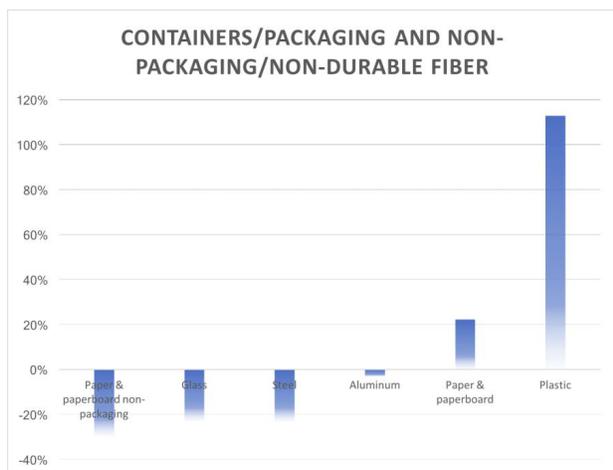


Material Recovery Facilities November 2018

Overview

Materials Recovery Facilities (MRF) serve as the primary method of processing commingled recyclables in the United States. The material is unloaded, processed and stored for sale as commodities. Since 1991, the number of MRFs increased by double digits on a yearly basis until the number peaked in 2014. Since then, the number of MRFs have declined to just fewer than 500 MRFs in 2018.

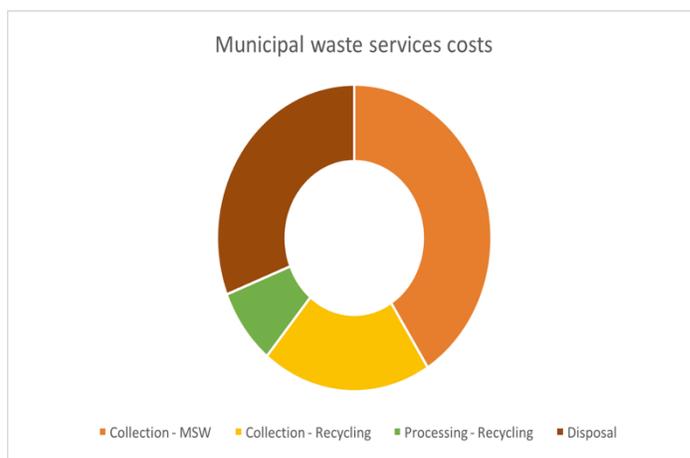


MRFs are now a mature industry and while not many new facilities are being built, many older facilities are undergoing upgrades. The material stream has changed significantly since the first MRFs were built and many of those MRFs were not designed to accept today's mix of materials.

The major changes to the material stream over the last 30 years is the dramatic decline in newspapers, increase in plastics, lightweighting of materials, increase in OCC and increased complexity of materials with the introduction of multi-layer materials.

Number of MRFs

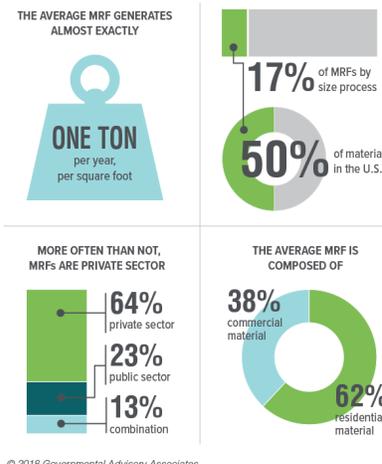
In 1991, there were only 40 MRFs in the country, more than half of them in the northeast. The number of MRFs peaked in 2014 at 556. Since then, the number of MRFs have declined to just fewer than 500 MRFs in 2018. About two-thirds of MRF process single stream material compared to only about a quarter ten years ago. In general, single-stream MRFs will divert more material but will also result in greater contamination and processing costs are higher. Also, recycling collection costs account for approximately 20% of total municipal waste service costs 8%. Given that collection accounts for 2.5 times the cost of processing, single-stream maybe favored. Also, storage space may be limited for carts leading customers to demand the fewest carts necessary.



The “Average MRF”

While no MRF is truly average, nonetheless, the average MRF has a throughput of 200 TPD and between 30,000 and 70,000 sf. The greatest variation in square footage can be attributed to the amount dedicated to storage. Approximately 64% of MRFs are privately owned.

Larger facilities tend to be more efficient with the tons processed per employee increasing with facility throughput. The largest 17% of MRFs process half the recyclables in the country.



MRF Economic Pressures

During 2018, there was a significant downturn in the value of the materials that were processed by MRFs leading the industry to focus on reducing contamination and MRF owners to consider

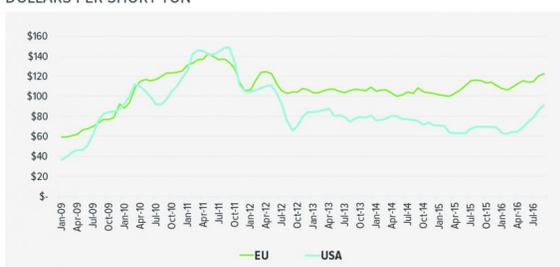
eliminating low-value items. Nationwide estimates for contamination rates are at 25-35%. Other factors that jeopardize the economic stability of MRFs are the tight labor market and increasing transportation costs.

Materials Managed

RECYCLED GLASS COMMODITY PRICES: EU vs. USA
DOLLARS PER SHORT TON



RECYCLED FIBER COMMODITY PRICES: EU vs. USA
DOLLARS PER SHORT TON



In general, single-stream MRFs manage plastic bottles, metal cans, paper and cardboard and glass containers. However, approximately 20% are no longer taking glass due to issues with contamination and low-value.

Rigid plastics are recycled less frequently than plastic bottles. Flexible film is mostly considered a contaminant and is frequently cited as the most common contaminant. Aseptic packaging is accepted at programs representing about half the population.

While newspapers have declined significantly, cardboard boxes have increased due to the Amazon effect. Mixed paper prices plunged when China instituted a ban on it leading many programs to drop it from their acceptable list.

Research indications that MRFs utilizing best practices that include advanced cleaning systems can increase glass recycling by 34%. However, the additional costs associated with installing the equipment may not be supported by the potential revenue. Recycled glass commodity value is significantly higher in the EU than in the U.S.

MRF Contracts

Given that today's MRF is much larger than MRFs from thirty years ago, they are servicing many communities. Privately owned MRFs will contract with municipalities for processing and marketing the materials. Increasingly, MRF processing contracts are reflecting a shared risk between municipalities and MRF owners. The contracts frequently include a base processing fee with a revenue share once the actual costs to process the material has been recovered.

In addition, continued public education is emphasized. Contracts checks consisting of routine audits and contaminated load fees are also common.

Technology Improvements and Future Trends

The future has arrived and MRFs are adapting by upgrading their equipment to adjust to the ever-evolving material stream. MRFs are adding robots with AI, ballistic separators to improve 2D/3D sorting, additional optical sorters, and more screens.

Will single-stream yield capacity to dual stream or will mixed waste processing become more prevalent. While decisions are made based on local demands, the convenience and collection costs will have to be offset by the need to generate a salable product. Perhaps with continued technological enhancements, single-stream is in the sweet spot.

For the future, industry experts predict that the industry will consolidate and new or improved MRFs will have increased throughput.

Resources

Recycling Partnership - MRFshed Report:

https://recyclingpartnership.org/wp-content/uploads/2018/05/TheRecyclingPartnership_MRFshedReport_7.3.17.pdf

Recycling Partnership – Single stream cart infographic:

<https://recyclingpartnership.org/wp-content/uploads/2018/05/single-stream-carts-infographic24x36.pdf>

Materials Recovery for the Future:

<https://www.materialsrecoveryforthefuture.com/>

Nat Egosi - MRF Technology & Future Economics presentation:

<https://www.materialsrecoveryforthefuture.com/>

Eileen Berenyi – What is happening out there?: Future trends in recycling processing presentation:

https://nerc.org/documents/conferences/Fall%202018%20Conference/Trends%20in%20Recycling%20Processing_Eileen%20Berenyi.pdf

Resource Recycling - Sortation by the numbers:

<https://resource-recycling.com/recycling/2018/10/01/sortation-by-the-numbers/>

Resource Recycling – Data corner: Bolstering glass recycling at MRFs

<https://resource-recycling.com/recycling/2017/04/06/data-corner-bolstering-glass-recycling-mrfs/>

Resource Recycling – Data corner: How the US and EU stack up on pricing

<https://resource-recycling.com/recycling/2017/09/04/data-corner-us-eu-stack-pricing/>

Resource Recycling – Data corner: MRFs by the numbers

<https://resource-recycling.com/recycling/2018/07/25/data-corner-mrfs-by-the-numbers/>

EPA – Containers and Packaging: Product-Specific Data

<https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/containers-and-packaging-product-specific-data#PaperandPaperboardC&P>

EPA – Paper and Paperboard: Material-Specific Data

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