Recycling System Analysis for the Vermont Bottle Bill

ANALYSIS OF SYSTEM COSTS AND ENVIRONMENTAL IMPACTS OF THREE SCENARIOS

OCTOBER 9, 2025

Welcome

- You all play an important role in the recycling of beverage containers and the implementation of VT's bottle bill

- This study began in summer of 2024 and is close to complete – VT DEC has shared the report on its website and by email

- Importance of stakeholder input throughout this study

  - Interviews

  - Data gathering for model inputs

  - Feedback on model assumptions and outputs

- Purpose of today

  - Present the findings from the study

  - Answer questions and gather reactions/feedback (~45 minutes)

Agenda

1. Background & Overview of the Three Models
2. Methodology
3. Comparative Impacts of the Bottle Bill Models
   1. Material Diversion Rates
   2. Costs
   3. Greenhouse Gas Emissions
   4. Litter
4. Next Steps
5. Questions & Discussion

SIGNALFIRE
GROUP

Background &
Overview of Three Models

Background

- The ANR of VT DEC commissioned the Signalfire Group to conduct this study to analyze and compare the costs and benefits – financial and environmental – associated with three models for the management of beverage containers via the "bottle bill" deposit return system and the regular Vermont recycling system

- State currently has 54 redemption centers and 69 retail redemption locations (~123 total sites)

- Program places a 5¢ deposit on beer, malt beverages, mineral water, mixed wine drinks, soda water, carbonated soft drinks, and ready-to-drink spirits, and a 15¢ deposit on liquor

- Redemption rate ~72% for containers covered by the Bottle Bill

- In 2023, H.158 was introduced (but did not pass) with the aim of expanding the scope of covered beverages. There are still ongoing discussions around potentially reforming VT's Bottle Bill

Three Models

1. **Model 1, Existing Bottle Bill:** The current Vermont bottle bill and recycling systems.

2. **Model 2 (A and B), PRO Bottle Bill:** All currently "covered" bottle bill beverage containers, except liquor, are managed by a beverage manufacturer/distributor producer responsibility organization (PRO); a convenience standard is established to increase redemption sites (similar to H.158), sorting by brand at redemption sites is eliminated, and all redemption sites must accept all redeemable containers, not just what they sell. Model 2A relies primarily on bag drop systems, while Model 2B relies on reverse vending machines (RVM).

3. **Model 3, Expanded Bottle Bill (EBB) with PRO:** Includes all the elements of Model 2 and expands the types of beverages included in the bottle bill deposit program as originally proposed in H.158

Key Differences Between Models

	MODEL 1	MODEL 2	MODEL 3
Beverage Containers Included in Deposit / Redemption System	Beer, wine coolers, other malt beverages, pre-mixed spirits cocktails, carbonated non-alcoholic beverages including sodas, sparkling waters and juices, and carbonated sports and energy drinks (5 cent deposit). Liquor and spirits (15 cent deposit).		All beverages included, except milk, dairy, plant-based beverages, infant formula, meal replacement drinks, and nonalcoholic cider.
Containers Requiring Brand Sorting at Point of Redemption	18% of containers	None, brand sorting at point of redemption is eliminated.	
Containers in Commingling Agreement	82%[1]	100%[2]	
Handling fee	3.5 cents for commingling; 4 cents for others	No set handling fee. PRO negotiates appropriate compensation for the redemption site which would likely be based on a per container fee[3].	
Convenience Requirements	Retailers are required to take back covered containers of the kind, size, and brand they sell, unless they receive an exemption from the Secretary based on alternate redemption sites that can serve the public need.	• Universal redemption • Minimum of 3 redemption sites per county. • Retailers of 5,000 square feet or more must redeem • Municipalities with populations of 7,000+ must have at least one point of redemption.	
Bottle Bill Management	Distributors/manufacturers "Pickup agent" + Dept. of Liquor & Lottery (DLL for liquor	PRO + DLL (for liquor)	
Number of Redemption Sites	123	170	

Methodology

Approach

- Data collection
- Stakeholder engagement
- Redemption site interviews
- Modeling of:
  - Bottle Bill System (BBS)
  - Recycling System (RS)
  - Separate trips taken by consumers to redeem containers (BBS) or recycle containers via drop-off (RS)
  - Greenhouse gas emissions
  - Bottles from out-of-state redeemed in VT
  - Elimination of brand sorting
  - Choice of technology and its impact on redemption rates and consumer engagement

Stakeholders Consulted During this Study

- Breezeway Consulting LLC, representing the Vermont Commingling Group, LLC
- Casella (MRF operator in Chittenden and Rutland Counties)
- Chittenden Solid Waste District
- Container Recycling Institute (CRI)
- Department of Liquor and Lottery (DLL)
- Green Up Vermont
- TOMRA
- Redemption sites (21 interviews completed across a representative range of locations)
- Vermont Agency of Natural Resources (ANR) Department of Environmental Conservation (DEC)
- Vermont Public Interest Research Group (VPIRG)
- Vermont Retail & Grocers Association

Comparative Impacts of the Bottle Bill Models

Considerations when Interpreting Results

- **Model 1 costs and convenience:** Model 1 quantifies costs for the VT Bottle Bill system as it currently functions, i.e., without full compliance. If there were comparable convenience in Model 1 to those levels assumed in Models 2 and 3, the total annual cost of Model 1 would increase by an estimated 20%, surpassing the total cost of Model 2 but not that of Model 3.

- **Model 2 and Model 3 costs and convenience:** Model 2 and 3 quantify costs associated with increased convenience standards, but they do not include any corresponding impact on redemption rates that may result from this change. However, expanded bottle bill systems can increase overall beverage container diversion by capturing more beverage containers from trash/litter in addition to pulling in more containers from the recycling system.

- **Brand sorting is eliminated in Model 2 and Model 3:** In the extensive interviews conducted with redemption centers, there were a wide range of responses with some redemption centers noting potential significant labor savings and some reporting little or none at all. The analysis reflects the average savings projected; it should be noted that when a sensitivity analysis was conducted, it was found that cost impact was highly sensitive to changes in assumptions around labor reduction from elimination of brand sorting.
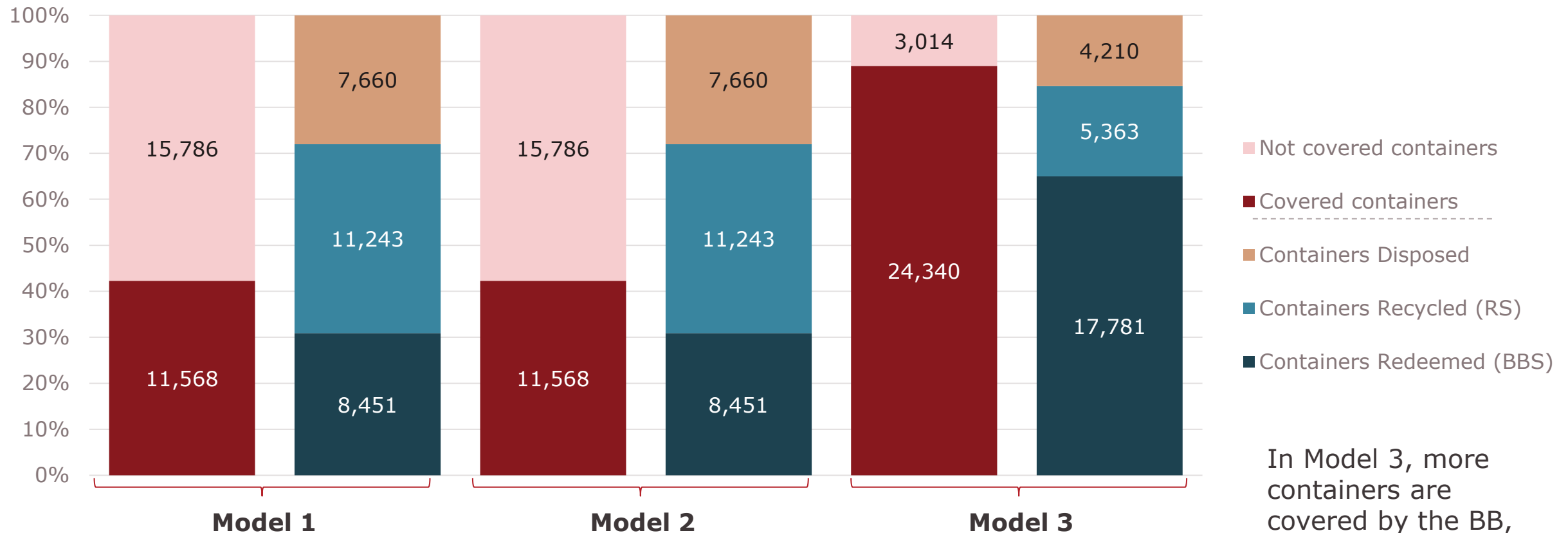
Material Diversion Rates
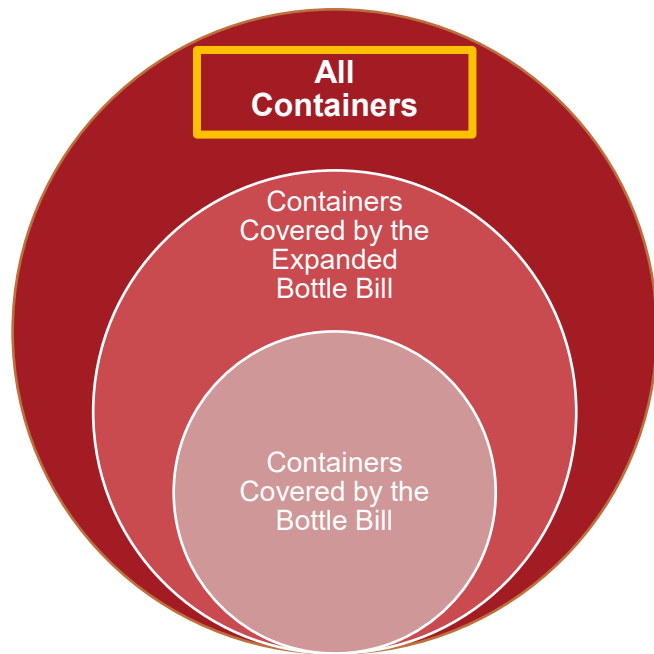
- For Models 1, 2A (Bag Drop), and 2B (RVM), the diversion of beverage containers, through both the RS and BBS, remain at current levels

- For Model 3, overall diversion of beverage containers is estimated to grow from 72% to 85% due to the addition of new types of covered containers to the bottle bill program – primarily #1 PET plastic bottles, wine bottles, hard ciders, juice and tea

BEVERAGE CONTAINER DIVERSION RATES	MODEL 1:	MODEL 2:	MODEL 3:
	72%	72%	85%

- Diversion rates for all beverage containers include estimated collection through the RS i.e. mandatory curbside and drop off recycling service and programs, as well as the bottle bill system. They include all beverage containers sold in Vermont made of aluminum, glass, PET plastic, or HDPE plastic and, therefore, include containers not currently covered.

All Containers

Containers Covered by the Expanded Bottle Bill

Containers Covered by the Bottle Bill

Comparison of Beverage Container Destinations

Redemption rate $= \dfrac{Containers\ Redeemed\ (BBS)}{Covered\ containers}$

Diversion rate $= \dfrac{Containers\ Redeemed\ (BBS) + Containers\ Recycled\ (RS)}{Covered\ containers + Not\ covered\ containers}$

In Model 3, more containers are covered by the BB, and more are redeemed, but the redemption rate remains the same

Costs – Bottle Bill System (BBS)

- **System-Level Costs:** Model 1 represents the existing system and has a system-level cost similar to that of Model 2A and Model 2B. Model 3 has the highest system-level cost to support the increased container throughput due to expansion.

- **Per Container Cost:** Should Model 1 meet the same convenience standards required in Model 2 and Model 3, the per container cost is estimated to be $0.059. Model 3 is the most cost-efficient on a per container basis, largely due to increased throughput and adoption of a strategic mix of technologies, including bulk RVMs for high-volume redemption centers and a combination of retail redemption RVMs and bag drop options to meet required convenience standards.

	MODEL 1:	MODEL 2A, Bag Drop:	MODEL 2B, RVM:	MODEL 3, EBB:
BBS SYSTEM-LEVEL COSTS (excluding latent cost of separate trips taken by consumers to redeem)	$9.4 million	$10.5 million	$9.2 million	$14.0 million
BS COST PER REDEEMED CONTAINER (excluding latent costs of separate trips taken by consumers to redeem)	$0.050	$0.056	$0.049	$0.040

Costs – Recycling System (RS)

- **System-Level Costs and Container Costs:** No change in System-Level Costs between Model 1 and 2. 2% increase for Model 3 due to loss of revenue resulting from the Expanded Bottle Bill. Container Costs is reduced for Model 3 as less containers are recycled through the RS (recycled through the BBS instead).

- **Per Container Cost:** Models 1 and 2 per container cost are the most cost efficient across both BBS and RS per container costs, while Model 3 is less cost-efficient in the recycling system on a per container basis, largely due to decreased throughput.

RS SYSTEM-LEVEL COSTS (all recyclables: paper, cardboard, steel and aluminum cans, glass bottles and jars, plastic bottles and jugs, but excluding latent cost of separate trips taken by consumers to redeem)	MODEL 1:	MODEL 2:	MODEL 3:
	$37.95 million	$37.95 million	$38.85 million
RS CONTAINER COSTS (excluding latent cost of separate trips taken by consumers to redeem)	$4.25 million	$4.25 million	$2.2 million
RS COST PER CONTAINER (excluding latent costs of separate trips taken by consumers to redeem)	$0.033	$0.033	$0.045

Overall Financial Cost (BBS + RS)

- **Overall System (i.e., Weighted BBS + RS) per container cost:** Model 3 is the most cost-efficient on a per container basis, given the reduction in costs with the elimination of brand sorting, increased efficiencies through technology adoption and management by the PRO, as well as increased overall volume of containers collected.

OVERALL COST PER CONTAINER (excluding latent costs of separate trips taken by consumers to redeem)	MODEL 1	MODEL 2A, Bag Drop	MODEL 2B, RVM	MODEL 3, EBB
	$0.043	$0.047	$0.043	$0.040

Greenhouse Gas Emissions (GHG)

- GHG estimates for beverage containers managed through the BBS and the RS were developed using EPA's Waste Reduction Model (WARM) and supplemented with additional consumer trip information

- Model 2 yields slightly higher environmental benefits than Model 1, primarily due to reduced transportation emissions associated with a higher number of redemption locations. Model 3 provides the most significant environmental benefit (i.e., a greater emission reduction than Models 1 and 2).

		MODEL 1	MODEL 2	MODEL 3
MTCO$_2$-eq Avoided	BBS	(21,134)	(21,134)	(31,108)
	RS	(9,244)	(9,244)	(3,158)
MTCO$_2$-eq associated with Separate Consumer Trips	BBS	2,344	2,050	2,050
	RS	99	99	47
Net Total MTCO$_2$-eq (exc)		(30,074)	(30,074)	(34,108)
Net Total MTCO$_2$-eq (inc)		**(27,631)**	**(27,924)**	**(32,011)**

Key: (exc) = excluding separate trip cost
(inc) = including separate trip cost

Litter

- Litter tonnage estimates are expected to be the same for Models 1 and 2, with a slight decrease in Model 3 because of expansion in covered beverages.

- **Litter volume** is estimated using 2009 litter studies by Keep America Beautiful and Greenup Vermont. This is the most recent data available for per-capita litter generation

- **Litter composition** is estimated using data from a 2021 Keep America Beautiful study that suggests a composition of 40% cans, 36% PET, and 24% glass by units. Combined with container per pound conversion factors derived from CRI 2021 purchased data for the state of Vermont, this translates to a composition of 6% cans, 7% PET, 1% HDPE, and 86% glass by weight.

- **Reduction resulting from expansion** is estimated based on a study in New York from 2008 to 2015 that suggested expansion in the DRS to include plastic water bottles resulted in a reduction of plastic bottles in litter by about 40%. Assuming Vermont could respond similarly to this Northeastern state, a 40% reduction was applied to modeled litter for all material types, proportionate to the percentage of expansion containers over all container waste. **This resulted in a reduction of modeled litter for Model 3, decreasing by 22% from 411 tons in Model 1 to 322 tons in Model 3.**

Next Steps

Next Steps

- The reported analyses and metrics on cost, material flows, and environmental impacts are intended to support evidence-based policy decisions.

- This report will continue to be publicly available on the VT DEC website

- DEC and Signalfire Group will be available to answer questions from lawmakers and others

Questions and Discussion

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