Key Metrics and Other Observations on Recycling Costs and Funding

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We mobilize people, data, and solutions across the value chain to reduce waste and our impact on the environment while also unlocking economic benefits.

General Observations

Recycling generally a **high fixed cost system**, where units of production over capital costs matter in the base economics

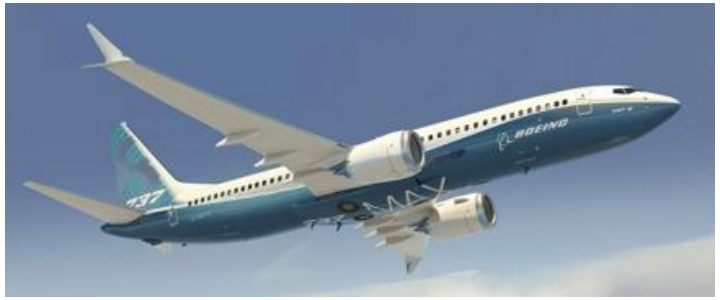
Material **market values never cover the full costs** of collection and initial processing (not even close in most cases)

Nature and scale of materials being managed very important

A **System Performance** perspective helps map strategic interventions and needed improvements

Traditional model of recycling financing in the U.S. has reached the limits of performance – **other models needed** to produce higher performance

Productivity Across High Fixed Costs: An Analogy



$125,000,000

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Measuring Program Performance

Essential Program KPIs

- Tons being managed
- Generating units being served
  (tons/generating unit)
- Participation rates (service utilization rate)
- Tons/generating unit collected
- Costs and cost/ton of material collected
- Recovery/capture rates (generally and by specific material)
- Contamination rates

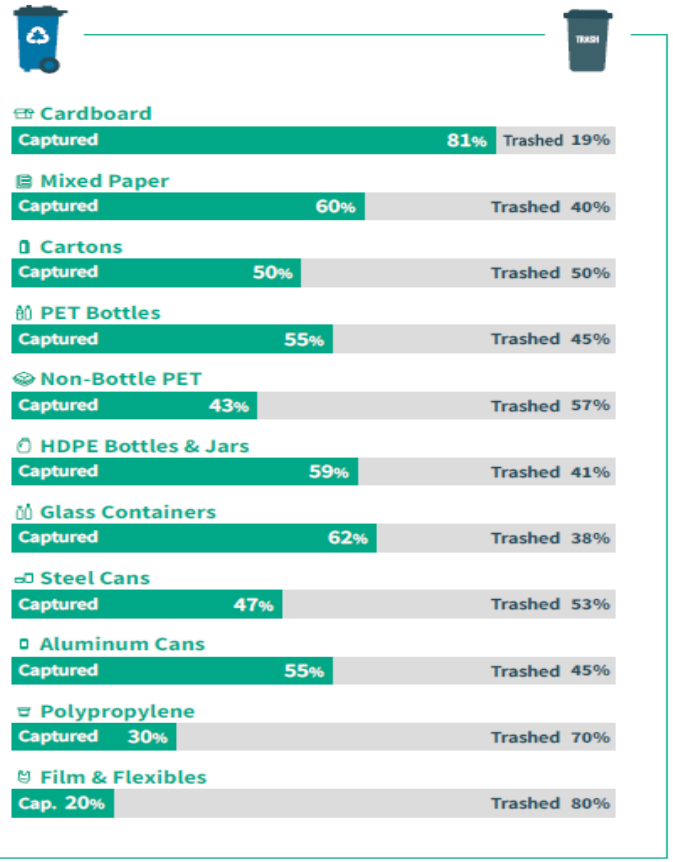
These metrics can apply to any kind of recycling program for any material

Material Stream: What is Being Managed?

Data on Residential Paper and Packaging Recyclables

	Single Family Pounds per Household per Year	Multi-family Pounds per Household per Year	Weighted Residential Pounds per HH/Year	Relative percentage
Cardboard	128	96	122	15%
Mixed Paper	259	194	247	31%
Aseptic & Gabletop	8	6	7	1%
PET Bottles	55	41	52	7%
Non-bottle PET	13	10	13	2%
HDPE Natural Bottles & Jars	12	9	12	1%
HDPE Colored Bottles & Jars	16	12	15	2%
Non-bottle HDPE	2	1	2	0%
Glass Containers	138	103	131	16%
Steel Cans	22	17	21	3%
Aluminum Cans	22	17	21	3%
Aluminum Foil & Trays	9	6	8	1%
PP Containers	23	17	21	3%
Other Plastic Packaging (#3-7)	12	9	12	1%
Bulky Rigid Plastics	24	18	23	3%
Film and Flexible	96	72	92	11%
Total Pounds/HH	838	629	800	100%

Participant Capture of Different Material Types*



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Factors that Determine System Performance (and the Fate of Materials)

Example Calculation **70%** * **80%** * **75%** * **65%** * **90%**

= 25% Recycling Rate

In a theoretical state where 1 million tons of recyclable packaging and paper enters households, 250,000 tons would exit the back of MRFs and head to market

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National Residential Recycling Rates by Material Category*

Material	Tons Generated	Tons Recycled	Recycling Rate	Total Tons Lost (Homes & MRFs)	% Lost (Homes & MRFs)
Cardboard	7,509,483	2,371,572	32%	5,137,912	68%
Mixed Paper	14,814,158	3,401,524	23%	11,412,635	77%
Aseptic & Gabletop	422,553	35,762	8%	386,791	92%
Glass Containers**	8,000,677	2,152,303	27%	5,848,374	73%
Steel Cans	1,198,282	231,156	19%	967,126	81%
Aluminum Cans**	1,308,956	393,488	30%	915,469	70%
PET Bottles**	3,412,310	971,215	28%	2,441,095	72%
Non-bottle PET	748,974	58,443	8%	690,531	92%
HDPE Natural Bottles	739,178	188,704	26%	550,474	74%
HDPE Colored Bottles	928,780	208,624	22%	720,155	78%
Polypropylene Containers	1,225,325	94,881	8%	1,130,444	92%
Plastics #3-7 (minus PP)	754,006	8,909	1%	745,097	99%
Bulky Rigid Plastics	1,516,711	17,231	1%	1,499,479	99%
Film & Flexible	4,787,126	4,569	<1%	4,782,556	>99%
TOTAL	**47,366,519**	**10,138,381**	**21%**	**37,228,139**	**79%**

*out of tons generated

**includes material captured through state deposit return systems

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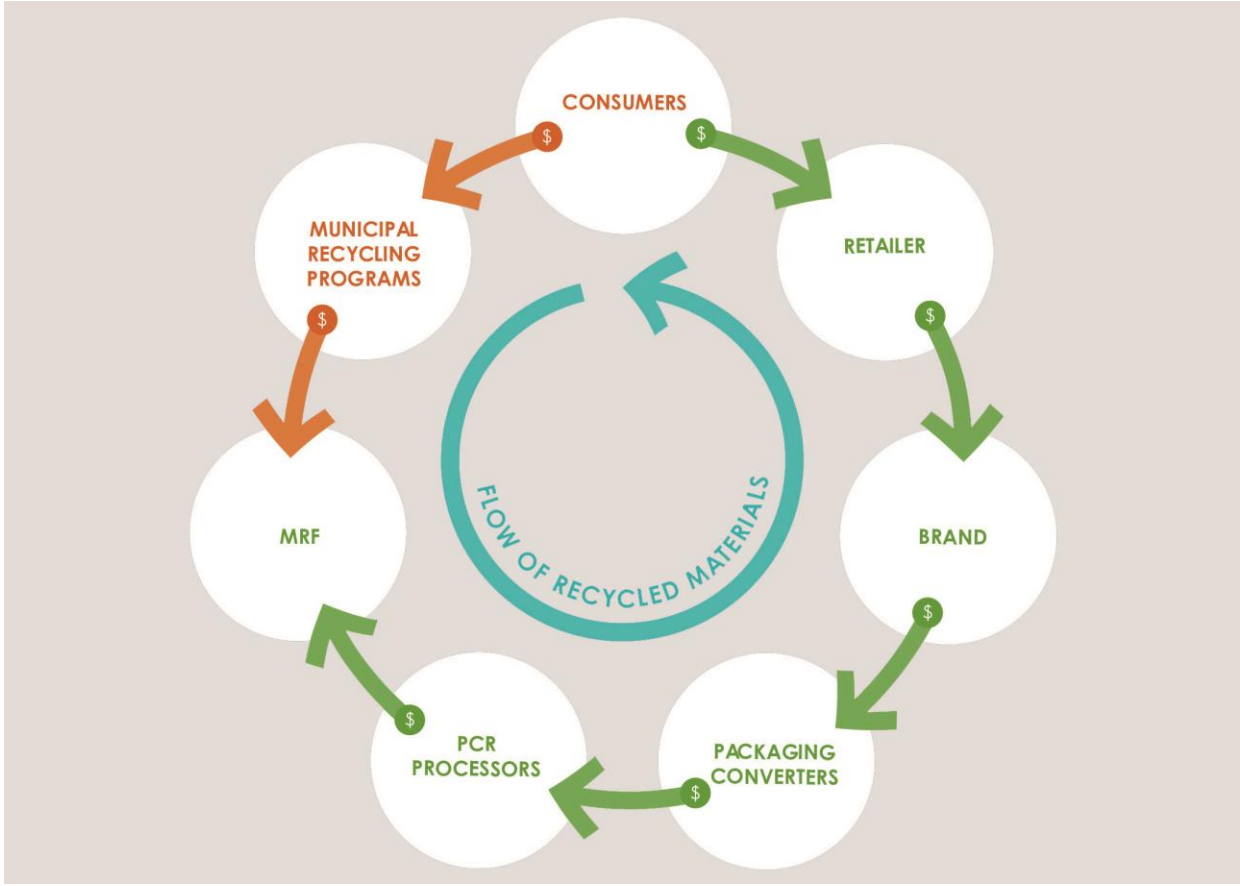
https://recyclingpartnership.org/residential-recycling-report/

Challenges to System Performance

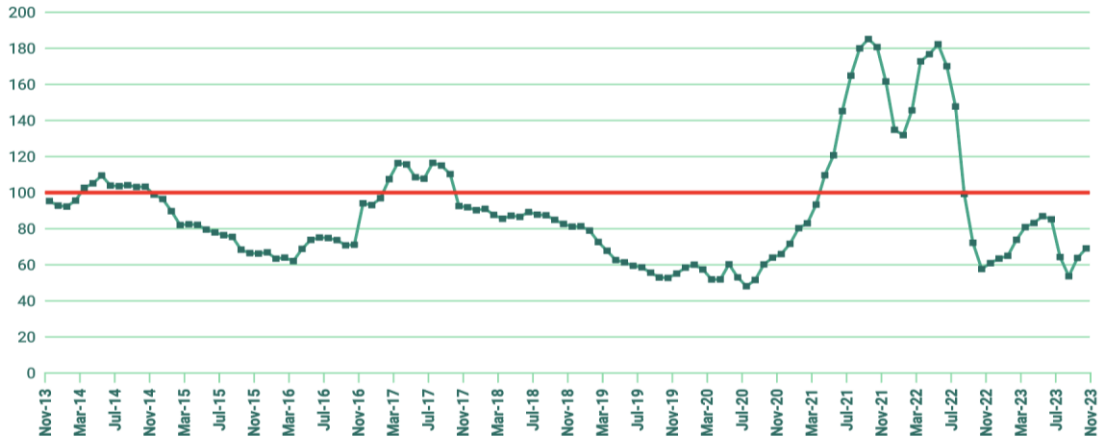
Material and money flow model indicates structural issues

Commodity prices fail to provide stability or adequate financing

Transformed MRF business model provides clarity to system economics but also new barriers



Blended Materials Values for Materials Recovery Facilities



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Cost Observations – General Rules of Thumb

Generally, a universally carted curbside program costs $6/month/household = $72 year

In an example city of 1,000 households, the full cost of program = $72,000

At ~750 lbs*/household/year generation, 750,000 lbs available (375 tons)

*excluding film packaging

Scenario	Tons collected	Cost per ton
Full collection of all recyclables (100% participation and 100% participant capture)	375	$192
80% participation and 80% participant capture	240	$300
50% participation and 50% participant capture	93.75	$768

What Kind of Capital Investment Would Improve System Performance?

Paying It Forward Model and Report – May 2021

Projected $17 Billion needed for:

- System of universal equitable collection access
- Full system of efficient MRFs
- Robust, consistent education
- Pathway for film packaging

Figure A1: **Main Components of Investments Needed, Further Detailed in Appendix A**

Component	Capital Needed	Cumulative Total
Collection Investment (including Hub-and-Spoke)	$4,123,000,000	
New MRF Investment	$998,000,000	$5,121,000,000
MRF Upgrades	$1,539,000,000	$6,660,000,000
Hub-and-Spoke Transfer	$59,400,000	$6,719,400,000
Education and Engagement for Material Quality and Optimized Recovery ($10/HH per year for five years)	$6,038,000,000	$12,757,400,000
Film and Flexible Packaging Collection and Processing	$4,086,000,000	**$16,843,400,000**

Figure 10: **Commodity Increases From Equitable Access**
(Note: For more details on impacts for specific commodities, see Appendix B.)

Material	Current Annual Tonnage	Increased Annual Tonnage From Equitable Access	New Total Annual Tons
Paper	10,245,400	8,946,800	19,192,200
Metals	577,900	709,700	1,287,700
Glass	2,977,300	3,363,300	6,340,600
Plastic*	1,611,200	3,878,700	5,489,900
Total	**15,411,800**	**16,898,600**	**32,310,400**

* Includes 2 million tons of film and flexible material facilitated by capital investments in collection and processing of that material.

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Alternate Financing to Achieve Higher Performance

Twin challenges

- General flat performance of U.S. recycling system
- Need for expansion into new critical areas (e.g., food waste, textiles)

System relying on local government financing has met its limits

- Fails to produce consistent, equitable and cost-efficient services
- Fails to provide capitalization at scale and at speed
- Highly welcome and needed new initiatives – e.g., EPA grant program - don't change the basic model and so will have limited impacts

Alternate financing through Extended Producer Responsibility gaining steam

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EPR Needs Assessments as Critical Data Exercises

- States implementing EPR are conducting processes that map needs and costs
- Cost exercises will be among the most comprehensive ever completed
- Scope of costs unique to each state law
- Historic EPR laws for non-packaging materials also a source of potential insights

Key Table in Colorado Needs Assessment

		Baseline (2022) Lower	Baseline (2022) Upper	2030 Lower	2030 Upper	2035 Lower	2035 Upper
Low	Total Annualized Cost ($ millions)	80	140	130	210	160	260
	Cost Per Household ($)	60	90	60	100	70	120
	Cost Per Household ($)	260	430	270	440	240	380
Medium	Total Annualized Cost ($ millions)	80	140	160	260	190	310
	Cost Per Household ($)	60	90	70	120	90	140
	Cost Per Ton Recycled ($)	260	430	300	490	270	430
High	Total Annualized Cost ($ millions)	80	140	160	260	210	340
	Cost Per Household ($)	60	90	70	120	100	150
	Cost Per Ton Recycled ($)	260	430	300	480	280	450

Conclusion

Recycling is a high fixed cost system

Cost, Performance, and Financing integrally linked

Recycling Behavior a critical factor

Capital intervention by itself will not drive scaled change