless of the state's deposit status) were the same within each container category in every state nationwide, as there are no sources of state-by-state beverage container recycling rates.

Reported state recycling data: California and Hawaii are the only states to report recycling data by container type. For CA, however, we used reported redemption numbers (in units) instead of reported recycling rates (in percentages). Massachusetts, New York and Connecticut reported overall recycling rates (not broken down by container type). For MA and CT, CRI assumed that the same rates applied for all covered materials, and we added 10% to the reported rates to account for estimated collection through curbside recycling programs (not included in deposit return data). For NY, our calculation was similar to that for MA, but we also used redemption data by beverage type that was available from 2009. For Oregon, we used 2007 reported data that concurred with 2012 estimates obtained through personal communication with the OR Dept. of Environmental Quality; 10% was added to account for curbside. Michigan data was obtained from the MI Dept. of the Treasury. Iowa estimates were obtained through personal communication with the IA Dept. of Natural Resources, and Maine estimates were obtained from public testimony of the Maine Beverage Association. Vermont estimates were obtained through personal communication with the VT Department of Environmental Conservation. CRI estimated rates for Delaware.

Aluminum cans: The 2010 nationwide recycling rate reported by the Aluminum Association was 58.1%. This rate includes 9 billion imported scrap cans: beverage cans that were not consumed in the United States. Using the standard method for computing recycling rates used by the U.S. Environmental Protection Agency, and using export and import data from the U.S. Department of Commerce for new and scrap cans, CRI adjusts Aluminum Association data, thus deriving an overall 49.7% recycling rate.

Steel cans: In the BMDA, CRI used the Steel Recycling Institute's 67.1% recycling rate for all beverages, in all states, regardless of what was reported by state agencies. Only 0.02% of the total beverage market is packaged in steel, and there are virtually no carbonated beverages packaged in steel anymore.

PET bottles: The National Association for PET Container Resources, together with the Association of Postconsumer Plastic Recyclers, reported a U.S. PET recycling rate of 29.1% in 2010. It is important to note that this is a "recovery rate," based on PET collection. Because of contamination of the recycling stream, the actual "utilization rate" for PET was 20.8% in 2010.

HDPE bottles and jugs: The American Chemistry Council reported a U.S. HDPE recycling rate of 29.9% in 2010.

Glass bottles: CRI used the national glass recycling rates as reported by the U.S. EPA's Office of Solid Waste. They reported that the 2010 recovery rate for beer and soft drink bottles was 41.4%, that the rate for wine and liquor bottles was 24.7%, and that the rate for other bottles and jars was 18.1%. CRI used this information, in combination with sales data from the Beverage Marketing Corporation, to derive an overall glass beverage container recycling rate of 36.9%.

Gable-top cartons & aseptic drink boxes: The U.S. EPA's Office of Solid Waste estimated that 6.5% of cartons & drink boxes were recycled in 2009, and this figure was used for 2010 as well, because the U.S. EPA did not provide an estimate for 2010.

Foil pouches: there is no data available on pouch recycling in the United States. It is presumed to be zero.

Appendix B.

Energy Impacts of Existing Recycling and Wasting (2010)

Table B-1. Beverage Container Sales, Recycling and Wasting in the U.S., 2010
(billion units)

	Aluminum cans	Steel cans	PET bottles	HDPE bottles	Glass bottles	Gable-top cartons	Aseptic boxes	Foil pouches	Total
Sold	100.0	0.0	79.0	8.5	35.0	14.2	2.7	3.1	**243**
Recycling rate	49.7%	67.1%	29.1%	29.9%	36.9%	6.5%	6.5%	0.0%	**36.8%**
Recycled	49.7	0.0	23.0	2.5	12.9	0.9	0.2	0.0	**89**
Wasted	50.3	0.0	56.0	6.0	22.1	13.3	2.5	3.1	**153**

Source: "2010 Beverage Market Data Analysis," The Container Recycling Institute, 2013. Sales are derived from: "Beverage Packaging in the U.S., 2011 Edition," Beverage Marketing Corporation (BMC), Dec. 2011; with additional data from BMC, the Beer Institute, the Wine Institute, and the Distilled Spirits Council. Data excludes wine coolers, champagne, sparkling wine, frozen fruit concentrates and non-dairy "milk" beverages. See Appendix C for notes on sources for U.S. average recycling rates. Wasting is sales minus recycling.

Table B-2. Beverage Container Sales, Recycling, and Wasting in the U.S., 2010
(thousand tons) (a)

	Aluminum cans	Steel cans	PET bottles	HDPE bottles	Glass bottles	Gable-top cartons	Aseptic boxes	Foil pouches	Total
Sold	1,456	3	2,189	626	9,753	354.9	45.4	12.0	**14,439**
Recycled	724	2	641	187	3,542	23.1	3.0	0.0	**5,123**
Wasted	732	1	1,547	438	6,211	331.8	42.4	12.0	**9,316**

(a) Container weights used in derivations are as follows (in units per ton): aluminum (all): 68,660; steel (all): 11,600; PET soda, beer, sparkling water, sports, tea, energy, wine: 26,462; PET bottled water: 66,154; PET fruit beverages, milk: 15,379; HDPE (all): 13,600; glass CSD, beer, sparkling & bottled water, fruit, tea; glass wine, milk: 1,882; glass spirits: 3,200; gable-top cartons (all): 40,000; aseptic boxes (all): 60,000; foil pouches (all): 256,000. Sources for container weights: Aluminum Association, NAPCOR, CalRecycle, Verallia/Saint-Gobain, CRI estimates.

Table B-3. Energy Saved by Recycling in 2010 ("Existing Recycling")*

	Aluminum cans	Steel cans	PET bottles	HDPE bottles	Glass bottles	Gable-top cartons	Aseptic boxes	Foil pouches	Total
MBTU per ton (b)	152.8	20.0	32.1	50.4	2.1	15.1	15.1	55.7	n/a
Energy saved through recycling in 2010 (trillion BTU)	110.6	0.0	20.6	9.4	7.5	0.3	0.0	0.0	**148.6**
Equivalent # of households' annual energy use (c)	1,234,471	499	229,571	105,342	83,802	3,880	496	0	**1,658,061**

* When a container is wasted—or landfilled—it must be "replaced" with a new container made from 100% virgin materials. The amount saved through recycling is the difference between the amount of energy required to produce containers from 100% virgin materials and the amount required to produce containers from 100% recycled materials.

(b) Source: Exhibit 7 in the "Energy Impacts" chapter of the U.S. EPA's Waste Reduction Model (WARM) version 12. U.S. Environmental Protection Agency, February 2012.

(c) Average residential energy consumption in 2009: 89.6 (MBTU/household).

Source of average residential energy consumption: "Table CE1.1 Summary Household Site Consumption and Expenditures in the U.S. – Totals and Intensities, 2009," U.S. Energy Information Administration, Dec., 2012.

Table B-4. Energy Required to "Replace" Wasted Containers* in 2010

	Aluminum cans	Steel cans	PET bottles	HDPE bottles	Glass bottles	Gable-top cartons	Aseptic boxes	Foil pouches	Total
Containers produced per ton of material (average)	68,660	11,600	36,091	13,600	3,588	40,000	60,000	256,000	n/a
MBTU per ton (b)	152.8	20.0	32.1	50.4	2.1	15.1	15.1	55.7	n/a
BTU/container (weighted average)	2,225	1,721	889	3,703	591	377	251	218	n/a
Energy required to replace wasted containers (trillion BTU)	112	0.0	50	22	13	5	1	1	**203**
Equivalent # of households' annual energy use (c)	1,248,490	245	553,826	246,404	146,960	55,808	7,138	7,437	**2,266,308**
Proportion of total energy impact from 2010 wasting	55%	0%	24%	11%	6%	2%	0%	0%	**100%**

(b and c) See notes and sources in Table B-3 above.

Appendix C.

Energy Savings from Additional Recycling with a National Deposit System

Table C-1. Hypothetical Recycling and Wasting* With National Deposit System (Using 2010 Sales Figures)

(billion units)

	Aluminum cans	Steel cans	PET bottles	HDPE bottles	Glass bottles	Gable-top cartons	Aseptic boxes	Foil pouches	Total
Sold	100.0	0.0	79.0	8.5	35.0	14.2	2.7	3.1	**242.5**
Recycling rate	75%	75%	75%	75%	75%	69%	60%	50%	n/a
Recycled	75.0	0.0	59.2	6.4	26.2	9.8	1.6	1.5	**179.9**
Wasted	25.0	0.0	19.7	2.1	8.7	4.4	1.1	1.5	**62.7**

Source: "2010 Beverage Market Data Analysis," The Container Recycling Institute, 2013. Sales are derived from: "Beverage Packaging in the U.S., 2011 Edition," Beverage Marketing Corporation (BMC), Dec. 2011; with additional data from BMC, the Beer Institute, the Wine Institute, and the Distilled Spirits Council. Data excludes wine coolers, champagne, sparkling wine, frozen fruit concentrates and non-dairy "milk" beverages.

* Hypothetical recycling and wasting quantities are based on what would be recycled and wasted—hypothetically—if there were a national container deposit system with a 5¢ deposit on all beverages. Hypothetical recycling rates of 75% are used for bottles and cans; recycling rates for flexible containers are based on current achievements in British Columbia. Wasting is sales minus recycling.

Table C-2. Hypothetical Recycling and Wasting* With National Deposit System (Using 2010 Sales Figures)

(thousand tons) (a)

	Aluminum cans	Steel cans	PET bottles	HDPE bottles	Glass bottles	Gable-top cartons	Aseptic boxes	Foil pouches	Total
Sold	1,456	3	2,189	626	9,753	355	45	12	**14,439**
Recycled	1,092	3	1,642	469	7,315	245	27	6	**10,798**
Wasted	364	1	547	156	2,438	110	18	6	**3,641**

(a) For notes on sources of container weights, see (a) in Table B-2.

* Hypothetical recycling and wasting: see notes in Table C-1.

Table C-3. Hypothetical Energy Savings With a National Container Deposit System*

	Aluminum cans	Steel cans	PET bottles	HDPE bottles	Glass bottles	Gable-top cartons	Aseptic boxes	Foil pouches	Total
MBTU per ton (b)	152.8	20.0	32.1	50.4	2.1	15.1	15.1	55.7	n/a
Hypothetical energy savings* (trillion BTU)	166.9	0.0	52.6	23.6	15.5	3.7	0.4	0.3	**263.1**
Equivalent # of households' annual energy use (c)	1,862,221	557	587,544	263,809	173,072	41,185	4,581	3,719	**2,936,687**

* Hypothetical energy savings are those achieveable through the recycling rates noted in Table E-1.

(b) Source: Exhibit 7 in the "Energy Impacts" chapter of the U.S. EPA's Waste Reduction Model (WARM) version 12, Feb. 2012.

(c) Average residential energy consumption in 2009: 89.6 (MBTU/household).

(c) "Table CE1.1 Summary Household Site Consumption and Expenditures in the U.S. – Totals and Intensities, 2009," U.S. Energy Information Administration, Dec., 2012.

Table C-4. Additional Tons Recovered (000) and Energy Saved With a National Container Deposit System*

	Aluminum cans	Steel cans	PET bottles	HDPE bottles	Glass bottles	Gable-top cartons	Aseptic boxes	Foil pouches	Total
Additional tonnage recovered (=Table E-2 minus Table D-2)	368.2	0.3	1,000.1	281.9	3,772.9	221.8	24.3	6.0	**5,676**
Additional energy saved* over & above existing savings (trillion BTU)	56.2	0.0	32.1	14.2	8.0	3.3	0.4	0.3	**114.6**
Equivalent # of households' annual energy use (d)	627,750	59	357,973	158,467	89,269	37,305	4,084	3,719	**1,278,626**
Proportion of total additional savings	49%	0%	28%	12%	7%	3%	0%	0%	**100%**

* "Additional" Energy Savings is the difference between existing energy savings (see Table B-3) and hypothetical energy savings (Table C-3) under a national container deposit system achieving the recycling rates noted in Table E-1.

(d) Average residential energy consumption in 2009: 89.6 (MBTU/household).

Appendix D.

Greenhouse Gas Emissions From Existing Recycling and Wasting (2010)

Table D-1. Greenhouse Gas Emissions Avoided* by Recycling in 2010 ("Existing Recycling")

	Aluminum cans	Steel cans	PET bottles	HDPE bottles	Glass bottles	Gable-top cartons	Aseptic boxes	Foil pouches	Total
Metric tons of CO_2 equivalent ($MTCO_2E$) per ton (b)	8.9	1.8	1.1	0.9	0.3	3.1	3.1	4.0	n/a
Thousand tons recycled in 2010	724	2	641	187	3,542	23	3	0	**5,123**
Greenhouse gases avoided through recycling (million $MTCO_2E$)	6.4	0.0	0.7	0.161	1.0	0.1	0.0	0.0	**8.4**

* When a container is wasted—or landfilled—it must be "replaced" with a new container made from 100% virgin materials. The amount of greenhouse gases avoided through recycling is the difference in emissions from producing containers with 100% virgin materials versus 100% recycled materials.

(b) Source: column f, Exhibit 2 in the "Recycling" chapter of the U.S. EPA's Waste Reduction Model (WARM) version 12, Feb. 2012.

Table D-2. Greenhouse Gases Emitted From "Replacing" Wasted Containers*

	Aluminum cans	Steel cans	PET bottles	HDPE bottles	Glass bottles	Gable-top cartons	Aseptic boxes	Foil pouches	Total
Metric tons of CO_2 equivalent ($MTCO_2E$) per ton (b)	8.9	1.8	1.1	0.9	0.3	3.1	3.1	4.0	n/a
Tons of material wasted in 2010	732	1	1,547	438	6,211	332	42	12	**9,316**
Greenhouse gas emissions due to wasting (million $MTCO_2E$)	6.5	0.0	1.7	0	1.7	1.0	0.1	0.0	**11.6**
# of cars' equivalent emissions (c)	1,276,483	387	336,771	73,926	341,004	202,341	25,880	9,273	**2,266,065**
Proportion of total greenhouse gas impact	56%	0%	15%	3%	15%	9%	1%	0%	**100%**

* When a container is wasted—or landfilled—it must be "replaced" with a new container made from 100% virgin materials. The amount of greenhouse gases emitted through "replacement" production is the difference in emissions from producing containers with 100% virgin materials vs. 100% recycled materials.

(b) See note b in Table D-1 above.

(c) Emissions from 1 passenger car: 5.1 $MTCO_2E$ per year.

Source: "Greenhouse Gas Emissions from a Typical Passenger Vehicle," Office of Transportation and Air Quality. EPA-420-F-11-041, Dec. 2011.

Appendix E.

Avoided Greenhouse Gas Emissions From Additional Recycling With a National Deposit System

Table E-1. Hypothetical Greenhouse Gas Emissions Avoided With a National Container Deposit System*

	Aluminum cans	Steel cans	PET bottles	HDPE bottles	Glass bottles	Gable-top cartons	Aseptic boxes	Foil pouches	Total
Metric tons of CO_2 equivalent ($MTCO_2E$) per ton (b)	8.9	1.8	1.1	0.9	0.3	3.1	3.1	4.0	n/a
Hypothetical greenhouse gases avoided with recycling (million $MTCO_2E$)	9.7	0.0	1.8	0.4	2.0	0.8	0.1	0.0	**14.9**
# of cars' equivalent emissions (c)	1,903,974	883	357,275	79,148	401,593	149,321	16,607	4,636	**2,913,438**

* Hypothetical energy savings are those achieveable through the recycling rates noted in Table C-1.

(b) Source: column f, Exhibit 2 in the "Recycling" chapter of the U.S. EPA's Waste Reduction Model (WARM) version 12, Feb. 2012.

(c) Emissions from 1 passenger car: 5.1 $MTCO_2E$ per year.

Table E-2. Additional Greenhouse Gas Emissions Avoided With a National Container Deposit System*

	Aluminum cans	Steel cans	PET bottles	HDPE bottles	Glass bottles	Gable-top cartons	Aseptic boxes	Foil pouches	Total
Additional recovery (thousand tons)	368	0	1,000	282	3,773	222	24	6	**5,676**
Additional GHGs avoided* over & above existing avoidance (million $MTCO_2E$)	3.3	0.0	1.1	0.2	1.1	0.7	0.1	0.0	**6.5**
# of cars' equivalent emissions (c)	641,825	93	217,677	47,543	207,139	135,255	14,808	4,636	**1,268,977**
Proportion of total greenhouse gas impact	51%	0%	17%	4%	16%	11%	1%	0%	**100%**

* "Additional" Greenhouse Gas Emissions Avoided is the difference between existing GHG avoidance (see Table C-1) and hypothetical GHG avoidance (Table D-1) under a national container deposit system achieving the recycling rates noted in Table E-1.

(c) Emissions from 1 passenger car: 5.1 $MTCO_2E$ per year.

Source: "Greenhouse Gas Emissions from a Typical Passenger Vehicle," Office of Transportation and Air Quality. EPA-420-F-11-041, Dec. 2011.

Endnotes

1 The terms "wasting" or "wasted" are defined as the sum of beverage containers that have been landfilled, incinerated or littered.

2 Defined as soft drinks (soda), sparkling water and beer. Carbonated soft drinks are sometimes abbreviated as CSD.

3 Defined as still (non-carbonated) water, fruit juices and drinks (excluding frozen), energy drinks, sports drinks, and ready-to-drink tea.

4 Noncarbonated, alcoholic beverages include wine and spirits. This report does not include the following beverage categories: cider, coconut water, ready-to-drink coffee, kombucha, champagne, sparkling wine, mixed liquor drinks, wine coolers, frozen fruit concentrates or non-dairy "milk" (e.g. soy, rice and almond milk) beverages. Combined, these beverage categories represent a small fraction of the total beverage market. Also excluded are flavored, enhanced and sweetened water, which in 2011 accounted for about 1.3% of the total beverge market.

5 This dataset includes beverage packaging consumed and collected for recycling in the United States. After collection, most aluminum and glass containers are recycled in the U.S., but approximately 50% of PET (polyethylene terephthalate) bottles are exported (mainly to China) for final processing into new manufactured products.

6 Bartow J. Elmore, "The American Beverage Industry and the Development of Curbside Recycling Programs, 1950-2000," Business History Review 86 (Autumn 2012): 493.

7 Ibid.

8 Bottlebill.org, Bottle Bill Resource Guide **http://www.bottlebill.org/legislation/usa/allstates.htm**.

9 Washington State Department of Community, Trade and Economic Development's Clean Washington Center, Best Practices and Industry Standards in PET Plastic Recycling (1997).

10 United States Environmental Protection Agency Office of Solid Waste and Emergency Response, Opportunities to Reduce Greenhouse Gas Emissions through Materials and Land Mangement Practices (September 2009).

11 United States Environmental Protection Agency Office of Resource Conservation and Recovery, Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Tables and Figures for 2010 (December 2011).

12 United States Environmental Protection Agency, Municpal Solid Waste in the United States: 2011 Facts and Figures (2013) Table 19.

13 Usman Valiante, "Energy to Waste: Measuring diversion by weight distracts us from more environmentally revelant criteria," Solid Waste & Recycling April/May 2000.

14 CRI estimates, based on estimates of tons sold and recycled multiplied by published scrap prices.

15 Susan Collins, "A Common Theme," Resource Recycling February 2012: 14.

16 Traditional beverage containers are defined as refillable and one-way glass bottles, polyethylene terephthalate (PET) and high-density polyethylene (HDPE) plastic bottles, steel (bi-metal) cans and aluminum cans. Non-traditional containers include gable-top cartons, aseptic drink boxes and foil pouches.

17 California, Connecticut, Delaware (repealed in Dec. 2010), Hawaii, Iowa, Massachusetts, Maine, Michigan, New York, Oregon and Vermont. Delaware's recycling rate was 31% in 2010; and Delaware's program only included carbonated beverages in glass and plastic. A container deposit law was passed in the U.S. territory of Guam in 2011, and has yet to be implemented.

18 Packaged beverage sales exclude fountain drinks and on-tap beer sales.

19 **http://www.census.gov/popest/data/state/totals/2011/tables/NST-EST2011-01.xls**; the 800 containers figure was generated by CRI.

20 "The State of Garbage in America," BioCycle December 2001.

21 Includes milk, aseptic boxes, gable-top cartons and foil pouches. Excludes flavored, enhanced and sweetened waters; wine coolers, mixed liquor drinks, champagne and sparkling wine; frozen fruit concentrates; soy, almond and rice beverages.

22 While the overall U.S. beverage container recycling rate is able to be calculated because nationwide recycling data are available for beverage containers, the same is less true for each state's beverage container recycling rate. States generally do not track recycling levels for beverage containers unless they have a beverage container deposit program.

23 The national PET recycling rate is for all PET bottles, including PET beverage bottles, food bottles and non-food bottles. We have used the NAPCOR/APR recycling rate for the sake of consistency, but that recycling rate is overstated, due to the inclusion of caps, labels, glue, base cups and thermoforms in the numerator, but not the denominator of the recycling rate.

24 The energy and greenhouse gas calculations for PET bottles are based on the weight of the PET portion of the bottle only, not including caps, labels, glue and base cups.

25 CRI used the American Chemistry Council's HDPE recycling rate for the sake of consistency, but that recycling rate is overstated, due to the inclusion of caps, labels, glue in the numerator, but not the denominator of the recycling rate.

26 The glass recycling rate has increased compared to previous versions of this report, and a portion of that increase is due to CRI's internal change in methodology. We used the beverage-specific glass recycling rates in this report, compared to using the U.S.E.P.A.'s overall glass recycling rate in previous reports. Also, there is less certainty about the overall glass bottle recycling rate than there is for the other material types. Information about glass recycling for bottles and fiberglass versus use as aggregate or road base is unavailable from the U.S.E.P.A.

27 David Saphire, Case Reopened: Reassessing Refillable Bottles (New York: Inform, 1994) 9.

28 NAPCOR.

29 Saphire, Case Reopened 9.

30 Can Manufacturers Institute, Aluminum Association and Institute of Scrap Recycling Industries, "Aluminum Can Extends Lead As Most Recycled Beverage Container," Washington, DC, August 28, 2012.

31 Glass Packaging Institute, Glass Recycling Statistics, **http://www.gpi.org/recycling/glass-recycling-facts**.

32 Based on National Multi-Housing Council's 2011 American Community Survery of housing unit statistics by city.

33 Aluminum cans have an average weight of 34 cans per pound, compared to approximately 6 steel cans per pound, approximately 18 PET bottles per pound, 7 HDPE bottles or jugs per pound, roughly 2 glass bottles per pound, 20 gable top cartons per pound, 30 aseptic boxes per pound, and roughly 130 pouches per pound.

34 When the amount of energy required to produce a ton of material is divided by the number of containers per ton of material (i.e. container weight), the result is the energy required per container.

35 "The 10¢ Incentive to Recycle," 4th Ed., by Jenny Gitlitz & Pat Franklin. Container Recycling Institute, July 2006.

36 In our Beverage Market Data Analysis (for the U.S. and for all 50 states) CRI has referred to a deposit system that includes carbonated and non-carbonated beverages as an Updated Bottle Bill (UBB), because beginning in 1971, traditional deposit systems only covered carbonated beverages. Maine and California both updated their deposit systems to cover non-carbonated beverages; and New York, Oregon and Connecticut have updated their laws to include water. When Hawaii implemented its new deposit law in January 2005, non-carbonated beverages were included from the start.

37 Natural Resources Defense Council, Waste in our Water: The Annual Cost to California Communities of Reducing Litter that Pollutes our Waterways (August 2013).

38 **http://www.nypirg.org/enviro/bottlebill/BottledUp.pdf**.

39 **http://www.commoncause.org/atf/cf/%7BFB3C17E2-CDD1-4DF6-92BE-BD4429893665%7D/CT.BOTTLEBILL.PDF**.

40 "The State of Garbage in America," BioCycle December 2001.

41 As previously noted, a portion of the increase in the glass recycling rate is due to a change in the methodology.

42 Container Recycling Institute, Understanding Economic and Environmental Impacts of Single-Stream Collection Systems (December 2009).

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