Recycling & Climate Change

Like most developed countries, the United States must reduce the generation of greenhouse gases that contribute to climate change. These reductions must come from changes in domestic systems and systems that extract, transport and manufacture materials and products for export. Among the various ways available to help achieve these reductions is recovering materials for manufacturing through recycling collection and processing. Significant reductions in energy consumption are realized when goods are manufactured from secondary, versus primary materials. Thus, recycling post-consumer goods is a necessary component of the State legislative framework being designed to address climate change.

This paper is intended to enhance the level of understanding of beverage container recycling in the United States and the State Iowa, and to demonstrate the impact of recycling on emissions reduction and the economy. The information contained in this paper should be used to support and expand the Iowa bottle bill instead of a repeal, as is currently being proposed.

This paper is presented by the Container Recycling Institute (CRI). CRI is a nonprofit organization that studies and promotes policies and programs that increase recovery and recycling of beverage containers, and shift the societal and environmental costs associated with manufacturing, recycling, and disposal of container and packaging waste from government and taxpayers to producers and consumers.

CRI plays a vital national role in educating policy makers, government officials and the general public regarding the societal and environmental impacts of the production and disposal of beverage containers and the need for producers to take responsibility for their packaging.

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Recycling & Climate Change

Understanding the impact of beverage container recycling on saving energy and reducing greenhouse gas emissions

The United States, and indeed, all nations around the world must actively participate in strategies to minimize greenhouse gas emissions. Reducing energy consumption, curtailing natural resource depletion, minimizing pollution and eliminating waste are all part of the solution. Recycling requires a small amount of effort on the parts of each link of a product's value chain, yet the total impact of these efforts can help solve this global problem. As a solid waste management strategy, recycling reduces the amount of waste sent to landfills or incinerated, but recycling in the twenty-first century is no longer merely a waste minimization tool. Mining silica or bauxite ore and drilling for petroleum and natural gas are primary extractive industries necessary for the production of glass, aluminum and plastics. Recycling post consumer goods is secondary extraction of valuable aluminum, glass and plastic containers, and the recovery of the energy embedded in those cans and bottles that was used to transform primary raw materials into consumer products in the first place. Recycling significantly diminishes all of the inputs needed to make the replacement product from virgin materials. Avoiding these "up-stream" functions means significantly reducing energy usage and associated greenhouse gas (GHG) emissions.

The Role of Recycling Beverage Containers

Every year in America, millions of tons of empty beverage containers are disposed of in garbage bins, or tossed out as litter. Communities incur considerable waste management and litter cleanup costs. From an economic perspective, empty beverage containers are worth a lot of money as a secondary commodity. In terms of aluminum and steel cans, plastic PET & HDPE, and glass bottles, more than $2.9 billion in recyclable scrap was buried in a landfill, littered, or burned in an incinerator[1] last year. This represents a loss of nearly 65 percent of potential revenues from empty containers.

More than $2.9 billion worth of recyclable scrap from empty beverage containers was either buried, littered or incinerated in last year.

[1] Based on industry-reported recycled commodity values for 2010.

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Given our need to conserve energy and reduce emissions, ramping up beverage container recycling is essential. In one year alone, if Americans were to recycle 75 percent of all the aluminum, steel, PET and HDPE plastic, and glass beverage bottles sold, nearly 10 million metric tons of greenhouse gases would be avoided compared to the reductions from the current beverage container recycling rate of 35 percent (by unit). This would be equivalent to taking nearly two million cars off the road.

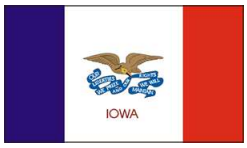
A significant improvement in beverage container recycling could help the United States achieve its 2020 greenhouse gas reduction target. Specifically, a 90 percent recovery rate will result in 25.2 million metric tons of avoided greenhouse gas emissions, equivalent to 1 percent of the 2020 reduction target. [2]

Recycling 90 percent of all beverage containers would contribute to one percent of our 2020 greenhouse gas reduction goal.

From an energy perspective, nationwide recycling of 75 percent of all beverage containers would save nearly 185 million MBTUs of energy, equivalent to the energy contained in over 1.6 billion gallons of gasoline - enough fuel for over 3 million average passenger vehicles for one year.[3]

Bottle Bill Repeal Would Move Recycling Backward in IOWA

Iowa's existing beverage container recycling rates are very high compared to the 39 non bottle bill states. More specifically, CRI estimates that Iowa recovery rates for beverages containers covered by the bottle bill are:



Beverage Container Type	Aluminum Cans	PET bottles	Glass Bottles
Recycling Rate	**88%**	**76%**	**92%**

* Source: CRI's *Beverage Market Data Analysis 2008*, based on 2006 data.

Iowa has a deposit-return program ("bottle bill") which ensures high recovery rates for the containers covered by the deposit. Currently in Iowa the containers covered are limited to glass, plastic, or metal bottles, cans, jars or cartons containing beer, carbonated soft drinks & mineral water, wine coolers, wine & liquor. Bottled water, sports drinks and juice are not covered by the deposit. The average recovery rates for beverage containers in 39 non bottle bill states are: 35% for aluminum cans,

[2] The 2020 GHG reduction target is equal to ~2.548 billion MTCO2e, of which beverage recycling to 90 percent would contribute 1 percent of that goal (25.2 million MTCO2e).
[3] Energy savings calculated using: *Solid Waste Management and Greenhouse Gases – A Life-Cycle Assessment of Emissions and Sinks,* 3rd Edition, US EPA, September 2006; Avoided GHG Equivalents (MTCO2e/ton): Exhibit 8-8, Avoided Energy Equivalents (MBTU/ton): Exhibit 7-8; GHG emission savings derived from US EPA Waste Reduction Model (WARM) Update August 2010. One US gallon of gasoline contains 115,000 BTUs., The average consumption per year is 502 gallons per vehicle. Sources : http://www.fuelgaugereport.com/

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14% for PET bottles, and 12% for glass bottles. The average total container recovery rate for these 39 states is 24%.[4]

A decrease in recovery rates in Iowa to the rates in non-bottle bill states could result in material revenue loss in excess of $23 million from not recycling these containers. The materials (glass, plastic and aluminum) that are currently recovered in Iowa each year have scrap value of over $36 million.

Why Municipal Curbside Programs Don't Work for Beverage Containers

The beverage industry is keen to shift the burden of collection and recycling to municipal governments, by suggesting that curbside recycling programs are the most efficient and convenient way to recycle.

While curbside recycling programs are necessary for many household generated materials (like paper and other packaging), in the case of beverage container recycling, they are simply nowhere near as effective. This is primarily due to the fact that many beverage containers are generated away from home or "on-the-go" and end up being discarded in locations where municipal curbside receptacles do not exist (offices, bars, restaurants, public parks, beaches, bus stops, tourist sites, shopping strips and malls, etc.)

Mature curbside programs throughout America have demonstrated that on average, residential recycling programs achieve less than 35 percent recycling rates for beverage containers, and increase overall recycling costs for ratepayers.

Curbside recycling for most beverage containers is also expensive. Costs of door-to-door collection, processing of highly commingled (mixed) and compacted material, and litter abatement are expensive, and the revenue generated from these lower quality commodities is significantly lower than source separated "clean" containers which are collected through deposit-return systems. One benefit of deposit-return programs is that they do not rely on municipal revenues to fund the system. Instead, most deposit-return programs utilize material revenues and unredeemed deposits to help offset costs.

As such, ten US states and most Canadian provinces have opted for comprehensive deposit-return programs in addition to municipal curbside recycling programs. In some cases, like California or the Province of Nova Scotia, the deposit-return program financially supports municipal curbside recycling.

Moving recycling forward in Iowa requires investigating ways to make the existing system more efficient, rather than a repeal. This would require expanding the

[4] Source: CRI's *Beverage Market Data Analysis 2008*, based on 2006 data

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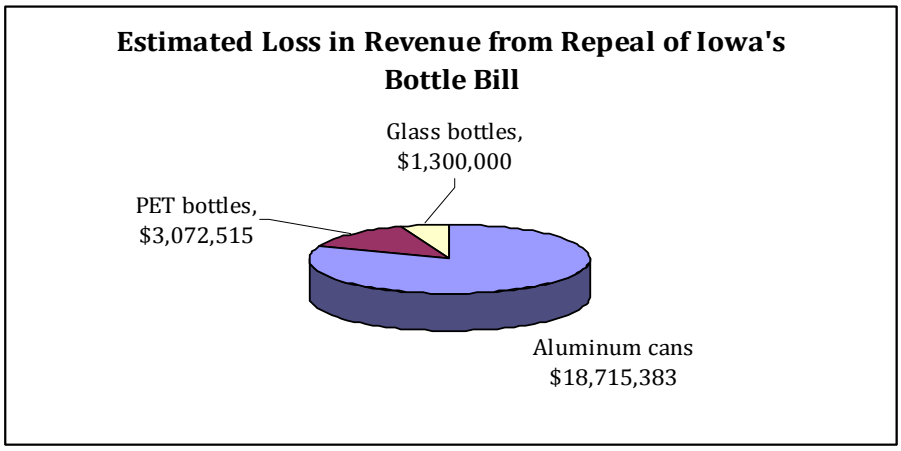
existing program to include non-carbonated bottles as well (see page 9 for analysis). Sales data shows that there are actually more plastic water bottles and sports drinks that do not carry a deposit (472 million units) than carbonated drinks sold in plastic bottles that do carry a deposit (361 million units). Modern deposit-return programs are proven to be highly effective, low-cost, equitable, and supported by the general public. Expansion will lead to greater economies of scale; increased revenues from the sale of recyclables; savings to municipalities through avoided disposal; recycling; and litter mitigation costs. Expansion programs in CT; NY; OR and CA have all proven to be effective in not only improving the recovery rate for beverage containers, but improving the economics around program delivery.

Estimated Impacts of Potential Repeal

Repeal on the other hand would lead to increased costs to municipalities; less revenue generated form the sale of recyclables; and more containers to landfill. Consider the negative effects from decreased container recycling in Iowa (see table on page 6):

- Decreasing the recovery rate on aluminum cans to 35 percent; glass bottles to 12 percent; and PET bottles to 14 percent (equal to rates in 39 non bottle bill states) could result in revenue loss in excess of $23 million in can, glass, and PET commodity revenues for the State.



- Decreasing the recovery rate in Iowa would add an additional 71,000 tons of beverage container waste to Iowa landfills.

- Decreasing the recovery rate in Iowa could add nearly 175,000 metric tons of greenhouse gas emissions – equal in pollution to putting an additional 33,000 cars on the road in a year (these emissions come from the extraction and production of beverage containers from virgin materials).

- Decreasing the recovery rate in Iowa would require the use of an additional 2.8 million MBTUs of energy – equivalent to the energy contained in over 24

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million gallons of gasoline[5], or over 480,000 barrels of crude oil[6] - worth over $41 million[7], to produce new containers from virgin materials.

- Decreasing the recovery rate will lead to an increase in the costs borne by municipalities (and therefore taxpayers) through increased recycling and disposal costs. These cost estimates will vary depending on the costs of disposal and recycling per ton. Based on a scenario where municipalities only capture 30% of available aluminum cans and pay $40/ton for disposal municipalities would be required to pay an additional $3.4 million for recycling and disposal. [8]

- Litter mitigation alone would cost businesses and governments upwards to an additional $1.6 million.[9]

The current repeal law (S.F.249) only offers a temporary fee to fund start-up costs for recycling, with no financial support for annual operating costs. After 2015, municipalities will be responsible for funding the entire recycling; disposal and litter mitigation system themselves. Repealing the existing bottle bill is a regressive step which will only further entrench municipal responsibility for recycling and disposal costs; lead to decreased recycling of valuable beverage containers in Iowa; and let producers off the hook for taking responsibility of their own packaging waste.

[5] There are 115,000 BTUs of energy contained in a gallon of gasoline: bioenergy.ornl.gov/papers/misc/energy_conv.html
[6] There are 5.8 MBTUs of energy containers in a barrel of crude oil. Source: Ibid,.
[7] On February 8, 2010, crude oil was valued at $87/barrel. Source: Bloomberg
[8] High-low cost ranges run from $0 to $5.8 million based on ranges of aluminum recovery from 15% to 35% in municipal curbside programs and disposal costs from $15 to $60 per ton.
[9] Assumed 1% of un-recovered beverage containers ends up as litter. Litter costs are estimated to be $2,300/ton on average from *2009 Visible Litter Survey and Litter Cost Study*. *Final Report, September 18, 2009.* Prepared by MSW Consultants for Keep America Beautiful, Inc. Stamford, CT.

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ESTIMATED LOSS IN REVENUES, INCREASES IN GREENHOUSE GAS EMISSIONS AND REQUIRED ENERGY IF IOWA'S BOTTLE BILL WERE REPEALED				
	Aluminum cans	**PET bottles**	**Glass bottles**	**Total**
Estimate of number of units sold 2006	1,365,000,000	370,000,000	260,000,000	1,995,000,000
Estimate of number of units collected	1,201,200,000	281,200,000	239,200,000	1,721,600,000
Tons available for recycling (based on BMDA 2006)	**19,950**	**13,960**	**65,000**	**98,910**
Tons collected (BMDA 2006)	**17,556**	**10,609**	**59,800**	**87,966**
Tons wasted (garbage/disposal)	**2,394**	**3,350**	**5,200**	**10,944**
Current recovery rates (units)	**88%**	**76%**	**92%**	**86%**
Estimated recovery rate with repeal (Based on rates from 39 non-bottle bill states)	**35%**	**14%**	**12%**	**24% by unit; 17% by weight**
Estimated recovery with repeal (in tons)	**6,983**	**1,954**	**7,800**	**16,737**
Estimated change in tons recovered from repeal (losses)	**(10,574)**	**(8,655)**	**(52,000)**	**(71,229)**
Value of empty beverage containers (average $/ton) - based on three-year average or industry forecast	**$ 1,770**	**$ 355**	**$ 25**	
Total value of recyclable beverage containers at current recovery rates	$ 31,074,598	$ 3,766,308	$ 1,495,000	**$ 36,335,906**
Estimate revenues from containers at lower recovery rate	$ 12,359,215	$ 693,794	$ 195,000	**$ 13,248,009**
Estimated loss in revenue from repeal of Iowa's bottle bill	**$ 18,715,383**	**$ 3,072,515**	**$ 1,300,000**	**$ 23,087,898**
Avoided ENERGY per ton (MBTU/ton) (Source: EPA)	**206.95**	**53.36**	**2.65**	-
Energy saved from status quo recovery (MBTU)	3,633,270	566,113	158,470	**4,357,853**
Energy saved from anticipated lower recovery rate	1,445,051	104,284	20,670	**1,570,005**
Estimated additional energy required to extract new virgin materials	**2,188,219**	**461,829**	**137,800**	**2,787,849**
Avoided GHG equivalents (MTC02E)/ton (Source: EPA)	**13.65**	**1.56**	**0.32**	
Greenhouse Gases GHGs avoided from status quo recovery (MTCO2e)	239,643	16,551	19,136	**275,330**
GHGs avoided from anticipated lower recovery rate (MTCO2e)	95,313	3,049	2,496	**100,857**
Estimated additional GHG emissions from increased extraction of virgin materials	**144,330**	**13,502**	**16,640**	**174,472**

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Recycling Containers is good for the Manufacturing Sector

When manufacturers use secondary feedstock like empty bottles and cans, costs associated with sourcing, extracting, processing and shipping raw virgin materials are eliminated. Manufacturers are able to reduce their need for primary feedstock and gain both environmental benefits and cost savings. For example, using recycled aluminum cans to make new cans means avoiding limestone, salt and bauxite mining; it also eliminates the need for caustic soda, chlorine, alumina, crude oil, petroleum coke, and anode production. Making a new can from a recycled can saves 95 percent of the energy and related emissions.[10]

In today's uncertain economy, producers of products and packaging can benefit greatly from the efficiencies gained from using recycled instead of virgin feedstock. Maintaining a supply of nearly 100,000 tons of recycled materials and maintaining a high quality of empty beverage containers for domestic recycling is an important step towards economic recovery and stimulus.

Real Economic and Socio-economic Benefits from Recycling

The value of recycling goes far beyond commodity-based revenues and energy conservation. Recycling infrastructure creates jobs in Iowa that cannot be outsourced. Repealing state beverage container deposit-return system would eliminate hundreds of 'green jobs' for Iowans. In 2007, the United States generated $236 billion in revenues from recycling and ancillary services; creating some 1 million jobs – all contributing about 2 percent of the US GDP[11]. Mandates for increased recycling helped create 1,800 new jobs in Massachusetts, 4,684 in Michigan, 3,800 in New York, and 14,000 in California. In addition, these are jobs that employ local drivers, plant and equipment construction, technicians, low-skilled labor, and administrative and management positions.

Nationwide Beverage Container Recycling Enhancement Requires State Leadership

Across most of the United States, municipalities bear the responsibility for beverage container recycling, beverage container litter, and disposal. Local budgetary pressures, exacerbated by the economic downturn, have constrained the expansion of existing recycling programs and the adoption of new ones. Reliance on local property taxes to fund materials recovery has stagnated both private sector recycling infrastructure investments and commitments to using recycled content in manufacturing. Without a State mandate, many municipal recycling programs with limited budgets will opt to curtail or delay implementing recycling programs. Many of these communities have very limited investment in efficient capital, and are inexperienced in commodity brokering and social marketing. Consider that in 2006

[10] Source: Novelis
[11] Business Week

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there were 8,660 curbside recycling programs in the US, down from 8,875 programs in 2002[12].

Developing a Strategy for Increased Beverage Recycling in Iowa

States like Iowa are well-positioned to change the status quo, because they already have a bottle bill in place. A program expansion to include water and sports drinks will likely lead to an increase in recovery of approximately 13,500 tons of PET; 811 tons of aluminum; and nearly 10,000 tons of glass,[13] worth over $5 million in commodity value alone – all with limited to no requirements for increased capital investments, because the collection infrastructure is already in place.

Estimated Impacts of Bottle Bill Expansion in Iowa

- Recycling aluminum, PET, HDPE, and glass non-carbonated beverage containers in Iowa would divert an additional 21,394 tons of waste from disposal.

- Recovering those additional containers would bring an additional $5.6 million in commodity revenues for to off-set program costs.

- Recycling those containers would lead to the avoidance of over 27 thousand metric tons of greenhouse gas emissions – equal in pollution mitigation to taking 5,173 cars off the road for one year[14].

- Recycling those containers in Iowa would enable savings of an additional 716,777 MBTUs of energy – equivalent to the energy contained in over 6 million gallons of gasoline[15], or over 123,000 barrels of crude oil[16] - worth today nearly 11 million[17].

- With a bottle bill expansion to include non-carbonated water and sports drink bottles and cans, municipalities would save approximately $3 million in avoided recycling and disposal costs.[18]

[12] Biocycle Magazine, 2006
[13] Based on existing recycling rates by material applied to non-deposit non-carbonated containers (water and sports drinks) sales from BMDA 2006.
[14] Each US auto generated about 5.23 MTCO2e per vehicle per car. http://www.epa.gov/cleanenergy/energy-resources/refs.html#vehicles
[15] There are 115,000 BTUs of energy contained in a gallon of gasoline: bioenergy.ornl.gov/papers/misc/energy_conv.html
[16] There are 5.8 MBTUs of energy containers in a barrel of crude oil. Source: Ibid,.
[17] On February 8, 2010, crude oil was valued at $87/barrel. Source: Bloomberg
[18] Based on a disposal cost of $40 per ton and recycling costs of ($586) for aluminum; $907 for PET and HDPE; and $160 for glass/ ton. These are 2009 Activity Based Costs from Ontario, Canada's curbside recycling program. Source: Stewardship Ontario, 2009.

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ESTIMATED INCREASES IN REVENUES, GREENHOUSE GAS EMISSION REDUCTIONS, AND ENERGY SAVINGS FROM EXPANDING THE BOTTLE BILL IN IOWA					
	Aluminum cans	**PET bottles**	**HDPE**	**Glass bottles**	**Total**
Estimate of number of units sold 2006	63,072,262	472,321,864	32,733,394	42,736,825	610,864,345
Estimate of number of units collected	22,075,292	66,125,061	3,928,007	5,128,419	97,256,779
Estimated units recovered with expansion	**55,503,591**	**358,964,617**	**24,877,379**	**39,317,879**	**478,663,466**
Tons available for recycling (based on BMDA 2006)	**922**	**17,820**	**2,046**	**10,684**	**31,472**
Tons collected (BMDA 2006)	**323**	**2,495**	**246**	**1,282**	**4,345**
Estimated tons recovered from expansion	**811**	**13,543**	**1,555**	**9,829**	**25,739**
Current recovery rates (units)	**35%**	**14%**	**12%**	**12%**	**16%**
Estimated recovery rate with expansion	**88%**	**76%**	**76%**	**92%**	**78% by unit; 86% by weight**
Estimated NET increase in tons recovered from expansion	**489**	**11,048**	**1,309**	**8,547**	**21,394**
Value of empty beverage containers (average $/ton) - based on industry forecast	**$ 1,770**	**$ 355**	**$ 421**	**$ 25**	
Estimated additional revenue from expansion of Iowa's bottle bill	**$ 864,778**	**$ 3,922,205**	**$ 551,230**	**$ 213,684**	**$ 5,551,897**
Avoided ENERGY per ton (MBTU/ton) (Source: EPA)	**206.95**	**53.36**	**2.65**	**2.65**	**-**
Energy saved from status quo recovery (MBTU)	66,771	133,123	651	3,398	**203,943**
Energy saved from anticipated higher recovery rate (bottle bill expansion)	167,882	722,669	4,120	26,048	**920,720**
Estimated additional energy saved from expansion of Iowa's bottle bill (from more recycling)	**101,111**	**589,546**	**3,470**	**22,651**	**716,777**
Avoided GHG equivalents (MTC02E)/ton (Source: EPA)	**13.65**	**1.56**	**0.32**	**0.32**	
Greenhouse Gases (GHGs) avoided from status quo recovery (MTCO2e)	4,404	3,892	79	410	**8,785**
GHGs avoided from anticipated higher recovery rate (MTCO2e) (bottle bill expansion)	11,073	21,128	498	3,145	**35,844**
Estimated additional GHGs avoided from expansion of Iowa's bottle bill (from more recycling)	**6,669**	**17,236**	**419**	**2,735**	**27,059**

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Meeting Targets: Case Studies

In spite of the overall low recovery rates for beverage container recovery, some states like Iowa *are* meeting high recycling targets through a combination of collection systems. While each system is different, common to all successful programs are bottle bills.

California's many state-wide recycling initiatives have supported their achievement of a 65 percent diversion rate for 2009.[19] Among the varied recycling and composting programs is the innovative California Redemption Value (CRV) deposit-return program, which has an overall recovery rate of 82 percent (91 percent for aluminum cans, 73 percent for PET plastic bottles, and 80 percent for glass bottles)[20]. Expanded in 2000 to redeem more beverage container categories, the California deposit-return system is considered by many as state-of-the-art in terms of system design and stakeholder equity. The California model offers convenient collection centers known as "convenience zones" within a half-mile radius of a beverage retailer. In addition, the program allocates funds for market development and municipal payments.

In addition to the beverage container program, California's state-administered grant programs for municipalities, industry and entrepreneurs funds new opportunities to collect separated materials for recycling. For example, CalRecycle also offers a financial incentive to any program operator for municipal recycling to improve the quality and marketability of glass beverage container material. CalRecycle will pay quality incentive payments for some recyclable materials (like glass bottles) which are substantially free of contamination for recycling. Most municipalities also offer convenient curbside and drop-off recycling services for packaging and paper generated in households.

At the state level, **Oregon** has implemented a variety of regulated initiatives that promote beverage container recycling. State regulations mandate recycled content for glass, newsprint and telephone directories[21]; and container deposit legislation for beer, carbonated drinks, and water[22]. Curbside recycling is offered to about 75 percent of the residential sector. Together this hybrid program recovers about 81 percent of all deposit bearing containers. 77 percent of beverage containers are captured through the bottle bill and 4 percent[23] through curbside recycling. Non-deposit containers collected through municipal curbside programs are recovered at a rate of 35 percent[24]. The state also offers financial grants to local governments for waste recovery projects.

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[19] Calrecycle. Larry Stevens
[20] Calrecycle, *California's Beverage Container recycling and litter reduction fact sheet. 2009*
[21] Statute: ORS 459A
[22] Statute: ORS 459A.700
[23] 2005 data, prepared on January 15, 2008 by Oregon Department of Environmental Quality
[24] Ibid.

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Canada's largest province of **Ontario** (population 13 million) utilizes a hybrid model of comprehensive mandated curbside recycling which is partially funded by industry, as well as a deposit-return program for all alcoholic beverage containers. The curbside program, which is offered to 99 percent of the province's residents, recovers about 46 percent of all aluminum cans and 50 percent of plastic beverage bottles, while the provincial deposit-return program for beverage alcohol containers collects 82 percent of aluminum cans and 96 percent of glass bottles[25].

Currently there are ten US states that offer deposit-return for a variety of beverage containers, which include: **California, Hawaii, Connecticut, Iowa, Maine, Massachusetts, Michigan, New York, Oregon,** and **Vermont.** These states rank as leaders in America in terms of setting the bar for high recovery rates and, in some cases, very high recovery. More specifically, the leaders include: Michigan at 97 percent; Maine at 93 percent; Vermont at 85 percent; Iowa at 86 percent; Oregon at 84 percent; Hawaii at 76 percent; California at 82 percent; and New York at 70 percent.[26] Not only do deposit states lead in terms of high recovery rates, but in general, they also supply recyclers with the highest quality scrap material compared with any other type of recycling program in the US, which improves overall efficiency in terms of processing and recycling.

These examples illustrate that recycling greater numbers of beverage containers is possible through a variety of programs that can be designed in a way to reflect consumption patterns and meet the needs of cities, states and the nation.

[25] *Responsible Stewardship 2009-2010*, The Beer Store
[26] Bottle Bill.org

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Information Sources

RECYCLING FIGURES
Beverage Market Data Analysis 2006 – Container Recycling Institute

ENERGY AND GHG SAVINGS
Solid Waste Management and Greenhouse Gases – A Life-Cycle Assessment of Emissions and Sinks, 3rd Edition, US EPA, September 2006; GHG emission savings derived from US EPA Waste Reduction Model (WARM) Update August 2010

VALUE OF EMPTY BEVERAGE CONTAINERS
Aluminum price is $1770/ton for baled aluminum: Source Evermore Recycling, Feb 2011
Steel price is $239/ton - average rate for 2010, Source: Steward Edge Price Sheet
PET price is $355/ton - average rate for 2010, Source: Steward Edge Price Sheet
HDPE price is $421/ton - average rate for 2010, Source: Steward Edge Price Sheet
Glass price is based on the value of amber glass as representative of an average price for secondary clean glass: Flint: $30, Amber: $25, Green: $5, Mixed: $5 to negative $60 depending on quality. Source: Strategic Materials.

STATS USED FOR ENERGY CONVERSION CALCULATIONS
There are 115,000 BTUs of energy contained in a gallon of gasoline
There are 5.8 MBTUs of energy containers in a barrel of crude oil. Source: bioenergy.ornl.gov/papers/misc/energy_conv.html

LIGHTING
Average lighting consumption per household in the USA is 940 kWh.
Source: Residential Consumption of Electricity by End Use, 2001, End-Use Consumption of Electricity 2001, www.eia.doe.gov
The national average heat rate is about 10,722 BTU per kWh of delivered electricity.
Therefore, each household consumes about 10 MBTUs of electricity per year in delivered electricity. (0.010722 MBTUs * 940 kWh = 10 MBTUs)

HOME HEATING
The average American home in a moderate climate uses about 50 MBTUs of energy for heating per year.
Source: U.S. Department of Energy – Energy Efficiency and Renewable Energy – Industrial Technologies Program

EMISSIONS FROM CARS :
Each US auto generates about 5.23 MTCO2e per vehicle per car per year.
http://www.epa.gov/cleanenergy/energy-resources/refs.html#vehicles

GASOLINE
One US gallon of gasoline contains 115,000 BTUs. Source:
http://bioenergy.ornl.gov/papers/misc/energy_conv.html
Value : $4.06 per gallon of mid-level unleaded gas. Source : http://www.fuelgaugereport.com/
The average consumption per year is 502 gallons per vehicle. Source : EPA – Gateway calculator

OIL
5.8 million BTUs per barrel of crude oil
Value of a barrel of crude oil : $87 (February 8, 2010, Source Bloomberg)

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