
PAYING IT FORWARD:

How Investment in Recycling Will Pay Dividends



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About The Recycling Partnership

The Recycling Partnership is the action agent transforming the recycling system and activating a circular economy for packaging. We work on the ground with thousands of communities to transform underperforming recycling programs and tackle circular economy challenges. We work with companies to make their packaging more circular and help them meet their climate and sustainability goals. And we work with government on the policy solutions that will strengthen the foundation of our residential recycling system through a shared-responsibility approach with all stakeholders at the table.

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Executive Summary

Recycling is unique. It starts in the home but feeds a complex reverse supply chain that determines the fate of corporate recycled content and sustainability goals.

It only works if everyone can participate and the materials collected can be processed, but recycling is not provided evenly across the U.S., and many packages currently found on store shelves cannot be recycled through residential programs. The plateaued and abysmal national recycling rate makes clear that scaled and systemic intervention is needed.

We have the proven solutions to level up the U.S. recycling system, and it is imperative that we do so to meet the demands of both people and the planet, to create sustainable, low-carbon supply chains, and to realize the promises of a circular economy.



40% of Americans Lack Equitable Recycling

It is easy to assume that everyone can recycle as easily as they can throw something away. However, approximately 40 million U.S. households still do not have recycling access that is equitable to their trash service.

At its most basic level, equitable and informed recycling access means all people living in the U.S. can recycle just as easily as they can throw something away and understand how and when to do so. The recycling system needs dramatic investment to finally, equitably, serve all people and be inclusive of the paper and packaging found in the home.¹

What will it cost to make recycling a reality for everyone?

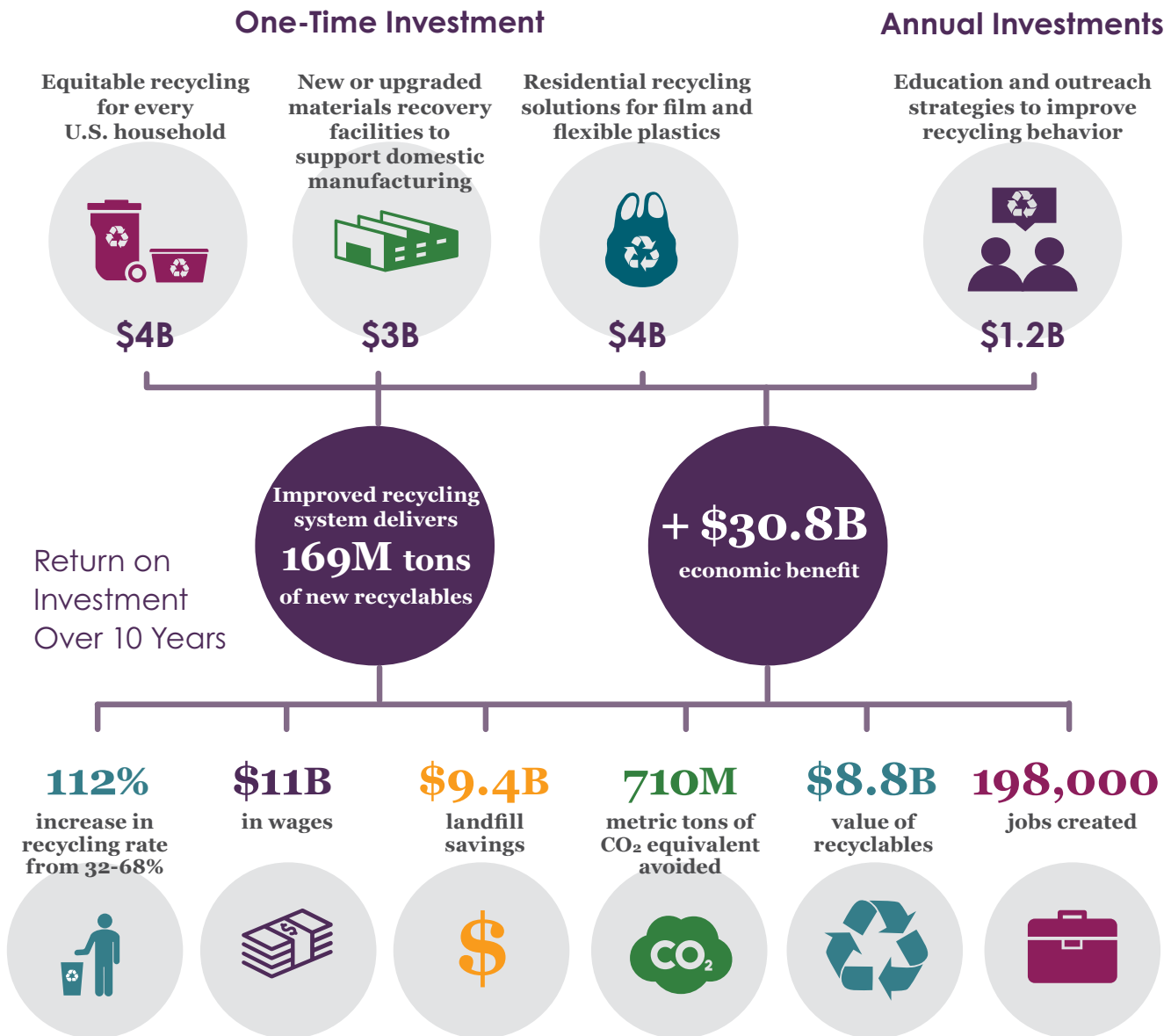
A \$17 billion investment over five years will transform the U.S. residential recycling system and make it as accessible and as ubiquitous to everyone as trash disposal.

¹ Over the past decades, many packaging sectors have invested millions, if not billions, in building a better recycling system and that investment is to be commended. This report recognizes the value of the existing capital deployed in the system while also calling for a scaled and systematic investment to address its shortcomings.

Improving Our Recycling System Will Pay Dividends in the Future

\$17 billion applied to proven recycling solutions will have immediate positive impact, including an economic benefit of \$30.8 billion over 10 years (including wages, taxes, landfill savings, and the value of recyclables)²

\$17B investment is needed over 5 years



² Wages and taxes were calculated from here: 2020 EPA Recycling Economic Information Report www.epa.gov/sites/production/files/2020-11/documents/rei_report_508_compliant.pdf

Key Finding #1:

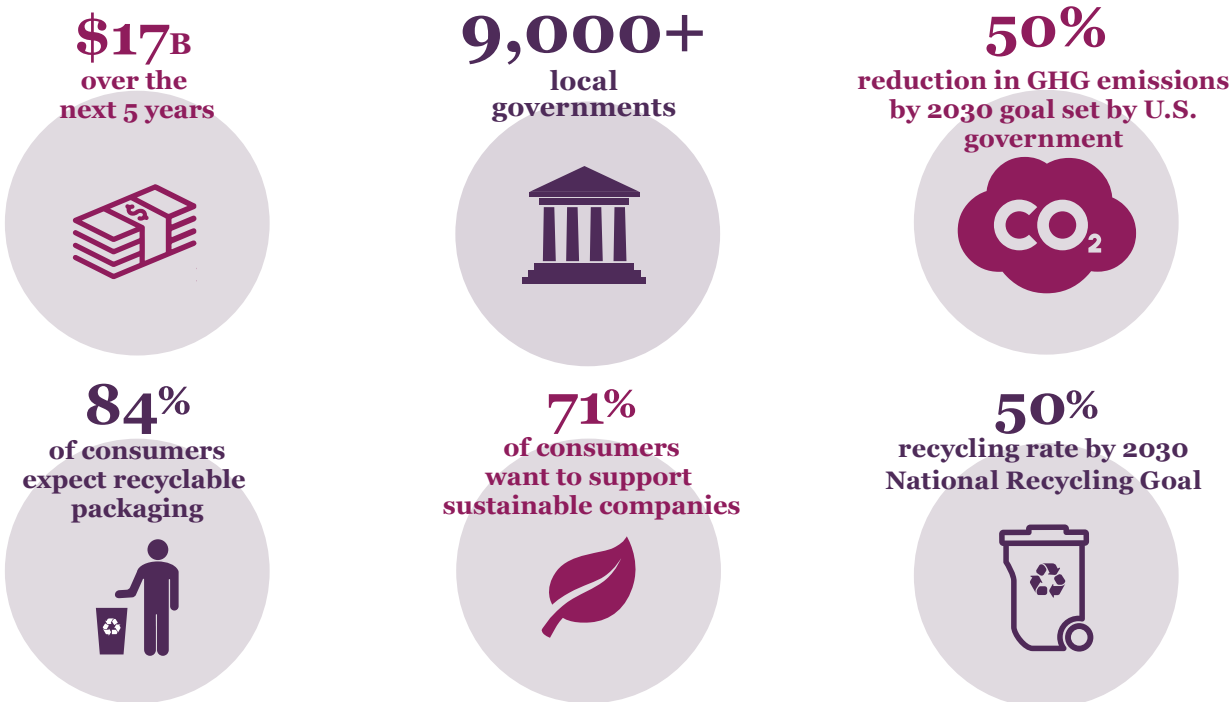
The US Needs an Overall Investment of \$17 Billion Over 5 Years

It is a big task, but it comes with good news: the opportunity to build a better recycling system has never been more timely or needed. There is a readiness for change among the diverse set of public and private entities – from the 9,000 local governments³ that run recycling programs to consumer goods companies and the private-sector collectors and processors of recyclables.

What are the signs that the time is now?

- 1. The public demands it.** 84% of consumers expect packages to be recyclable and made from recycled material and 71% will go out of their way to support sustainable companies.⁴
- 2. Corporate engagement has never been higher.** Companies are making aggressive commitments to use more recycled content, reduce waste, achieve higher recycling rates, and curb greenhouse gases.⁵ We see a movement not just through individual company and industry association pledges, but importantly through collaborative efforts such as the 70+ companies that fund The Recycling Partnership and the recently launched U.S. Plastics Pact. These companies realize that significant change is required

BY THE NUMBERS — OVERVIEW



³ Recycling Partnership data indicates a baseline of 7,700 programs in communities with more than 2,500 households. An unknown number of additional programs are operated by smaller communities – conservatively, these would add another 1,300 programs. The need for a more definitive number prompted The Recycling Partnership's successful effort to win Congressional approval for EPA funding to conduct a national Recycling Needs Survey and Assessment.

⁴ [SWNS survey results](#) demonstrate that Americans prefer sustainable companies.

⁵ In addition to corporate goal-setting, companies are also signing onto commitments like the [U.S. Plastics Pact](#) and [The Climate Pledge](#).

to meet their commitments – they need increased and steady material supply, and they do not want their packaging to end up in landfills or as litter.

- 3. Federal and state policymakers from both parties are energized.** In addition to a growing number of bills concerning recycling and circularity at the state and federal levels, there is also increased support in Congress for the U.S. Environmental Protection Agency (EPA) to take bold action, with the expectation that the U.S. will reach its National Recycling Goal of 50% by 2030.
- 4. The U.S. is taking a leadership role on climate.** The U.S. has pledged to cut greenhouse gas emissions by 50% by 2030. This aggressive goal will require innovative solutions and a shift to a circular economy.

What's not included in this analysis?

This report focuses on the residential recycling system and both traditionally accepted paper and packaging, as well as those packaging formats not commonly collected in residential programs, like film and flexible plastics. It does not include an analysis of capital needs to improve recycling for commercial (retail, restaurants, offices, etc.), institutional (schools, universities, hospitals, etc.), and public spaces (parks, sports fields, pedestrian areas, etc.) – these sources of discarded material also need attention and investment to optimize material sustainability. Composting, material reduction, and reuse are also critical parts of the circular economy – an economy in which waste and pollution are designed out – but they also fall outside the scope of this analysis.

Finally, this report does not include funding for recycling operations. However, without operational support, which is the largest cost center to local governments for recycling service, uptake of recycling capital improvements envisioned by this model could be uneven and not fully optimized for maximum participation or efficiency. Packaging and products have changed significantly, and municipal service areas have expanded since recycling programs were implemented in the 1990s, but local governments still solely bear the estimated \$10 billion annual cost of operational expenses to keep the U.S. residential recycling system in motion. Communities face continual and significant budgetary pressures, only exacerbated by COVID-19. Without sustainable funding for operations, communities cannot be compelled to offer recycling service, even if the cost of capital equipment is covered.⁶

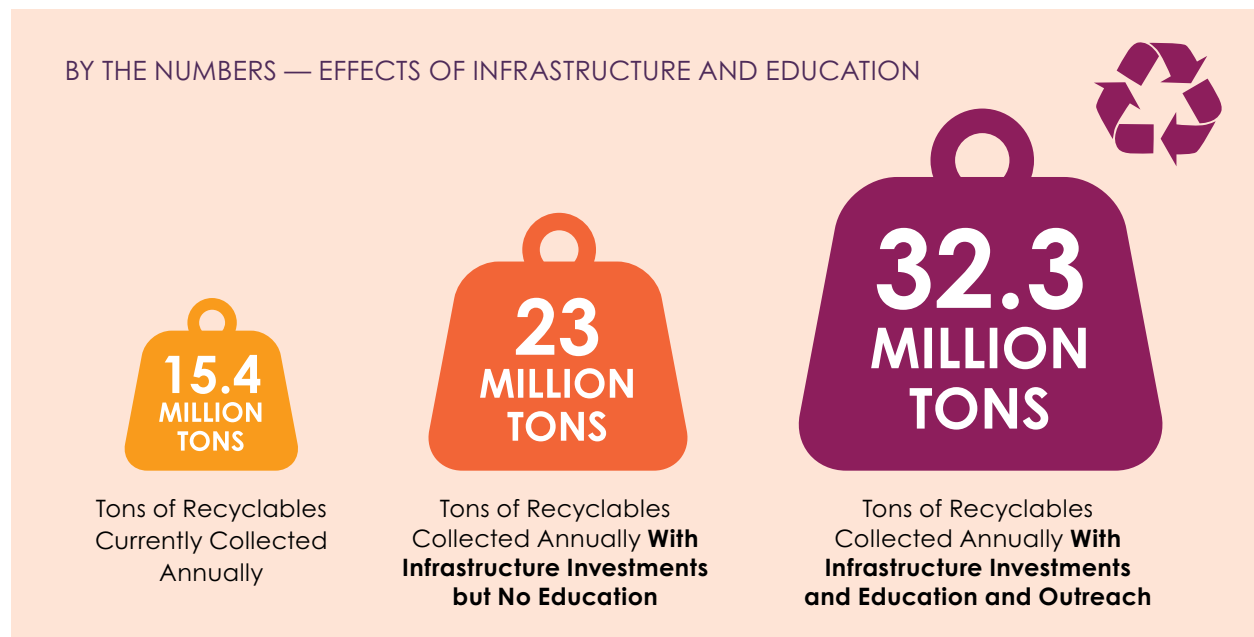
⁶ More on the operation of recycling and how those costs are currently carried by local governments can be found in The Recycling Partnership's [2020 State of Curbside Recycling Report](#) and [The Bridge to Circularity](#) reports.

Key Finding #2:

Fully capitalized recycling infrastructure and education could double the national residential recycling rate, delivering a better, cleaner supply of all recycled materials to the U.S. economy.

The U.S. recycling system has been stuck for decades at a dismal residential recycling rate that hovers in the mid-30% range. We can increase the recovery of recyclables up to 70% with the investments outlined in this report, consistently delivering an annual supply of 32 million cleaner tons to manufacturers across the U.S. But to jump-start the U.S. recycling system, we must provide three things:

- 1. Recycling containers for every household that are on par with their trash disposal**, making it as easy to recycle as it is to throw something away.
- 2. Education, outreach, and behavior change strategies** to reduce public confusion of what and how to recycle, substantially improve consumer use of the recycling system, and restore trust in the recycling system.
- 3. Modernized and upgraded materials recovery facilities⁷ (MRF) sortation** to accommodate all packaging materials currently found in the home, including those not typically collected in residential programs, like film and flexible plastics.⁸



⁷ Materials recovery facilities (MRFs) employ various manual and machine processes to sort recyclable materials, remove contamination, and process, usually by baling, for shipment and sale to various markets.

⁸ Materials traditionally collected in curbside programs include glass bottles and jars, plastic bottles and containers, steel and aluminum cans, cardboard and paperboard boxes, printed paper, and cartons. Common packaging formats not typically collected in the current residential system include film and flexible plastics, tubes, and plastic clamshells.

Key Finding #3:

Policy solutions need to be built with collaborative corporate, government, NGO, and policymaker engagement.

The foundations of the modern U.S. recycling system were built on sensible policies. A new wave of policy action can take the system to the next level. A shared responsibility model is needed to drive significant new investment in recycling; otherwise, we cannot address the system challenges presented in this report. It is simply too slow and expensive for any one company, community, or organization to solve.

Policymakers are looking to nonprofit and private-sector partners to inform and build pragmatic and uniquely American solutions to recycling's challenges. The Circular Economy Accelerator (CEA) understands that if we want to level up and unify the U.S. recycling system, then we must get serious about the need for federal policy and the important role packaging companies can play in crafting a plan that works for all. In late 2020 the CEA released a policy report, [Accelerating Recycling: Policy to Unlock Supply for the Circular Economy Report \(Policy Report\)](#). The policy report is a testament to the need to act and the power of public-private solution-building.⁹

The system needs outlined in this report are quantifiable and achievable, but they will require collaboration from all parts of industry, all levels of government, policymakers, investors, and the public to bring them to fruition and maximize their potential. ***It is a challenge we know all stakeholders are ready and eager to achieve.***

While outside the scope of this report, we recognize that the success of improved recycling access and processing is also contingent on companies designing packaging for circularity.

Circular packaging design will improve the recovery of materials as they move through the recycling system and increase the use of recycled content to stimulate market demand.

Additionally, investments are needed to grow adequate end-market capacity, which is an important consideration for policymakers and businesses alike. End markets may also need policy and financial support to accelerate expansion, but it will pay dividends as domestic end markets provide market pull for the increased supply of recyclable materials, while concurrently supporting growth in U.S.-based processing and manufacturing jobs.

⁹ The CEA's members collectively helped draft the policy report, published in late 2020, which was ultimately endorsed by 18 of the world's largest companies and trade organizations. Learn more at: recyclingpartnership.org/accelerator-policy/.

Return on Investment

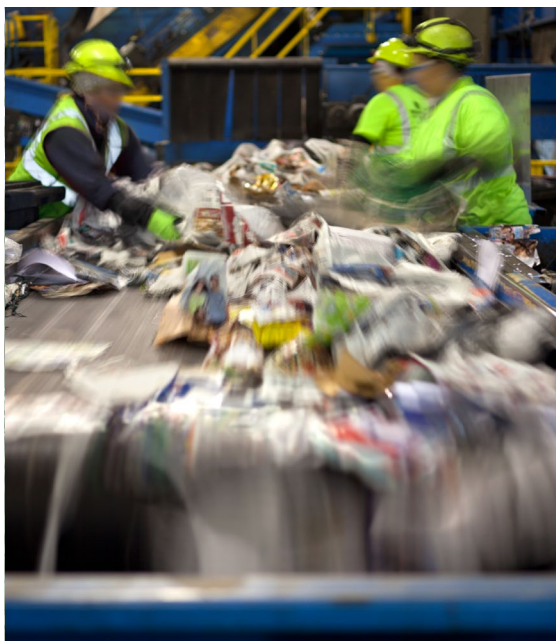
Solving today's recycling system challenges will double the return on investment within 10 years and deliver almost 200,000 new jobs.

We estimate these improvements will cost \$11 billion for infrastructure and \$6 billion for education investments over five years, and \$1.2 billion annually thereafter for continued resident education.

These improvements will have an immediate positive impact, including an economic benefit of \$30.8 billion over 10 years (including wages, taxes, landfill savings, and the value of recyclables).



Environment



Jobs



Economy

There are important returns on investment in the first 10 years alone:

1. We create almost 200,000 new jobs and deliver \$30 billion in economic impact.¹⁰
2. The recycling rate goes from approximately 32% to 68%, delivering 169 million tons of new recyclables.
3. 40 million underserved households are able to recycle the packaging they receive in their homes.
4. We achieve high levels of MRF efficiency and bale quality through upgrades to 375 MRFs and the construction of 57 new MRFs, streamlining material flow from collection to market.
5. We solve tough recycling challenges like packaging that is not yet recyclable at scale.
6. We avoid an estimated \$9.4 billion in landfill costs.¹¹
7. We create an estimated \$8.8 billion in new, high-quality recyclable commodities.
8. We generate huge environmental benefits from the total 320 million tons of materials recovered, saving:
 - 710 million metric tons of CO₂ equivalent
 - The average water usage of 30 million people
 - The average energy usage of 28 million people
 - The equivalent of 129 million cars' emissions
9. We create the confidence in material supply to spur investments in new end markets and technologies.
10. We build consumer confidence in recycling and in the brands that create the products and packaging that people want and need.

Conclusion

The headwinds are significant, and as we have seen over the past few decades of attempted interventions, the U.S. recycling system will not fix itself.

The current strategy of partial grants and low-interest loans are effective at the community level but do not provide the pace of change needed.

The U.S. currently lags every other developed nation in its approach to managing recyclables in the home.

The good news, however, is that there are proven solutions, the scale of the challenge is known, and it is all within our collective power to fix through dramatically expanded public-private partnerships and robust policy that provides sustainable funding.

¹⁰ Calculated using the wage and tax multiplier from the 2020 EPA Recycling Economic Information Report, [epa.gov/sites/production/files/2020-11/documents/rei_report_508_compliant.pdf](https://www.epa.gov/sites/production/files/2020-11/documents/rei_report_508_compliant.pdf), and adding The Partnership's calculated landfill savings and value of recyclables figures.

¹¹ Environmental Research and Education Foundation, Analysis of MSW Landfill Tipping Fees: [2020 erefdn.org/product/analysis-msw-landfill-tipping-fees-2/](https://www.eref.org/product/analysis-msw-landfill-tipping-fees-2/)

Introduction – A Dramatic Investment in Recycling Is Required



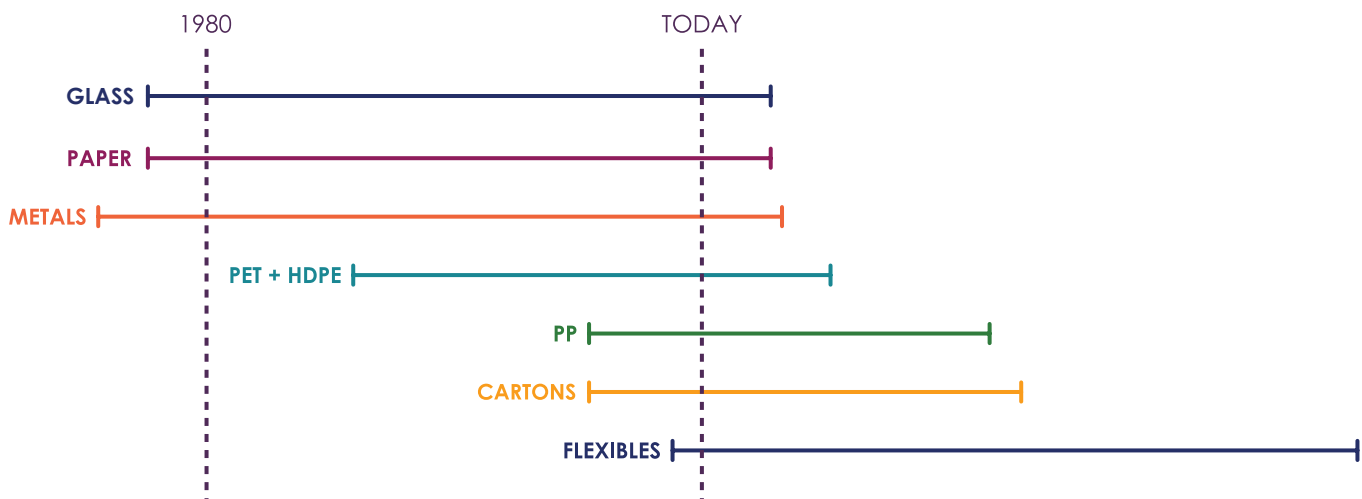
Without an estimated \$17 billion intervention over five years, recycling will fail to deliver on the needs of industry, the sustainability promises of companies, and the expectations of consumers and elected officials.

The flat performance of the U.S. recycling system over the past two decades is due to its inability to serve the entire U.S. population with fully optimized collection systems, provide comprehensive education and outreach, and create an adequate materials recovery facility (MRF) infrastructure.

These shortfalls illustrate fundamental constraints that must be addressed through bold leadership. The interventions described in this report, which are based on the Recycling Capital and Education Needs Model (model), will reverse the current system inertia, overturn the status quo, and dynamically move us beyond the dismal 32% residential recycling rate, which will remain stubbornly stuck without large-scale investment.

As illustrated in Figure 1, for decades industry sectors have invested in recycling for their materials. As packaging types evolve, new investments by different material sectors emerge. However, to date there has not been a systematic and large-scale investment in recycling, so improvements are uneven across locations and material types.

Figure 1: Investment in Recycling Infrastructure by Material Sector



These gaps in the U.S. curbside recycling system were documented in The Recycling Partnership's [2019 Bridge to Circularity](#) and [2020 State of Curbside Recycling](#) reports. The headwinds and challenges include:

More than two out of five Americans simply cannot recycle conveniently at home. With 40 million U.S. households experiencing no or inequitable access, millions of tons of recyclables end up in the landfill every year. Equitable access means all people, rich or poor, rural or urban, in multifamily or single-family housing, can recycle and that they have the confidence and understanding to do it well.

Multifamily housing is categorically underserved. Multifamily recycling access relies on individual private property owners to prioritize recycling services. While multifamily recycling can be supported by local recycling ordinances, enforcement efforts are costly and function with varying degrees of success.

Some people must pay extra to recycle. In key areas of the country, curbside access relies on households requesting subscription service and adding the expense to their monthly budget — a barrier that leaves millions of families outside the recycling system.¹²

It is difficult for MRFs to invest in modernization without increasing fees to communities. Although MRF investment is critical to keep pace with packaging innovations and maximize material recovery, MRFs rely heavily on community recycling programs to pay processing fees, leading to reliance on local taxation and service fees, which create financial barriers that can deter local recycling program expansion and further hinder needed MRF upgrades.¹³

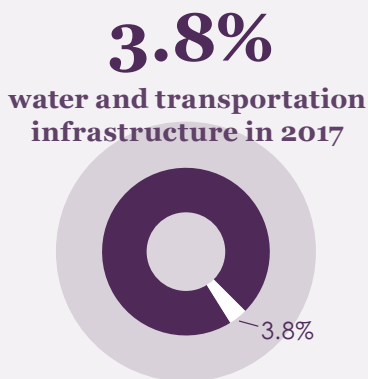
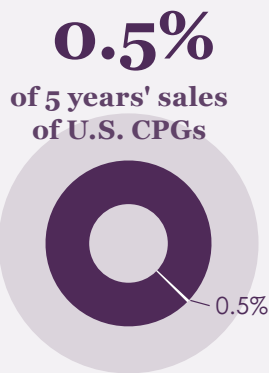
¹² In Indianapolis, the barrier of an \$8/month service charge has led to a subscription rate of only 10% of the city's 290,000 households.

¹³ The growth of processing fees has led some communities to decide they cannot afford a continual investment in recycling services, as documented in the [2020 State of Curbside Recycling Report](#) and in ongoing local news stories in various parts of the country.

Putting \$17 Billion in Context

\$17 billion is a large number, but to put it into context with the U.S. consumer-packaged goods (CPG) industry as a whole, it represents 0.5% over five years of annual sales.¹⁴

Looking at another sector, in 2017, \$441 billion was spent by federal, state, and local governments on water and transportation infrastructure.¹⁵



The public is confused and needs help building trust. Recycling education is a key and critical factor to success. While we see other kinds of outreach efforts to enlist public action receive between \$2 and \$75 per household in education and outreach funding annually, recycling programs frequently invest little more than the cost of printing and posting an annual mailer to engage with residents, if they invest at all.¹⁶ Many communities have no outreach budget whatsoever, leaving Americans wondering what they can recycle and how to participate. And the importance of engaging multicultural communities remains a largely unmet need.

Low cost of disposal. Inexpensive landfills turn smart environmental decisions against the bottom line, with landfilling often half the cost of recycling. Local governments bear the brunt of this cost disparity and too often choose disposal over recycling.

Competing priorities for communities. A system that relies on cities to make investment choices between recycling and essential services such as police, fire, streets, and schools faces an uphill battle in making scaled improvement.¹⁷

¹⁴ www.mckinsey.com/industries/consumer-packaged-goods/our-insights/what-got-us-here-wont-get-us-there-a-new-model-for-the-consumer-goods-industry

¹⁵ www.cbo.gov/publication/54539.

¹⁶ The U.S. Census spent between \$2 and \$75 per household to reach residents. The [2020 State of Curbside Recycling Report](#) found that, for those communities that did have outreach budgets, the average community allocated \$1.16 per household for recycling education. The Partnership's recently released [Behavior Change White Paper](#) provides more context to resident education needs.

¹⁷ In December 2020, the U.S. Conference of Mayors, National League of Cities, and National Association of Counties submitted comments to the U.S. EPA on the Draft National Recycling Strategy. In the [letter](#), they outlined the headwinds faced by communities and support EPA's engagement to build a better recycling system.

The Risk of Inaction

Stagnant recycling rates are not the only risk of inaction. Mitigating other risks should be considered as part of the return on investment for informed and equitable recycling access:

- 1. Climate Change:** The carbon impact of tons lost to disposal is some of the lowest-hanging fruit in climate change action plans. In February 2021, the U.S. government released a new figure for the social cost of carbon at \$51/ton. Applying that figure to an EPA WARM model calculation of metric ton CO₂ equivalent for disposing currently unrecovered residential recyclables results in a cost impact of \$4.7 billion per year. This cost can be heavily mitigated and progress can be made toward the federal government's 50% reduction in GHGs pledge by achieving equitable and informed recycling access.
- 2. Social License to Operate:** Packaging is under intense scrutiny, and with 40% of the population lacking adequate means to recycle, we see heightened focus on packaging format elimination.
- 3. Corporate Goals:** Companies cannot reach their internal or public goals or environmental, social, and corporate governance expectations without bold action. Almost every materials trade association has recovery goals or objectives related to higher recycling rates. Reaching these goals depends on every person having recycling access and high levels of quality material delivered to upgraded MRFs.
- 4. Social Justice:** Populations underserved by recycling are overrepresented by communities of color, people living in rural areas of the country, and regions dominated by subscription-based service.
- 5. A Patchwork of State and Local Regulatory Action:** Without a coordinated federal-level approach, the more than 30,000 local units of government and 50 states may enact responses on their own, potentially creating a patchwork regulatory framework. See [Accelerating Recycling: Policy to Unlock Supply for the Circular Economy](#) for more information related to a coordinated federal approach.



Breaking Down the Needed Investment

The Recycling Partnership is calling for a \$17 billion investment over five years. While detailed in Appendix A, this investment model was constructed to include three main recycling system components for the paper and packaging that people encounter most often in their homes.



We must do the following to achieve our goals:

- 1. Complete Equitable Access:** Ensure that everyone can recycle the paper and packaging that enters their homes by expanding recycling infrastructure to establish equitable collection access for everyone in the U.S.
- 2. Educate and Restore Trust in Recycling:** Ensure that everyone has the information needed to recycle as much as they can, as often as they can, and as cleanly as they can.
- 3. Modernize and Upgrade MRF Sortation:** Ensure that MRFs are equipped to handle more material efficiently as well as recycle the full range of types of packages found in homes today.

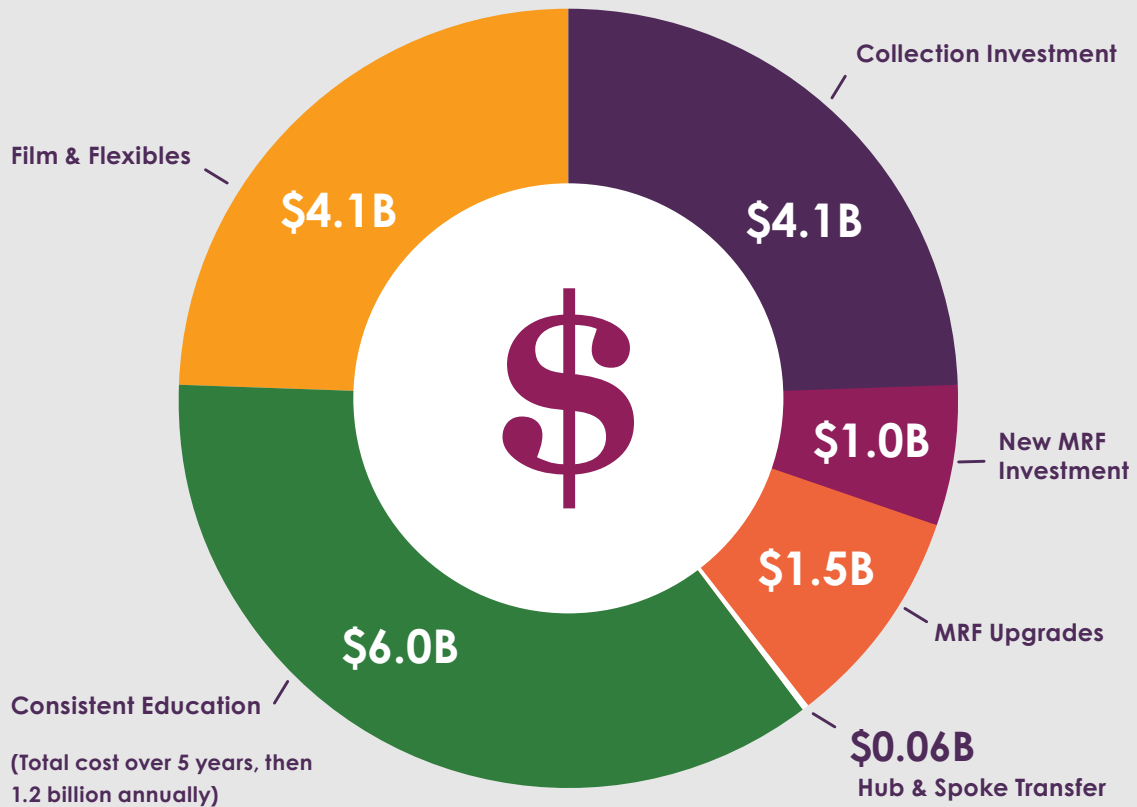
While these investments form the core of the \$17 billion investment figure, The Partnership also recognizes that we must continue to engage companies in aligning the manufacturing of goods around circular economy principles.¹⁸

Examples of avenues for engagement include our Pathway to Circularity program and the recently launched U.S. Plastics Pact. Likewise, investments in end markets are needed to pull materials through the system and shore up a more circular economy.

¹⁸ Circular economy principles include designing out waste and pollution, keeping products and materials in use, and regenerating natural systems. Recycling alone will not maximize the circular economy; reduction of material usage through reuse and redesign must also be embraced. However, a robust and effective recycling system is necessary for the circular economy as the final safety net for products and packages entering the system. Learn more about the circular economy at: ellenmacarthurfoundation.org/circular-economy/concept

Figure 2 shows the basic components and balance of needed investments across the system, improving collection, processing, outreach, and recyclability pathways for additional materials.

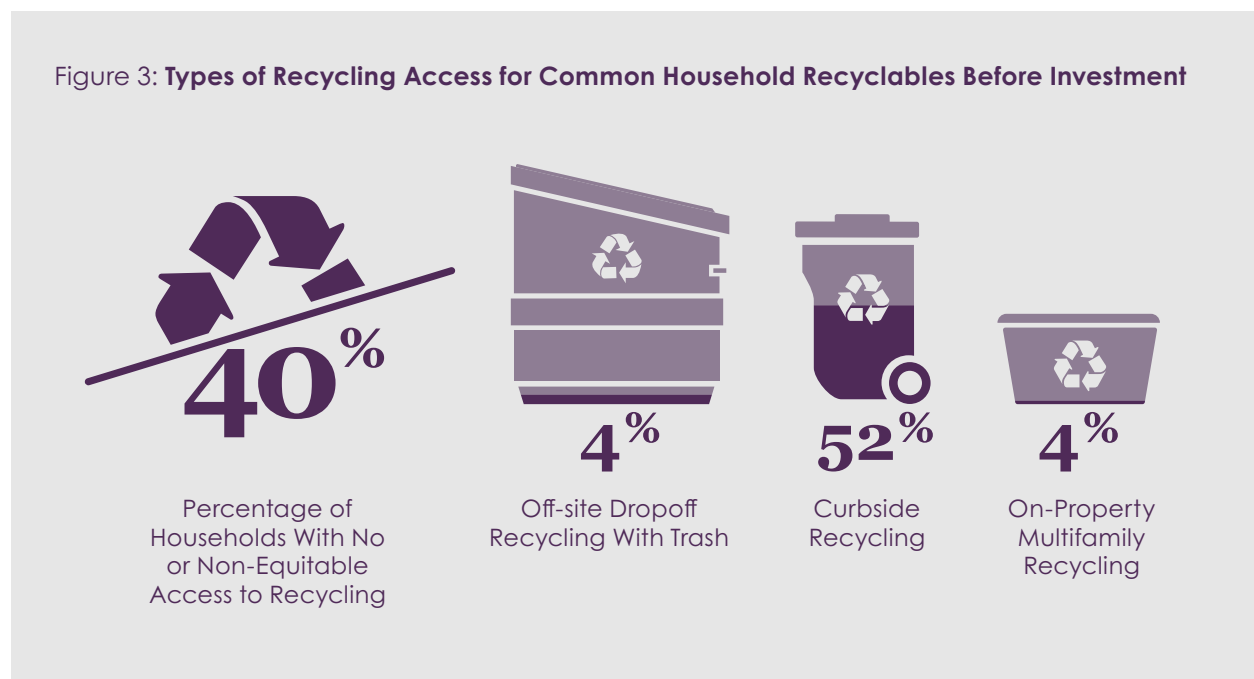
Figure 2: **Main Components of Investments Needed, Further Detailed in Appendix A**



Collection Investments – The Path to Equitable Access

Not everyone recycles the same way – different urban, suburban, rural, multi or single family home settings all impact how recycling services are most efficiently and effectively delivered. However, no one should be excluded from being able to participate, be required to go through extra steps or pay extra fees to recycle, make extra trips to recycle when it isn't required for trash disposal, or have to find alternative ways to keep their recyclables out of the landfill.

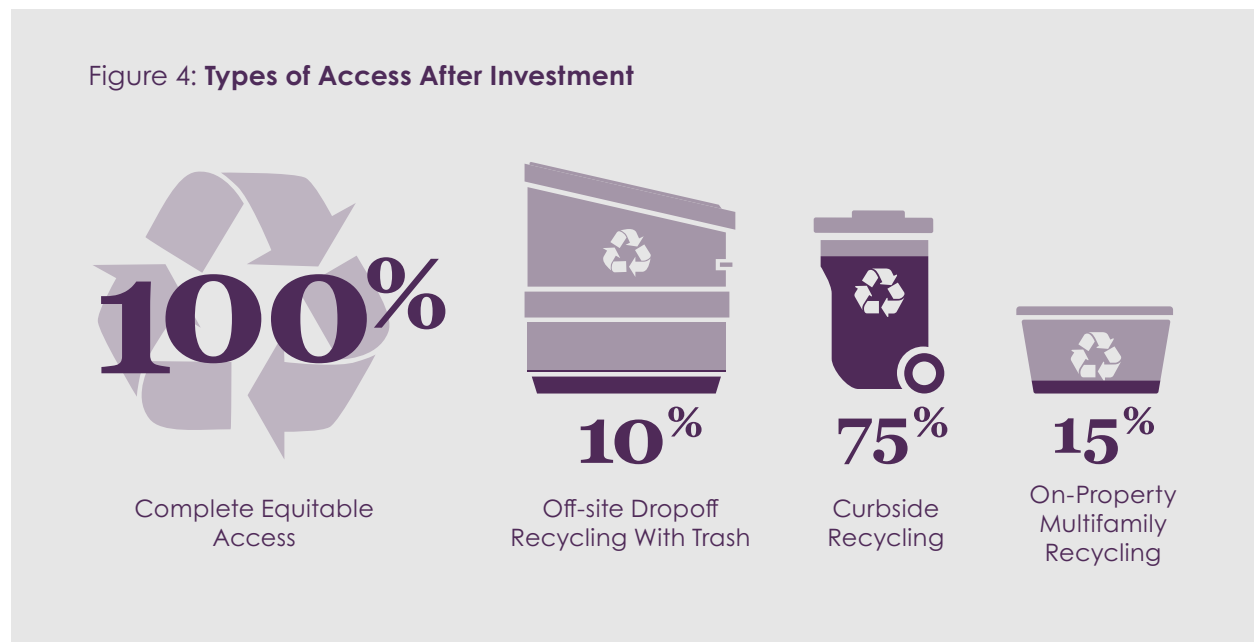
Figure 3 below outlines The Recycling Partnership's current picture of access based on 2018 Census data, accounting for instances of inadequate service, which is a form of inequitable access. The “No or Non-Equitable Access to Recycling” label refers to households with no access at all, households that could subscribe to recycling but do not, multifamily households that lack on-property recycling, and curbside households and dropoff programs with inadequate access compared to trash service.¹⁹



¹⁹ As in the [2020 State of Curbside Recycling Report](#), this analysis uses the definition of dwellings of one to four units or less constituting single family homes, with five or more being multifamily. Some communities use different parameters, but the one to four rubric is common across the country. For households still receiving off-site dropoff recycling in an equitable access system, it is presumed that those households will continue to be users of rural waste systems that rely on combined waste/recycling depots, also known as convenience centers.

Figure 4 shows how the numbers break down when all households have equitable access that's on par with their trash disposal. The largest changes behind this model are: 1) giving access to households that currently do not have any recycling service at all, 2) the large-scale creation of on-property access for multifamily households, and 3) transitioning non-subscribing curbside-eligible households to full subscription or automatic curbside service.²⁰ In each case, the objective is to provide recycling access on par to what these households experience with waste collection.²¹

...no one should be excluded from being able to participate, be required to go through extra steps or pay extra fees to recycle, make extra trips to recycle when it isn't required for trash disposal...



²⁰ This report calculates the cost to fully capitalize collection infrastructure. It does not cover subscription fees or cover the costs associated with recycling provision. The model assumes that providing those capital costs will help compel recycling provision and lower subscription costs.

²¹ In some case, service frequency may still vary, in particular with curbside recycling. Many programs collect recyclables every other week while collecting garbage weekly due to concerns about odor and sanitation. Evidence suggests that capture rates are highly comparable between weekly and every-other-week recycling collection, as long as households have adequate storage capacity for their recyclables.



Single-Family Recycling



On-Property Multifamily Recycling



Off-Site Dropoff

Figures 5-8 further illustrate the before/after creation of equitable access from a scaled capital intervention:

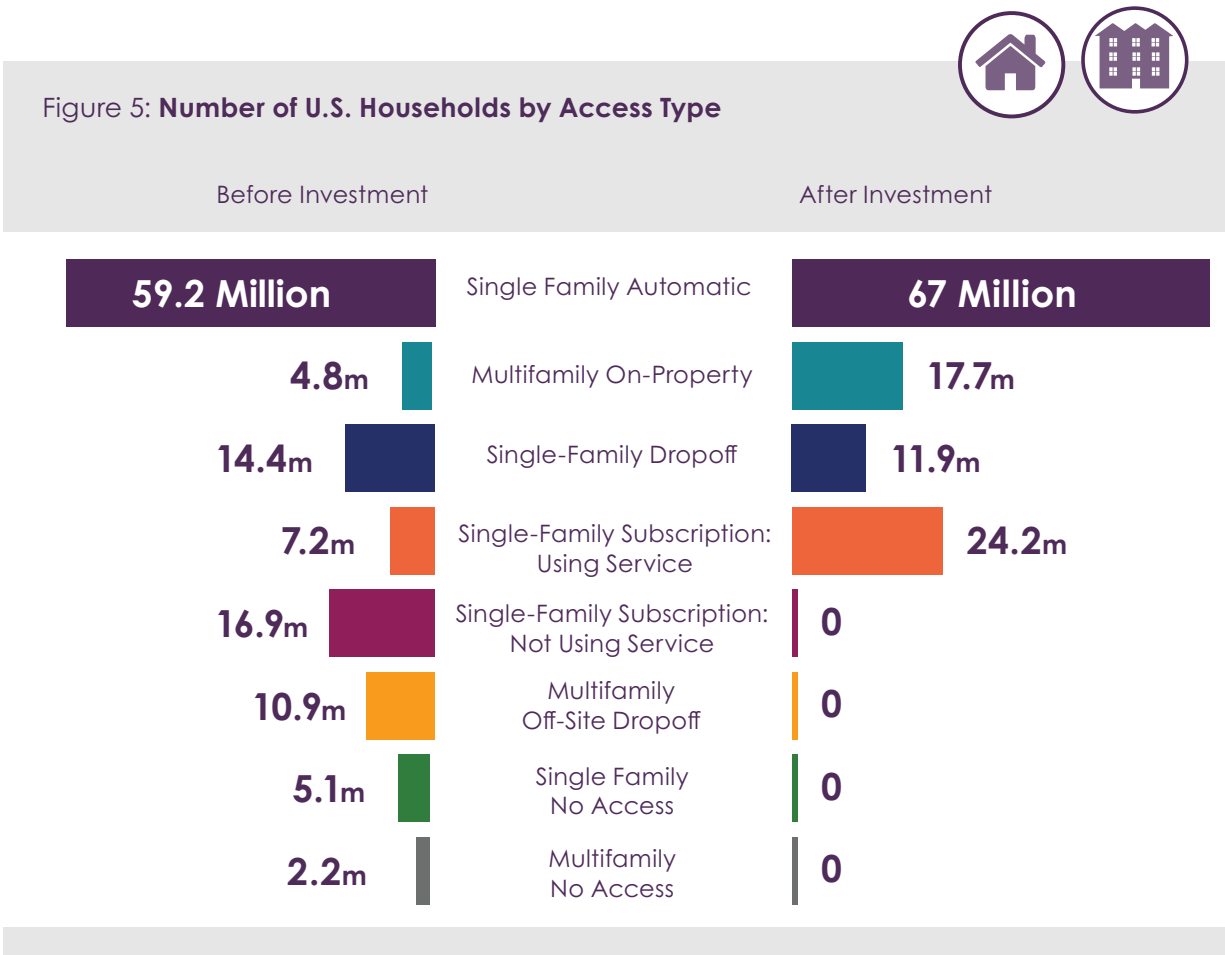




Figure 6: Further Illustrates the Before/After Creation of Equitable Access From a Scaled Capital Intervention

Before Investment

After Investment

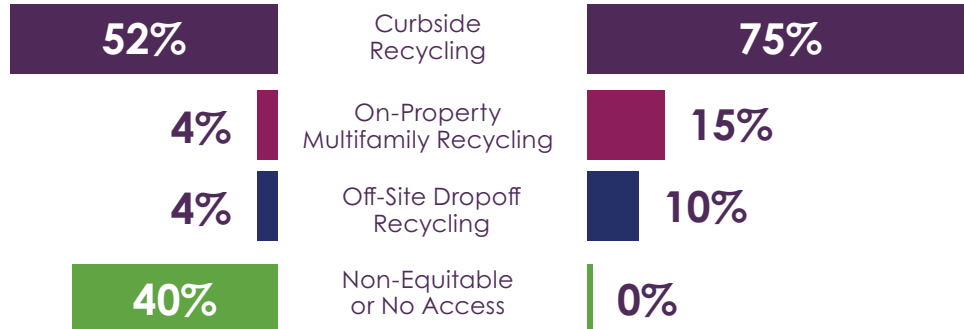


Figure 7: Number of Single-Family Households by Access Type

Before Investment

After Investment

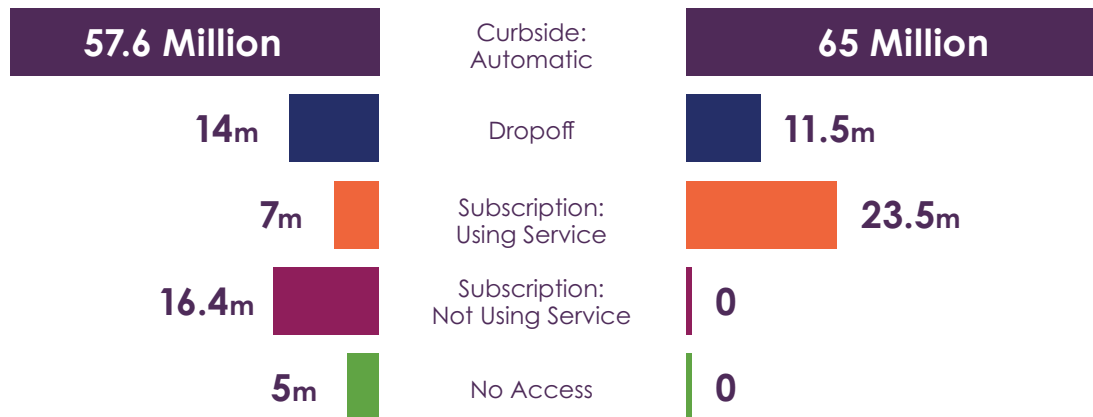
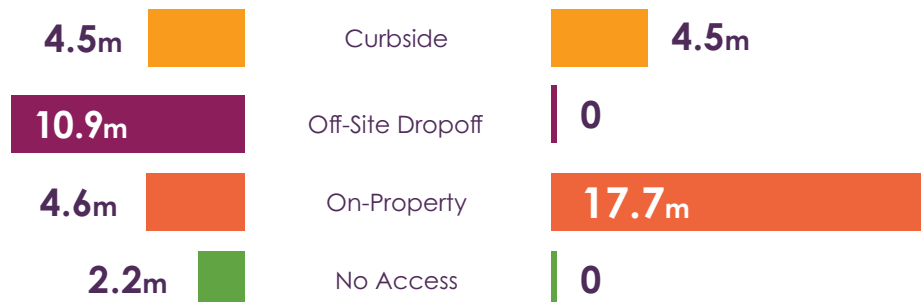


Figure 8: Number of Multifamily Households by Access Type

Before Investment

After Investment



Educate, Motivate, and Restore Public Trust

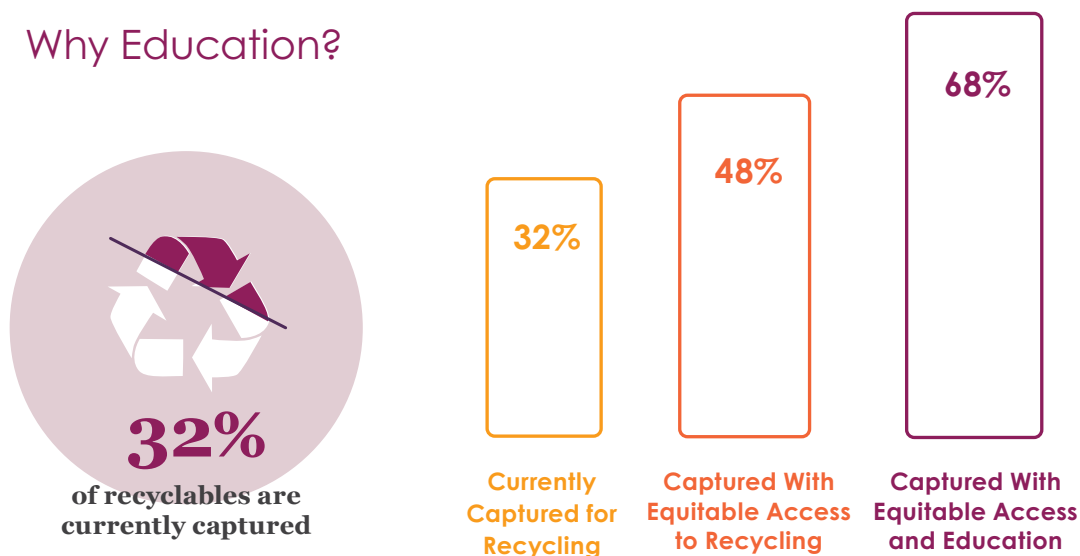
Achieving consistent education is estimated to be an annual cost of \$6 billion over five years, then \$1.2 billion annually, and is the largest cost center included in the model. This commitment to educating people is crucial to recycling's success as a reverse supply chain that starts in the home. While too often considered "nice to have," strong consumer education programs:

- 1. Reduce costs by lowering contamination (trash and other non-recyclables in the recycling) by up to 50%**, which preserves material values and improves MRF operations.
- 2. Increase efficiency by raising participation** – the more homes that set out recycling, the more efficient collection becomes and the higher average pounds per household collected for the community.
- 3. Deepen trust in the system** – the public is confused about what is recyclable and unsure if it is worthwhile, but strong and consistently funded public education can resolve that barrier to engagement.
- 4. Create social norms around recycling** and support a recycling culture critical to the optimal use of the infrastructure investment.

Adequate infrastructure and strong recycling behavior are the one-two punch that delivers a high-functioning recycling system.

Based on prior experience and a data-backed best practice approach to resident education and engagement, we estimate an average cost of \$10 per household annually is needed to support recycling's success. This level of engagement can increase material recovery by 40% or more and could push recycling rates up to 70%. Strong education and outreach is especially important for residents previously lacking service as they learn what, when, and how to participate in the system.

Why Education?



Modernize and Upgrade MRF Sortation and Hub-and-Spoke Systems

Currently, recycling infrastructure lags behind packaging innovation, and without investment to modernize material processing, the innovation gap will provide an unbreachable barrier to deliver more recyclables to end markets. The levels of increased collection tonnage envisioned in this report will also require new and upgraded MRFs. Strategic investments will allow the U.S. recycling system to more cleanly and efficiently sort and recycle the types of packages found in homes today and be ready for the formats of the future.

To address these needs, the model includes the investments needed to upgrade 375 MRFs and build 57 new MRFs, improving capacity, efficiency, bale quality, and material value. The model also includes 71 major and 133 minor hub-and-spoke systems that aggregate and deliver remotely collected material to centralized MRFs, allowing more cost-effective rural access. The aggregate capital needed is illustrated in Figure 9.

Figure 9: Total Estimated Cost to Modernize and Upgrade MRF Sortation and Hub-and-Spoke Systems

Type of Investment	Capital Needed
Total Estimated Capital Needed for All MRF Upgrades	\$1,539,000,000
Total Estimated Capital Needed for 204 Hub-and-Spoke Systems	\$59,000,000
Total Estimated Capital Needed for 57 New MRFs	\$998,000,000
Total	\$2,596,000,000

Impacts on Material Recovery

Equitable and informed access along with improved MRF infrastructure and the addition of new materials in the stream will get the U.S. system beyond its stubbornly flat business-as-usual performance, delivering new tonnage into the circular economy.



Figure 10 below shows these tonnage impacts. With the intervention we are proposing, the system pushes upward from recovering an estimated 32% of residential material to 68%, an enormous jump given the stagnation of the past decades.

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.

Continued annual investment in recycling education will be critical to maintain these high levels of material recovery. In addition to reducing the overall system contamination rate (from 17% to a projected 12% in the model), a consistently high level of education and outreach will allow strong progress to be made on participation and recycling behavior, combining with infrastructure investment to more than double residential recovery in the U.S.

Recognizing Additional System Costs

While a \$17 billion investment will make a significant leap forward in the U.S. recycling system, there are many other system costs and challenges that will need to be addressed by various stakeholders. Other key elements include operational costs, recycling infrastructure that is already in place that will need to be replaced over time, and capital for post-MRF processing and end-market development. Although they are not the focus of this report, these elements matter greatly in achieving the full benefits of equitable access.

Capital Investments vs. System Operational Costs

Putting the necessary capital infrastructure in place is one part of ensuring a healthy residential recycling system. Operating the system is the other side of the coin. Currently, U.S. communities pay the operating expenses for recycling programs to the tune of \$10 billion annually.²² While the \$17 billion system investments outlined in this report are a critical first step, absent any other kinds of intervention, the bulk of program operational costs will continue to be borne by local governments and financed through disaggregated decision-making and localized taxation, which has led to the patchwork recycling system in place today.

A recycling capitalization plan must recognize this as a central feature of the U.S. recycling system and, over time or in parallel, incentivize or otherwise address the challenge of operational costs, including the standard

Restrictions of Local Taxation Approach

A recycling system that relies mostly on local taxation to finance system improvement will continue to suffer the inherent restrictions of that approach. Recycling collection investment will compete with the entire array of local services for limited funding as local elected officials endeavor to keep tax burdens as low as possible. Over the past several years, 1 million families have lost recycling service due to challenging recycling markets and local budgeting decisions, a challenge further amplified by COVID-19's impact on local and state finances. Multifamily property owners will need to weigh the recycling services against the need to keep rent affordable. And because investment decisions are made at the facility level and not the system level, MRFs will continue to make slow and sporadic investments that do not necessarily keep pace with packaging changes, even at a time when interest rates are at their lowest in decades. The result will continue to be a disaggregated patchwork of investments (or non-investments) that hold back equitable access and strong processing infrastructure.

²² The Recycling Partnership's [2020 State of Curbside Recycling Report](#) estimated a cost range of \$4.2 billion to \$5.8 billion to collect curbside recyclables in the U.S. That estimate would grow larger as curbside is provided to almost 40 million more households under the equitable-access model. Additional collection costs are incurred across the country in servicing dropoff centers, in collecting materials from multifamily locations, and in material transfer to MRFs. Although more difficult to project, these operational costs would also expand by more than 30% once equitable access is established.

tax and fee-based financing of curbside collection, as well as the service fees that private multifamily properties incur to provide on-property recycling access.

Capital in Place: Replacement Cost Estimates

There are costs associated with the maintenance and replacement of existing recycling infrastructure that are not included in this report. Using factors of current access, accounting for different curbside, multifamily, and dropoff situations, and the MRF infrastructure that serves the system, we estimate existing capital in place to be between \$28 billion and \$30 billion. On a straight-line 10-year amortization, this capital needs to be replaced at a rate of \$3 billion per year. Failure to replace this capital could lead to erosion in services over time and possibly the loss of access currently in place.

What are the current operating costs of the residential recycling system?

More work needs to be done on this question, but the basic estimate exceeds \$10 billion per year. That figure would expand to more than \$13 billion with the advent of equitable and informed access. When compared to capital infrastructure investments called for in this report, we believe local governments bear a similar, but annual, cost burden to fuel the reverse supply chain of the circular economy.

MRF operating costs are harder to project, but an estimate can be offered using general processing costs of \$90 per ton.²³ Assuming that the approximate 12 million tons of curbside recyclables collected annually are all processed by MRFs and an additional 2 million tons come from dropoff and multifamily collection, a total throughput of 14 million tons translates to \$1.26 billion in MRF operating costs per year. Although a portion of these operating costs are offset by material revenues, there is still a net cost that must be financed in operational budgets in the form of contracts and tip fees. The increase in MRF tonnage achieved through equitable access will increase this figure by more than \$600 million per year.

Taken together then, annual operating costs for collection and MRF processing in the U.S. with expanded equitable access to recycling would likely increase to \$15 billion or more annually.

²³ As one example of a data-based estimate, the Northeast Recycling Council (NERC) publishes a quarterly survey of blended values and processing costs for MRFs in its region. The [February 2021 report](#) listed the average processing costs of \$80/ton for surveyed MRFs from October to December 2020.

Processing and End-Market Investments

As processed commodities leave the MRF, they enter a system of additional processing and manufacturing into new products, which would also need to expand as the equitable-access model delivers more tons into the supply chain. This part of the recycling system is dynamic and represents another area of necessary and ongoing capital investment.

The equitable- and informed-access model does not attempt to estimate those needs, in part because of the quickly changing nature of commodity utilization and the many variables involved. Industry announcements of new capacity for paper, plastics, metals, and glass are made regularly, indicating an active deployment of capital. This should continue as markets react to the economic opportunities of both increased recycled supply and increased demand for recycled content.²⁴

Designing for Circularity

Finally, it is important to understand that carts and education will not fix recycling if the packages entering the system are not recyclable in residential recycling programs. Private investments will need to better align the manufacture of goods around circular economy principles, ensure that packages are thoughtfully and safely designed with circularity in mind, can be recovered as they move through the recycling system, and increasingly use recycled content. Examples of collaborative efforts and private investments in this space include our Pathway to Circularity program, industry design guides, and the U.S. Plastics Pact.

The build-out of equitable access will deliver more material into that supply stream, both creating a need for and helping to spur economic development opportunities for domestic manufacturing investment, entrepreneurship, and innovation for post-MRF processing and end use.

Public and private stakeholders can help spur this investment in post-MRF infrastructure. Public-sector grants and loans, tax incentives, and technical assistance are proven mechanisms that could be ramped up as job and economic development strategies, in particular at the state level. In the private sector, capital formation can include partnerships and consortiums, lending, equity investment, guaranteed off-take agreements, and permanent commitments to recycled content, which will help drive end-market expansion. These strategies can be effectively driven or incentivized by policy, and they support and complement the achievement of scaled equitable recycling.

²⁴ Paper mill investment has been active in the U.S. as China has reduced imports of recycled paper. Announced capacity, much of which is already in place but some still coming, likely exceeds \$4 billion. Plastics reclamation investment has also been active, amounting to more than \$500 million and possibly approaching \$1 billion. Metal-oriented investments have included new aluminum processing plants and new can-making capacity. A new \$125 million glass bottle plant announced for Valdosta, Georgia, indicates investment activity for that material as well.

Conclusion: Delivering the Needs of the System

Imagine a fully built-out U.S. recycling system with complete equitable access added for more than 40 million underserved households.

Then imagine all 120 million households across the country fully understanding what to recycle and when, in a manner that is relevant to them, while receiving tailored feedback to improve their recycling behavior. These households deliver 17 million new tons of recyclables annually to 375 upgraded and 57 new MRFs. We avoid an estimated \$9.4 billion in landfill costs over the next ten years, preventing long-term environmental damage, creating an estimated \$8.8 billion in new recyclable commodity value, and supporting 200,000 new jobs.



We solve tough recycling challenges like packaging that is not yet recyclable at scale, and we create the confidence in supply that will generate new feedstocks for brands and predictable material flow for new end markets and technologies to thrive. And, critically, we start building consumer confidence in recycling, and we meet consumer expectations that companies create sustainable products, paper, and packaging that have a circular post-consumer story.

The \$17 billion investment to deliver this reality will take policy. No one organization or collective of companies can do this alone – everyone must be at the table to reach the scale and consistency of investment needed. The Recycling Partnership released a policy report, [Accelerating Recycling: Policy to Unlock Supply for the Circular Economy](#), that outlines one such approach, which we believe will create the equitable recycling future envisioned here. In addition, several supporting policies²⁵ can play a role to help accelerate change. Three particularly impactful examples include:

- **Multifamily recycling ordinances** – In a number of jurisdictions around the country, both state and local laws requiring multifamily property owners to provide on-property recycling ensures equitable access for millions of families. The goal of 100% equitable access, which relies on 17 million multifamily households being able to recycle where they live, likely cannot be achieved without widespread adoption of multifamily local

²⁵ A national deposit system or a massively scaled adoption of state deposit programs could also be a key strategy for generating supply for some key container materials, but with evidence showing that many households use curbside services for recycling of deposit containers, deposit and residential access optimization should be viewed as necessarily complementary strategies. This value of residential access alongside deposit programs is also detailed in Eunomia and Ball Corporation's The 50 States of Recycling report.

ordinances and state laws, paired with enforcement.

- **Curbside subscription laws** – The largest jump in access and tonnage in the equitable access model relies on more than 16.9 million households either subscribing to curbside services or receiving automatic service. Local and state laws can help make that happen and are likely necessary to achieve full access. Whether it is imposing minimum service on local haulers or helping a city the size of Indianapolis adopt automatic curbside access, the shortfalls of subscription-based recycling must be addressed in policy action.
- **Disposal policies** – Counties and states have enacted material bans that prohibit the landfilling of certain recyclable commodities. These bans have the effect of clarifying the value of these materials as commodities rather than waste and provide a lever for local governments to enforce recycling provision, especially at multifamily complexes and businesses. Landfill tip fee surcharge revenues can be used to support local recycling program costs and incentivize recycling over landfilling.

States' recycling grant programs are powerful tools that also deserve attention. Many states have long-standing recycling grant programs supporting the development and improvement of residential recycling programs and, in some cases, MRF operations. Unfortunately, some grant programs have seen their funding decline when dedicated funding is used for another purpose or authorized monies are not appropriated to grants. Others have been suspended in the face of budget challenges. While often facing their own organizational budgetary and staffing challenges, state recycling programs can be very effective partners in providing technical assistance and educational support to local communities, as

well as key implementers of recycling policy. Policy action to strengthen these programs and expand or restore their grant funding is a significant strategy for achieving equitable access.

As stated in The Recycling Partnership's report, [Accelerating Recycling: Policy to Unlock Supply for the Circular Economy](#), it takes everyone working together on sensible policies and investments supported by public-private partnerships for recycling to meet its full potential.

Only through a coordinated public-private partnership can the U.S. chart a new course to a comprehensive and efficient recycling system.

That system must deliver equitable access for all people and a stronger infrastructure to support both current and emerging recyclables alike. By catalyzing a recycling culture that will transform how materials are managed and commodities are considered, we can spur innovation that will stimulate the circular economy.

This approach is actionable, quantifiable, and achievable. It serves people, the economy, and the planet. However, it will require collaboration from all parts of the industry, all levels of government, policymakers, investors, and the public, to bring it to fruition and maximize its potential.

Most importantly, without policy we cannot create the capital flows necessary to solve the significant challenges of the current U.S. recycling system. It is a task, we believe, all stakeholders are ready to take on. The time is now.

APPENDIX A: Details on Capital Investments

Digging Into the Details of Infrastructure and Education Investments

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

Cart-Based Collection

Equitable and informed access envisions investments in curbside recycling that establish efficient best management practices focused on cart-based collection while recognizing that some curbside-served households will still require bin-based collection.²⁶ In addition to investment in collection containers (carts and bins), the model also projects the need for new trucks to serve the expansion in cart use and to optimize curbside service. Trucks with automated collection improve the efficiencies of recycling collection and protect the health and safety of sanitation workers through a contactless system.

In general terms, the model shows the curbside system will advance through:

- Converting 2.5 million households currently with no access to cart-based collection
- Converting 4.2 million households currently with off-site dropoff to cart-based collection
- Providing new carts to 3.6 million current curbside-subscribing households
- Achieving full cart-based subscription of curbside service for 16.9 million current non-subscribers
- Converting 4.8 million automatically served households from bin- or bag-based collection to carts
- Providing a second bin to 6 million households that will likely stay in bin-based collection

Using basic cost factors of \$50 per cart, \$8 per bin, and \$300,000 per truck, as well as a basic truck utilization assumption, Figure A2 shows the projected capital investment needed to achieve

²⁶ Some urban landscapes do not easily accommodate cart-based collection – e.g., row housing in many cities in the Northeast.

final equitable access for the 91.2 million U.S. households best suited for curbside collection.²⁷ This investment of \$2.6 billion results in an equitable-access curbside system that is ready to deliver new material supply to the circular economy.

Figure A2: **Capital Needs for Equitable Curbside Recycling Access**

	Units Needed	Total Spent
Carts for no-access households converted to curbside	2,535,900	\$126,794,000
Carts for dropoff households converted to curbside	4,152,400	\$207,621,000
Carts for subscribing households still not in carts	3,622,700	\$181,134,000
Carts for newly subscribing households eligible for curbside subscription	16,905,900	\$845,292,000
Conversion of bins/bags to carts (automatically served households)	4,830,200	\$241,512,000
Binned households getting a second bin	6,037,800	\$60,378,000
Total carts and second bins	38,084,900	\$1,662,731,000
<i>Cart Fraction</i>	32,047,100	
Trucks needed	3,100	\$926,179,000
Total Curbside Collection Capital Investment		\$2,588,910,000

Multifamily Housing

Multifamily dwellings are an often overlooked but increasingly important source of future material supply. However, achieving equitable access will require a nuanced application of capital to align with different types of properties. Establishing widespread on-property access is key to any successful multifamily recycling program and recognizing that certain kinds of containers and infrastructure work better depending on the type of multifamily building: high-rise, mid-rise, and garden-style.²⁸

Multifamily properties use three general kinds of collection infrastructure – compacting roll-offs, front-end containers, and carts. Figure A3 applies the costs of these varying service options to multifamily properties, along with ancillary infrastructure and related truck needs, and includes providing for at least 80% of multifamily households to receive an in-home tote to prompt recycling behavior. The combined effect is to achieve on-property access to recycling for an additional 13 million households.

²⁷ A Recycling Partnership best practice is that everyone receives a cart, even if everyone will not use the cart. Why? Because recycling containers are connected to the address, not the person living there. People move and properties change ownership. By every property receiving a cart, we can ensure that recycling is available as people, and their inclinations to participate in recycling, change.

²⁸ The model used categories from Freddie Mac's apartment housing types provided here: http://www.freddiemac.com/blog/rental_housing/20190325_spelling_it_out_apartment_types.page. Walk-up properties were included in the mid-rise category and special-purpose included in garden-style. The on-property access analysis nets out the estimated 4.5 million multifamily households already receiving curbside recycling services.

Figure A3: **Capital Needs for Equitable On-Property Multifamily Recycling Access**

Multifamily Housing Type	Assumed % of Multifamily Households	Assumed Number of Households Currently With On-Site Access	Number of Households Needing On-Property Access	Total Spent
High-Rise	30%	2,121,500	3,182,300	\$153,275,000
Mid-Rise and Walk-Up	35%	1,237,600	4,950,200	\$422,146,000
Garden-Style and Special-Purpose	35%	1,237,600	4,950,200	\$430,141,000
Total Collection Infrastructure				\$1,005,562,000
Trucks (rolling stock to serve new collection infrastructure)				\$305,978,000
In-Home Totes				\$120,220,000
Total				\$1,431,760,000

Upgrading Off-Site Dropoff

The equitable- and informed-access model suggests an overall decrease in off-site dropoff recycling because of a shift for some households to curbside and a large-scale transition to on-property multifamily access. But off-site dropoff remains a key pathway for material recovery and requires capital investment along two lines: 1) creating new dropoff sites for households that previously had no access and 2) upgrading existing dropoff sites to be more efficient and effective. The model uses assumptions about different collection containers (compacted roll-off, non-compacted roll-off, front-end containers, carts), ancillary infrastructure (including signage), and how many sites would need to be staffed. The model also applies assumptions on how many households new or upgraded sites can serve, and like curbside and multifamily, estimates of new trucks needed to serve new and upgraded off-site dropoff infrastructure. Figure A4 shows the level of projected capital investment needed for this part of the recycling system.

Figure A4: **Capital Needs for Equitable Off-Site Dropoff Access**

Type of Investment	Number Needed	Capital Needed
New Dropoff Sites	746	\$20,187,000
Upgraded Dropoff Sites	746	\$7,655,000
Trucks	293	\$74,130,000
Total		\$101,972,000

Informed Access Through Consistent Education and Engagement

Before we can implore the public to recycle, every person needs the ability to do so. But once that condition is met, we cannot expect people to recycle without educating and engaging with them in a meaningful way, including considerations of language, culture, and motivators. This coupling of access and meaningful education results in not only an increase in the amount of material recovered (40% or more recovered than just access alone), but the material is also cleaner and more readily usable in the circular economy (up to a 50% reduction in contamination rates).

For these reasons, the model includes an average annual investment of at least \$10 per household per year across the country over five years.²⁹ The \$10 per household average funding level reflects The Recycling Partnership's experience in deploying basic education to 100% of households, and integrated cart-tagging and outreach strategies proven to increase collected material quality and participation at a subset of households needing additional engagement. Importantly, these materials should reflect the communities receiving them, providing culturally relevant images and supporting text in a language that can be understood by the recipient. Without this level of investment in education, MRFs will continue to be plagued by high contamination and, we will struggle to build consumer trust and engagement with the U.S. recycling system.

The \$6 billion education and outreach investment³⁰ over five years, , then 1.2 billion annually, will address material quality and improve participation

²⁹ Not every household will require this level of education support; some will require more and some less. It will also vary by curbside, multifamily, or dropoff. The \$10 per household estimate reflects an estimated total amount required on average.

³⁰ Assuming 120 million households and a \$10 per household education cost each year for five years, the total cost is \$1.2 billion annually or \$6 billion for five years.

Recycling aligns with a number of values: family, future, environment, faith, community, and personal responsibility, but not everyone sees themselves in the process yet.

This is largely due to inadequate access, a lack of relationship with city programs, and a lack of tailored outreach. **Surveys show 9 out of 10 people believe in recycling, but access data show only 6 out of 10 have easy access, and behaviors indicate even fewer are adequately served and supported through education and outreach.**

Building trust in recycling programs through informed access and engagement with trusted members of the community will be especially important for people who have been historically excluded from the recycling system, including socioeconomically disadvantaged families, rural households, and people of color.

For minority populations, there has historically been a lack of inclusive education resources that are delivered in their language and that speak to their culture and needs. Addressing these barriers is critical to maximize material recovery and fully engage all people in the circular economy regardless of where they live or what language they speak.

and capture behavior rates, which are extremely important components of a high functioning residential recycling system and will deliver a dramatic increase in the recycling rate compared to access alone.³¹

Projecting the Need for New MRFs

Increased collection tonnage can be used to estimate the need for new MRFs and the associated capital required. The Recycling Partnership uses a baseline assumption that 25% of the increased tonnage will require new MRFs to process the material. Recognizing the variable universe of MRFs in the U.S., three basic size categories of MRFs were used for this analysis, along with assumptions as to how many MRFs fall into each category and varying levels of investment that correspond with each category. Figure A5 shows the projected capital needs for new MRFs.

Figure A5: **New MRF Capital Needs From New Equitable-Access Tonnage**

Tons Requiring New MRF Capacity	Number of New MRFs Needed (using balanced portfolio of MRF sizes)	Estimated Cost per MRF	Total Estimated Capital Needs for New MRF Capacity
4,051,687	57	\$17,657,500	\$998,269,620

Upgrading Existing MRFs

For the increased tonnage resulting from equitable access and for the tonnage already collected, existing MRFs in the U.S. need capital for new and best-in-class equipment. A substantial injection of capital would modernize the national MRF infrastructure and improve the fate of all materials in the system, whether in establishing recyclability, enhancing quality, or improving processing capture rates.

Using the same categories as the new MRF analysis, the model employs basic assumptions as to how many upgrades MRFs need and the basic costs of those upgrades, including equipment such as optical sorters, robotics, and ancillary investments in conveyor lines and bunker capacity, plus installation. Figure A6 provides the estimates of this analysis.

Figure A6: **Capital Needs for Upgraded MRFs**

Upgrades	Total Estimated Capital Needed
Large MRF Upgrades	\$303,750,000
Medium MRF Upgrades	\$810,000,000
Small MRF Upgrades	\$425,250,000
All MRF Upgrades	\$1,539,000,000

³¹ The Recycling Partnership recently released a Behavior Change White Paper, which will be followed by a Capture and Participation Behavior Report at the end of 2021

Note that figure A6 does not include the equipment costs required to accommodate film and flexible materials in large MRFs. This would add \$847 million in capital needs, both in the form of upgrades and in establishing capacity in new MRFs, and is covered in Appendix B.

Investment into Hub-and-Spoke Infrastructure

The final piece of equitable- and informed-access investments is the need to move remotely collected material efficiently to centralized processing centers. This piece of the system is often called “hub and spoke” in which mostly rural curbside or dropoff programs use transfer capacity to consolidate and send material to mostly urban-based MRFs. It recognizes that MRFs require a critical level of material flow that rural areas cannot meet alone, but those rural areas also need processing options to take advantage of the efficiencies of commingled collection; it often parallels infrastructure in place to transfer solid waste. The model uses two different categories of material transport – large tractor trailer-based transfer stations and smaller compactor-based transfer. It uses a basic analysis of where MRFs exist and where transport is needed in each state to estimate hub-and-spoke capital requirements. Some hub-and-spoke systems already exist in the U.S., and a factor was applied to recognize infrastructure already in place. Figure A7 shows the resulting capital needs analysis.

Figure A7: Capital Needs for Hub-and-Spoke Infrastructure

Hub-and-Spoke Systems	Number Needed	Capital Needed
Major Hub-and-Spoke Systems Needed	71	\$42,840,000
Minor Hub-and-Spoke Systems Needed	133	\$16,575,000
Total Cost of Hub-and-Spoke	--	\$59,415,000

In total then, the combined infrastructure capital needs of creating equitable access, a modernized national MRF infrastructure, and hub-and-spoke infrastructure to connect in remote collection is \$6.7 billion. Moving film and flexible materials toward mainstream recyclable status would require an additional \$4 billion.

Appendix B:

Specific Actions Needed for Flexible Plastic Packaging, Including Pouches, Bags, and Wrap

The investment model in this report shows \$4 billion in capital will be needed for film and flexible packaging to become widely accepted in residential collection and processing, recognizing a combined need for both specialized equipment in large MRFs to process loose film and flexibles into commodity bales and specialized bagged collection of film and flexibles in areas served by smaller MRFs. This model anticipates that critical progress will continue to be made on key recyclability issues for film and flexible packaging, such as conversion of multi-resin formats into mono-material packaging.

The equipment necessary to process loosely collected film and flexibles has been demonstrated by the Materials Recovery for the Future (MRFF) project. The high level of required investment means that approach will only be suitable for large-scale MRFs.³² The majority of MRFs in the U.S. are smaller facilities in which expensive specialized investments to process the loose film and flexible material will be difficult to justify from a business perspective. For many small MRFs, the needed capital for a MRFF-style investment could be more than 50% of a facility's entire capitalization for a material that may represent, at full flow, only 2–3% of all inbound materials.

Most MRFs, therefore, will need to receive film and flexibles pre-separated from other materials during collection in the form of household bagging. But even with inbound film bagged, capital investment in those MRFs will still be needed in the form of expanded bunkers, lengthened or additional conveyor lines, and sorting equipment such as robotics. In addition, for film and flexibles to be widely collected at participation and capture rates comparable to existing mainstream materials, ongoing provision of bags to households will be necessary, and end-market innovation and demand will be essential. Finally, as the material becomes more widely processable by MRFs, funding will be needed to successfully educate households when film and flexible materials are then introduced into collection services. Figure B1 shows the layout of investments to create a pathway to full acceptance in residential collection for film and flexible materials, something that the Pathway to Circularity's Film and Flexibles Coalition is currently working toward.

³² The 2020 Flexible Packaging Recycling in Material Recovery Facilities Pilot Research Report provides additional detail on the large, high-speed MRF environment.

Figure B1: Investments for Film and Flexible Packaging

Expense Element	Cost
Upgraded MRF Investment (establishes loose film processing capacity in 136 MRFs and bagged capacity in 239 MRFs)	\$786,328,000
New MRF Investment (cost of building in film and flexible capacity in new MRFs)	\$145,107,000
Bag Supply Over Five Years (all households under bagged systems receiving a supply of bags to participate in collection)	\$2,550,972,000
General Education for Adding Film and Flexibles to Existing Collection Programs	\$603,780,000
Total	\$4,086,187,000

Appendix C:

Estimated Impacts From Capital Investments

What Equitable and Informed Access Means for Overall System Performance

Recycling infrastructure change alone - without supporting education and outreach - will deliver significant improvements over the current recycling rate, however it will not achieve recycling's full potential.

The match to full collection infrastructure is robust and consistent recycling behavior, and resident engagement will be the real key to unlocking significant unrecovered tons of materials.³³

With the \$10 per household annual investment in resident education and engagement, improvements to recycling behavior are projected to deliver 9.3 million additional tons of new recyclables into the circular economy, **raising the overall residential recycling rate to 68% and recovering over 32 million tons of material annually.**

Figure C1: **32% Current Tonnage Collected**

	Tonnage Impact
Current Residential Total Generation	47,474,300
Current Estimated Tonnage of Material Recovered Through Curbside Recycling	11,285,200 ³⁴
Current Estimated Tonnage of Material Recovered Through Dropoff, Multifamily On-Site, and Deposit Programs	4,126,600
Current Estimated Total Recovery	15,411,800

Tonnage Unrecovered and Total Participation and Capture Losses do not exactly match the Residential Tonnage Unrecovered data because estimates use aligned but different factors and assumptions. However, the relative difference is within a 0.2% range.

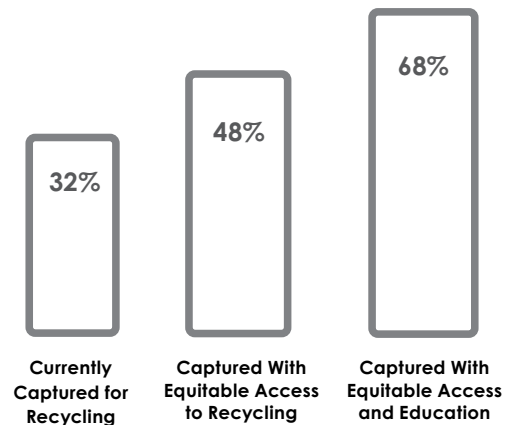
³³ The 2020 State of Curbside report used a 72% participation rate (of those who have access) in its analysis that was derived from a national survey of community programs. However, recycling participation can be substantially less in older, bin-based curbside programs and for dropoff and multifamily on-property recycling.

³⁴ This figure is less than the 11.9 million tons projected in the 2020 State of Curbside Recycling report, reflecting revisions to material generation estimates from new capture study data and some erosion in household access and material collection due to program elimination during the COVID-19 pandemic.

Figure C2: Tonnage Impact From Equitable Access, Participation and Capture Behavior

	Tonnage Impact
Tonnage Increase From Establishing Equitable Access	7,586,900
Total Recovery After Establishing Equitable Access	22,998,700
Recycling Rate	48%
Tonnage Increase From Education on Participation and Capture Behavior	9,311,700
Total Final Recovery Following Infrastructure and Education Intervention	32,310,400
Recycling Rate	68%

As Figure C2 demonstrates, when equitable recycling access is added to the existing recycling system, an additional 7,586,900 tons of material are recovered, resulting in a 48% recycling rate. Over 24,500,000 tons are still unrecovered in this scenario, with losses primarily attributed to participation and imperfect recycling behavior. When robust recycling education and engagement efforts are added to the infrastructure investments, participation and capture losses are reduced by 9,311,700 tons, raising the total recycling rate to 68% with 32,310,400 tons recovered, and demonstrating the critical importance of ongoing resident education.



The numbers in Figure C3 demonstrate the necessary complementary nature of infrastructure and educational investments. None of the stakeholders in the recycling system can achieve their supply and recovery goals without 100% access, nor can we expect recycling to fulfill its full potential as a climate change strategy and driver of economic activity without all Americans fully being able to participate. Achieving 100% access is what will allow and ensure the success of scaled interventions on participation and capture behavior, which then deliver an additional large-scale increase in collected tons.

Figure C3: **Estimated Annual Increase in Individual Commodity Tonnage From Equitable Collection Access**

Commodity	New Tons
Corrugated Cardboard	2,741,300
Mixed Paper	6,116,100
Cartons/Aseptic Containers	89,400
PET	985,600
HDPE-Natural	195,800
HDPE-Color	276,300
Bulky Rigid Plastics	95,400
PP	185,100
Aluminum	405,000
Steel Cans/Ferrous Metal	304,800
Glass	3,363,300
Film and Flexible Plastics	2,140,400
TOTAL	16,898,600

Implications of Increased Supply Across Materials

Equitable investment would increase the recovery of all materials regardless of their market demand and value. In some cases, markets might be severely tested by a rapid jump in supply against an imbalance of demand for certain materials in certain regions. One option for deploying the equitable access investments would be to first target areas where demand for all materials would be relatively strong and where gaps in regional supply have been well-documented, such as the U.S. Southeast and states from Pennsylvania through Wisconsin, including Michigan. Additional implications for specific materials are explored below.

Implications for Key Plastics

Plastics recovery, after more than a decade of flat recycling rates, would dramatically rise in the U.S., which is critically needed to address corporate goals and the commitments of the U.S. Plastics Pact. Figure C4 shows the increase in PET, HDPE, and PP collection from the fully capitalized and informed residential system, increasing PET recycling by 31% and HDPE by 29%. Polypropylene would more than double in tonnage; with the boost through the work of the Polypropylene Recycling Coalition to achieve more widely accepted status in collection programs, PP recovery could begin to approach the recovery rates of PET and HDPE.

Figure C4: Effects of Equitable Access on Plastic Supply

Material	Current tonnage recycled (current recycling rate) ³⁵	Additional tonnage collected through full capitalization and education investment	Resulting total tonnage (resulting recycling rate)
PET	906,500 (29%)	961,300	1,867,800 (60%)
HDPE	503,250 (30%)	472,100	975,400 (59%)
PP	149,000 (18%)	185,100	334,100 (41%)
F&F ³⁶	86,410 (2%)	2,054,000	2,140,400 (50%)

The gains in PET, HDPE, and PP recovery would make it much more feasible to achieve the publicly committed goals by brands and other stakeholders, as well as the 50% recycling goal of the U.S. Plastics Pact. In addition, the processing investments envisioned in the model would mitigate PET, HDPE, and PP loss in MRFs, improving the yield from inbound material. Complemented by robust strategies to increase commercial, institutional, and away-from-home recovery, key plastics recycling rates could push well past 60%.³⁷

Projections for Film and Flexible Recovery

The mainstreaming of film and flexible materials into residential recycling will require a substantial and intensive effort of collection and processing investment, market development, and education. MRFs are already seeing large volumes of this material, and it continues to be one of the most significant contamination challenges. Investment and focus on this material would start solving the contamination issue with processing solutions. If investments are made

³⁵ Data for PET and HDPE come from the 2018 United States National Postconsumer Plastic Bottle Recycling Report; data for PP comes from The Recycling Partnership analysis of PP recovery from residential and other sources.

³⁶ https://recyclingpartnership.org/wp-content/uploads/dlm_uploads/2021/04/FF_Whitepaper_final.pdf

³⁷ This analysis does not account for the possible effects of new or expanded deposit programs. The Recycling Partnership's work to improve curbside recycling programs in communities in deposit states shows that curbside and deposit options have a complementary effect, raising overall container recycling rates together. The data show that some consumers choose the convenience of home recycling over trips to deposit centers, which also keeps some of the higher-value materials in the commingled MRF stream. The COVID-19 pandemic has made it clear that curbside programs can act as an important backstop to disrupted deposit programs. At the same time, the financial incentive of deposits motivates higher capture behavior overall beyond what residential collection programs can deliver. Implemented in parallel, deposit and equitable-access capital intervention could amply provide the supply needed from discarded container streams.

in the collection of film and flexible materials to help them achieve the status of mainstream recyclability, it would add tonnage to the estimate above.

Like all other materials, film and flexibles would experience recovery limitations related to participation and capture behavior. Because there is no established market that provides consistent market or bale specifications and because of the wide range of film and flexible materials, it is challenging to make an exact projection of recovery. However, using the per household estimate of 75 pounds per year included in The Recycling Partnership's 2020 State of Curbside Recycling Report (which includes retail bags and sacks) and applying participation and capture behavior factors, a base level estimate of film and flexible recovery in an equitable and informed access system is 2.1 million tons per year.

Implications for Metals

Like plastics, the equitable and informed access model delivers a large jump for stagnant metal packaging recycling rates. Figure C5 shows The Recycling Partnership estimates for recovery of steel and aluminum can recovery through current residential curbside, dropoff, and multifamily efforts (not counting recovery from household use of deposit systems) and the tonnage and percent increase projected from equitable access.

Figure C5: Effects of Equitable Access on Metal Packaging Recycling

	Estimated Current Residential Tonnage Recycled (estimated % of cans recycled through residential collection)	Projected Increase in Tonnage From Equitable Access and Robust Education	Resulting Residential Tonnage Recycled
Aluminum Cans	340,700 (29%)	389,800	730,500 (62%)
Steel Cans	322,100 (25%)	304,800	626,900 (48%)

For used beverage cans (UBCs) in particular, the capital investments envisioned for MRFs in this model is a path toward scaled intervention on MRF UBC loss. The Can Manufacturers Institutes recent study shows the clear need and potential for additional equipment to address this issue.³⁸ The equitable and informed access model projects funding for between three and five major investments per MRF, depending on MRF size, which creates substantial room for strategies to increase MRF UBC capture.

³⁸ Can Manufacturers Institute, Aluminum Beverage Can: Driver of the U.S. Recycling System <https://www.cancentral.com/sites/cancentral.com/files/public-documents/GBB%20Report%20Aluminum%20Can%20Drives%20U.S.%20Recycling%20System%20Final%202020-0623.pdf>

Implications for Paper

The most important effect of equitable and informed access for paper is the projected increase in residential old corrugated cardboard (OCC) recovery. As e-commerce moves more OCC into homes compared to traditional retail sources, households will be relied on to feed new and existing containerboard mills against what is expected to be strong growth in cardboard consumption. In addition, equitable access would bring scaled usage of large carts necessary to provide households with the recycling storage space for more cardboard boxes. It would also provide on-property access for multifamily homes that represent a rapidly growing source of OCC. The overall result, as displayed in Figure C6, is a more than 50% improvement in residential OCC supply. Residential recovery would effectively reach historically high levels of commercial OCC recovery.

Figure C6: Effects of Equitable Access on Residential OCC Recovery

Estimated Current Residential OCC Recovery (residential recycling rate)	Projected Increase in OCC Tonnage From Equitable Access	Resulting Residential Tonnage (resulting recycling rate)
2,464,200 (41%)	2,741,300	5,205,500 (86%)

In addition, the equitable access model raises mixed paper supplies that help support the substantial investments underway by U.S. paper companies in mixed paper furnish. These supplies could improve the ROI for the stock preparation systems that have been deployed in recent years to accommodate the unique characteristics of mixed paper. Overall increases in both OCC and mixed paper would help the industry achieve its publicly stated recycling goals, while the investments in both outreach and MRF equipment envisioned in this model would raise the overall quality of residential paper.

Implications for Glass

Glass bottles and jars would see similar increases in collected tonnage from the provision of equitable access. Figure C7 projects the results for residential glass as collected through curbside, dropoff, and multifamily collection (excluding deposit).

Figure C7: Effects of Equitable Access on Residential Glass Recovery

Estimated Current Residential Glass Recovery (estimated percentage of glass recycled through residential collection)	Projected Increase in Glass Tonnage From Equitable Access	Resulting Total Tonnage (estimated percentage of glass recycled through residential collection)
2,932,800 (34%)	3,363,300	6,296,100 (72%)

The MRF investment and hub and spoke components of the model could be highly beneficial for glass.³⁹ Glass is a core recyclable that has been disproportionately affected by the transition to single-stream, and in the MRF, is most often a negative sort commodity with residual contamination. Quality of material has a dramatic impact on commodity value, and therefore there is a strong correlation between the presence of glass cleaning equipment in MRFs and the acceptability of glass in local collection programs. Investment in facilities lacking the basic equipment necessary to process glass through a MRF can help protect glass as a material collected in recycling programs and provide the glass industry with a supply that helps meet its recycling goals.⁴⁰

Additional Materials

Other types of consumer packaging also currently sit outside mainstream recyclable status for reasons ranging from design to critical mass for processing and market acceptance. Packaging examples such as tubes and thermoforms are not widely recycled but, like film and flexibles, demand attention in how they would be treated in a fully equitable and informed access system.

The model envisioned in this report assumes that brands and packagers would continue to engage in activities to build a pathway to circularity for the items that are currently outside of historical collection: problem-solving about material use, MRF sortability, and market utilization. As those activities progress, the materials should be easily accommodated into existing and expanding collection under equitable access and can be facilitated by the MRF investments described in this report. In short, other than some use of the MRF upgrade capital described in Figure A5, no additional investment would be needed for these packaging types, **as long as the design and other challenges of circularity are addressed.**

³⁹ In April 2021, the glass container industry released a commitment to work with recycling stakeholders to achieve meet 50 percent recycling rates and recycled content goals, along with a policy roadmap for how to achieve those objectives - see: <https://www.gpi.org/a-circular-future-for-glass>. The glass industry coalition (GRC) has also developed a MRF glass certification program - [glassrecycles.org/mrfglasscertification](https://www.gpi.org/a-circular-future-for-glass) - based on market standards to ensure that collected glass is recovered and not sent to landfill.

⁴⁰ <https://www.gpi.org/a-circular-future-for-glass>

APPENDIX D:

Potential Sources of Capital to Achieve Equitable and Informed Access

The U.S. needs an overall investment of \$17 billion to upgrade its recycling system, create equitable recycling access for all people, solidify strong recycling behaviors, and build an infrastructure ready to handle more and different types of recyclable materials.

What will it take to raise and deploy \$17 billion over five years? Sustainable and dedicated funding to make dramatic changes at scale. And funding and scale means policy. Without policy to create significant new investment, we cannot address the system challenges presented by the current U.S. recycling landscape. It is simply too slow and expensive for any one company, community, or organization to solve. However, in addition to state and federal policy, we have other potential capital sources available to use for equitable access, which is described below.

Capital Source	Notations
Carbon Trading Credits	With strong documentation of GHG benefits, it is conceivable that carbon credits could start to be applied to recycling. However, it would compete with already-extensive (and possibly more important) deployment of credits to renewables, reforestation, and other initiatives.
Deposit Systems	Escheats (unredeemed deposits) could be used for recycling capital investment if not siphoned to other non-recycling uses. There is little current momentum for new deposit systems, and this remains a politically complicated strategy. Deposits are also not a proven strategy for recyclables beyond a limited range of containers.
Federal Funding	Congressional interest has been evident, but there are competing models and many complicating factors, including impacts on the overall federal budget.
Loan Capital	This will continue to be an important option, made more viable by low interest rates. But very few local governments will use their limited borrowing capacity to improve recycling collection compared to other infrastructure priorities (streets, schools, parks, etc.). Loan capital will be mostly applicable to the MRF and end market components but will rely on willingness to take on debt and the expected return on investment, especially in regard to low-value materials.
Localized Taxation/ Investment	Some communities are still willing to make capital investments, but local budgets are under stress and recycling is a relatively low priority, especially given the fiscal pressure of the COVID-19 pandemic. This source of capital would need to be strongly leveraged to grow in scale.
National-Level EPR	This approach can be presumed to take care of the full capital needs in the country. One bill has been proposed, but passage is extremely unlikely.

Capital Source	Notations
Partnership Legislative Model	In the Accelerator legislative model, packaging fees pay for the achievement of scaled equitable access. The model will require extensive activity and stakeholder support to pass at the national or state level.
Plastics Trading Credits	A potentially promising possible source of capital for both collection and reclamation investment. This idea is untried, but important platforms will be available in 2021 to test stakeholder interest and scaling.
Private Investment	This can be expected to be an active factor for MRF infrastructure (and already is), but it is likely to remain fairly disaggregated, with return-on-investment encouraged by the current low price of capital but hampered by material values.
Recycling Mandates/ Disposal Bans	Recycling regulation drives investment through the need of stakeholders to comply with mandates. This could be an especially important strategy for multifamily recycling with local ordinances or state mandates but will require cultivation of political will and a dedication to enforcement.
State-Level EPR	This approach can be presumed to take care of the full capital needs in a state. Legislative initiatives remain alive in some states and could close some regional gaps, but passage is uncertain and controversial.
State Recycling Grants	This is an important and long-standing source of needed capital but has been under stress, is not pervasive to all states, and is not always focused on residential materials. Some states have shown leadership that should be encouraged and held up as examples.
Voluntary Brand/Industry Grant Funding	This is The Recycling Partnership's current grant model and has been deployed successfully against a system facing serious headwinds, developing many examples of solutions to the equitable-access issue. Scale is required to allow greater leveraging of local action. Beyond changes to collection infrastructure, The Recycling Partnership is demonstrating that grants can also effectively upgrade MRF capacity. ⁴¹

⁴¹ The Recycling Partnership is leveraging grants as a mechanism to upgrade MRFs to support recovery of polypropylene and used beverage containers.

Glossary of Terms

Automatic collection – Households in a given community are automatically included in a recycling program, much in the way that almost all communities will automatically provide a means for trash pickup and hauling.

Cartons – Packaging for food and beverage products, both shelf-stable and refrigerated. Aseptic cartons are often used for shelf-stable applications. Gable-top cartons are commonly used in refrigerated applications, such as milk and juice.

Circular economy - The circular economy is an evolving framework toward an industrial system that is restorative and regenerative by design. It rests on three main principles: preserving and enhancing natural capital, optimizing resource yields, and fostering system effectiveness.

Commercial recycling – Recycling collected from commercial, institutional, or industrial sources.

Contamination – Trash and/or materials that are not accepted in a given curbside recycling program, such as food, plastic bags, or toys. It can also refer to improperly sorted or managed materials – food-soiled paper or containers that still include liquids.

Curbside mix – The combination of recyclable materials in recycling collection containers. This mix of materials can vary based on what types of packaging are collected for recycling in different regions.

Drop-off services – Recycling collection points for residential and sometimes commercial recyclables. Can be used as a replacement for a community that does not offer curbside collection of recyclables, or in rural areas where no curbside collection of recyclables or trash is offered.

Equitable and informed recycling access – Recycling service is provided in a manner that is commensurate with garbage service, and they receive adequate education and engagement to understand how and when to do so.

Film plastics – This material term can refer to anything from plastic wrap to plastic bags to vegetable freezer bags and plastic bags filled with air in shipping boxes. Plastic film is typically less than 10 millimeters thick and typically is made from polyethylene resin. It is a common packaging material but is typically not accepted in curbside recycling.

Flexible packaging – Packaging whose shape is likely to change after the contents are added or removed. This includes plastic bags and film such as bread bags, produce bags, paper towel and beverage overwraps, and new packaging technologies such as pouches and multilayer films. Multilayer packaging may consist of multiple layers of the same polymer or incorporate different polymers or substances.

Hub and Spoke – Rural curbside or dropoff programs will use transfer capacity, often called “hub-and-spoke” systems, to consolidate and send material to mostly urban-based MRFs.

Glossary of Terms (cont.)

Landfill – A disposal site for the deposit of waste onto or into land under controlled or regulated conditions.

Material processing fees – Costs incurred to process collected recyclables.

Materials recovery facility (MRF) – A facility that sorts, processes, and bales different types of aggregated recyclables for sale to reprocessors.

Multifamily recycling – Recycling collection from locations with numerous households, such as apartments, townhomes, condos, or generally any property with five or more habitable units.

Municipal solid waste (MSW) – Residential and commercial non-hazardous waste generated by municipalities and commercial entities, not including medical, industrial or construction/demolition waste.

Old corrugated containers (OCC) or corrugated containers – A type of fiber packaging often used in shipping products that contains a wavy middle layer that gives the packaging strength, commonly referred to as cardboard.

Plastics abbreviations – This report uses many abbreviations to describe different types of plastics used in the manufacture of packaging, including:

- **PET:** polyethylene terephthalate (PET) (beverage containers, cups, clamshells, etc.)
- **HDPE:** high-density polyethylene (HDPE) (milk jugs, detergent containers, etc.)
- **PVC:** polyvinyl chloride (PVC) (pipes, siding, flooring, etc.)
- **LDPE:** low-density polyethylene (LDPE) (plastic bags, six-pack rings, tubing, etc.)
- **PP:** polypropylene (PP) (yogurt cups, margarine tubs, other food containers, etc.)
- **PS:** polystyrene (PS) (Styrofoam, or expanded polystyrene, coffee cups, cafeteria trays, etc.)
- **Other:** also known as #7, these other plastics include acrylic, polycarbonate, and polylactic acid (PLA), etc.

Recyclable – Characteristic of a product, packaging, or associated component that can be diverted from the waste stream through available processes and programs and can be collected, processed, and returned to use in the form of raw materials or products.

Glossary of Terms (cont.)

Residential mixed paper or mixed paper (RMP) – The fiber portion of the curbside mix that includes everything but separated OCC. This includes all sorts of fiber-based packaging, such as containerboard, paperboard, magazines, office and scrap paper, and catalogs.

Shared Producer Responsibility – A policy approach for funding recycling that outlines a public-private partnership to fund the recovery of residential printed paper and packaging. In the shared responsibility approach put forth by the Circular Economy Accelerator and its members, the public sector continues to fund the operations of the recycling system and the private sector funds system infrastructure, as well as education and outreach to improve the capture and quality of residential recycling materials collected.

Single-family recycling – Recycling collection from single-family homes or generally from buildings up to four habitable units.

Single-stream collection of recyclables – The practice of collecting commingled recyclable materials all in one container at the curbside. This varies from “dual-stream” or “multi-stream” collection, which aggregates fiber, such as newspaper and cardboard, and bottles, cans, and other containers in two or more receptacles.

Subscription-based (or “opt-in”) recycling collection – A community recycling collection program that requires some level of household action or engagement to initiate curbside recycling pickup, whether it be simply calling a city or waste hauler and requesting a cart or bin for recycling, or having to research and contract with a hauler in the area to set up and be charged for the service.



Learn more at: recyclingpartnership.org