NEXTCYCLE MICHIGAN

GAP ANALYSIS 2021 UPDATE

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OVERVIEW OF THE 2021 GAP ANALYSIS

The Michigan Department of Environment, Great Lakes, and Energy (EGLE) has a goal of increasing Michigan's recycling rate to 45%, growing end-use recycling markets in a circular economy framework and building the foundation for a decarbonized and thriving Michigan economy. The work described in this report is intended to illuminate gaps in Michigan's recycling supply chain to guide the development of the NextCycle Michigan Initiative (NCMI) Innovation Challenge Tracks and focus activity within Renew Partnership Portal Projects. The body of this report contains detailed analysis and data informing the gaps presented below through the Recycling Rate Update, Potential Recovery Update, Investment, Infrastructure, and Program Updates, and End Markets Update. The NextCycle Michigan Initiative and this 2021 Gap Analysis Report are funded by EGLE as part of Renew Michigan.

SUMMARY OF GAPS AND OPPORTUNITIES

Translating gaps into priority action opportunities in recycling infrastructure and end-markets through investment, innovation and building networks in Michigan is the goal for 2021 and beyond to reach the 45% recycling rate. Building on the 2019 Michigan Recyclables Market Development Study and the 2020 Gap Analysis, the 2021 Gap Analysis has delved deeper into the community program data, recycling infrastructure, and material commodities and end markets to gain a better understanding of the gaps and opportunities to grow Michigan's circular economy across the supply chain. Some of this year's take-aways include the following recommended priorities for innovation, collaboration, and investment and inform the goals of EGLE's NextCycle Michigan Initiative and "shovel ready" Renew Partnership Portal projects.

COLLECTION PROGRAMS

- For collection programs to achieve 45% recycling rate there is a need for increased infrastructure for recycling and organics, particularly food waste, glass, plastics and corrugated cardboard, throughout the state.
- Commercial, institutional, multi-family and rural residential programs for recycling and organics are currently a large gap and increasing collection programs for these sectors will accelerate recycling rates.
- 100 strategically placed comprehensive drop-off centers would provide access to 98% of Michiganders; 17 sites in most densely populated areas would provide access to half of Michigan's population.
- Communication to residents through community websites on drop-off programs or curbside collection available is not always available and although communication gaps may not always indicate a program gap, communication improvements can be made to increase recycling awareness.

EGLE FUNDING PRIORITY RECOMMENDATION: Continue to fund residential, commercial and multi-family carted recycling and organics collection infrastructure, with strong educational support, while funding the expansion of commercial and residential drop-off recycling capacity across the state.

PROCESSING CAPACITY

- At current processing capacity statewide, achieving a 45 percent recycling rate requires an additional 1,173,000 tons/year of throughput capacity for recyclables – this equates to 12 to 59 new commercial and residential MRFs across the state (depending on facility throughput) for a robust hub and spoke recycling processing network. Refer to the MRFs Map on the NextCycleMichigan.com website: https://www.nextcyclemichigan.com/mrfs-base-map.
- While some additional capacity can be achieved with increased work hours, equipment upgrades, automation, and/or expansion of existing MRFs, greater recycling processing capacity will also be needed regionally to meet this future throughput target.
- A key opportunity for recovery is found in the waste that is generated by the commercial and institutional (CI) sectors, especially corrugated cardboard. There may be a potential for a portion of commercial material to go straight to processors (essentially simpler push and bale versions of MRFs) as well as end markets as the

collection and processing infrastructure and networks grow. Current recovery needs to be better tracked and documented in reported data. Improvements in commercial recycling access, infrastructure, and participation is one of the 'low hanging fruits' available to accelerate recycling rates.

- Achieving a 45 percent recycling rate requires an estimated additional 1,012,000 tons/year of organics processing capacity, handling approximately 500,000 additional for food waste and 300,000 additional for wood waste. Management options for food waste include prevention, rescue/recovery and recycling; policy and education throughout the state need to support the entire value chain,
- Food waste processing is lacking in Michigan with only ten of approximately 150 registered composting sites statewide accepting food scraps for processing – although this is up from 5 sites reported in the 2020 Gap Analysis. Both wet and dry anaerobic digestion represent processing opportunities that warrant further exploration as do more aerobic composting technologies. Refer to the Organics Map on the NextCycleMichigan.com website: https://www.nextcyclemichigan.com/organics-base-map.
- Little is known about the hemp and cannabis plant waste volumes in the state, although data is starting to be collected as more and more growers, composters and end markets are interested in diverting this wastestream from the landfills and into composting and other markets. There is a potentially huge opportunity for Michigan to encourage diversion and recycling of this organic waste stream through supporting policy to make this more easily attainable and to allow for responsible composting and other end market opportunities.
- Although tires are not part of the 45% recycling rate goal because they are not currently part of the municipal solid waste (MSW) equation, there is a push for increased tire recovery and alternative uses of scrap tires for road building.

EGLE FUNDING PRIORITY RECOMMENDATION: Continue to fund expanded and upgraded residential and commercial hub and spoke recycling and organics processing infrastructure, with focus on food waste and working with industry partnerships and their matching grant capacity in key challenging packaging formats (glass, mixed plastics, PP, PET, food and beverage cartons, OCC and mixed paper).

END MARKETS

- Increasing consumer demand due to the impact of the Covid 19 pandemic and the relaxation of business restrictions from pandemic contact protocols have driven an increase in demand for rPET (recycled PET) that should eventually delink the rPET market from virgin PET.
- A long-term trend is emerging for a recycled Colored High-Density Polyethylene (rCHDPE) bale with higher demand with short term impacts related to increased consumer demand from relaxation of Covid 19 restrictions.
- Most types of plastics packaging, but especially 3 through 7s as well as films and flexibles need further development in MRF to end-market supply chain connections to increase MRF productivity, decrease contamination, and feed emerging plastics end-markets.
- The plastics industry is responding with chemical recycling initiatives which deconstructs polymers to address the low market demand for mixed plastics.
- Cartons have maintained a positive value since the grade was tracked. Markets in Michigan are strong and regional mill process provide a high price premium for use in tissue production, with a Michigan domestic end-market, Great Lakes Tissue, in Cheboygan providing a strong regional market solution.
- Capacity to move cardboard and mixed paper from both residential as well as commercial sources is needed to fill growing end-market demand both in Michigan as well as in nearby Great Lakes States. The new Pratt Industries mill in Wapakoneta, Ohio. is the first new mill that will use a substantial amount of mixed paper as a raw material, providing nearly 1M tons of new demand in the larger region. Graphic Packaging, with its new Kalamazoo mill investment, is adding further demand for this grade in the region – while collection capacity for these tons lag in both residential and commercial programs.
- Container glass recycling for those formats not covered by the deposit law need improved supply chain infrastructure to feed end markets. Both glass to glass container recycling markets, as well as glass to fiberglass recycling markets are looking for increased supply of quality non-deposit glass cullet.
- Michigan lacks end markets for aluminum used beverage containers (UBC) and glass. Many markets for plastic are often geared towards post industrial or clean commercial streams with fewer capabilities around post-

consumer plastics. Refer to the MRFs Map on the NextCycleMichigan.com website: https://www.nextcyclemichigan.com/end-markets-base-map.

- Development of organics end-products such as wood waste and wood waste-based products (mulch, pellets) and compost and compost-based products (soil erosion, green stormwater infrastructure, soil remediation, landscaping, agriculture) will drive the demand for more organics recovery and infrastructure.
- Other materials that demonstrate opportunity for end market investment and recovery potential include textiles, asphalt shingles, and tires; all represent opportunities for significant growth in end market development.

EGLE FUNDING PRIORITY RECOMMENDATION: Continue to fund demand driving end-market investments, including those that increase recycled content in purchasing practices and feedstock prep for manufacturing, with special focus on priority gap areas including glass, aluminum UBC, mixed plastics, PP, PET, food and beverage cartons, OCC and mixed paper.

PROGRAM INVESTMENT

- More than $1B in capital investment is required in all components of infrastructure and related programming to physically support a 45% recycling rate. To date, the total investment captured is $381,374,787, or 38% progress toward the $1B investment goal. The Project Investment visualization with the most up-to-date data can be found on the NextCycle Michigan website (https://nextcyclemichigan.com/investment-map).

EGLE FUNDING PRIORITY RECOMMENDATION: Continue to use grant program to leverage public and private industry investment in the state's recycling infrastructure and related programming, working with grant matching formulas to encourage that investment and coordinating grant programs and NextCycle Challenge Tracks align with grant matching partners like the Alliance to End Plastic Waste, Glass Packaging Institute, PP Recycling Coalition, Closed Loop Partners, the Carton Council, the Foodservice Packaging Institute and the Recycling Partnership, along with internal State of Michigan funding partners like the EGLE Scrap Tire fund, MDOT road funding and both state and local American Rescue Plan stimulus funds.

UNDERSERVED REGIONS OF THE STATE

- The southeast region of Michigan represents the largest demographic and hence the greatest opportunity for significant recovery.
- Many parts of rural Michigan have limited or no curbside recycling or commercial recycling collection service, limited or no drop-off sites for residential or commercial recycling, and no comprehensive drop-off centers for bulky and hard-to-recycle materials.
- The entire state is lacking in local end markets for recyclable materials.
- The entire state has inadequate food scrap/organics collection for residential, commercial/institutional sectors, and insufficient processing or robust end markets for compost or anaerobic digestion outputs.

EGLE FUNDING PRIORITY RECOMMENDATION: Continue to use grant program to expand super drop-off recycling and processing centers in both rural and urban areas across the state, expanding access to traditional recycling (paper and containers) and reuse opportunities (textiles, furniture, shoes, electronics, etc.), as well as those challenging materials that homes and small businesses across the state generate (tires, e-scrap, bulky and challenging materials like mattresses, carpet, Styrofoam, film, stretch wrap, etc.)

OPPORTUNITIES FOR THE NEXTCYCLE MICHIGAN INITIATIVE

The NextCycle Michigan Initiative (NCMI) represents an opportunity to bring communities, entrepreneurs, organizations, and funders together to address these pressing access and processing gaps and develop innovative and creative partnerships and solutions to channel and accelerate teams in developing solutions. Not only will NCMI challenge track projects help to fill these gaps and inform the NextCycle Michigan 2022 Gap Analysis, but so will EGLE's Materials Management Infrastructure (Mega Data) Project as the team gathers and analyzes further data. Each year's Gap Analysis will provide NextCycle Michigan's Technical Advisory Committee with the information necessary to set the priorities and opportunities for the coming year's Innovation Challenge Tracks and will assist the NextCycle Michigan team in bringing focus to "shovel ready" Renew Partnership Portal projects. The resulting partnerships, investments, and projects will lead directly to outcomes and impacts that will increase recovery and grow robust circular solutions for Michigan's economy and environment.

All the gaps identified represent opportunities for innovation, investment, and partnership. To demonstrate how some of these prioritized gaps align with and inform the Innovation Challenge Track development within the NextCycle Michigan Initiative, the NextCycle Team encourages consideration of the following types of projects:

FOOD, LIQUIDS, AND ORGANIC WASTE SYSTEMS (FLOWS) TRACK

- Access, collection, processing, and end market development for organics all present opportunities for growth in all regions of the state.
- Management options for food waste include prevention, rescue/recovery and recycling; policy and education throughout the state need to support the entire value chain,
- Expanded food waste collection, drop-off and processing capacity both in residential as well as commercial/institutional markets and including both larger scale anaerobic digestion processing capacity as well as mid and small scale aerobic (windrow and static pile) composting processing capacity.
- End market development for compost, compost-based products and other by-products of organics processing offer diverse and multiple opportunities, from agriculture to erosion control to roadway construction and more.
- Hemp and cannabis plant waste collection and composting opportunities for landfill diversion are being developed and are likely to grow this industry in the coming years.

RECYCLING SUPPLY CHAIN (RSC) TRACK

Convenient and cost-effective access to recycling and organics recovery is a highlighted priority. Numerous gaps across the supply chain have been identified in this report. Top access recommendations include:

- Capacity to move cardboard and mixed paper from both residential as well as commercial sources is needed to fill growing end-market demand both in Michigan as well as in nearby Great Lakes States.
- Most types of plastics packaging, but especially 3 through 7's, as well as films and flexibles, need further development in MRF to end-market supply chain connections to increase MRF productivity, decrease contamination, and feed emerging plastics end-markets.
- Container glass recycling for those formats not covered by the deposit law need improved supply chain infrastructure to feed end markets including upgraded glass cleaning equipment at Michigan's larger MRFs, hub and spoke aggregation infrastructure to expand supply chain channels across the state, and expanded glass collection programming (e.g. glass recycling drop-offs, bar and restaurant collection and similar clean glass collection infrastructure).
- Increase demand pull through an orchestrated "demand champion" initiative to direct collected recyclables (including tires) into both circular economy markets as well as up and downcycled end markets in durable goods, roads, agriculture and construction materials markets.
- Comprehensive curbside collection and drop off sites for residential, commercial, and institutional use.
- Comprehensive drop-off centers statewide will provide convenient access for up to half of the material stream that cannot be recovered curbside.

- 100 drop-off sites statewide would provide adequate coverage for the recovery of paints, motor oil, batteries, e-waste, large appliances (including refrigerant recovery), mattresses, bulky plastics, marine shrink wrap and agricultural plastics, tires, wood waste, textiles and more.
- Strategically placing 17 comprehensive drop-off centers would provide convenient access (within 30-minute drive) to almost half of all Michiganders in the state.

- Hub and spoke MRF infrastructure development to meet the growing need for processing.
- Build infrastructure and end markets for materials that demonstrate recovery potential such as bricks, blocks, rubble, wood waste, other construction and demolition materials, textiles, paint, and other materials.

INTERGOVERNMENTAL INITIATIVES & PUBLIC-PRIVATE PARTNERSHIPS (I^2P^3) TRACK

- Public-public, public-nonprofit, and public-private partnerships are essential to developing a robust circular economy in Michigan, with opportunities to have significant impact across all identified gaps.
- Intergovernmental agreements, development of authorities, and other available mechanisms offer opportunities to close gaps in access, processing, and end markets to increase cost effectiveness and efficiencies across the supply chain.
- Best practice policy development at the local and regional level can achieve significant outcomes. Policy development and implementation can improve access, collection, communication, and outreach, and increase use of compost and other recyclables in many applications.

ROADS AND PATHWAYS (ROADS) TRACK

- Road-building provides ample opportunity for investment, innovation, and partnership in the increased use of recycled-content materials that are high priorities for end market development, including post-consumer glass, asphalt shingles, tires, and compost. The use of mixed plastics in drain beds and other applications also offers opportunities for increased recovery.
- Applications can be broad across many types of hardscape surfaces including state, county, and local roadways, supporting transportation infrastructure (e.g., rest-areas, park and ride lots, stormwater management infrastructure, service ramps, etc.), pathways and trails, institutional, commercial and multi-family residential parking, sidewalks and hardscapes, playground surfaces, and more.
- Many recycled content treatments are proven and ready to scale including rubber modified asphalt (RMA) for paving, tire derived aggregate (TDA) for drainage, retention systems and the like, tire derived sealers (TSD aka chipseal), pulverized glass as a cementitious pozzolanic additive to concrete projects, compost and wood chip use in stormwater run-off management, pathways, and road right of ways and medians, and more.

RECYCLING INNOVATION & TECHNOLOGY (RIT) TRACK

- The development of an innovative process, product, or service that increases the use of recyclables that are lacking end markets represents a significant opportunity for economic development and diversion in Michigan.
- Materials prioritized for innovation initiatives include glass, textiles, tires, wood waste, food waste, mixed plastics, film plastics, tires, and asphalt shingles.
- Innovations in sortation technology, including improvements in robotics, conveyance, AI, and decontamination all represent opportunities for investment.

MICRO SCALE 3RS SOLUTIONS (MICROS) TRACK

- Access, collection, processing, and end market development sometimes start small, and some communities, entrepreneurs or endeavors may need only a small boost of funding, expertise, or mentorship to get an idea off the ground.
- Many communities with interest in collaborating across their region lack the resources to meet and develop collaborative approaches to filling gaps in diversion in their areas.
- Demonstration projects that are replicable at small scale, or scalable, can take their next step towards implementation to determine viability for growth and investment.

DATA INFORMING THE 2021 GAP ANALYSIS UPDATE

INTRODUCTION

This Gap Analysis 2021 Update, along with the full Gap Analysis 2015 Report and the Gap Analysis 2020 Update Executive Summary, provide a road map for growing Michigan's circular economy, building resilience, and working towards a low carbon future. This road map informs the application of best practices for sustainable materials management across the state's regions, metro areas, counties, and communities, and reinforces the role of recycling supply chain based economic development – across all commodities and sectors, including reuse, recovery, and repair. This gap analysis is an opportunity road map for achieving a 45% recycling rate, but also a path to decarbonizing Michigan and a cleaner, healthier future.

The first section of this update, the Recycling Rate Update highlights the 2019 18% recycling rate and breakdown of the material recovery by category. This serves as a baseline for increased recovery opportunities. The opportunities for increased recovery by category are shown in the third section.

The second section, Investment Updates, demonstrates the investment need of more than $1 Billion in infrastructure projects such as processing facilities, secondary processing, and end markets for recoverable materials, as well as collection containers and trucks to haul those materials to meet the 45% recycling rate in Michigan. The stages of the project investments by category such as "Completed or Underway", "Planned", "Under Discussion", and the Target Investment and Remaining needed for each category are being tracked and shown with a link to an investment visualization on the NextCycle website. This section highlights the need for support to accelerate investment and build engagement.

The third section, Infrastructure Updates and Potential Additional Recovery, details the existing infrastructure and summarizes the potential recovery through recycling facilities, drop-offs and organics processing, their gaps, and recommended next steps.

The fourth section, Community Program Communication Access Updates, summarizes the data that has been collected through the Michigan Materials Management and Infrastructure Program Project on residential diversion program information including communication to residents on the availability of curbside and drop-off programs.

The fifth section, End Markets Update, identifies end market trends by commodity type, and suggests investment in collection, processing, and end market development where there is insufficient market capacity. There is no single track or pathway that taken alone will get Michigan to 45 percent recycling. Processing and end market gaps and solutions vary by commodity type so that a comprehensive approach to waste diversion must be undertaken to increase Michigan's recycling rate.

WHY IS THIS 45% DIVERSION GOAL IMPORTANT?

With more than 80 percent of the material being landfilled or incinerated in Michigan, there is significant opportunity to divert more material. If Michigan's recycling rate reached 45%, the economic benefits of the recycling, reuse, and recovery industry would total **138,000 jobs** in Michigan in collection, processing, and manufacturing, **$9B total annual labor income** and **$34B in economic output**. The recycling, reuse, and recovery industry would account for 3.3% of total output for the State of Michigan, overtaking the transportation and tourism output. Additionally, a 45% recycling rate achieves an additional 7M tons of greenhouse gas (GHG) emission reductions per year.

7M TONS OF GHG EMISSION REDUCTIONS PER YEAR IS THE EQUIVALENT OF...

GHG EMISSIONS FROM
1,498,030
PASSENGER VEHICLES DRIVEN FOR ONE YEAR

GHG EMISSIONS AVOIDED BY
760,731
HOUSEHOLDS' ENERGY CONSUMPTION

RECYCLING RATE UPDATE

BACKGROUND

Part 175, Recycling Reporting, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA), requires recycling establishments to report each year on a portion of commonly recycled materials that contribute to calculating a statewide recycling rate. As of November 1, 2019, 85 organizations registered with the Module. Of the registered organizations, 86 percent (73 of 85) reported their recycling data through the system. The most common organizations to report include materials recovery facilities, municipalities, and scrap metal/salvage yards.

METHODOLOGY

The 2019 reported recycled data was evaluated by EGLE staff and adjustments were made to the reported data to deal with material that was industrial recycling. This analysis was not performed on the 2018 reported data. The 2019 reported data, as adjusted, resulted in a reported 1,089,040 tons of recycled material. This reported data did not include other recycled material data such as material recovered under the Michigan Bottle Bill.

In addition, RRS evaluated the reported quantity of organic material, primarily yard waste, that was reported to the EGLE. The total reported to EGLE for the 2019 FY was 1,687,951 CY (yard waste, wood waste, and food waste), which was converted to tons using a 450 lb./CY conversion, resulting in 380,221 tons of diverted organics. This does not include any volumes of organics going to anaerobic digestion (AD) as they are not required to report volumes to EGLE.

In 2019, the recycling rate was 18.0% based on the disposal of 8.013 million tons of MSW[1] (Table 1) to recycling and composting activities. The 2019 recycling rate is lower than 2018 in which Michigan diverted 18.1% from landfill. Based on the revised reported recycling and diversion data and the tonnage of material disposed using 3.3 Cubic Yards (CY)/ ton the 2019 recycling rate is comparable to the 2018 rate of 18.1% using unadjusted recycling data and a landfill disposal conversion rate of 3.0 CY/ton. This report and future reported tonnage will use the EPA value of 3.3 cubic yards (cy)/ton for the conversion of MSW disposed in cubic yards to the equivalent tonnage.

Table 1: Recycling Rate and Updated MSW Conversion

Recycling Rate based on 3.3 CY/ Ton of MSW

YEAR	RECYCLING RATE	RECYCLED TONNAGE**	MSW DISPOSED
2018	19.3%*	1,946,970 ***	7,152,152
2019	18.0%	1,763,083 ****	8,012,760

* The 2018 Diversion rate identified in the 2020 Gap Analysis was 18.1% based on a conversion rate of 3.0 CY/Ton
** Includes curbside and drop off recyclables, Deposit Material reported by Dept. of Treasury, e-waste, white goods, textiles, and batteries
*** Based on unadjusted 2018 reported data.
**** Based on reviewed and adjusted 2019 reported data

[1] The State of Michigan reports MCW, which is municipal and commercial waste that is typically residential-like waste as defined by the State of Michigan and does not include industrial waste or construction and demolition waste. The conversion from Cubic Yards (CY) to tons is based on a 3.3 CY/ton conversion.

CURRENT RECOVERY

Figure 1 breaks down the material recovered by category. Paper, organics, and metals are the three largest recovered categories. The material collected under the Container Deposit law are included in material breakdown in the plastic, metals, and glass categories. (See Table 3: Container Deposit Measurement).

Figure 1: Material Recycled by Category (in tons and % of total)

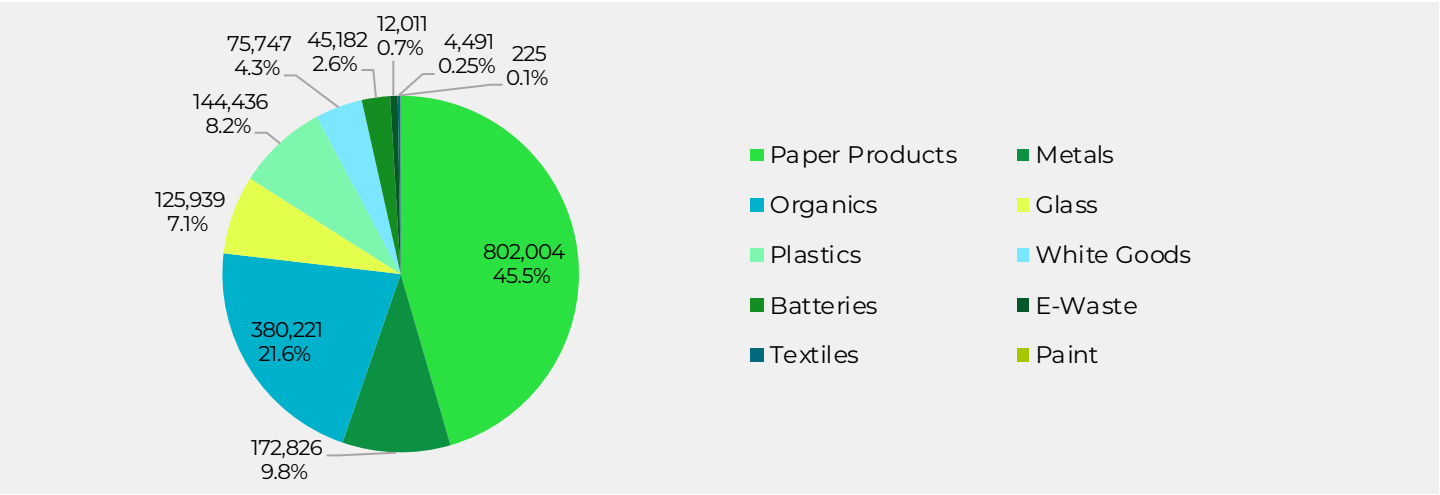


Table 2 shows the breakdown of the total diverted and recycled material in 2019 of 1,763,083 tons. Diverted tons such as organics, white goods, batteries, e-waste textiles, and paint, as well as commercial sector recycled material, will continue to be explored and added to the total diverted and recycled.

Table 2: Current Estimated Recovery by Material Type

Material	Percent	Total Tons	EGLE Reported Tons (Adjusted)	EGLE Reported Additional Single Stream (Distributed)	Bottle Deposit Tons	Other Estimated Tons
Paper Products	45.49%	**802,004**	789,596	12,408		
Ferrous Metals	6.60%	**116,445**	111,887	1,758		2800
Nonferrous Metals	3.20%	**56,381**	23,349	367	32,665	
Glass	7.14%	**125,939**	29,526	464	95,949*	
Plastics	8.19%	**144,436**	113,530	1,784	29,122	
Organics	21.57%	**380,221**	380,221			
White Goods	4.30%	**75,747**				75,747
Batteries	2.56%	**45,182**				45,182
E-Waste	0.68%	**12,011**				12,011
Textiles	0.25%	**4,491**	4,371			120
Paint	0.01%	**225**				225
Total	**100%**	**1,763,083**	**1,452,480**	**16,781**	**157,737**	**136,085**

*Deposit Glass was 95,949 tons or 76.1% of the estimated glass recovery

TAKE-BACK PROGRAMS

A variety of materials which are diverted from a destination as MSW are collected through take-back programs. Examples include electronic waste, textiles and beverage containers that are included in the state's 10-cent bottle deposit system. RRS gathered information from a variety of these take-back program operators on an individual basis.

CONTAINER DEPOSITS

RRS was engaged by the National Association for PET Container Resources (NAPCOR) and the Glass Packaging Institute (GPI) in 2015 to conduct a study to assess different approaches to a container redemption program. The purpose of this project was to develop an analytical tool that can provide decision makers information on the total system costs and the tradeoffs between various redemption and recycling schemes. The percentage distributions between different material type is based on reported data by redemption programs that provide this level of detail. The Michigan Deposit Law does not require this detailed reporting. The average weight per container is always changing but the industry group agreed that the conversion factors were a fair assessment to use in the initial study of the Michigan recycling rate in 2015. The implementation of more detailed reporting or the institution of a redemption system advisory group that would advise on the current best data conversions should be considered for future program assessments.

Michigan container deposit data is recorded in unredeemed deposit revenue and must be converted to material tonnage accordingly (Table 3). RRS reviewed data on the volume of 2019 container deposit returns from the Michigan Department of Treasury. Using data provided by the Treasury, the RRS team determined the number and material composition of total deposits redeemed, then projected the total tonnage with average container weights for each material (metal, glass, plastic) commonly used, using average container weights calculated by Franklin Associates for the California BEAR Report.

Table 3: Container Deposit Measurement

MATERIAL	CONTAINER WEIGHT (LBS)	% OF STREAM	# OF CONTAINERS	WEIGHT (LBS)	WEIGHT (TONS)
Glass	0.4366	13%	439,530,000	191,898,798	95,949
PET	0.0749	23%	777,630,000	58,244,487	29,122
Aluminum	0.0302	64%	2,163,840,000	65,330,560	32,665
TOTAL			**3,381,000,000**	**315,473,845**	**157,737**

E-WASTE

The MI EGLE directly provided a report on the total tonnage of electronic waste that was reported recycled by the recyclers that are registered with the state's Electronics Reuse and Recycling Program in the 2019 program year, covering October 2018 through September 2019.

TEXTILES

Approximately fifteen textile collectors are operating in the state of Michigan through a variety of take-back channels including nearly 7,000 bins, store drop-offs and free household collection services. The state's most prominent non-profit and for-profit textile collectors were contacted with a request to provide information concerning the amount recycled in Michigan and collected information on the market and supply chain for these materials. Additionally, generation and supply chain information was collected directly from the national association which tracks these textile statistics, Secondary Materials and Recycled Textiles (SMART). Quantities for specific take-back programs were obtained, and total aggregate quantities of material were projected, which totaled 29,730 tons. The quantity reported to EGLE under Part 175 reporting requirements was 4,371 tons and RRS included an additional 120 tons of carpet.

WHITE GOODS

Data on reported recovery of other major appliance was obtained from US EPA databases for major appliances (White Goods including refrigerators, freezers, dehumidifiers, air conditioners, dishwashers, clothes washers and dryers, and stoves). The recovery data on a per capita (lbs./person) national average was used to estimate potential total recovery on and adjusted based on data reported by national appliance manufacturers. Additional data on white goods included

estimates based on the appliance collection data reported under the Energy Waste Reduction reports submitted to the MI Public Service Commission. These reports include information on recycled appliances including refrigerators, freezers, dehumidifiers, and air conditioners. The data is reported in number of units and RRS converted to tons using national average weights for the different major appliance.

BATTERIES

The Project Team collected information from the Association of Battery Recyclers for an industry-leading calculation methodology for measuring lead acid battery recycling. The resultant extrapolation provided what was determined to be an aggressive scenario, especially when benchmarked against an alternative approach following a US EPA protocol. A blended approach for the baseline calculation utilized these reference approaches for aggressive and conservative scenarios in the sensitivity analysis. Data obtained on recycled batteries was from Call2Recycle, the primary take-back program for rechargeable batteries and mobile phones operated by US manufacturers of rechargeable batteries.

HAZARDOUS HOUSEHOLD WASTE

Data on hazardous household waste was obtained directly from MRFs and County programs that responded to the data requests under other data research being conducted for EGLE. Additionally, data was provided by ePaint Recycling (epaintrecycling.com), representing the total amount of paint that was collected from Michigan communities through the ePaint program.

TAKE-BACK PROGRAM TOTALS

The result of the assessment of diverted material resulted in an estimate of an additional 140,456 tons of material diverted and recycled from e-waste, textiles, batteries, white goods, paint, and metals recovered from incinerators. Table 4 shows that breakdown of these take-back materials.

Table 4: Total Tons Other Recyclables Diverted from Disposal

MATERIAL	TONS COLLECTED (ESTIMATED)
Total E-Waste	12,011
Total Batteries	45,182
Total Paint	225
Total White Goods	75,747
Recovered Metal*	2,800
Total Textiles	4,491
TOTAL	**140,456**

*Reported by Kent County Incinerator (Covanta)

MICHIGAN'S MUNICIPAL SOLID WASTE DISPOSAL STREAM

Disposal tonnage was retrieved from 2019 annual landfill report[2] of solid waste landfilled in Michigan, as well as from reported data from the incinerator in Kent County. Disposed MSW is reported to EGLE in cubic yards and reported material quantities are converted to tons using MSW conversion factors. The 2019 disposal data identified 25,840,848 cubic yards (CY) of MCW (municipal and commercial waste that is typically residential-like waste) disposed from instate sources. The Kent County incinerator reported that it processed an additional 185,000 tons (610,500 CY) with 2,800 tons of recovered metal for a net total of 182,200 tons.

The reported MSW volumes were converted using the EPA conversion factor of 3.3 CY/ton (600 lbs./CY). The quantity of landfilled material was 7,830,560 tons. Landfill disposal quantities were adjusted to avoid double-counting incinerator ash, then added to the total quantities of incinerated materials, yielding a total disposed of 8,012,760 tons.

As reported in the 2020 Gap Analysis and based on a waste characterization of the disposal stream conducted in 2015, approximately 84 percent of the disposed waste could be recovered while the remaining 16 percent is considered non-recoverable (Figure 2). Recoverable material includes traditional mixed recyclables (26 percent of the disposal stream), other recyclables such as textiles, appliances, scrap metal, electronics, bulky plastics, and plastic films (20 percent of the disposal stream) and organics such as yard, food waste as well as compostable paper and compostable food service packaging (38 percent of the disposal stream). Of the total 8.012 million tons disposed in Michigan in 2019, approximately 2.48 million tons of mixed recyclables, 1.19 million tons of other recyclables, and 3.08 million tons of organics and compostables were sent to disposal in 2019 in the state.

Michigan is organized into 14 Councils of Government (COG) regions that group counties together based on economic, political, and geographic similarities (Figure 3). The analysis of disposal uses this political structure as the basis to evaluate planning related to the infrastructure required to achieve the State of Michigan goal of a 45% recycling rate (Table 5). For example, the Region 1 COG includes Livingston, Macomb, Monroe, Oakland, Saint Claire, Washtenaw, and Wayne Counties and disposed of 1.16 million tons of mixed recyclables, 560,000 tons of other recyclables, and 1.45 million tons of organics and other compostables in 2019. These factors can be used to determine the gap in infrastructure capacity and to evaluate the most effective approach to managing increased recovery through regional cooperation.

Figure 2: 2019 Disposal Composition

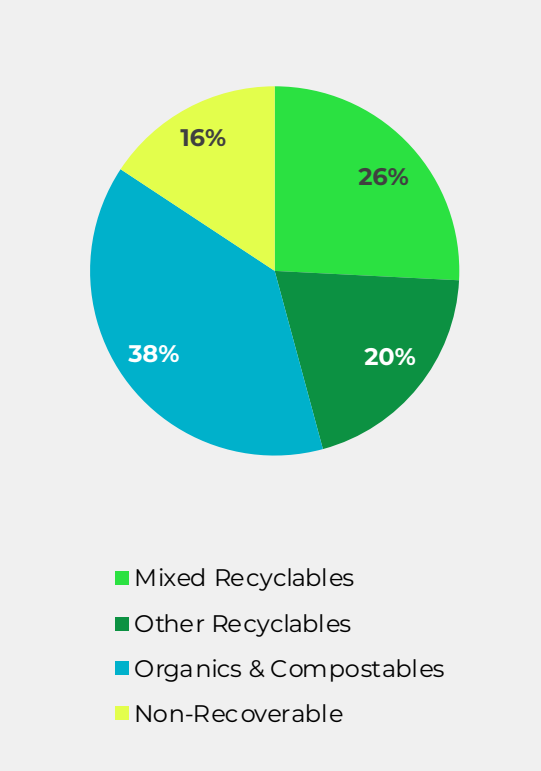
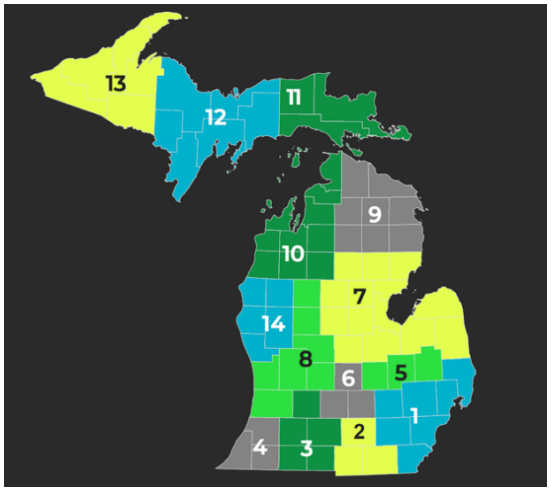


Figure 3: Michigan Councils of Government



[2] Report of Solid Waste Landfilled in Michigan, October 1, 2018 - September 30, 2019, Prepared by Michigan Department of Environment, Great Lakes, and Energy, Materials Management Division, Solid Waste Section. February 14, 2020

Table 5. Breakdown of Michigan's Disposal Stream by Council of Government Regions

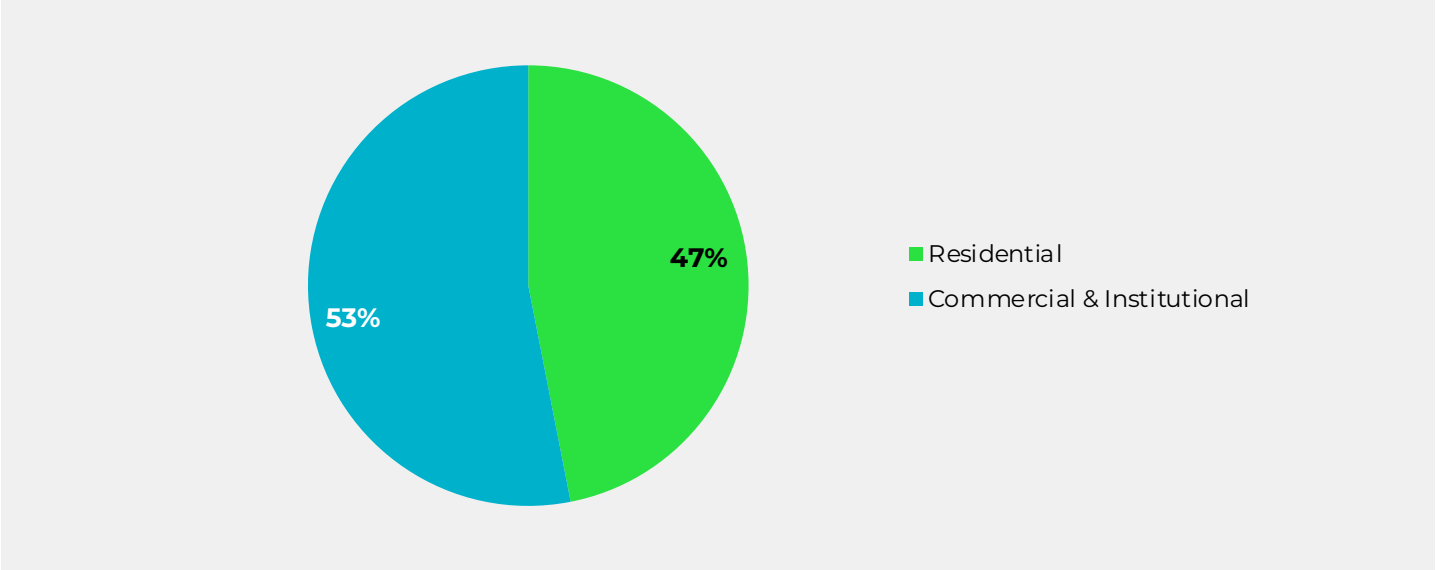
COG	MIXED RECYCLABLES	OTHER RECYCLABLES	ORGANICS & COMPOSTABLES	NON-RECOVERABLE	TOTAL
1	1,161,043	560,253	1,446,549	590,757	3,758,610
2	73,870	35,646	92,035	37,586	239,137
3	139,606	67,366	173,935	71,034	451,940
4	68,602	33,104	85,472	34,906	222,084
5	130,769	63,102	162,926	66,537	423,334
6	117,546	56,721	146,451	59,809	380,528
7	212,987	102,776	265,362	108,371	689,496
8	306,535	147,916	381,913	155,970	992,334
9	32,437	15,652	40,414	16,505	105,008
10	74,626	36,010	92,977	37,971	241,585
11	13,315	6,425	16,589	6,775	43,105
12	53,878	25,999	67,127	27,414	174,418
13	19,187	9,259	23,905	9,763	62,114
14	70,760	34,145	88,160	36,004	229,067
TOTAL	**2,475,162**	**1,194,373**	**3,083,816**	**1,259,401**	**8,012,760**

As noted above, the total disposal stream analyzed here is MSW which includes the residential, commercial, and institutional sectors and encompasses 60 percent of material generated in-state that goes to landfill[3]. Roughly 47 percent of municipal solid waste sent to disposal (3.758 million tons) is generated in the residential sector and the other 63 percent (4.254 million tons) is generated in the commercial and institutional sectors (Figure 4).

It should be noted that of the reported 1.763 million tons recycled in Michigan, 1.09 million tons of traditional recyclables are often associated with MRF processing such as paper, cardboard, aluminum, glass, and plastic bottles and jars, as well as paper and plastic take out containers. This is significantly greater than the in-state MRF processing capacity stated below. There are a couple factors to consider. First some of Michigan's recyclables are processed out-of-state and in Canada; however out-of-state processing most likely accounts for only a small portion of the total recycling processed from Michigan. A more likely explanation is that a large portion of the 1.09 million tons of traditional recyclables is bypassing known MRFs and/or is processed at private sector operations.

[3] The remaining material generated in-state and sent to disposal includes industrial and construction and demolition waste which is not analyzed in this report.

Figure 4: Source of Municipal Solid Waste Disposal



Roughly 47 percent of municipal solid waste sent to disposal is generated in the residential sector and the other 53 percent is generated in the commercial and institutional sectors (Figure 4) based on the review of waste characterization studies conducted in 2015 with a focus on Great Lakes regional state data on the split between commercial and residential waste. Of the 1.09 million tons of traditional recyclables that were recovered in Michigan, more than half is estimated to be sourced from the commercial and institutional sectors which can often be collected source separated from the business directly. Without greater data tracking and transparency in the commercial sector in Michigan, it is challenging to understand exact MRF processing operations across the state and business-to-business recovery operations that are significantly contributing to Michigan's overall recycling rate. A concerted effort should be undertaken to work with the commercial sector and various material processors and brokers to understand this activity as it is crucial for the commercial sector to increase recovery if Michigan is going to achieve the 45% recycling goal.

INVESTMENT UPDATES

PROJECT INVESTMENT UPDATES

Analysis completed in 2017 as part of the Governor's Recycling Council's Recommendations calculates more than $800M in capital investment required in all components of infrastructure and related programming to physically support a 45% recycling rate. This includes investments in processing facilities for recyclables, food waste, other compostables, etc. as well as investments in secondary processing and end markets to use those materials. It also includes the collection containers and trucks to haul those materials and other support services to both accelerate investment and build engagement in actual recycling behavior. With global market dynamics pushing more domestic end-market development in paper and plastics, and with advances in automation at recycling facilities via robotic sorting and artificial intelligence, coupled with increases in construction costs, the updated required investment has reached $1Billion.

The calculated investment need of more than $1Billion serves as a benchmark for tracked progress towards this targeted investment. The following recycling related investments tracked include:

TRANSFER, PRIMARY AND SECONDARY PROCESSING AND END MARKETS

- Recycling facilities – aka Material Recovery Facilities or MRFs, single and dual stream, as well as commercial recycling operations (sometimes referred to as push and bale plants) – small, medium, large.
- Compost facilities – dry and wet anaerobic digestion facilities as well as static pile and windrow compost facilities of all sizes.
- Hub and spoke transfer networks for recyclables and organics – feeding the above facilities.
- Super drop-off convenience and take back centers
- Secondary processing facilities (e.g. glass pre-cleaning and beneficiation, plastics sorting, MRF residue processing)
- End market capacity expansions

COLLECTION CARTS, CONTAINERS AND TRUCKS

- Curbside recycling carts
- Curbside organics carts
- Recycling roll-offs for high density drop-offs
- Commercial recycling collection containers
- Commercial organics collection containers
- Multi-family recycling dumpsters
- Automated curbside collection trucks
- Semi-automated curbside collection trucks
- Front load collection trucks
- Roll-off collection trucks
- Support vehicles

SUPPORT SERVICES

- Curbside Cart Roll-out and Targeted Local Education
- Research and Development
- Statewide Outreach/Engagement/Messaging
- County Recycling Plans
- Program Support/Management

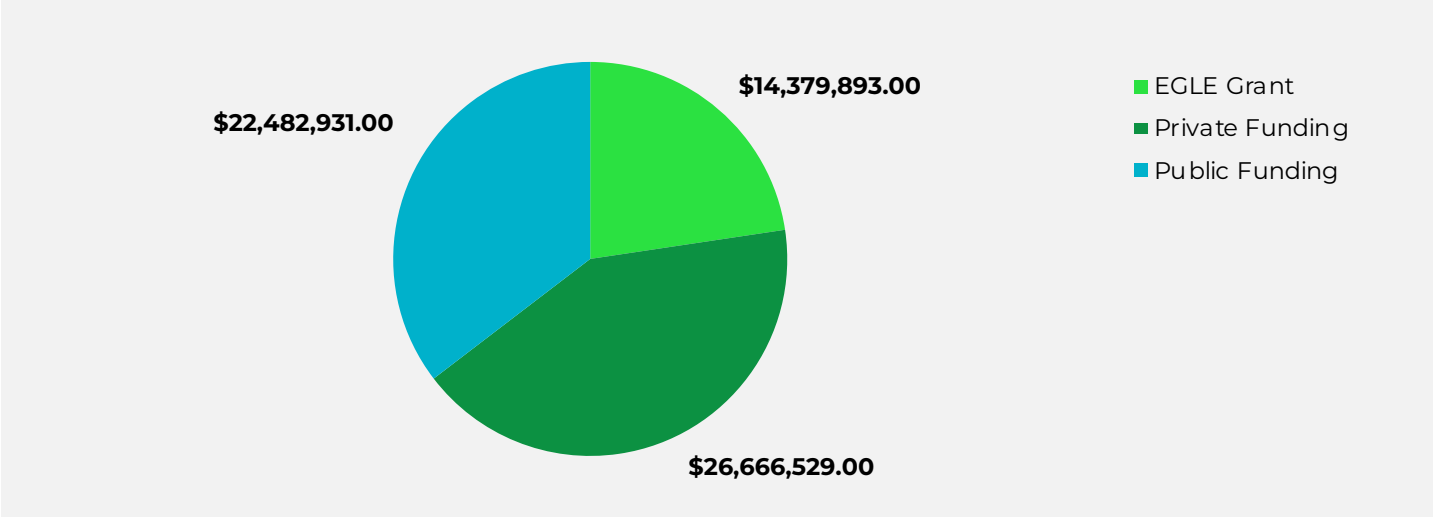
Table 6 indicates the stages of the project investments by category such as “Completed or Underway”, “Planned”, “Under Discussion”, as well as the Target Investment and Remaining needed for each category.

Table 6: Project Investments

BUILD OUT STAGES	PROCESSING AND END MARKETS	CONTAINERS AND TRUCKS	SUPPORT SERVICES	TOTAL INVESTMENT
Completed or Underway investments	$ 247,299,802	$ 14,186,327	$ 1,728,589	$ 263,214,718
Planned or Under Development	$ 34,396,000	$ 71,214.00	$ -	$ 34,467,214
Under Discussion	$ 71,040,000	$ -	$ -	$ 71,040,000
Target Investment	$ 687,800,000	$ 320,325,000	$ 37,870,082	$ 1,045,995,082
Remaining for target (gap)	$ 335,064,198	$ 306,067,459	$ 36,141,493	$ 677,273,150

Progress towards investment goals includes tracking of 110 different projects with many still under discussion and conceptualization for total investment needs. While this data is not exhaustive and is actively being gathered, 104 complete or underway projects are tracked with 95 mapped to visually show project investments across the State of Michigan, including statewide projects. The Project Investment visualization with the most up-to-date data can be found on the NextCycle Michigan website (https://nextcyclemichigan.com/investment-map). Over $14M in EGLE Recycling Grants since 2018 have been leveraged by Public and Private investments to support project implementation. Figure 5 demonstrates the nearly $50M of public and private investment which leverages the contributions from EGLE Recycling Grants supported from Renew Michigan funds.

Figure 5: Breakdown of Public and Private Investment



INFRASTRUCTURE UPDATES AND POTENTIAL ADDITIONAL RECOVERY

RRS analyzed Michigan's current disposal stream and applied a composition estimate to MSW so that the proportion of recoverable material in MSW could be identified. Overall, 84 percent of disposed MSW is estimated to be recoverable through recycling and organics processing activities. RRS estimated a reasonable capture rate for each disposed commodity[4] that, if achieved, would move enough recyclables and organics from disposal to recovery for Michigan to achieve a 45% recycling rate. From this analysis, diversion infrastructure gaps were identified (Table 7). The materials recycled under the Container Deposit law are incorporated in the current diversion quantities and no additional material was estimated from this source as part of additional material diversion.

Table 7: Summary of Additional Diversion and Diversion Infrastructure Gaps

	NEEDED CAPTURE RATE	ADDITIONAL COLLECTION TONS	IDENTIFIED INFRASTRUCTURE GAP	ACCOMPLISHMENTS SINCE 2020 GAP ANALYSIS	NEXT STEPS
Mixed Recycling Processing at Material Recovery Facilities (MRFs)	47%	1.173 million	12 to 59 new MRFs depending on facility throughput across the state for robust hub and spoke network	3 MRFs online or coming online in 2021 adding 79,000 additional tons per year in processing capacity	• What portion of commercial material can bypass a MRF and go straight to processors and end markets? • Where are smaller community MRFs preferable over larger scale 35- and 50-TPH MRFs?
Other Recycling at Recycling Drop-Off Facilities	34%	411,950	100 strategically placed comprehensive drop-offs would provide access to 98% of Michiganders, 17 sites in most densely populated areas provides access to half of Michigan's population		• What is the current drop-off diversion capacity in Michigan? • Where are opportunities to co-locate MRFs, transfer stations, landfills, and drop-offs?
Organics Processing	33%	1.012 million	Approximately 500,000 additional organics processing capacity for food waste and 300,000 additional processing capacity for wood waste.	5 additional organics processing sites began accepting food waste	• Where can new facilities be established? • What compost facilities have the potential to expand? • What compost facilities have the potential to accept food waste?

For Michigan to achieve a 45 percent recycling rate, both recycling and organics access, collection and processing will need to be ramped up throughout the state. The following sections highlight current processing updates and potential additional recovery for each of the three areas above, MRFS, Organics, and Other Recycling and Drop-offs.

[4] Capture rate refers to the movement of recoverable material from disposal to recycling or organics processing to reach 45% recovery rate. For example, it may not be reasonable to assume 100% of plastic PET bottles in the disposal stream could be captured for recycling. However, it may be reasonable to assume 50% of plastic PET bottles in disposal could be captured for recycling with improved outreach and education, collection, and processing programs. Thus, for this example the capture rate for plastic PET bottles would be 50%.

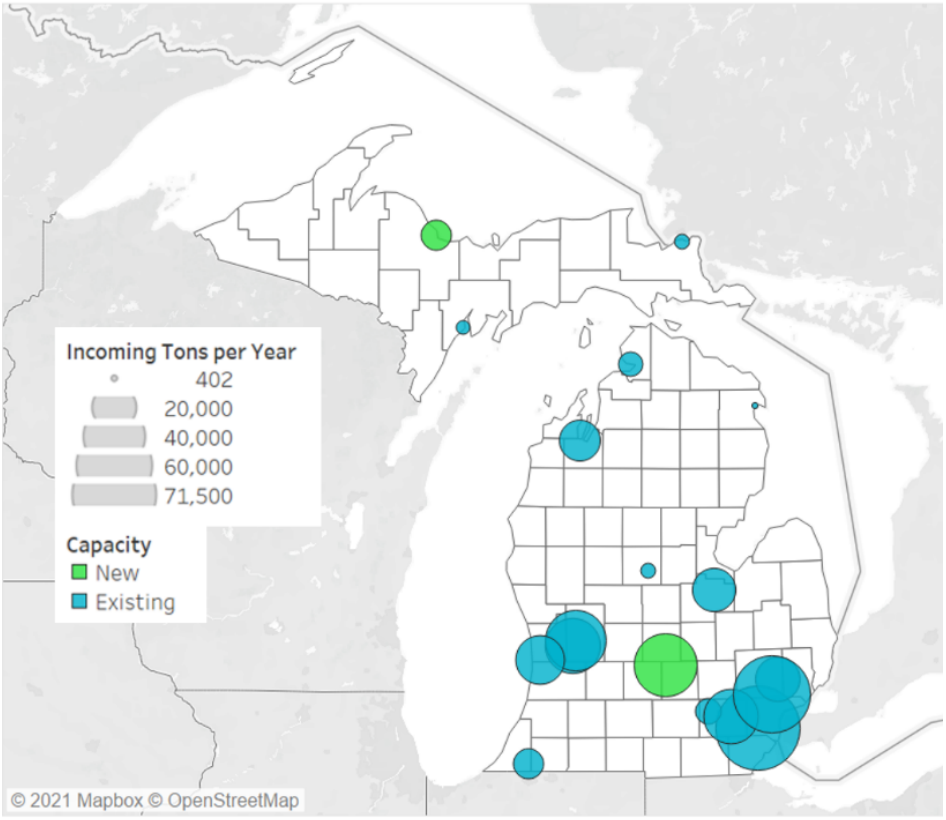
RECYCLING PROCESSING

The quantity of material that is potentially recyclable will need to be processed into specific commodity grades at MRFs. An evaluation of the current capacity of MRFs that primarily process residential curbside recovered materials illustrates the potential gap in processing capacity. It is estimated that the current throughput of MRFs that process curbside materials is 440,828 tons/year, based on the design throughput capacity when available or on reported current thruput (Table 8 and Figure 6). This does not include the capacity of facilities that only process commercial material. The capacity and capability of the commercial processors needs to be more clearly understood.

Table 8: Current Material Recovery Facility Throughput (Tons Per Year)

COG	MRF THROUGHPUT
1	227,600
2	0
3	0
4	9,200
5	0
6	41,600
7	33,280
8	91,860
9	402
10	30,750
11	2,122
12	4,014
13	0
14	0
TOTAL	440,828

Figure 6. Existing and New MRF Capacity Since Fall 2020



Source: https://www.nextcyclemichigan.com/mrfs-base-map

Since 2020, two additional MRFs have come online in the state, and a third MRF is under construction. In total these MRFs will add 79,000 tons per year of capacity to Michigan's recycling processing. These new MRFs are essential to building out the state's hub and spoke processing network, and while this additional capacity is needed to get Michigan to 45%, completely utilizing the additional capacity will require Michigan communities and businesses to collect and send more recycling than what is currently being processed in the state. The three new MRFs are highlighted below:

CITY OF LANSING MRF

Emterra Environmental, a Canadian based company opened a new MRF in Lansing in April of 2021 built on a brownfields site as a private-public partnership with the Cities of Lansing and East Lansing to improve recycling processing capacity in the region. The facility is capable of processing 40,000 tons per year. Lansing and East Lansing combined will send 7,500 tons of recyclables annually, and Emterra will be delivering recyclables with a hub and spoke feeder network that serves nearly 50+ communities stretching all the way east to Port Huron and northeast to cover Michigan's thumb region. Previously, Lansing and East Lansing were sending their recycling for processing in the Detroit area. The Emterra Lansing MRF was able to install a state-of-the-art glass cleaning system with grant support from EGLE, and includes robotic sorting of paper cartons and cups, funded with EGLE grant support and industry support from the Carton Council and the Foodservice Packaging Institute/Paper Cup Alliance. Emterra is currently looking for additional regional tons to supply the new MRF. The MRF accepts glass, cartons/paper cups, aluminum cans and foil, plastic bottles and containers, cardboard, mixed paper and boxboard.

MARQUETTE MRF

The Marquette County Solid Waste Management Authority (MCSWMA) obtained funding from Closed Loop Partners and EGLE in 2019 to upgrade their MRF from dual stream to a single stream facility capable of processing 9,000 tons per year with the potential to expand processing to 12,000 - 14,000 tons per year. The new facility has state-of-the-art equipment including optical sorters and robotics with artificial intelligence. Prior to upgrading the MRF, MCSWMA conducted a survey and found there was overwhelming support in the region to move towards single stream, and the Authority hoped this would translate to greater participation from the 40% they were finding with the dual stream program. The facility serves all of Marquette County, approximately 65,000 residents and has the potential to serve the larger region of 200,000 residents. Residents can recycle cardboard, paper, plastic, aluminum, and glass. Glass was previously removed from the County's curbside program in 2018. Along with the MRF upgrade, MCSWMA is bringing glass back into the recycling program. Glass will be collected source separated curbside once per month within Marquette City. Other municipalities within the authority can individually choose to collect glass either curbside or drop-off. Glass will be processed into aggregate and sand-like material and used for local road construction projects.

RECYCLE ANN ARBOR MRF

Recycle Ann Arbor raised over $7 million in capital to rebuild the City of Ann Arbor's Materials Recovery Facility (MRF), a new, state-of-the-art designed and built by Machinex. It took the right mix of experts, advocates, and recyclers on RAA's team to achieve a loan with a local bank, a contract with the local municipality, agreements with emerging regional end markets, support from State grant programs, financing from private funders, and consultation from national recycling and zero waste organizations. RAA's MRF project partners--Level One Bank, The City of Ann Arbor, Nothing Left to Waste (NL2W), Resource Recycling Systems, the Ecology Center, Closed Loop Partners, Pratt Paper, Machinex, Rumpke Waste Services, and the State of Michigan EGLE--all played essential roles. Seeded by RAAs vision and sustained by its partnerships, the Ann Arbor Area MRF will turn on its cutting-edge equipment and begin processing materials in November 2021, processing 30,000 tons per year on a single shift; about 15 tons per hour. Twenty people will work good paying union jobs with great benefits. The MRF will serve the Eastern Washtenaw County region and can accommodate additional growth in the Southeast Michigan region.

Table 9 compares Michigan's current MRF processing and the needed MRF processing to achieve a 45% recycling rate. From this comparison the MRF processing gap can be calculated by subtracting the needed MRF processing from the current MRF processing. In all of Michigan COGs, more processing will be needed is needed, with the largest MRF processing gaps occurring in COGs 1, 7, and 3. Overall an additional 732 thousand tons of mixed recyclables will need to be processed.

Table 9: Comparison of Current MRF Processing and Needed MRF Processing

COG	CURRENT MRF PROCESSING (TPY)	NEEDED MRF PROCESSING (TPY)	MRF PROCESSING GAP (TPY)
1	227,600	550,643	(323,043)
2	0	35,010	(35,010)
3	0	66,172	(66,172)
4	9,200	32,508	(23,308)
5	0	61,996	(61,996)
6	41,600	55,725	(14,125)
7	33,280	100,877	(67,597)
8	91,860	145,323	(53,463)
9	402	15,310	(14,908)
10	30,750	35,294	(4,544)
11	2,122	6,283	(4,161)
12	4,014	25,495	(21,481)
13	0	9,041	(9,041)
14	0	33,516	(33,516)
TOTAL	**440,828**	**1,173,193**	**(732,366)**

An additional 1.29 million tons of residential, commercial, and institutional mixed recyclables will need to be collected from the disposal stream and processed at MRFs (56 percent capture rate, Table 10). Mixed recyclables include materials such as paper, cardboard, aluminum, glass, and plastic bottles and jars, as well as paper and plastic take out containers. The additional recycling can be broken down by COG to understand the regional implications.

Table 10: Additional Mixed Recyclables to Achieve a 45% Recycling Rate (Tons)

COG	RESIDENTIAL	COMMERCIAL & INSTITUTIONAL	TOTAL
1	230,467	320,176	550,815
2	14,650	20,360	35,016
3	27,691	38,481	66,184
4	13,605	18,903	32,520
5	25,947	36,049	62,015
6	23,322	32,403	55,741
7	42,208	58,669	100,911
8	60,822	84,501	145,365
9	6,403	8,907	15,312
10	14,766	20,528	35,300
11	2,627	3,656	6,283
12	10,665	14,830	25,499
13	3,778	5,263	9,040
14	14,024	19,492	33,525
TOTAL ADDITIONAL MRF DIVERSION	**490,975**	**682,218**	**1,173,526**

The additional recycling and MRF processing deficieny gap can be translated into number of additional MRFs needed for processing (Table 11). Whether facilities need to be developed in each region to accommodate the additional materials that need to be collected depends on both the source of the material (residential or commercial) and the type of material and how the material is collected. The potential recoverable material that is generated in the commercial sector, where there is a higher prevalence of material that is collected as source separated material (OCC, Office Paper), this material may be managed by fiber packers that only process paper fibers. A major unknown at this time is the capacity of MRFs and other processors that manage material generated by the commercial sector. The evaluation of the current and future capacity to manage commercial generated materials is a key assessment that should be conducted in the near term and the methodology on how best to collect this data is still to be determined.

Larger, regional MRFs may be developed due to the high quantity of recovered material in certain regions where short distance direct haul from curbside routes is feasible. On the other hand, less densly populated regions in Michigan may still want to consider adding MRF processing capacity rather than relying on transfer and the increased cost of transpoting unprocessed mixed recyclables. These could be better suited to smaller processing facilities due to lower collection volumes and longer haul distances to regional facilites. The following table illustrates the large variance in the number of MRFs that may need to be developed depending on facility throughput and facility location. There is most likely no one size fits all solution for each Michigan region or wasteshed.

Table 11: Translating Additional Recovery to Additional MRF Capacity

COG	10-TPH 1-SHIFT	35-TPH 1-SHIFT	50-TPH 1-SHIFT
1	28	8	6
2	2	0	0
3	3	1	1
4	2	0	0
5	3	1	1
6	3	1	1
7	5	1	1
8	7	2	1
9	1	0	0
10	2	0	0
11	0	0	0
12	1	0	0
13	0	0	0
14	2	1	0
TOTAL	**59**	**17**	**12**

ORGANICS PROCESSING

In 2019, 109 facilities reported bringing organic material onto site with a total approximate estimated 393,300 tons of organics processed. This is slightly more tons than were processed in 2018. Comparing the two years further, yard waste, food waste, and other organics processing were all greater in 2019 while wood waste processed through reporting facilities declined from 2018 to 2019 (Table 12). Although more food waste was processed in 2019 than 2018, food waste remains a large gap in processing in Michigan.

Table 12: Organics Processed in Michigan in 2018 and 2019 (Tons)

YEAR	WOOD	YARD WASTE	FOOD	OTHER ORGANICS	TOTAL
2018	11,540	339,685	3,848	12,125	367,197
2019	6,010	365,826	5,107	16,390	393,333

As was found in the 2020 gap analysis, approximately 93% of composted organics is yard waste, reflecting Michigan's yard waste disposal ban (Figure 7). The remaining composted material includes food (1%), other organics (4%), and wood waste (2%). Table 13 shows tons of organics processed at Michigan compost facilities by COG.

Figure 7: Proportion of Organics Processed at Michigan Compost Facilities

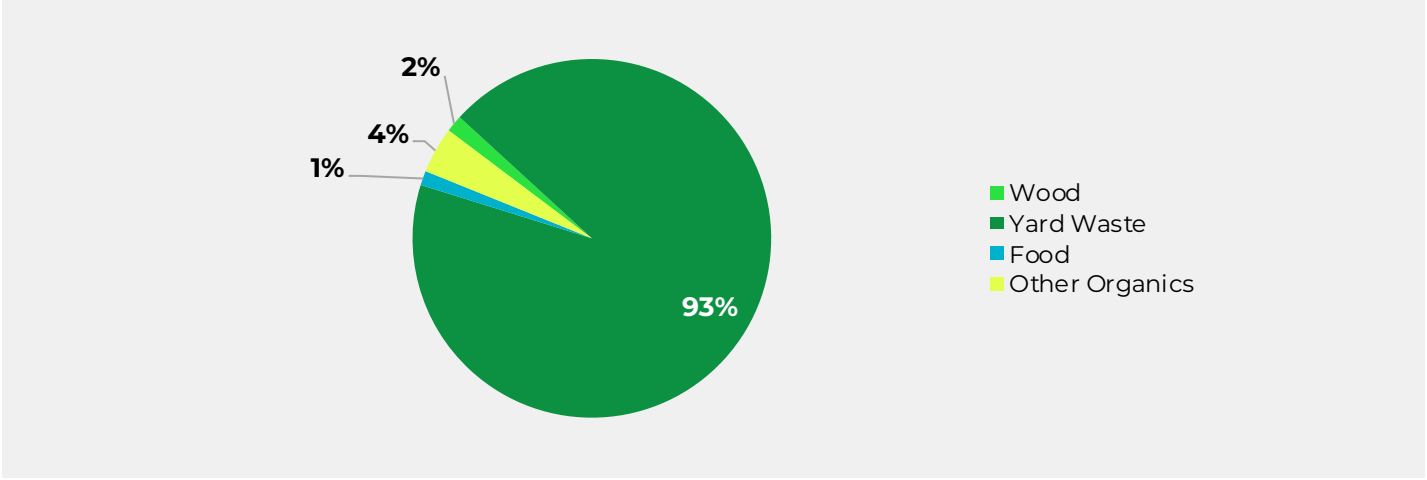


Table 13: Tons of Organics Processed at Michigan Compost Facilities in 2019

COG	WOOD	YARD WASTE	FOOD	OTHER ORGANICS	TOTAL
1	3,102	192,986	1,748	621	198,457
2	125	2,739	0	0	2,864
3	86	11,998	0	0	12,084
4	634	4,347	85	336	5,402
5	310	23,408	0	521	24,239
6	55	22,598	584	7,412	30,649
7	558	29,337	0	0	29,894
8	414	41,176	2,438	6,497	50,526
9	179	2,804	0	0	2,983
10	11	5,080	240	503	5,833
11	0	293	0	0	293
12	537	7,355	13	0	7,905
13	0	0	0	0	0
14	0	21,704	0	500	22,204
TOTAL	**6,010**	**365,826**	**5,107**	**16,390**	**393,333**

As noted in the 2020 gap analysis, to increase Michigan's recycling rate to 45%, approximately 33 percent of the organics currently going to disposal will need to be captured for organics processing at compost or anaerobic digestion facilities. Table 14 provides an updated look into how that translates to additional tons collected by COG, broken down between the residential and commercial sectors. In both the 2020 and this gap analysis, at a minimum an additional 1 million tons of organics need to be collected and processed if Michigan is going to achieve 45% recycling rate.

Table 14: Total Additional Organics Targeted for Recovery (Tons)

COG	RESIDENTIAL	COMMERCIAL	TOTAL
1	241,096	234,174	475,270
2	15,335	14,894	30,229
3	28,981	28,149	57,130
4	14,240	13,831	28,071
5	27,151	26,372	53,523
6	24,405	23,703	48,108
7	44,200	42,933	87,133
8	63,645	61,814	125,459
9	6,721	6,524	13,245
10	15,475	15,033	30,508
11	2,760	2,679	5,439
12	11,178	10,855	22,033
13	3,974	3,861	7,835
14	14,684	14,265	28,949
TOTAL ADDITIONAL DIVERSION	**513,845**	**499,087**	**1,012,932**

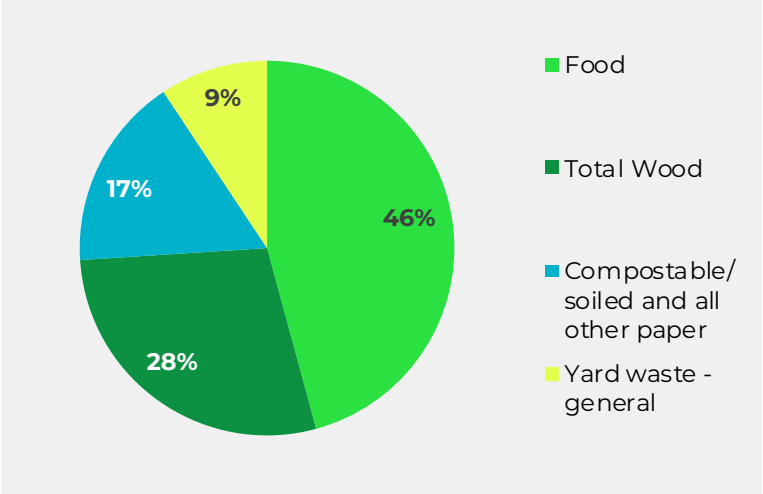
Finally, additional organics recovery needs to have a major focus on food. As shown in Table 15 and Figure 8, 46 percent of the estimated organics for potential recovery is food and, as noted above, food accounts for only 1 percent of the current organic's recovery in the state. In contrast, yard waste accounts for 9 percent of organics for potential recovery and 93 percent of currently recovered organics, demonstrating Michigan's success in the yard waste landfill ban to promote yard waste collection and diversion.

Table 15: Total Additional Organics (Tons)

MATERIAL	TONS	PERCENT
Food	463,692	46%
Wood	285,660	28%
Compostable/ soiled and all other paper	169,154	17%
Yard waste - general	94,426	9%
TOTAL	1,012,932	100%

Percentages in Table are Rounded for Clarity

Figure 8. Proportion of Additional Organics



Nextcycle's FLOWS, RIT and I2P3 Challenge Tracks could be ideal avenues to promote expanding organics collection and composting and anaerobic digestion capacity in Michigan to capture disposed food from the waste stream.

RECYCLING TAKE BACK AND DROP-OFF

Current collection methods for these items varies across Michigan and is often provided to residents as a patchwork of takeback programs, scrap yards, and government organized drop-off sites or events. To reach a 45 percent recycling rate, Michigan needs to capture an additional 412,000 tons of Other Recyclables that would need to be collected across Michigan (Table 16). The capacity and current recovery of these materials by the commercial sector through takeback programs, scrap yards, and textile recovery through drop boxes and donations to charitable organizations is not clearly understood and needs to be more thoroughly evaluated once the data is collected through the Mega Data project.

Table 16: Additional Other Recyclables to Achieve a 45% Diversion Rate (Tons)

COG	RESIDENTIAL ADDITIONAL OTHER RECYCLABLES	COMMERCIAL ADDITIONAL OTHER RECYCLABLES	TOTAL ADDITIONAL OTHER RECYCLABLES
1	85,844	107,683	193,527
2	5,454	6,840	12,294
3	10,307	12,931	23,238
4	5,063	6,354	11,417
5	9,661	12,123	21,784
6	8,682	10,897	19,579
7	15,703	19,709	35,412
8	22,648	28,410	51,058
9	2,370	2,984	5,354
10	5,481	6,890	12,371
11	973	1,225	2,198
12	3,963	4,978	8,941
13	1,398	1,758	3,156
14	5,215	6,548	11,763
TOTAL ADDITIONAL DIVERSION	**182,762**	**229,330**	**412,092**

COMMUNITY PROGRAM COMMUNICATION ACCESS UPDATES

BACKGROUND

Through the Michigan Materials Management and Infrastructure Program Project ("MegaData" Project), RRS has gathered residential diversion program information including Michiganders' access to curbside and drop-off recycling and organics programs. The data was collected via a systematic direct verification of online published diversion program information on community websites. All Michigan cities, villages, and townships were searched through this process such that this approach represents a census snapshot of residential program access in Michigan. In addition of web searching, communities were encouraged to complete an online survey called the Municipal Measurement Program and some interviews were conducted with counties.

The data gathered is capturing communication to residents on the availability of curbside and drop-off programs. It is important to point out that communication forms the backbone of collecting material - residents and businesses will not participate in programs they don't know about - and that communication gaps may not always indicate a program gap but do point to areas where improvements can be made to increase recycling awareness.

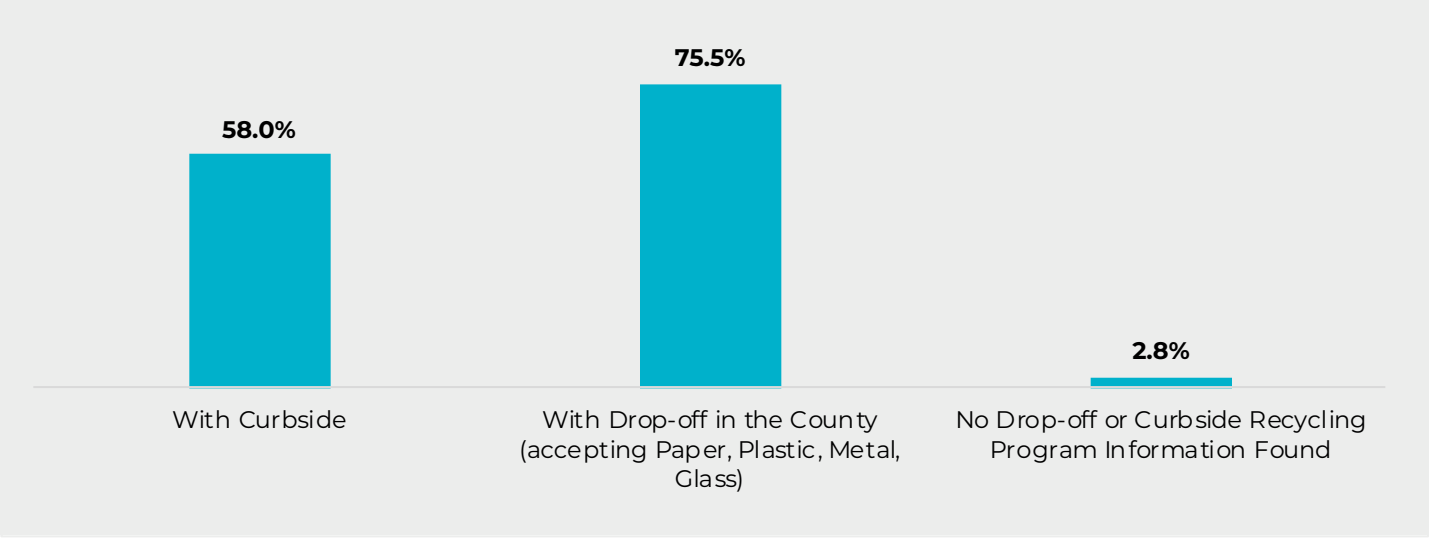
This analysis does not take into account implementation of best practices and achieving high recycling rates depends on the programs utilizing best practices. Some best practices to consider capturing in future data gathering and analysis are:

- Curbside - universal cart-based access with pick-up same day as trash
- Drop-off - drop-offs located on common travel routes, sized appropriately, monitored for dumping, clear signage

This data gathering project is still underway and additional information will be included in future analyses.

More than half of Michigan residents, 58 percent, have access to curbside recycling programs and 75 percent (by population) of Michigan residents live in a county, township, or municipality that has a drop-off recycling program available to residents[5]. A lack of any recycling program was identified for 3 percent of Michigan residents, although it may still be possible that some of these residents have access to hauler provided subscription recycling programs that are challenging to track (Figure 9).

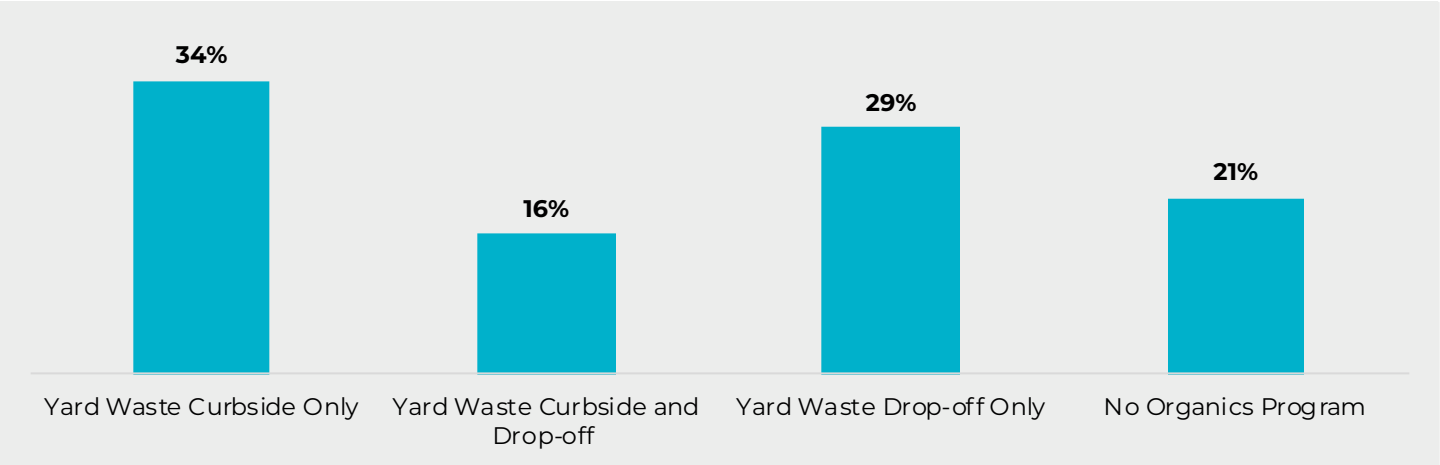
Figure 9: Percent of Michigan Households with Curbside and Drop-off Recycling Access



[5] In this report, drop-off access does not take into account number of drop-offs per households for a community or the convenience of drop-off access. The drop-off access is measuring whether a county, township, or municipal level program was found indicating residents had access to some level of drop-off recycling. Some are county-wide programs, and some are just for specific townships or cities.

At much lower overall levels of availability, approximately one-third (34 percent) of Michigan residents have access to curbside organics collection programs. The vast majority of collection programs accept yard waste and do not accept food waste and are seasonally operated. An estimated 16 percent of Michigan residents have access to both curbside and drop-off organics programs, and 29 percent of Michigan residents have access to organics drop-off programs only, and similar to curbside, these programs are predominantly focused on accepting yard waste and few accept food waste. Finally, 21 percent of Michigan residents do not have access to organics collection programs, with the majority of these residents living in rural areas of the state (Figure 10). A small percent of Michigan residents have access to curbside or drop-off food waste programs along with yard waste collection programs.

Figure 10: Percent of Michigan Households with Curbside and Drop-Off Organics Collection



METHODOLOGY

CURBSIDE PROGRAM COMMUNICATION

Residents may be provided with curbside recycling or organics collection through municipal collection, from a contracted or franchised private waste hauler, or through a subscription service with a private waste hauler. Additionally, programs can be organized in different ways such as universal collection where all eligible households automatically receive a recycling or organics curb cart or bin with establishment of waste collection services or residents may have to sign up for curbside diversion programs and pay a fee. While participation is highest for programs where residents have the fewest barriers to establishing services, access is defined as services being available such that an interested resident could receive services.

Curbside services are typically available to single family and small multi-family homes up to 4 units. Larger multi-family residences above 4 units may have access to curbside services provided to them through the same program as single family and small multi-family or through a separate commercial collection program. For the purposes of this analysis, RRS reviewed all community program information to identify curbside programs that specifically mention multi-family recycling services. When a community program made no mention of a curbside program for larger multi-family residents, RRS assumed the identified curbside program only applied to single family and small multi-family residents.

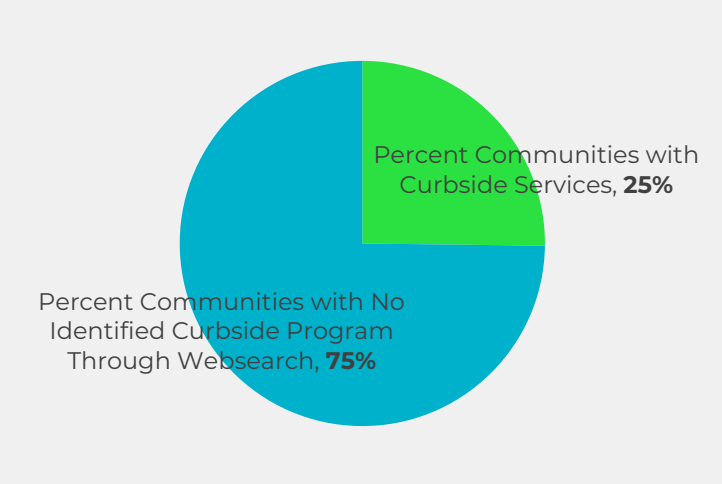
DROP-OFF PROGRAM COMMUNICATION

Drop-off recycling or organics services are programs where residents can take collected material to a local drop-off point for a fee or free of charge. In this analysis, drop-off access was defined as available to a community if an organized program was found on a city or village, township, or county level website. This analysis does not include drop-off access level such as number of drop-offs, convenience, operation times, etc. At this time, the analysis is only tracking how drop-off recycling and organics programs are communicated to residents which again is the backbone of collecting material. For example, a county run recycling drop-off program may indicate on their website that the program is open to all county residents and is counted as a drop-off program for all cities, villages, and townships in the county. Drop-off programs are considered accessible to all residents, single and multi-family.

CURBSIDE RECYCLING PROGRAM COMMUNICATION

The direct verification online search found more than 500 community curbside recycling programs across Michigan out of more than 2,000 individual communities. While a curbside program was found for approximately a quarter of Michigan communities, these programs provide access to more than half of Michigan single family households, 58% (Figure 11 and Figure 12). On average, communities that provide curbside recycling programs to residents are larger with 4,800 households compared to an average of 1,800 for the state, so that a smaller proportion of larger communities accounts for a significant proportion of curbside recycling access to residents (Figure 13).

Figure 11: Percent of Communities (left) and Households (right) with curbside recycling access



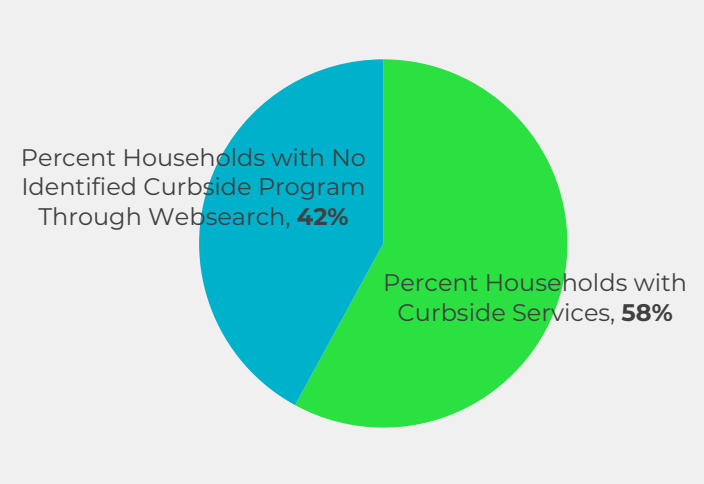
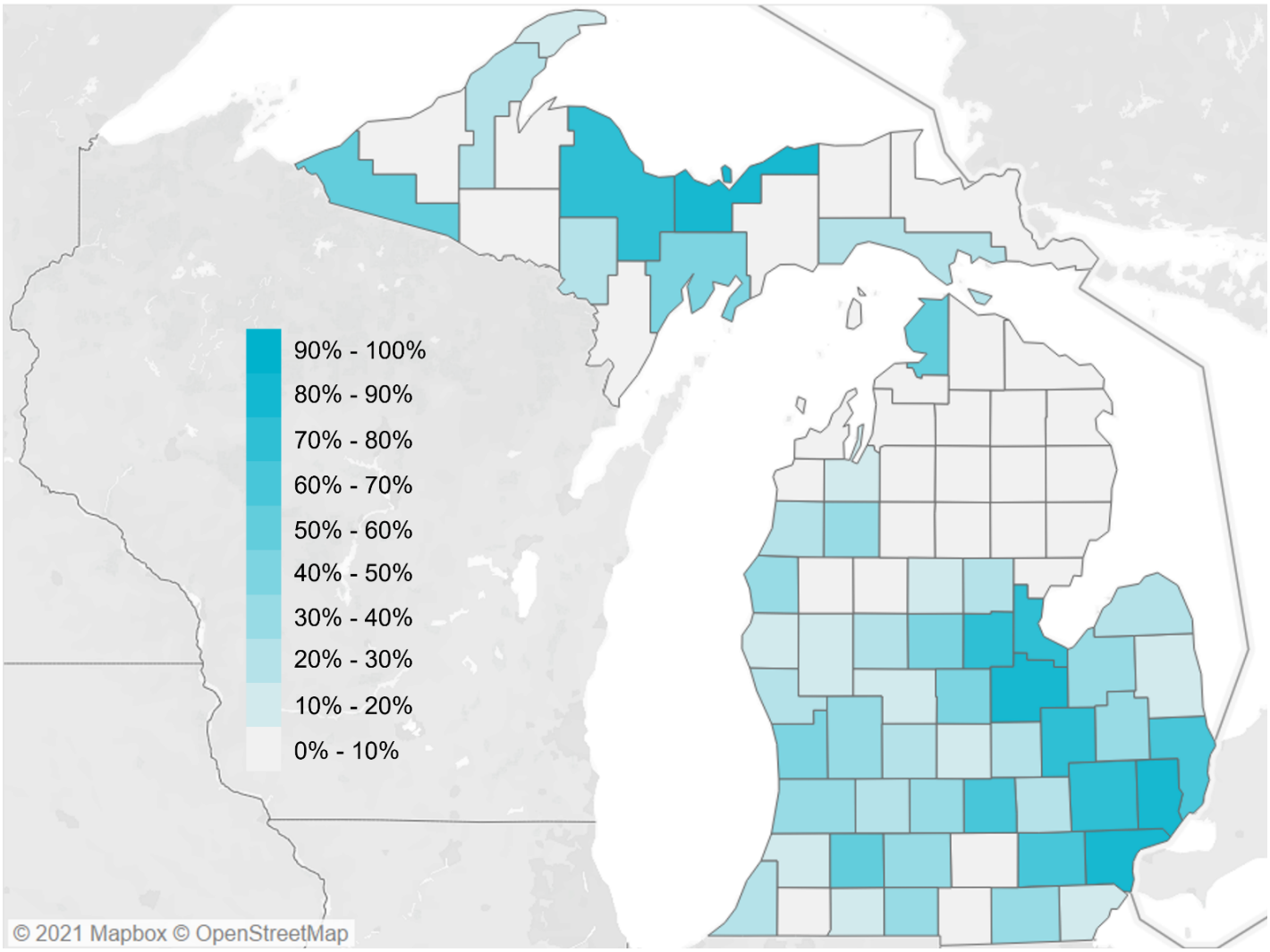
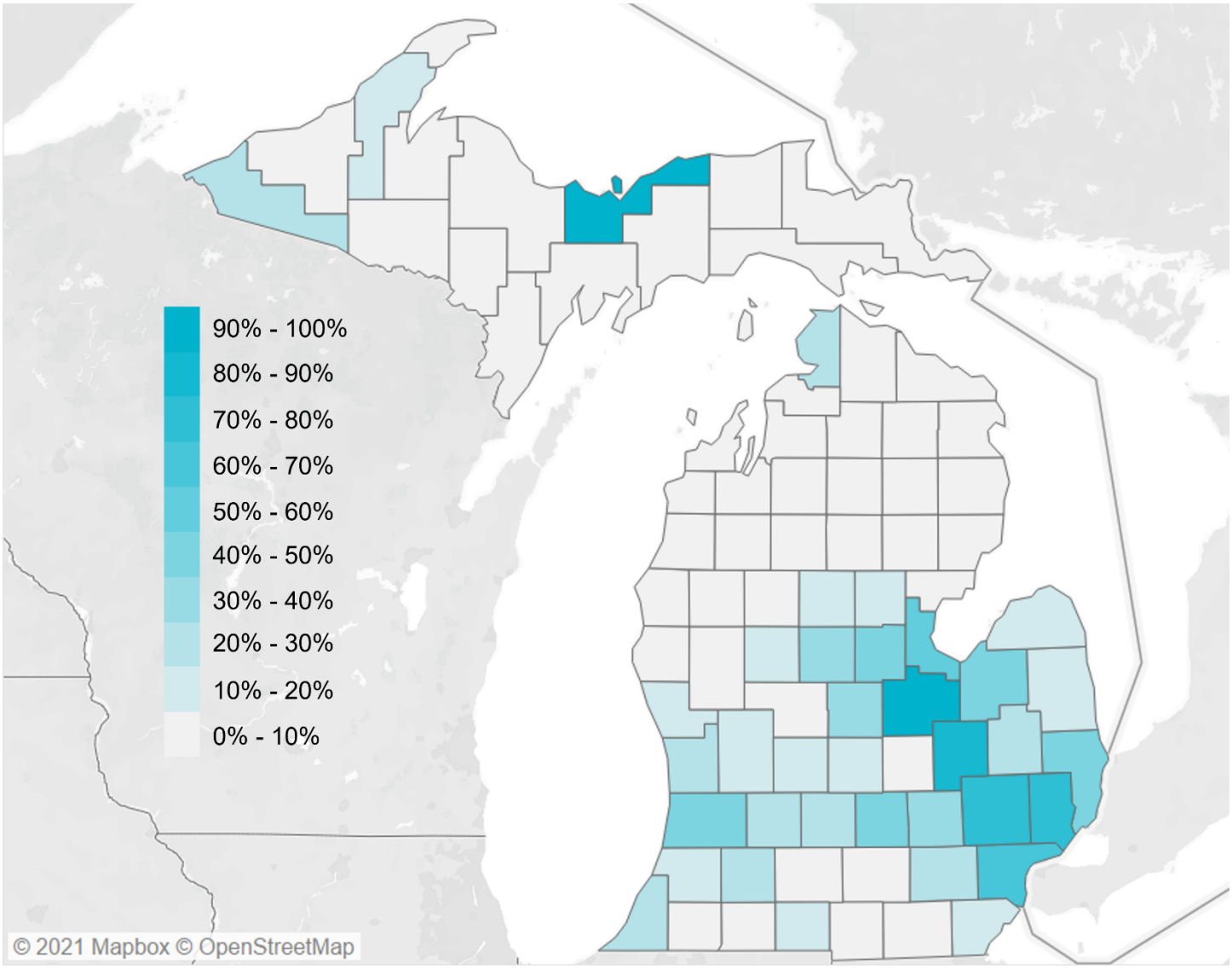


Figure 12: Percent of Households with Curbside Recycling Access



Includes access to paper, metal, plastic, and potentially glass
Source: https://nextcyclemichigan.com/communities-map

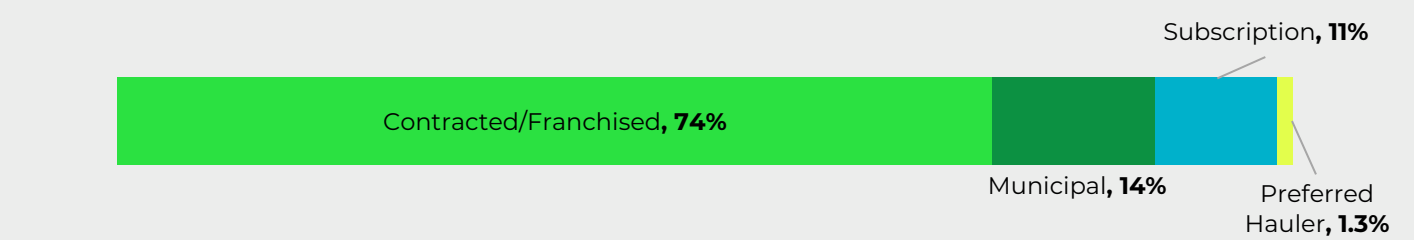
Figure 13: Percent of Communities with Curbside Recycling Access



Source: https://nextcyclemichigan.com/communities-map

Three-quarters of curbside recycling programs are provided to residents through private hauler contracts or franchise agreements with municipalities (Figure 14). Municipal collection accounts for 14% of curbside recycling service types. At least 10% of residents have access to curbside recycling through subscription services, however RRS views this percentage as a minimum subscription access rate. Subscription services are challenging to capture as service area information is not always readily available through online research. In a second phase of research, RRS is expanding research on availability of subscription curbside recycling service in Michigan. The expanded research will be available in the 2022 gap analysis. Finally, a small portion of Michigan residents, 1.3%, have access to curbside recycling through a preferred hauler. A preferred hauler system is when a local unit of government (LUG) establishes a service agreement with a private sector contractor to deliver services within the community. This service agreement is nonexclusive and voluntary for residents. A subscription-based system requires the LUG residents to secure their own needed solid waste and recycling services.

Figure 14: Curbside Recycling Access Type



With contracted and franchised agreements for recycling collection so prevalent, RRS has requested through the Freedom of Information Act (FOIA) copies of waste and recycling contracts from Michigan villages and cities. This process is ongoing and currently requests have been made to all cities and villages in Wayne, Macomb, and Oakland Counties along with all cities and villages A-H in Michigan. At present, the response rate to the FOIA requests is 67%. The preliminary analysis of the contract information is presented in Table 17.

Table 17: Waste and Recycling Contract Review Summary

CONTRACT LENGTH	Average length is 5 years Contract lengths ranged from 1-year to "indefinite"
PRICING	The average contract price for garbage only service is $11.74 per month per household. The average contract price for garbage and recycling curbside service is $14.19 per month per household. The average contract price for garbage, recycling and yard waste curbside service is $13.65 per month per household.
PICK-UP FREQUENCY	Weekly curbside recycling collection is the most common service offering

CURBSIDE GLASS RECYCLING COMMUNICATION

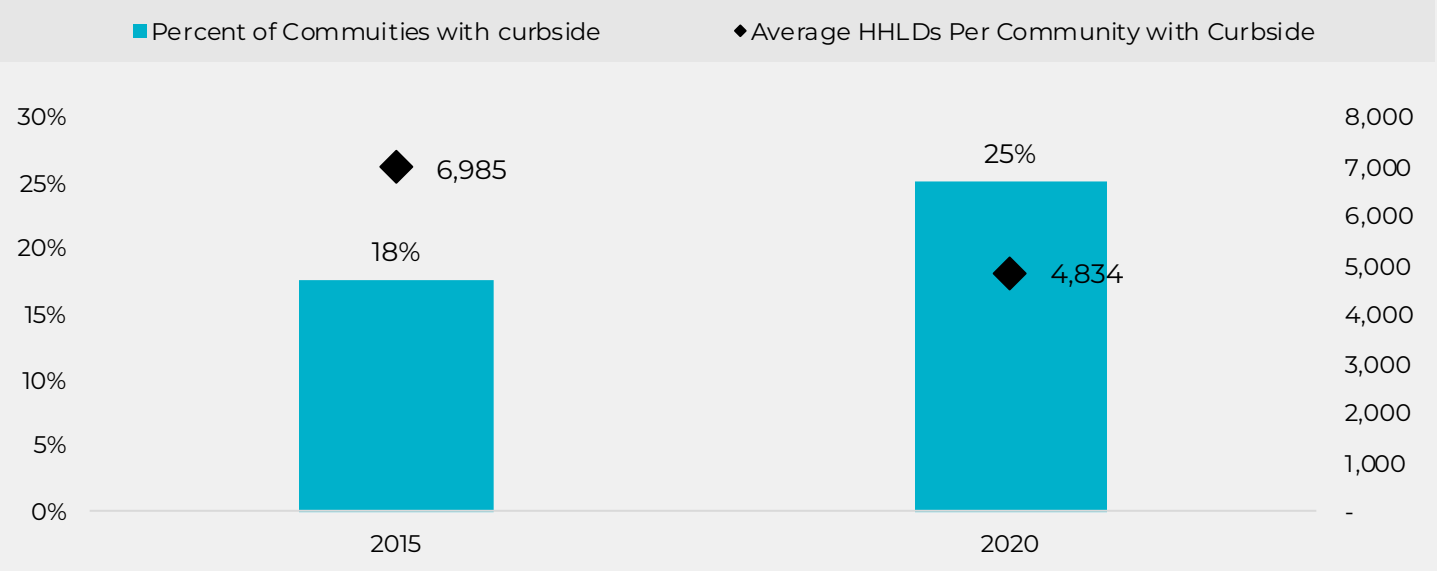
While 58% of Michigan single family and small multi-family households have access to curbside recycling that accepts some level of paper, metal, and plastics, a slightly smaller proportion of residents also have access to curbside glass recycling, 54%. In the past several years, glass has been dropped from curbside recycling programs nationwide. Overall, programs in Michigan have not been subject to the removal of glass from curbside programs at the same rate as nationally. Three Michigan communities have dropped glass in the curbside program since 2019. The slower pace of dropping curbside glass in Michigan may be attributed to Michigan's bottle deposit program that includes carbonated soft drinks, beer and malt beverages, and sparkling water and provides an incentive for residents to return glass bottles for the paid deposit and keeps curbside glass tonnages low. Nevertheless, curbside glass has the lowest acceptance rate of the typical curbside materials.

2015 TO 2020 COMPARISON OF CURBSIDE RECYCLING ACCESS

In 2015, RRS performed a survey of all communities with populations greater than 10,000 as well as all counties to gather data on curbside program access in Michigan. Based on the survey results, 61% of Michigan households were estimated to have access to curbside recycling. The data gathered in the Michigan Materials Management and Infrastructure Program Project is fundamentally different because the data was gathered for all communities in Michigan directly through internet verification as a census of recycling programs rather than a survey approach where data is collected from some communities and extrapolated to estimate access statewide. While total curbside access reported here is slightly lower at 58%, the differences between the data collection methods make a direct comparison of access challenging between the two studies.

Despite the differences in data collection methods, there are some comparisons worth noting. The 2015 survey estimated curbside programs available in 18% of communities with an average number of households per community of 6,985. The 2020 program census found 25% of communities in Michigan with curbside programs and an average number of households per community of 4,834 (Figure 15). Thus, the census approach method captured a greater number of smaller curbside community programs throughout Michigan than the survey approach, likely reflecting the survey skew towards larger cities and villages in Michigan.

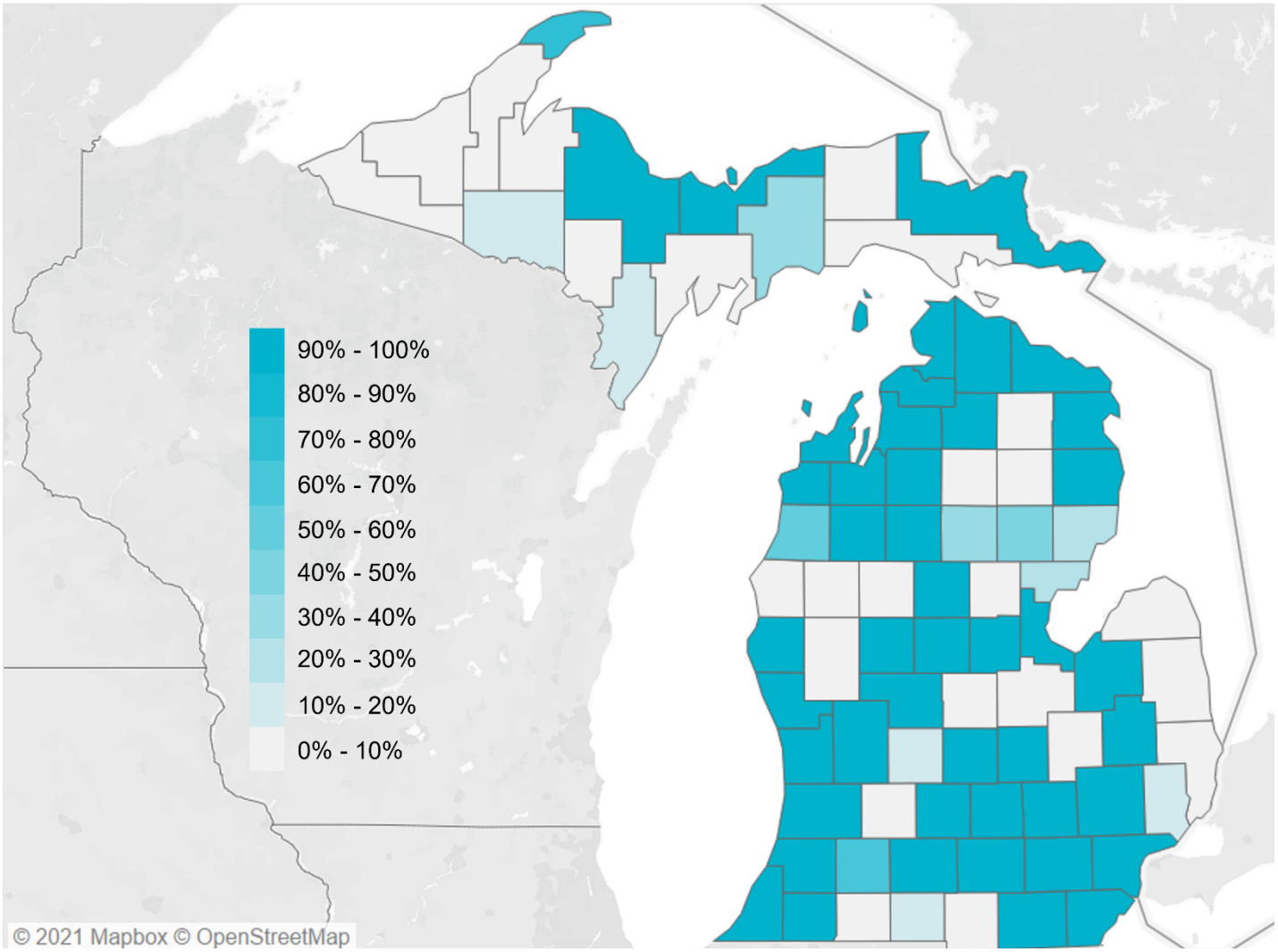
Figure 15: Comparison of 2015 Curbside Access Survey with 2020 Curbside Access Census



DROP-OFF RECYCLING PROGRAM COMMUNICATION

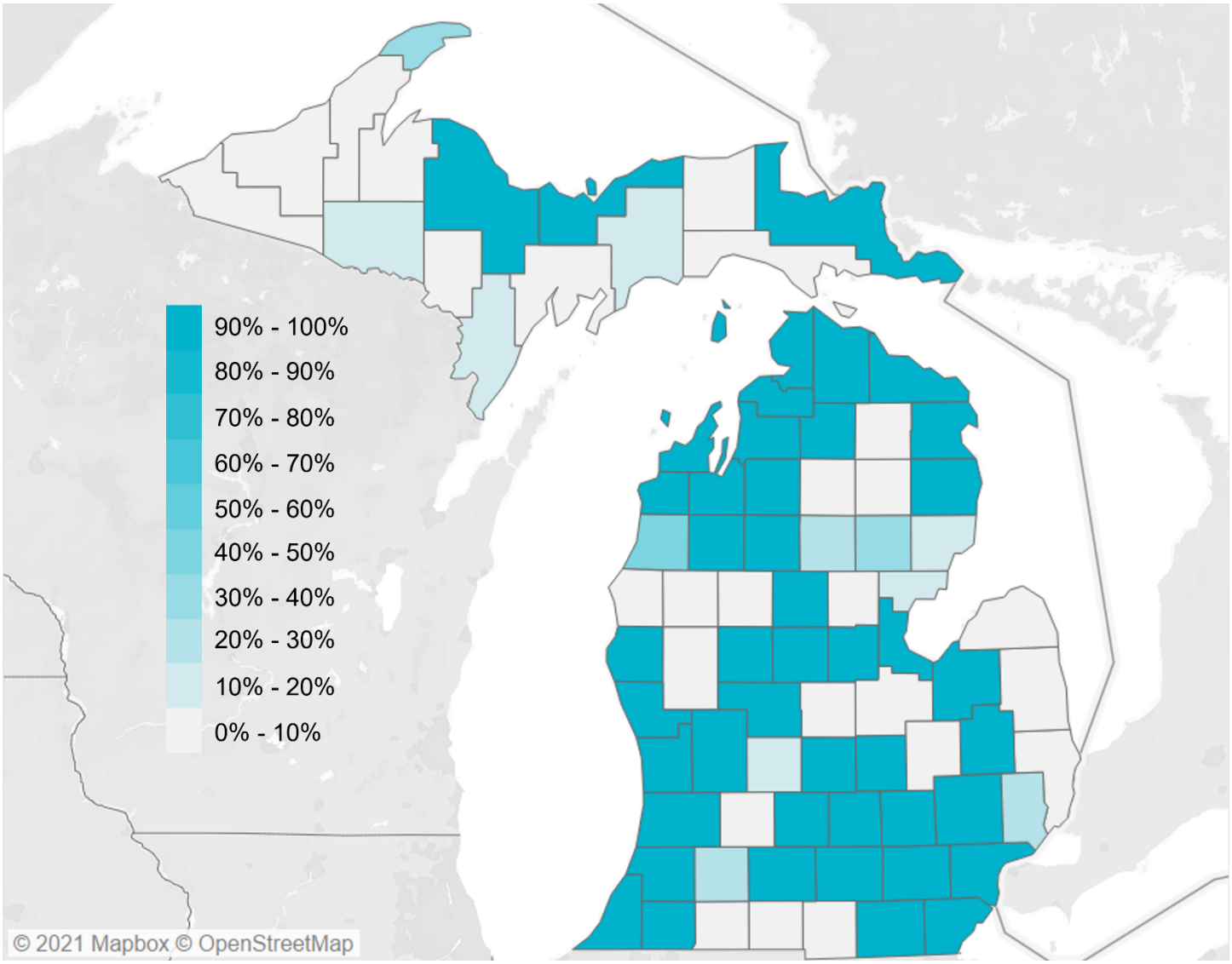
Approximately 75% of Michigan residents have access to some level of drop-off recycling programs that accept paper, plastic, metal, and glass and the majority of counties have curbside programs that cover 80 percent of the county's population (Figure 16). In comparison, the percent of communities in Michigan and in a particular county that communicate access to drop-off recycling are shown in Figure 17. This may include a drop-off program that accepts paper, plastic, metal, and/or glass items. A third of Michiganders only have access to recycling through drop-off, and only 3% of Michigan residents have no found access to a recycling program either curbside or drop-off. It may be possible that these residents do have some access to curbside recycling through subscription programs and this information is simply not captured on community or hauler websites. RRS is working to determine which communities may have access provided in this manner as well as comparing rural versus urban centers.

*Figure 16: Percent of Households with Drop-Off Recycling Access somewhere in the County**



*Every community may not have convenient access to a dropoff that meets a standard such as distance to a dropoff, drive time to a dropoff, or a specified number of households per dropoff.
Source: https://nextcyclemichigan.com/communities-map

*Figure 17: Percent of Communities with Drop-Off Recycling Access somewhere in the County**



*Every community may not have convenient access to a dropoff that meets a standard such as distance to a dropoff, drive time to a dropoff, or a specified number of households per dropoff.
Source: https://nextcyclemichigan.com/communities-map

RECYCLING PROGRAMS COMPARED TO COMMUNITY SIZE

The recycling programs available to residents is correlated to community household size. Communities with access to curbside recycling are on average much larger than communities with only drop-off access, 4,834 households per community compared to 861 households per community respectively. Communities without any recycling access are on average the smallest at only 424 households per community (Figure 18) and 12% of overall communities (Figure 19).

Figure 18: Access to Recycling Programs Compared to Community Size

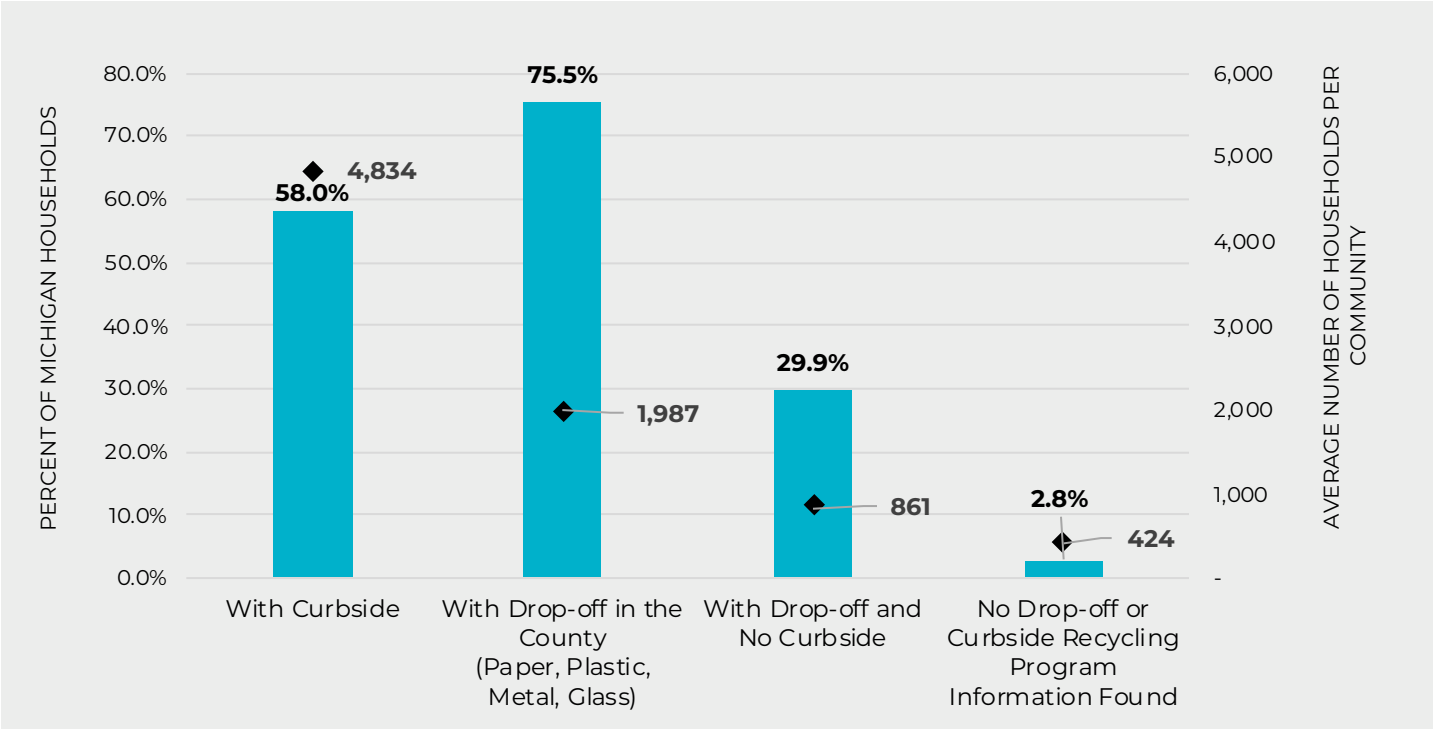
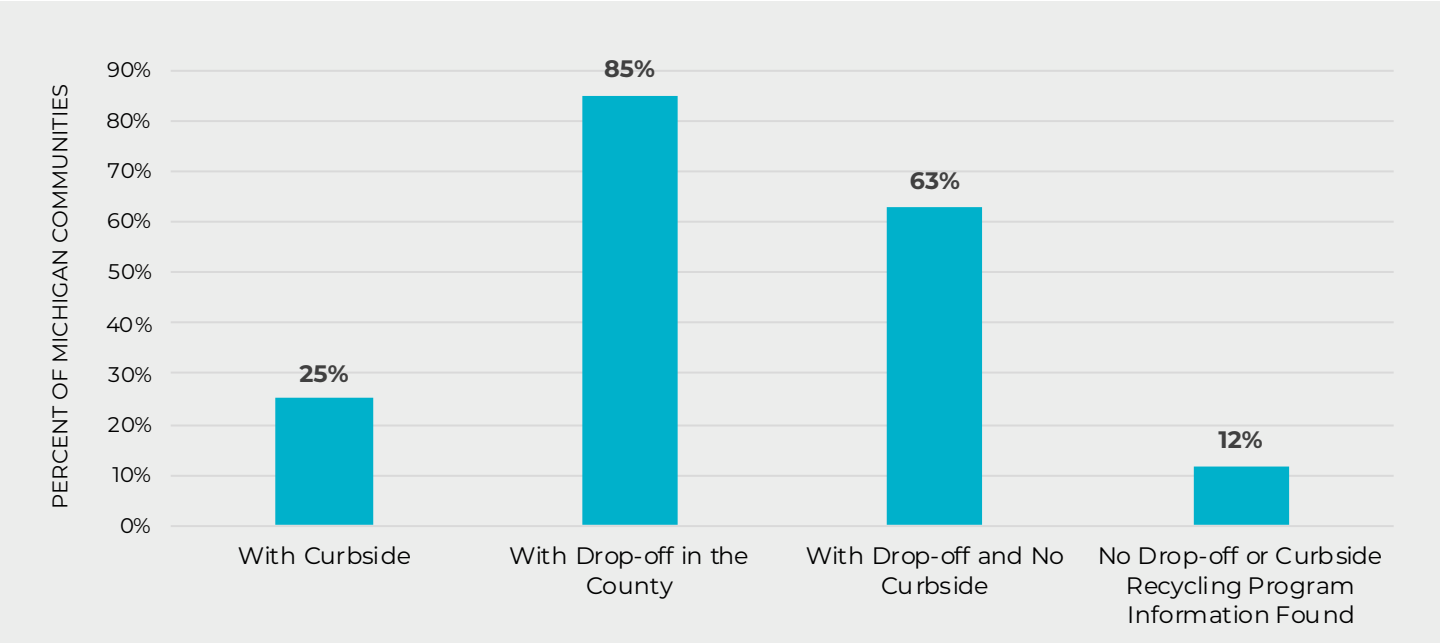


Figure 19: Access to Recycling Programs by Number of Communities



CURBSIDE YARD WASTE PROGRAM COMMUNICATION

Yard waste has been banned from landfills in Michigan since 1987, and this has promoted many municipalities to provide yard waste diversion programs to their residents. Approximately 44% of single family and small multi-family households in Michigan were found to have access to curbside yard waste collection (Figure 20), with the vast majority of this collection offered as a seasonal service typically from spring through fall. Only 3% of single family and small multi-family households have access to curbside food waste collection, and 1% have access to curbside compostable paper composting. In comparison, 45.9% of communities have access to curbside yardwaste collection (Figure 21). Figure 22 shows the percent of households and Figure 23 shows the percent of communities within each county that have access to curbside yard waste collection.

Figure 20: Percent of Michigan Households with Curbside Yard Waste and Food Waste Access

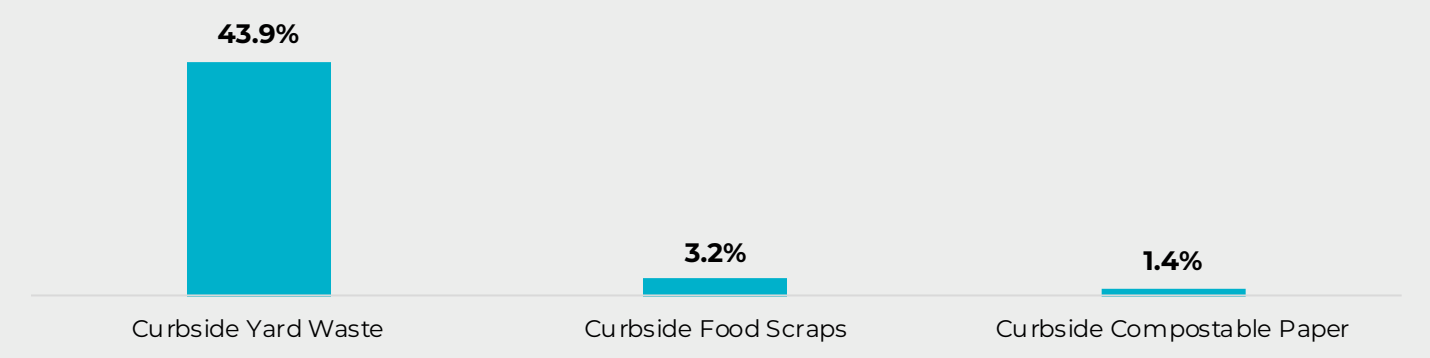
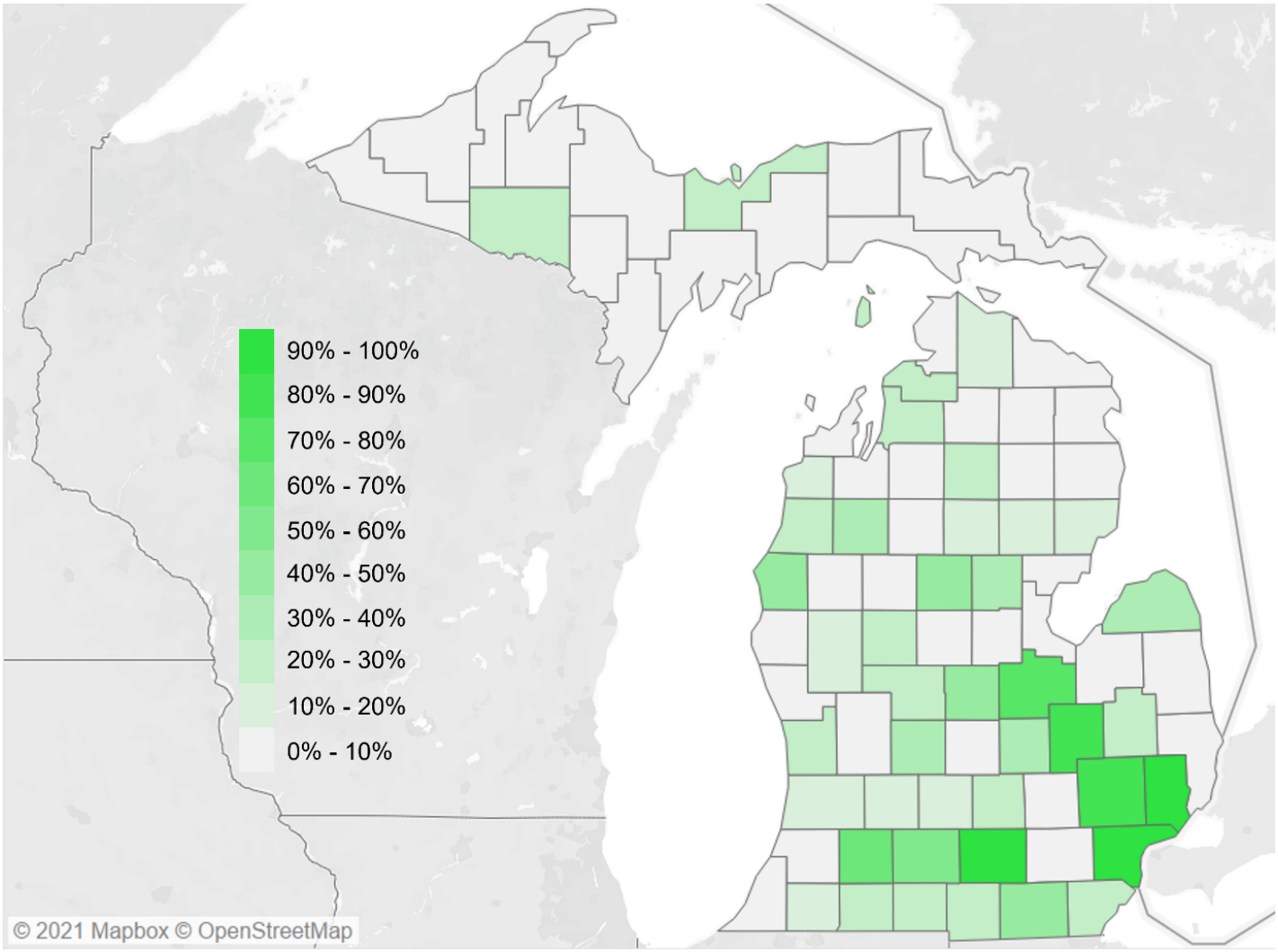


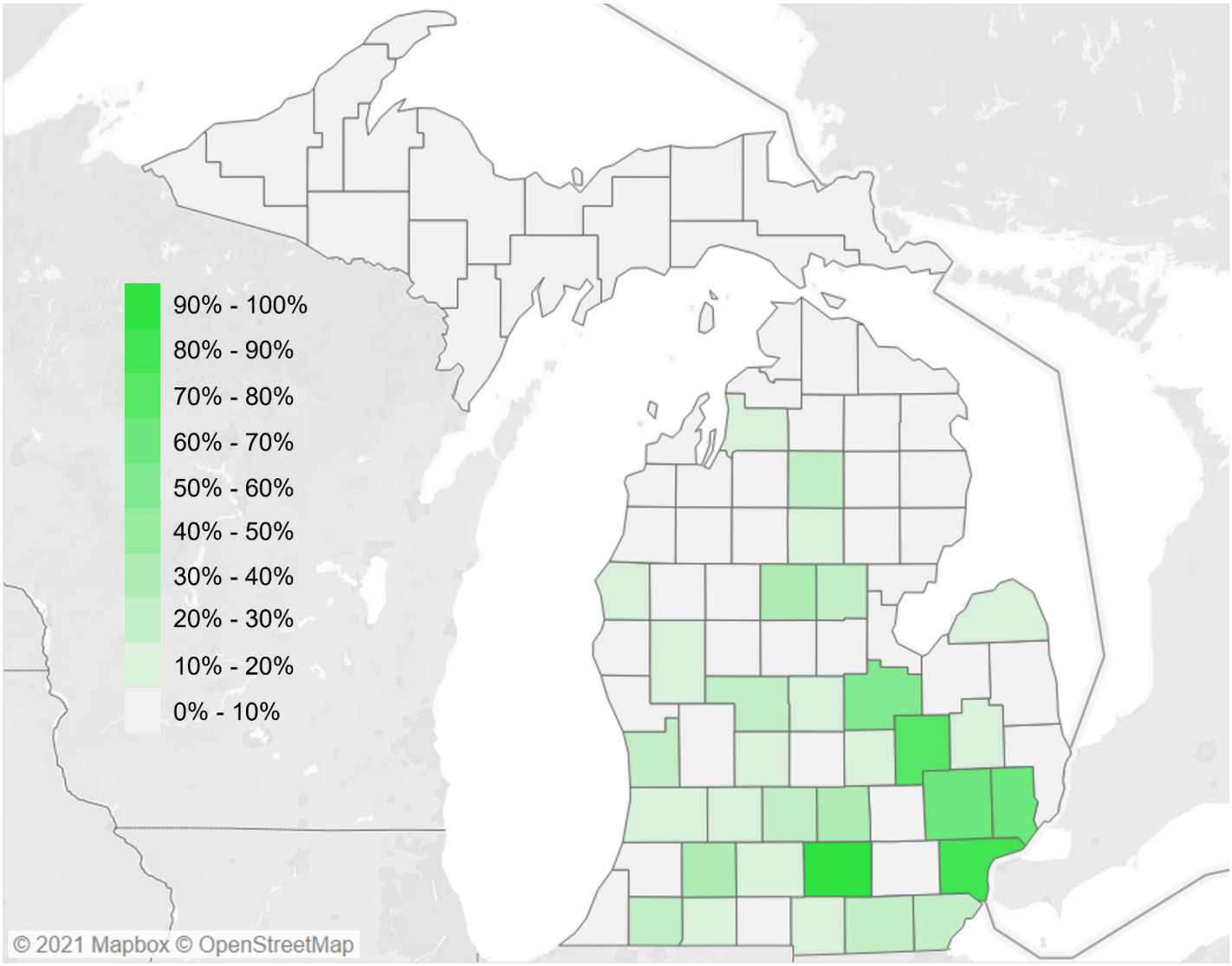
Figure 21: Percent of Communities with Curbside Yard Waste and Food Waste Access

Figure 22: Percent of Households with Curbside Yard Waste Collection Access



Source: https://nextcyclemichigan.com/communities-map

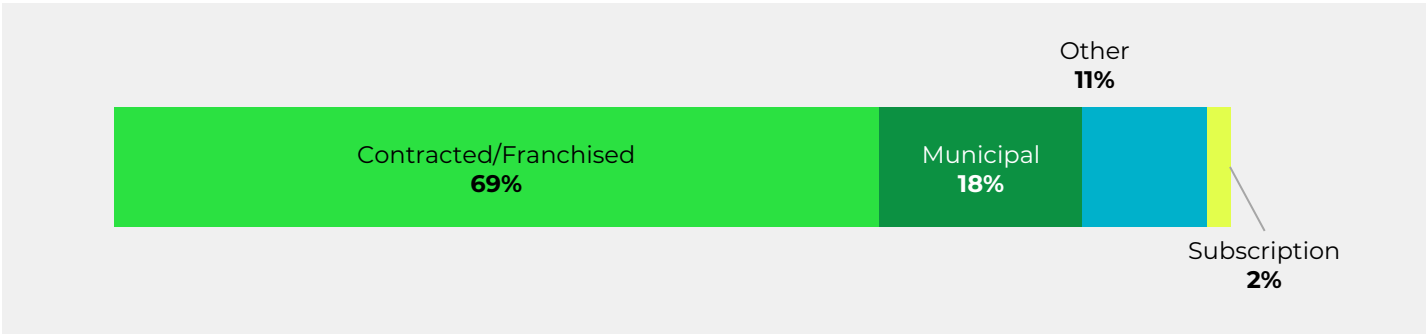
Figure 23: Percent of Communities with Curbside Yard Waste Collection Access



Source: https://nextcyclemichigan.com/communities-map

A small proportion of households have food waste collection access along with yard waste collection access. Municipally operated curbside yard waste collection is slightly more common than municipally operated curbside recycling collection, 18% compared to 14% respectively. Correspondingly, contracted and franchised collections are lower at 69% for curbside yard waste (Figure 24).

Figure 24: Curbside Yard Waste Access Type



DROP-OFF YARD WASTE PROGRAM COMMUNICATION

Approximately 45% of Michigan residents have access to yard waste drop-off programs. Of those residents, approximately, 16%, have access to both curbside and drop-off yard waste programs, and 29% have access to drop-off yard waste programs only. Around a fifth of Michigan residents have no access to either curbside or drop-off yard waste programs.

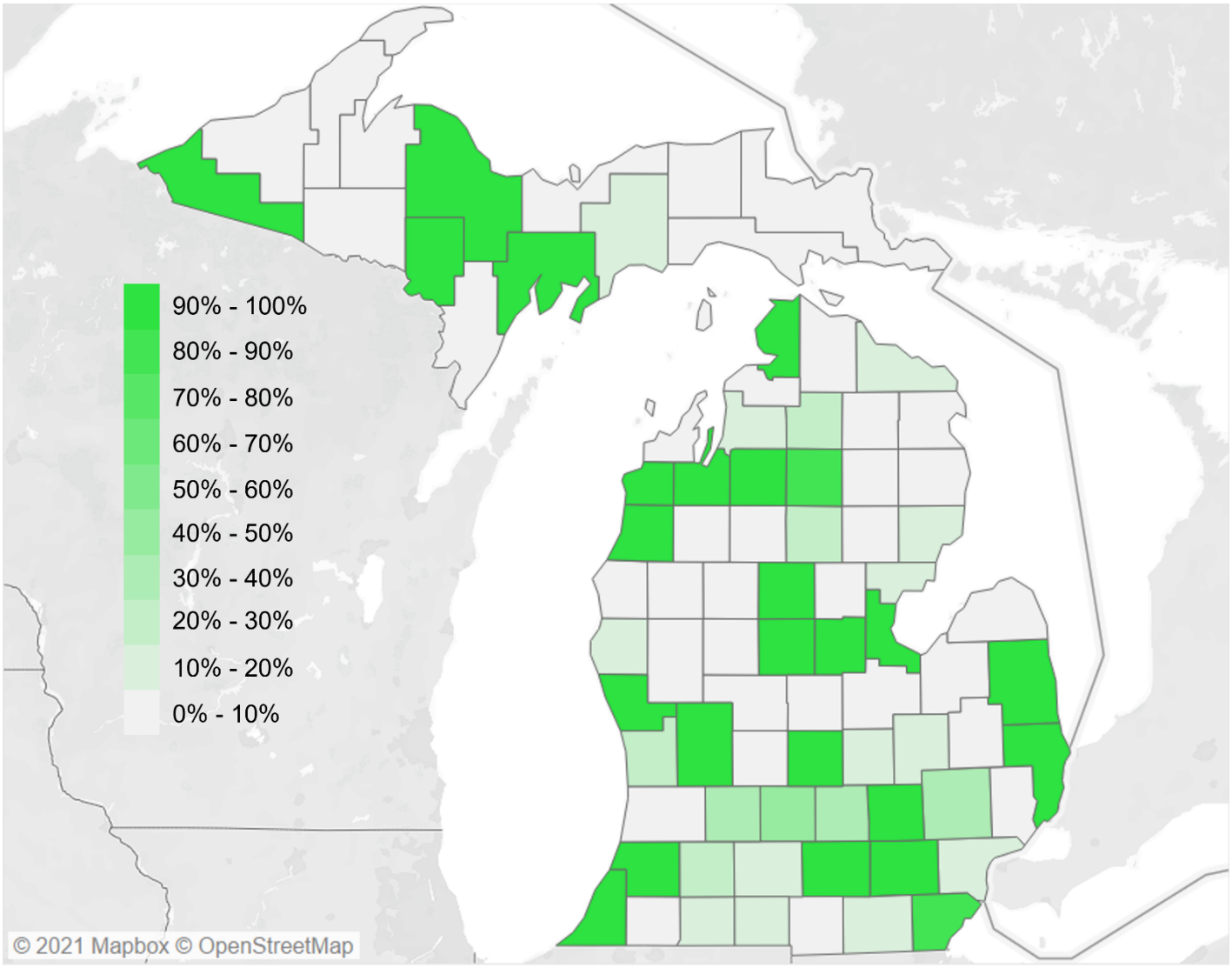
The average households per community with yard waste drop-offs is just over 2,000 households. Communities without any access to yard waste programs are on average much smaller at 736 households per community.

Table 18, Figure 25 and Figure 26 show the percent of access to curbside and drop-off yard waste programs in Michigan in total and by county respectively. A small portion of communities with access to yard waste drop-off programs, 3% of households, also have access to food waste collection.

Table 18: Yard Waste Curbside and Drop-Off Access

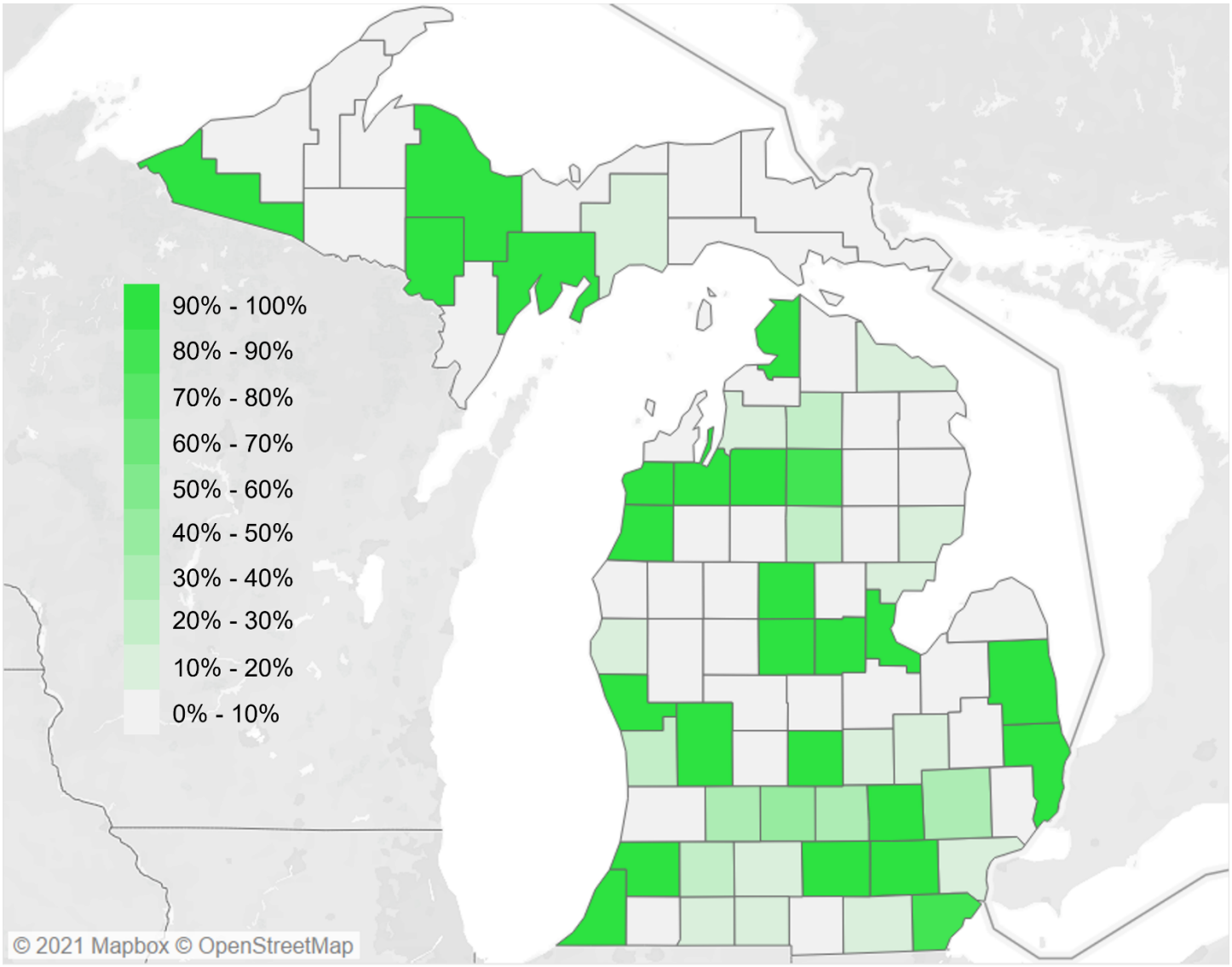
	YARD WASTE DROP-OFF	YARD WASTE CURBSIDE AND DROP-OFF	YARD WASTE DROP-OFF ONLY	NO YARD WASTE PROGRAM
Percent of Communities	39%	6%	33%	51%
Number of Households	1,749,213	633,368	1,115,845	798,134
Percent of Total Households	45%	16%	29%	21%
Average Households Per Community	2,090	4,798	1,583	736

Figure 25: Percent of Households with Drop-Off Yard Waste Collection Access



Source: https://nextcyclemichigan.com/communities-map

Figure 26: Percent of Communities with Drop-Off Yard Waste Collection Access



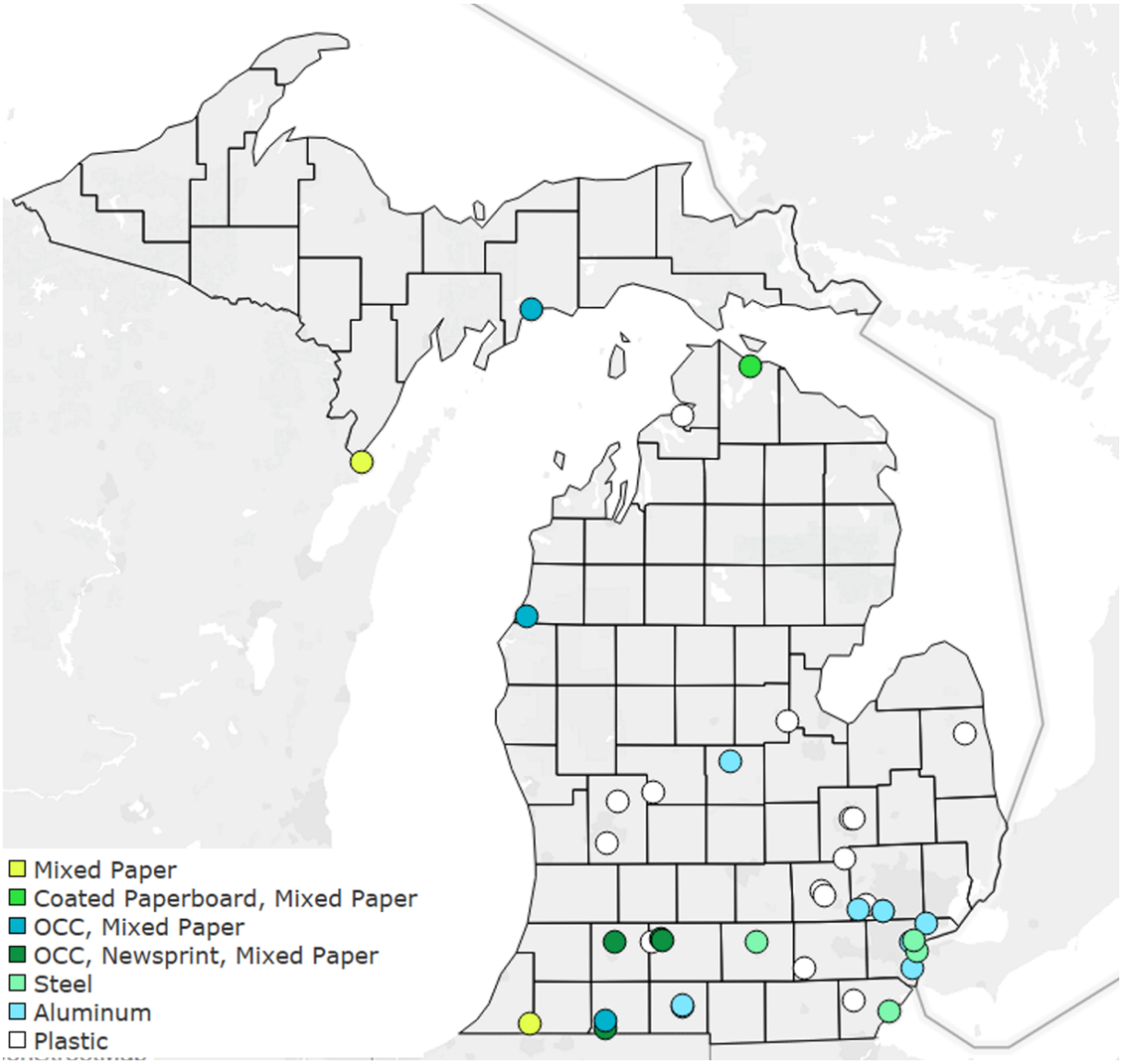
Source: https://nextcyclemichigan.com/communities-map

END MARKETS UPDATE

Increasing Michigan's recycling rate to 45 percent will require investment in collections, processing, and end markets where sufficient capacity to utilize specific commodities and value of the commodity is low. There is no single track or pathway that taken alone will get Michigan to 45 percent recycling. Processing and end market gaps and solutions vary by commodity type so that a comprehensive approach to waste diversion must be undertaken to increase Michigan's recycling rate.

End market development will need to occur to ensure that the additional collected and processed material for specific commodities where there are insufficient market capacity. While local end markets in Michigan generate jobs and revenue in the state and are desirable, most commodities are traded based on larger regional and national demand where process are of then determined by international markets. Each commodity is unique so that an assessment of end markets must be conducted on a per commodity basis. Michigan has strong end markets for high value plastics, mixed paper, newspaper, corrugated cardboard, and steel. The state does not have any end markets for glass, aluminum containers (non-deposit containers processed at single stream MRFs) or sufficient end markets for mixed plastics. See Figure 27 for locations and types of end market reclaimers and mills in Michigan,

Figure 27: Michigan Reclaimers and Mills (End Markets)

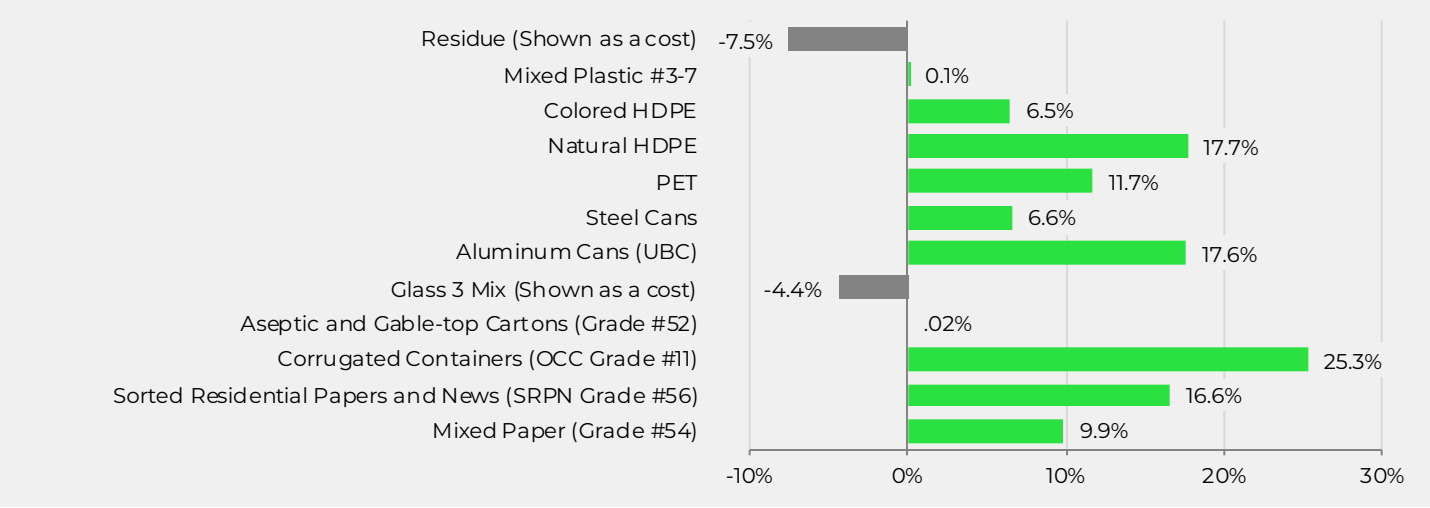


Source: https://www.nextcyclemichigan.com/end-markets-base-map

The Average Commodity Revenue (ACR) is a measure of the overall health of the end market demand for recycled materials. The ACR illustrates the blended value of the commodities typically sold by MRFs. It is calculated by taking the estimated quantity of each marketable material produced and sold at a typical MRF and multiplying each material by the regional market process from publish commodity indexes to get an aggregated value per ton of all materials. Every MRF has a different commodity mix and may have different end market arrangements for each commodity than is represented in the average mis so the ACR for a specific facility may be different than this estimate. For example, MRFS that sort cartons to meet the Aseptic Packaging and Gable-Top Cartons (ISRI Grade #52) can market material to Great Lakes Tissue in Cheboygan, MI at a value of $175/ton.

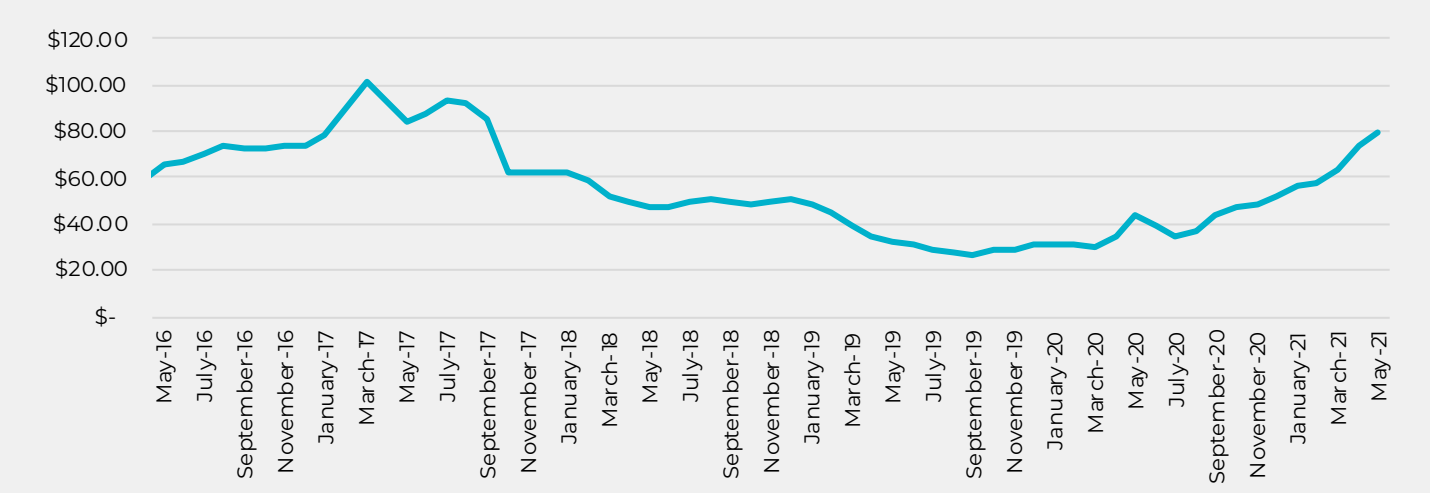
It is important to note that the ACR has varied significantly over the past five years. In May 2021, the ACR value was $79.92 per ton which was slightly up from July 2020 (Figure 28). The ACR is slightly lower than the 5-year high that occurred in 2017 where it reached above $100 per ton (Figure 29). There are 2 issues that negatively impact the value of the recyclables that are most often processed at MRFs: glass and residue (4.4% and -7.5% value share of the ACR). 3-mix glass is a net cost to most MRFs meaning that instead of selling the commodity for a profit, a MRF must pay to remove this material. An additional challenge for glass is that it is heavy and expensive to move so that the profitable transportation distance for glass is significantly smaller than for other higher value commodities.

*Figure 28. Percent Value Share of Single Stream ACR by Commodity - May 2021 Value and Estimated MI Recycled Tons**



** The majority of Grade #52 is sold as Mixed Paper Grade #54. If Cartons were marketed as Grade #52 at the value of $175/Ton based on select Michigan mills prices, then the contribution to the ACR would increase to .12%.*

Figure 29. Five-Year Average Commodity Revenue (ACR)



CURRENT END MARKET TRENDS - CURRENTLY RECYCLED COMMODITIES

RRS researched end markets in Michigan and market trends. A summary of commonly recycled commodities along with a forecast description and likely trend over the next several years is presented in Table 19 and a detailed market analysis by commodity follows, one page per commodity.

Table 19: Summary Forecast of Commonly Recycled Commodities

COMMODITIES	LONG TERM FORECAST DESCRIPTION	TREND
Polyethylene Terephthalate (PET)	Increasing consumer demand due to the impact of the Covid 19 pandemic and the relaxation of business restrictions from pandemic contact protocols have driven an increase in demand rPET (recycled PET) should eventually delink market with virgin PET within 3 years, like NHDPE, and pricing will trend up.	Trends Up
Natural High-Density Polyethylene	Increasing demand due to the impact of pent-up consumer demand during the Covid 19 pandemic and the relaxation of business restrictions from pandemic contact protocols, CPG commitments and minimum recycled content policy expected to improve demand and NHDPE pricing should increase over the next 6-12 months.	Trends Up
Colored High-Density Polyethylene	New, virgin capacity natural gas cracking markets and Chinese polyethylene will keep CHDPE bale pricing low for the next 1-3 years. However, like NHDPE, long-term trend is emergence of a rCHDPE bale with higher demand with short term impacts related to increased consumer demand from relaxation of Covid 19 restrictions	Trend up
Mixed Plastic	#3-#7 bales will continue to trade at or below zero for the next 2-5 years. However, plastics industry is responding through chemical recycling initiative which deconstructs polymers. Megatrend will grow markets for mixed plastic.	Stay Low
Polypropylene	New virgin PP capacity and increasing upward pricing for oil / natural gas markets and increasing consumer demand will drive #5 bale pricing higher for the next 18 months.	Trend up
Mixed Bulky Rigids	Increase virgin capacity and increasing oil and natural gas prices and increased consumer demand will drive pricing slowly higher over the next 18 months.	Slight Increase
Old Corrugated Cardboard (OCC)	OCC will have increased demand due to the impact of pent-up consumer demand during the Covid 19 pandemic. Market is increasing.	Slight Increases, Trend Stable
Mixed Paper	Market has rebounded from increasing demand with dwindling supply and domestic mill capacity increase.	Trend Up
Sorted Residential Papers and News (SRPN)	True mixed ONP (SRPN, #8 will have a differential of $20 or more compared to mixed paper because of lower contaminants from more sorting and because it can be used in groundwood applications.	Trend Up
Aseptic Packaging and Gable-Top Cartons	Cartons have maintained a positive value since the grade was tracked. Markets in Michigan are strong and regional mill process provide a high price premium for use in tissue production.	Trend up
Glass 3 Mix	3-mix glass has been disrupted by the COVID deposit return loss, which accounts for 33% to 50% of all cullet. At the same time, despite talk of recycled content, price will continue to trend lower, as construction slows (fiberglass usage) with the economy.	Trend Low
Aluminum Cans	Though aluminum cans have a home both for going back to can sheet or secondary aluminum pricing will continue to increase in the next 6-12 months.	Trend Up
Steel Cans	There is high demand for steel as factories ramp up production due to increasing consumer demand as the economy reopens after 14 months of pandemic restrictions and the announcement that China will limit steel exports. The value of steel has dramatically increased in the early part of 2021.	Trend Up

MIXED PAPER (MP, ISRI GRADE #54)

- Mixed Paper (MP, ISRI Grade #54) makes up 6.28% of the landfilled material in Mi or 493,800 tons
- 53% of material landfilled is generated from the commercial and multifamily sector.
- 280K Tons are currently recycled in Michigan through curbside and drop-off collection (residential and commercial).
- To help reach a 45% state recycling rate 332k tons of MP has been targeted to be recovered from landfill with an estimated $5.8M 5-year average value and a current value of $5.8M ($36.21/ton).

MARKET SIZE AND VALUE:	Estimated that over 332,000 tons (approximately 60% of disposed material) has been targeted to be recovered to help the State reach a recycling rate of 45%. Considering the current annual volume of MP landfilled (493,800 Tons) with **potential of additional recycled material being 282,000-381,000 tons** and current recovery of around 304K tons – combined recovery potential achieving 45% recycling rate is (304k+potential) = 58Kk-685K tons of MP recovered averaged 5-year commodity value of $17.49 /ton resulting a range of $10.2 M-$12.2 M in value through recovery of MP if the state recycling target of 45% recovery is achieved.
CURRENT MARKET BEHAVIOR	The MP is a steady market. Mills are accustomed to the grade. Mixed paper consumption is up 8% YOY. Price steady to dropping next 3-6 months due to mill outages. Future better due to loss of feedstock from COVID changes. The Pratt Industries mill in in Wapakoneta, Ohio. is the first new mill that will use a substantial amount of mixed paper as a raw material.
PAST MARKET BEHAVIOR	• Negative territory for almost 3 years • Domestic mills did not have the cleaning equipment to use the new supply from MRFs • Fiber of last resort • Over a million tons of new capacity will come online in the next two years for this grade.
SHORT TERM FORECAST	• Outages planned in Shenyang, Nine Dragons, Midwest in next two months. MP may lose a bit. • More finding its way into OCC in MRF • Movement better than before pandemic. AfH tissue increases with economy opening could boost it a little by summer • MP may see some modest increases in coming months, if OCC continues to climb
LONG TERM	• Malaysia, Vietnam and India inspections may dampen market as China presses • Loss of cleaner commercial sorted grades and new demand in Asia, will keep MP important • New N.A. mills can clean MP

SORTED RESIDENTIAL PAPERS AND NEWS (SRPN, ISRI GRADE #56)

- Sorted Residential Papers and News (SRPN), ISRI Grade #56, makes up 3.76% of the landfilled material in Mi or 301,600 tons
- 53% of material landfilled is generated from the commercial and multifamily sector.
- 148.6K Tons are currently recycled in Michigan through curbside and dropoff collection (residential and commercial).
- To help reach a 45% state recycling rate, an additional 162K tons of SRPN has been targeted to be recovered from landfill with an estimated $6.3M (based on 5-year average value) and a current value (April 2021) of $10.6M ($65.54/ton).

MARKET SIZE AND VALUE:	Estimated that over 132,400 tons (approximately 60% of disposed material) has been targeted to be recovered to help the State reach a recycling rate of 45%. Considering the current annual volume of SRPN landfilled (301,600 Tons) with **potential of additional recycled material estimated at 138-187K tons** and current recovery of around 149K tons – combined recovery potential achieving 45% recycling rate is (149k+potential) = 287K-335K tons of SRPN recovered averaged 5-year commodity value of $39.10 /ton resulting a range of $11.2 M-$13.1M in value through recovery of SRPN if the state recycling target of 45% recovery is achieved.
CURRENT MARKET BEHAVIOR	SRPN GRADE 56 **is** up 12%, averaging $48.44 per ton, compared with $43.13, good spot market premium of over $30 for specifications met. Mills are hungry for any clean paper.
PAST MARKET BEHAVIOR	• After initial oversupply due to National Sword, demand has returned for SRPN and price is significantly more than mixed paper • Market was shrinking for SRPN, and tissue and containerboard uses compete with paperboard because it is a cleaner MRF grade.
SHORT TERM FORECAST	• All sorted grades, including SRPN, will see price increases in coming months due to supply shortages and loss of commercial clean paper permanently due to COVID behavior shifts • More and more in OCC
LONG TERM	• SRPN pricing has separated from mixed paper • There will be less SRPN available as megatrend of conversion of newspaper production to digital media continues causing more demand and price

OLD CORRUGATED CARDBOARD (OCC, ISRI GRADE #11) WASTE IN MI

- Old Corrugated Cardboard (OCC, ISRI Grade #11, makes up 8.2% of the landfilled material in Mi or 659,060 tons
- 53% of material landfilled is generated from the commercial and multifamily sector.
- 346.1K Tons are currently recycled in Michigan through curbside and dropoff collection (residential and commercial).
- To help reach a 45% state recycling rate, an additional 378K tons of OCC has been targeted to be recovered from landfill with an an estimated $30.6M (based on 5-year average value) and a current value (April 2021) of $36.9M ($97.53/ton).

MARKET SIZE AND VALUE:	Approximately 60% of disposed material) has been targeted to be recovered to help the State reach a recycling rate of 45%. Considering the current annual volume of OCC landfilled (659,060 Tons) with **potential of additional recycled material estimated at 340.4 – 416.1K tons** and current recovery of around 346K tons – combined recovery potential achieving 45% recycling rate is (346k+potential) = 686.5K-762.2K tons of OCC recovered averaged 5-year commodity value of $81.06 /ton resulting a range of $55.6 M-$61.8M in value through recovery of OCC if the state recycling target of 45% recovery is achieved.
CURRENT MARKET BEHAVIOR	• Spot price in March 2021 still $20-60 higher than indexes • Mills owned by China and in N. America counter with staged outages to slow price rise in next 3 months • Growth in local consumption in Latin America, U.S. and EU - mill buyer desperation • Prices for the old, corrugated containers (OCC) have exceeded $300/MT in India and purchases are being made on LOCs • WestRock findings on Pizza boxes, “if all pizza boxes were recovered for recycling, they would represent approximately 2.6% of the OCC stream or 2.2% of the OCC and mixed paper stream combined”
PAST MARKET BEHAVIOR	• Function of the Economy • Plastic substitution slowing down growth of paper packaging • Bellwether
SHORT TERM FORECAST	• On the Ocean coasts, “there is not enough to go around, kind of a panic feeling, Europe is consuming their own material, left China in a lurch” • Counter-push against plastics packaging • Increasing capacity through conversion in U.S., Mexico, Brazil, and Canada very attractive to graphic paper mill owners
LONG TERM	• China’s need for high quality box inputs into massive mill system after ban remains- quality and quantity • CAGR of 4.2% now predicted for next five years, wiping our dreary projections last fall

ASEPTIC PACKAGING AND GABLE-TOP CARTONS (ISRI GRADE #52) WASTE IN MI

- Aseptic Packaging and Gable-Top Cartons (ISRI Grade #52), makes up 0.18% of the landfilled material in Mi or 14,200 tons
- 53% of material landfilled is generated from the commercial and multifamily sector.
- 3,576 Tons are currently recycled in Michigan through curbside and dropoff collection (residential and commercial).
- To help reach a 45% state recycling rate, an additional 3.9K tons of Cartons has been targeted to be recovered from landfill with an estimated $160K (based on 5-year average value) and a current value (April 2021) of $88K ($22.50/ton). If all Cartons were marketed as Grade 52 and sold to Michigan based mills for tissue production the value increase to $175/ton with a value of $683.900.

MARKET SIZE AND VALUE:	Approximately 25% of disposed material) has been targeted to be recovered to help the State reach a recycling rate of 45%. Considering the current annual volume of Cartons landfilled (14,200 Tons) **with potential of additional recycled material estimated at 3.7 – 4.1K tons** and current recovery of around 3.6K tons – combined recovery potential achieving 45% recycling rate is (3.6k+potential) = 7.3 - 7.7K tons of Cartons recovered averaged 5-year commodity value of $40.84 /ton resulting a range of $297.6 K-$313.6K in value through recovery of cartons if the state recycling target of 45% diversion is achieved.
CURRENT MARKET BEHAVIOR	• Consumption and recycling of cartons has shown growth, but volumes are still low (~.5% by MRF volume). • Limited MRFs sort as a separate grade. • Cartons have two facilities, Great Lakes Paper in Michigan, and a Sustana, Que. and Sustana, Wisconsin tissue mills which accept cartons. • Cartons are an additive or a substitute for SOP in tissue mills
PAST MARKET BEHAVIOR	• After initial oversupply due to National Sword, demand has returned for SRPN and price is significantly more than mixed paper • Market was shrinking for SRPN, and tissue and containerboard uses compete with paperboard because it is a cleaner MRF grade.
SHORT TERM FORECAST	• No pricing on RecyclingMarkets.net, spot somewhere near $20. Aseptic Packaging and Gable-Top Cartons (ISRI Grade #52) marketed to Great Lakes Tissue in Cheboygan, MI at a value of $175/ton. • Most MRFs sort cartons for MP now
LONG TERM	• Polycoat grade (expanded Grade 52), will emerge in the next 3-5 years to ensure sort at MRFs is sustainable • SOP is generated from offices that are closed during stay-at-home orders, and mills are struggling for supply • Long strand fiber will be coveted as recycling grows worldwide

POLYETHYLENE TEREPHTHALATE (PET,#1)

- Bottle Grade PET makes up 0.66% of the landfilled material in Mi or 57,850 tons with a range as high as 69K tons.
- 53% of material landfilled is generated from the commercial and multifamily sector.
- 64.2K Tons are currently recycled in Michigan with 78% (35K tons) through curbside and dropoff collection (residential and commercial) and the remainder through the bottle deposit system.
- To help reach a 45% state recycling rate 33.7k tons of PET has been targeted to be recovered from landfill with an estimated $8.4M 5-year average value (12.5 cents per lb).

MARKET SIZE AND VALUE:	Bottle Grade PET makes up approximately 0.78% of material landfilled in Michigan, or 62.6K tons. Approximately 33.7K tons (50% of disposed material) has been targeted to be recovered to help the State reach a recycling rate of 45%. Based on the average commodity value in the last 5 years, these lost resources (33,700 tons) have an annual value of roughly $8.4 million dollars based an a 5-year average commodity value of $250/ton (12.5 cents per lb). Considering the current annual volume of bottle grade PET landfilled (57,850 Tons) and current recovery of around 64,200 tons with **potential of additional recycled material being 30,000-37,000 tons** – combined recovery potential achieving 45% recycling rate is (64.2k+potential) = 94.5K - 101k tons of PET recovered averaged 5-year commodity value of $$250/ton (12.5 cents per lb) resulting in a value range of $23.6 M-$25.3 M in value through recovery of PET if the state recycling target of 45% recovery is achieved.
CURRENT MARKET BEHAVIOR	• Best prices in two years but still low • Virgin overproduction • Companies still supportive of rPET in packaging • Haulers and brands warm to regulatory prodding
PAST MARKET BEHAVIOR	• Low-cost virgin resin historically had capped pricing on recycled PET • PET recycling rate had been flat for the past 10 years at around 30%. • Oversupply of virgin material
SHORT TERM FORECAST	• **Best pricing since 2019, breaks $.10 per pound and is at pre-Covid levels.** Volatile soft oil market and virgin PET oversupply- offset by loss of deposit system PET bales in 2020, now helped by rising resin and oil pricing • Global warming and fire events have stabilized pricing and rPET demand. Pricing is uncertain given volatility in the energy sector • Thermoform removal being pushed to MRFs-
LONG TERM	• Low-cost virgin PE oversupply will push market down but will see demand driven increase in rPET (recycled PET)

HIGH-DENSITYPOLYETHYLENE (HDPE, #2)

- Natural NHDPE makes up 0.11% of the landfilled material or 9,119 tons. Colored or not specified CHDPE comprises approximately 0.67% of the landfilled material or 53,809 tons or 62,928 total tons.
- 53% of material landfilled is generated from the commercial and multifamily sector.
- 59,840 (8,350 in Natural and 51,165 Colored HDPE) tons are currently recycled in Michigan.
- To help reach a 45% state recycling rate, 31,400 tons of HDPE (4,400 NHDPE and 27,000 of CHDPE) has been targeted to be recovered from landfill with an estimated 5-year average value of $3.6M NHDPE and $7.6 M CHDPE.

MARKET SIZE AND VALUE:	HDPE makes up approximately .79%% of material landfilled in Michigan, Approximately 31,400 tons (50% of disposed material) has been targeted to be recovered to help the State reach a recycling rate of 45%. Based on the average commodity value in the last 5 years, these lost resources (31,400 tons) have an annual value of roughly $11.2 million dollars, but notably based on commodity values in April 2020 was worth over $23.4 million dollars). Considering the current annual volume of HDPE landfilled (62,928 Tons) and current recovery of around 59,840 tons with **potential of additional recycled material being 25,500-37,200 tons** – the combined recovery potential achieving 45% recycling rate is (60k+potential) = 85.3k-97K tons of HDPE recovered at an averaged 5-year commodity value of $553.15 /ton ($825/ton NHDPE and $281/ton CHDPE) resulting a range of $30.7M-$34.4M in value through recovery of HDPE if the state recycling target of 45% recovery is achieved.

NATURAL HDPE

CURRENT MARKET BEHAVIOR	• Strong domestic end markets in both Canada and U.S. • Recycled content demand in single use plastics from CPG brands grows • Domestic consumption has dominated • Less and less available
SHORT TERM FORECAST	• Passed UBC as most valuable commodity in 2020- Record demand for most useable of post-consumer plastics
LONG TERM	• NHDPE will remain at over-market value due to war on plastics, and push to recycled content • Low oil and natural gas prices will result in a glut of cheap virgin PE

COLORED HDPE

CURRENT MARKET BEHAVIOR	• Price treaded water until recently • B2B capability low • Just so much lumber to go around • Great recycling infrastructure present in N. America • Resin price still dominates CHDPE behavior
SHORT AND LONG TERM FORECAST	• Resin supply disruptions in Texas and Louisiana drive prices up for all grades • Plastics industry is responding through chemical recycling initiatives which deconstructs polymers • rCHDPE will eventually become more valuable for recycled content, if achieved

LOW DENSITY POLYETHYLENE (LDPE, #4) FILM

- LDPE makes up 5.11% of the landfilled material or 409,800 tons.
- 53% of material landfilled is generated from the commercial and multifamily sector.
- 25,00 tons are currently recycled in Michigan.
- To help reach a 45% state recycling rate, 195,800 tons of LDPE has been targeted to be recovered with 60% recovered from the commercial sector with an estimated 5-year average value of $90.1M (23 cents per lb.).

MARKET SIZE AND VALUE:	LDPE makes up approximately 5.11%% of material landfilled in Michigan, Estimated that over 195,800 tons (approximately 50% of disposed material) has been targeted to be recovered to help the State reach a recycling rate of 45%. Based on the average commodity value in the last 5 years, these lost resources (195,800 tons) have an annual value of roughly $90.1 million dollars, but based on commodity values in April 2020 was worth over $156.6 million dollars) Considering the current annual volume of LDPE landfilled (409,800 Tons) and current recovery of around 25,000 tons with **potential of additional recycled material being 81,000-99,000 tons** – combined recovery potential achieving 45% recycling rate is (25k+potential) = 201k-240k tons of LDPE recovered averaged 5-year commodity value of $460/ton resulting in (201k X $/ton) and (240k X $/ton) = range of $92M-$110 M in value through recovery of LDPE if the state recycling target of 45% recovery is achieved.

POLYPROPYLENE (RIC #5, ISRI GRADE – PP POST CONSUMER - TUBS AND LIDS IN SOME MARKETS)

- Nascent market for higher food-grade packaging applications is emerging for rPP, which could drive up price for #5 bales, but, as yet, has not affected the market.
- Many MRFs do not separate PP, instead letting it flow into a mixed #3-#7 bale. PP is around 50% of the #3-#7 mix.

CURRENT MARKET BEHAVIOR	• Was an emerging grade with volatile demand. • Market tracked with virgin PP and oil markets as a lower quality, low-cost substitute. • Pricing was at historic low, but Pricing in SE tracks consistently higher than the national average due to high relative demand.
SHORT AND LONG TERM FORECAST	• New virgin PP capacity and low oil / natural gas markets will keep #5 bale pricing low for next 1-3 years. • Expect low prices until clear rPP market emerges. New PP Recycling Coalition from The Recycling Partnership with big war chest will buoy positive feedback for this material.

POLYPROPYLENE (RIC #5, ISRI GRADE – PP POST CONSUMER)

- PP makes up 0.21% of the landfilled material or 23,300 tons.
- 53% of material landfilled is generated from the commercial and multifamily sector.
- 5,100 tons are currently recycled in Michigan as part of a mixed plastics #3-7 bale.
- To help reach a 45% state recycling rate, 8,900 tons of PP has been targeted to be recovered with 35% recovered from the commercial sector, with an estimated 5-year average value of $1.8 M (9.9 cents per lb.).

MARKET SIZE AND VALUE:	PP makes up approximately 0.21%% of material landfilled in Michigan, approximately 8,900 tons (35% of disposed material) has been targeted to be recovered to help the State reach a recycling rate of 45%. Based on the average commodity value in the last 5 years, these lost PP resources have an annual value of roughly $1.8 million dollars, but based on commodity values in April 2020 was worth over $6.1 million dollars) Considering the current annual volume of PP landfilled (23,300 Tons) and current recovery of around 5,100 tons with **potential of additional recycled material being 8,000-9,900 tons** – combined recovery potential achieving 45% recycling rate is (10.2k+potential) = 13.2K-15K tons of PP recovered averaged 5-year commodity value of $198/ton resulting in a range of $2.6 M-$3 M in value through recovery of PP if the state recycling target of 45% recovery is achieved.

ALUMINUM CANS (USED BEVERAGE CANS (UBC), ISRI DESIGNATIONS "TALC" AND "TALDON"

- UBC makes up 0.27% of the landfilled material or 21,800 tons.
- 53% of material landfilled is generated from the commercial and multifamily sector.
- 56,400 tons are currently recycled in Michigan.
- To help reach a 45% state recycling rate, 8,600 tons of UBC has been targeted to be recovered with 40% recovered from the commercial sector with an estimated 5-year average value of $10.1M (58.7 cents per lb).

CURRENT MARKET BEHAVIOR	• 2020 movement of UBC users into airplane and auto sheet • Increasing deductions in moisture, foil, etc. • Cheap foreign UBC • Low export demand in 2020 • $0.65 is same price as when Timpane left Reynolds Aluminum in 1985
SHORT TERM FORECAST	• SaH has increased aluminum can demand along with new aversion for plastics • Pricing up with all world metal commodities • Constellium to add over 400 MT capacity and new players in Midwest/Miss. Vy, focused on can sheet capacity • Similar with steel cans which has surged 200% • Initiatives by Aluminum NGOs for equipment to capture mis-sorted aluminum
LONG TERM	• Can sheet capacity in U.S. is sold out for 2021 and renewed aluminum exports will keep pricing healthy

OTHER MATERIALS NOT INCLUDED OR DEFINED AS MSW IN DISPOSAL AND RECOVERY

TIRES

In 2019, RRS developed a Market Development Strategy under contract to EGLE. The strategy had three components:

- Provide a summary report with strategic recommendations to build on the success of EGLE's scrap tire market development grants
- Identify best management practices for the scrap tire recycling industry
- Produce a Midwest directory of scrap tire market participants

In 1990 the State of Michigan created the Scrap Tire Regulatory Act and subsequently formalized its grant process with the Scrap Tire Regulatory Fund. Today, approximately10 million scrap tires are generated annually in Michigan, and processed into tire-derived fuel (TDF) (68%), other uses (22%), and authorized landfill (10%). However, the TDF market is waning, and Michigan must pivot and grow new markets that are more sustainable and economically viable. The tire market in Michigan has the following characteristics:

- Michigan produces approximately 10 million scrap tires per year
- The Michigan processor industry is comprised of small and mid-sized firms engaged in various facets of collecting, hauling, and shredding; in total there is extensive processor capacity in the State
- Michigan markedly over-represented in TDF (68% vs. 40% nationally) and under-represented in TDA, RMA, and crumb rubber
- These other markets represent an opportunity for EGLE in that they offer legitimate incremental value in cost, quality, and performance
- Michigan is well below national averages in crumb rubber (6% vs. 20%) and RMA (negligible vs. 4%)

In embarking upon the transformation, Michigan EGLE is well-positioned to drive market development and continue its leadership in Michigan and across the Midwest region. By taking vital and distinct actions, Michigan can transition the scrap tire industry from one of "managing waste" to "creating economic value," and in so doing, continue to champion a robust Circular Tire Economy of the future.

The scrap tire industry is steadily transitioning; it is now a billion-dollar industry, yet still growing faster than GDP; the private sector has demonstrated that the market is shifting from one of "reducing waste" to one that is successfully "creating economic value." However, there is still a degree of subsidization through tipping fees. The market is shifting into an interstate eco-system, comprised of one national player, a number of successful regional mid-size "owner-operator" firms, emerging new-technology firms, and numerous tipping fee-dependent small firms.

EGLE has an excellent foundation with its funding, grant structure, organization, and external engagement methods. EGLE is poised to accelerate its value creation in the Midwest scrap tire industry through programmatic actions, grant process enhancements, targeted market development, and expanded engagement. A primary market focus is rubber-modified asphalt.

The Market Development Strategy identified the following future possible activities:

- Facilitate Michigan adoption of RMA spec (dry, terminal, Balanced Mix) that is more permissive than the existing MDOT spec
- Facilitate STAC transformation (goals, structure, process, recruiting)
- Implement STEV metric and reporting process
- Inventory the geographic reach (e.g. within ~200 miles of tire sources) of higher-value market participants (i.e. vertically integrated firms whose end products extend beyond RMA and TDF)
- Additional market research: Canadian scrap tire industry, California rubber modified asphalt strategy
- Extend EGLE relationship to the World Business Council for Sustainable Development Tire Industry Project

FUTURE DATA COLLECTION AND RESEARCH CONSIDERATIONS

Data driven strategy is only as good as the transparency of quality data sources. The gaps identified above can be further targeted with improved access to data and more in-depth data collection and research that further details additional gaps and opportunities in infrastructure and end markets. Some materials of interest may be currently managed under other state regulatory programs, such as agricultural or industrial wastes, many more have been identified as areas of interest under the NextCycle Michigan Initiative (NCMI) and will be targeted through challenge track projects with support from industry partners, while others could be captured with expanded data gathering through the Michigan Materials Management and Infrastructure (Mega Data) Program Project. The resulting research can be used to further identify and refine gaps and opportunities. Data collection and research focus areas for consideration include:

CONSIDERATIONS FOR FUTURE

RECYCLING INFRASTRUCTURE, PROCESSING AND END MARKETS	• Update to the hub and spoke model for MRFs, comprehensive drop-offs, pre-processors
	• Comprehensive drop-offs and pre-processors network supply chain analysis*
	• MRF equipment and technology for increased processing capacity*
	• Commercial recovery and processing throughput
	• Material commodity to end-markets supply chain research and analysis
	  ○ Estimated recovery, targeted recovery and how to get there
	  ○ Identify the "value" and investment needed in specific areas
	  ○ Hierarchy of commodities that reduce GHGs
	• Recovery data for diverted material*
	  ○ White goods, batteries, and electronics
	  ○ Mattresses, bulky furniture, and textiles
	  ○ Other commodities as needed for selected NextCycle Challenge Track teams
	• Drop-off locations and “access” analysis in accordance to proposed Part 115 rules (Benchmark Recycling Standards)*
	• Curbside program “access” and best practices for increasing recovery*

RECYCLING AND ORGANICS COLLECTION	• Haulers and collection network data gathering and analysis
	• Management solutions representing entire organics value chain
	  ○ Prevention - education, waste tracking
	  ○ Rescue/Recovery - food donation, wood recovery and end use
	  ○ Recycle - backyard composting, community composting, vermicomposting, animal feed, Centralized Composting, AD

ORGANICS INFRASTRUCTURE, PROCESSING AND END MARKETS	• Organics material recovery opportunities, esp. food waste, wood waste, hemp and cannabis plant waste • Compost processing capacity beyond EGLE registered facilities • End markets and needs assessment for compost and compost-based products
INDUSTRIAL RECOVERY AND PROCESSING	• Anaerobic Digestion (AD) processing capacity for food processing waste, other organic waste streams • EV, solar, wind turbine fiberglass, other fiberglass wastes • Waste materials that can be used for roads, road base and pathways
DEI (DIVERSITY, EQUITY AND INCLUSION)	• Deeper dive into regional gaps for recycling and impact on underserved regions • Identifying opportunity gaps within minority, women, immigrant, disabled and veteran-owned business and populations within communities

** Asterisked research and data areas can be informed by the Michigan Materials Management and Infrastructure Program Project (“MegaData” Project), Other areas identified have shown interest under the NextCycle Michigan Initiative and may be targeted through challenge track support or industry/stakeholder partner support.*