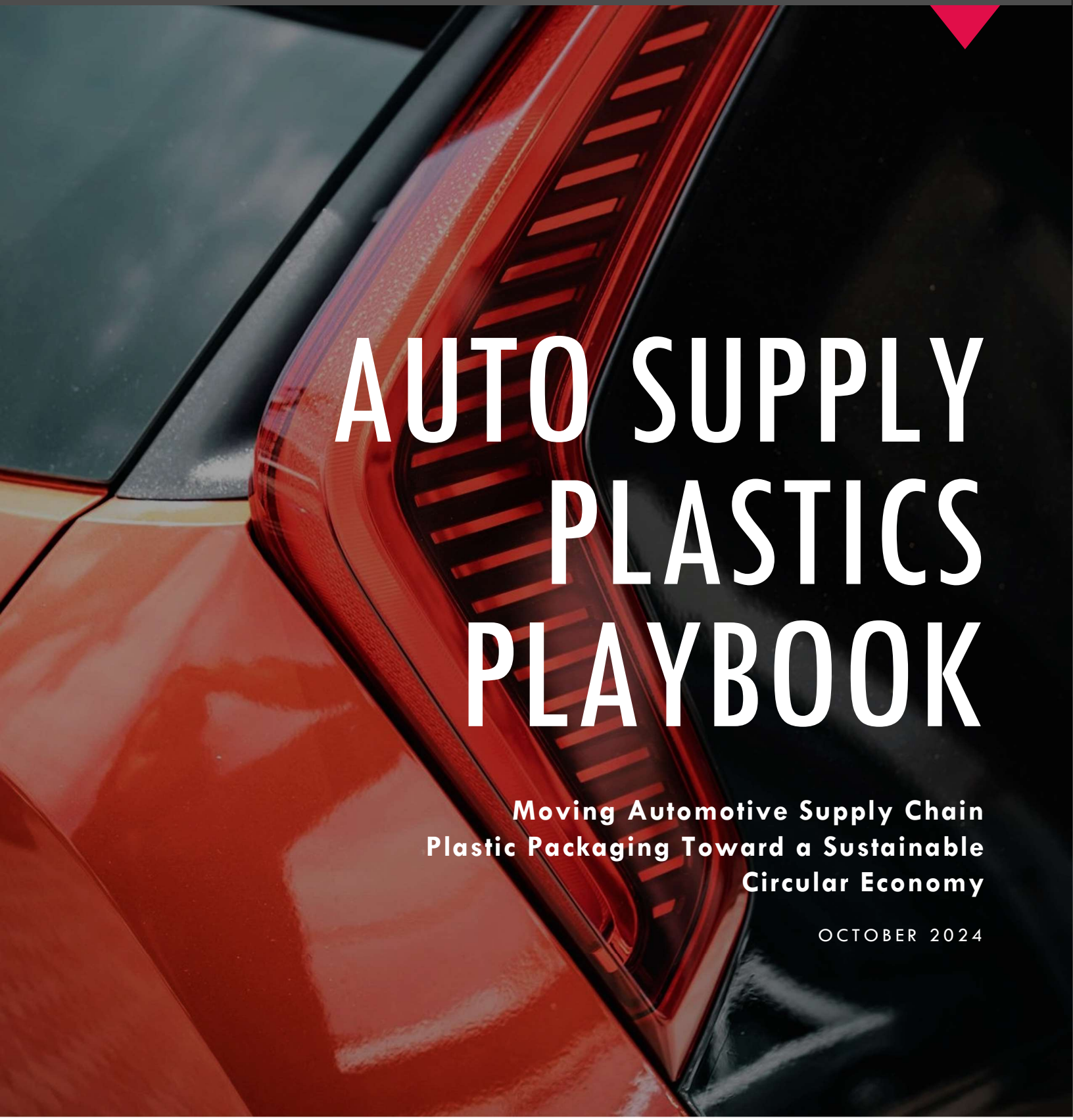

AUTO SUPPLY PLASTICS PLAYBOOK

Moving Automotive Supply Chain Plastic Packaging Toward a Sustainable Circular Economy

OCTOBER 2024

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INTRODUCTION

The Suppliers Partnership for the Environment (SP) provides leadership to help advance environmental sustainability across the automotive supply chain. One of the opportunity areas for improvement is management of plastic packaging and dunnage used to ship parts and components from plant to plant across the supply chain. The automotive industry uses many different packaging materials to safely ship parts damage-free through the supply chain. While reusable containers are a staple in the industry, the internal plastic dunnage and single use plastic packaging is often not recovered. This is in part due to difficulties in establishing an effective program to collect, aggregate, and market recyclable materials.

This playbook provides a practical framework for developing a plastic diversion program in original equipment manufacturers (OEM) and Tiered supplier plants. It includes a stepwise checklist for researching, planning and executing a program and presents priority opportunities, conditions needed for success, and challenges that are often confronted.

The playbook has an accompanying report that provides in-depth information on environmental outcomes of different management pathways, plastic recycling markets and opportunities for the automotive supply chain to recover more plastics in a circular economy. Make sure to consult the full report to learn more.

This report is based upon work supported by the Michigan Department of Environment, Great Lakes, and Energy, with matching grant funding provided by Magna.

PLASTIC RECOVERY PROGRAM CHECKLIST

CONSULT THE SP PACKAGING DESIGN GUIDE

The SP Guidance Document, "Sustainable Packaging Specification Recommendations for Automotive Manufacturing Operations Version 3, February 2024," provides a comprehensive list of best practice recommendations. The recommendations focus on opportunities to minimize automotive packaging waste and address barriers to recyclability in the design phase, including guidance related to a variety of commonly used plastic packaging and dunnage materials. The latest version of the guidance document can be found at: https://www.supplierspartnership.org/sustainablepackaging/

POLICY AND PROCESS

- Establish an internal monitoring program to track, measure, and formally approve package design conformance by environmental or sustainability team personnel. This includes carefully considering certain materials that present challenges to circularity, including:
  - Single use packaging
  - Packaging composed of multiple materials
  - Foams
  - Screws, nails, staples, clips
  - Metal brackets and banding
  - PVC
  - Non-clear film
  - Non-olefins
- Integrate goals and practices for packaging recycling into the company's sourcing policies and tactics.
- Keep in mind that certain regions have specific supply chain attributes, including access to recycling services, PCR feedstock and manufacturers able to utilize PCR (post-consumer recycled) content. materials that can be recycled, the ability to increase PCR (post-consumer recycled) content. Make sure the local/regional access and availability is there to support any sustainability policies for your goals.
- Use lean manufacturing principles in moving recyclables through system (including disassembly).

CHARACTERIZE YOUR WASTE

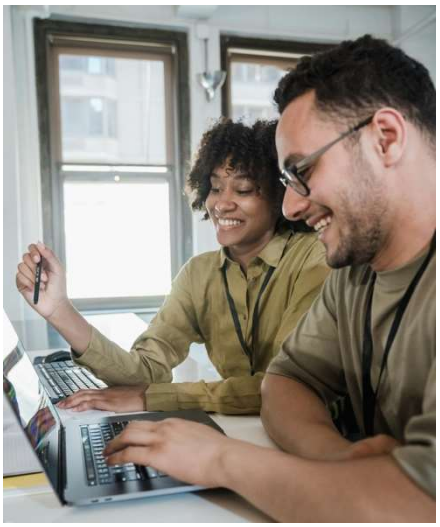
The opportunities for recycling in a specific plant relate to the type and amount of a specific plastics generated. Recyclability depends on a material's prevalence, the commodity value of that material and the costs of stewarding the material through the material recovery value chain. The first question that will come up when discussing opportunities with recycling collectors, processors or end markets are "what types of plastics are you generating and how much of each type?" To take the first steps towards designing a program, these questions should be definitively answerable. The best way to understand a material's prevalence is to conduct a waste characterization audit by sorting through all materials destined for disposal. This may require a third party researcher familiar with this study methodology. The most robust methodology to use is defined in ASTM standard D5231.[i]

The characterization of your "waste" is critical to this program – but the most important part is making sure it's comprehensive. The term Dumpster Diving isn't glamorous but making sure you're laying your eyes on what's currently being disposed of that could be recycled is an integral part of the waste characterization study and is a guiding pillar for program design.

PRIORITIZE OPPORTUNITIES

Once there are definitive numbers on the type and amount of plastic generated it is possible to identify and prioritize opportunities by considering its volume, value and environmental outcomes. Table 1 in the full report outlines environmental benefits of various recycling options. Based on observations from this study the most likely opportunities are broken or end-of-program rigid plastic reusable containers and source separated clear plastic bags and wrap. If you are in need of material identification, any local recycler can typically help with that and if they're stumped by a specific material, there are plastics producers/suppliers that can help or local Universities with Material Science programs. No fee is typically assessed for this service.

MAKE THE CASE TO MANAGEMENT



Generally, successful implementation of Sustainability initiatives, including programs for recycling and circular economy, requires the approval of a business case. The auto industry is intently focused on achieving profitability through the design, development, manufacture, sales, and service of its vehicles. Maximizing revenue and minimizing costs are paramount. As a result, endeavors that represent "the right way to do business," but lack a direct link to sales and variable costs, are less likely to gain full support of the management team and operational staff. Consequently, there are three primary ways in which Sustainability actions are justified.

1. **REGULATORY MANDATE**. Laws and rules are prominent throughout the industry, such as emissions standards, safety requirements, OSHA rules, and hazardous waste regulations. In these cases, there is understandably full support for compliance – essentially they are "must haves" vs. "nice to haves."
2. **FINANCIAL BUSINESS CASE**. If a Sustainability initiative can be cost-justified, then the project champion is more likely to garner management support. In the realm of recycling, this is the reason that cost-effective collection and processing is important, coupled with the existence of robust and profitable next-use markets. Cost-justification is also enabled by longer-term planning horizons, where ROIs can become favorable, and in firms where such traditionally "nonfinancial" issues are monetized; a good example of such an approach is the use of internal carbon pricing, which has been growing steadily as a practice among the private sector.
3. **CORPORATE SUSTAINABILITY GOALS**. Companies are now more frequently establishing and publicly reporting on non-financial ESG metrics. If a recycling project champion can clearly convey how the initiative will favorably impact a corporate sustainability goal, then they will more likely achieve support. The next sections covers KPI alignment in more depth. Zero Waste is one of the most frequently cited goals for major corporations. This entails making sure the materials leaving your facility are managed as valuable resources to the extent possible (or having an alternative end-of-life solution that does not include landfill). Aligning Zero Waste Goals with the Sustainable Materials Management Hierarchy (figure 1) should be the priority.

ALIGN KEY PERFORMANCE INDICATORS (KPIS)

Recycling projects need to define measurable and material metrics, or key performance indicators (KPIs). In so doing, the success of the project can be monitored, and more importantly, the justification for the initiatives will more likely be supported by the management team.

Overall, KPIs should:

- Align with corporate sustainability goals
- Align with desired recycling outcomes
- Encourage packaging recycling and reuse
- Empower local plant managers to invest in solutions
- Enable the identification and resolution of shortcomings

Using these corporate goals for reference, while also embracing the sustainable packaging guidelines published by SP, we can offer the following KPIs for possible use by a packaging recycling team:

(1) "INCOMING"

- Reduction of single-use packaging (volume and/or percent improvement)
- Use of recycled materials in packaging (volume and/or percent of total)
- Use of recyclable materials in packaging (volume and/or percent of total)

(2) "OUTGOING"

- Reduction of total plant waste (volume and/or percent improvement)
- Reduction of packaging waste (volume and/or percent improvement)
- Recycling rate for packaging materials (percentage)
- Rate of circular recycling for packaging materials (percentage)
- Leakage rate of reusable containers (percentage)
- Zero-waste-to-landfill plants (number of plants vs. total)

(3) GOVERNANCE

- Existence of a procurement policy for sourcing recycled and recyclable packaging materials
- Existence of a business process for approving single-use vs. recyclable packaging during product design phase
- Existence of goals, targets, and measurement method for gauging packaging waste performance

IDENTIFY AND ENGAGE PARTNERSHIPS ACROSS THE MATERIAL RECOVERY VALUE CHAIN AND WITH OTHER NEARBY PLANTS

Observations from this study indicate that most tiered suppliers and some OEM plants do not generate enough plastic materials on an ongoing basis to generate truckload quantities of materials, which is a key threshold. This means that a local recycler is needed to collect, aggregate and market materials from several sources. When developing a program, it is necessary to identify a recycling partner to conduct "milk run" pick-ups, aggregate and bale materials, and ship to end market. Typically, that partner will already have end market relationships. However, there are opportunities to engage preferred end markets in conversation with the local recycler. For example, if the recycler is sending clear bags and wrap to an open loop recycling process, such as aggregate lumber for decking, there are opportunities to request that they shift to a closed loop recycler that makes new bags with the recycled content. See Appendix D in the full report for a list of recyclers and plastic end markets in Michigan.

It may be difficult to direct downstream supply chain partners on end market decisions as a single generator of material with less than truckload quantities, but higher quantities of materials provide more leverage in those conversations. Engaging and coordinating with other local plants within a geography and working together can present added opportunities.

IDENTIFY AND ASSIGN ROLES AND RESPONSIBILITIES

A successful recycling initiative requires that all stakeholders are identified and that their respective priorities and responsibilities are confirmed; typically, the following categories of participants in an industrial facility will be involved:

WASTE MANAGER (also environmental services) – principally responsible to managing the process for collection and proper disposal of plant refuse.

PACKAGING ENGINEER (also material handling engineer) – oversees design and procurement of the dunnage and containers required for conveyance of components from supplier plants to assembly facilities.

MATERIAL HANDLING (also materials logistics management) – manages movement of materials within the plant from incoming docks to lineside; may also be responsible for return of waste and defective materials for disposition.

OPERATIONS MANAGEMENT – supervise production processes; these individuals usually play a supporting role in ensuring recyclable materials are collected at line side.

INDUSTRIAL ENGINEER – they will need to acknowledge the potential Takt time impact on any operator involvement in material collection.

SERVICE PROVIDERS – on-site total waste managers and other supporting services, such as janitorial staff and baling station operators. They will be involved in collecting materials throughout the plant and preparing for shipment.

SUPPORTING FUNCTION STAFF – organizations including finance, purchasing, legal, and HR/labor relations may also need to be consulted when developing a recycling/reuse plan.

PLAN AND DESIGN THE PROGRAM

CREATE A PLAN

A complete plan should be developed and circulated to gain support and approval within the plant. This should include at least three months' lead time to get equipment (collection containers, transport carts, etc), service providers and staff aligned. The planning phase should include:

- Discussions with vendors and end markets to determine available pathways and associated costs / revenues.
- Articulation of roles and responsibilities, designation of space within the plant to manage material before shipping to recyclers and processes for moving materials from the floor to the dock, and incentives for positive support and action
- Standard operating procedures

CONDUCT TRAINING

Engage a third party with experience to conduct a training. This could include an initial kickoff to announce the plan and reasoning followed by a demonstration of the plan in action. Let the program begin and have a follow up training with initial observations on performance and identify areas for improvement. Empower staff to have periodic updates on performance and announce incentives for areas of the plant demonstrating high performance. Establish the Third Pary Trainer's roles and responsibilities. Training and support for project management would be preferred as the on-site team has day-to-day responsibilities that sometimes are prioritized over the program for discovering recyclable material opportunities.

ENSURE CLEAR COMMUNICATION AND MESSAGING

A key mandate must be communication at every level of the program. This starts with the use of clear signage at each stage in the process within the plant, from the line to the intermediate pooling point to the back of the dock. Use pictures where possible instead of just words. Try to keep as simple and clear as possible. Figure 1 is an example of effective signage used in the pilot.

It is also essential to have effective communication with partners outside of the plant, especially if one of the steps was unable to be completed at the stated time. For example, if materials were not able to be collected from the end-of-line and properly placed on the dock for the recycler or hauler to pick-up, immediate communication needs to occur, so time and resources is not wasted. Also, the Recycler/Hauler needs to be held accountable to provide timely updates on material weights, if there were any exceptions (materials that were unable to be identified or caused system failure), and provide any general areas of improvement that they see.

Figure 1. Sample Communications Messaging, Clear Film and Other Plastic Packaging

TRACK, EVALUATE AND ADAPT

As the deep dive into the work begins, keep in mind that this is a program that needs frequent checks and monitoring. Different shifts of personnel, different products received, different materials presenting themselves that could be recycled, all indicate the need for very frequent communication after the initial company-wide kick-off discussion.

The program should review data on a regular basis to track performance in relative to the KPIs. Data on diversion quantity, quality and value of material down to the resin and form factor (e.g., HDPE rigid tray, LLDPE clear bags and wrap) is important for tracking market opportunities and seeking recovery at highest and best use based on the hierarchy. Ability to adapt and iterate should be built into the program, for example, to understand and respond to changing material composition within the industry.

PRIORITY OPPORTUNITIES

Based on the outcomes of this study the five greatest opportunities for recovery of plastic packaging based on a balance of environmental, economic and behavior considerations across the automotive supply chain are:

1. **OPTIMIZE REUSABLES.** The impact of inventory loss from reusable programs directly influences the amount of single use expendable dunnage generated throughout the system. Keeping tight inventory can reduce the need for "exception packaging," which is a prominent source of single use dunnage. This can be considered a waste prevention strategy that hits the very top of the waste hierarchy of preferred management options. Opportunities for managing this include setting a target on "leakage rate," or the amount of inventory loss over time, to use as a metric to track closely and from which to align performance. There are opportunities to further deploy systems using scanners, tags, and color coding to track down lost inventory. Further study is needed in this area.

2. **MAXIMIZE IMPACT OF EXISTING RECYCLING.** Prioritize closed loop mechanical options. A fair amount of plastic recycling is already taking place, particularly involving end of life reusable containers. However, there are instances where recyclers are bidding on reusable containers for use in downcycled products, such as pipes and other durable infrastructure. There are opportunities to direct these materials into more sustainable, circular pathways, by giving preference to a recycler that can demonstrate that the containers will be made into new reusable containers with the same intended use. Any instances where broken reusable containers are not being recycled should be immediately flagged as an opportunity. Plants should create a system to stack and store containers until a truckload is produced or coordinate with recyclers and other regional suppliers to aggregate truckload quantities.

3. **ALIGN WITH PURCHASING TO USE MORE RECYCLED CONTENT IN PACKAGING.** Closely related to the previous recommendation, more circular opportunities can be unlocked by engaging purchasing departments of the packaging supplies to commit to procuring packaging with increasing amounts of recycled content. In situations where there is revenue generated from recycling, there may be opportunities to turn that payment into a credit applied when purchasing back new containers. This can show clear net value and allow recycled content containers to be seen as more cost competitive by the purchasing agent. This may require coordination across OEMs, Tier 1 suppliers and their packaging suppliers. Further exploration of this concept is recommended.

4 **DIVERT CLEAR BAGS AND WRAP.** Of the expendable dunnage and packaging observed in the waste stream across all researched plants clear bags and pallet wrap, made from LDPE or LLDPE (low density polyethylene) was the most prevalent. This material is also commonly referred to as clear film. Source separating this film is the best chance to divert plastics without adding costs. The recycled commodity has a consistent market value ($.14/lb five-year average[ii]) and has circular potential with a regional end market, Petoskey Plastics, that can incorporate recycled clear film into new packaging, such as seating bags. Seating plants would be a good initial target for this type of diversion program, though all plants generate meaningful quantities. Due to the light weight of these materials and need to generate truckload quantities to reach recycling markets, a hub with baling and storage capabilities is a likely partner. Existing infrastructure found in recycling facilities should be sufficient to manage this. Plants should work with local recyclers and/or engage with other plants in the region to develop a hub and spoke network that can generate at least 30,000 lbs of film per month. The appendix in the full report shows a map with recyclers and end markets.

5 **DIVERT MIXED PLASTICS.** Beyond reusable containers and clear film, a diverse range of resin and form factors of plastic packaging is used. This limits practical recycling opportunities based on low quantities of single commodity types and high level of sorting required at the plant to source separate. Plants typically do not have space or staff to perform this level of sorting. Markets for mixed plastics are the most likely pathway for these materials. These may be either open loop mechanical or chemical recycling. Most mechanical recycling markets accept rigid-only mixed plastics, while chemical recyclers typically include all film and rigid olefins, polypropylene (PP), polyethylene (PE) and polystyrene (PS), included in the mix. The presence of PET trays in expendable dunnage and nylon strapping, and Velcro in returnable dunnage, likely require an end market partner with pre-processing capabilities to remove these materials which are incompatible with recycling of olefins. Alternatively, utilizing a hub to pre-sort olefins from non-olefins would overcome this barrier; however, this step adds costs and would likely require plants to pay for the collection of this category of plastics.

CONDITIONS NEEDED FOR SUCCESS

1 TRUCKLOAD QUANTITIES OF MARKETABLE COMMODITIES

- Truckload quantities range from 20,000 – 40,000 lbs of materials. This comes down to the amount of waste generated and space for storage.
- If a plant generates truckload quantities and has space to store, seek to add infrastructure and staff to bale material and work directly with end markets. This can generate revenue.
- If a single plant does not generate this much material work with other plants and service providers to contract for less than truckload pickup services. This may come at a cost.

2 BUY-IN FROM MANAGEMENT

- Frame environmental benefits (such ghg impact from table 1).
- Align key performance indicators. These are discussed below.
- Include expected revenues, costs and environmental outcomes.

3 BUY-IN AND COORDINATION WITHIN THE PLANT

- Plant sustainability lead and material handling and logistics departments need to work in partnership for a program to succeed.
- Behavior of plant staff will make or break the ability to sufficiently divert materials. Engaging them and obtaining their support is paramount. Seek opportunities to create incentives and gamify diversion activities.
- Plant contractors, including waste management service providers and janitorial, should have clearly defined roles and responsibilities and should be included in any trainings done to launch a program..

4 WELL-DESIGNED INTERNAL COLLECTION PROGRAM

- The program should be designed to provide at least 3 months of runway to obtain materials, engage staff and train them.
- Collection containers and signs at all three phases – collection points, pooling points, final in-plant aggregation point – are required to ensure everyone is clear on what to divert
- Prior to launch all staff should be trained on new procedures.
- Success in diverting and quality of diverted materials should be monitored. If they are not meeting expectations additional training and communications should be deployed.

5 COORDINATION WITH DOWNSTREAM PARTNERS

- Work directly with end markets if truckload quantities are being generated. This presents more revenue opportunities and transparency over what is being produced with the recycled content.
- If using service provider make end market expectations clear. Recyclers likely already have their end markets of preference. If the goal is mechanical recycling with a local company, work with recycling contractors to make this desired outcome clear and negotiate with them to arrive at an agreement for downstream disposition.
- Establish reporting requirements. Reporting weights of materials sent for recycling is a minimum reporting requirement. If possible, seek reporting on weight by resin type and what type of recycling market and or product is made with the material.

COMMON CHALLENGES

WITHIN THE PLANT
• **LACK OF DATA** on the types and quantities of plastics. Decisions for diverting plastics require an understanding of the type and quantity of plastics being generated down to the resin and format – e.g., x lbs LDPE clear film per month or x lbs of HDPE rigid per year. The first question a recycler will ask is "what do you have and how much." Without an answer it is difficult to move forward on a plan. Plants typically do not have this data. Any plant wanting to establish a plastic recycling program should conduct a waste composition study to understand what they have. The best option would be to follow ASTM standard (ASTM D5231-92) to sort the entire disposal stream, breaking down each plastic by resin and format.
• **INTERNAL COORDINATION.** Obtaining buy-in across the plant from management to line side workers to staff or contractors managing the flow of materials to the loading dock is a challenge. In some instances, there are as many as six different groups involved in the program, including corporate sustainability team, plant sustainability lead, plant environmental services contractors, janitorial services contractors, plant logistics and line staff. Alignment across these stakeholders and understanding of roles, responsibilities and various motivating factors is a significant challenge that can define the success of a diversion program.
• **LACK OF STAFF DEDICATED TO DIVERSION.** Some OEM plants have total waste management contractors on site that play a more active role in diversion programs. This is uncommon among suppliers. It is important to have a specific role defined for overseeing the diversion program throughout the plant all the way to the back of the loading dock. This role should include ensuring that containers and signs are appropriately distributed throughout the plant, that staff are following instructions appropriately and that materials are appropriately sorted and prepped for shipment out of the plant.
• **SORTING.** There are many barriers to source separating at the plant level, from space constraints to staff buy in. Opportunities to manage unsorted plastics may be the most realistic opportunity for most plants.
• **SPACE.** Many plants lack space to perform any centralized sorting, baling and/or storing materials in order to create truckload quantities of materials.
• **BUY IN.** Even though it's "the right thing to do", it's not a core competency of the plants and workers and introducing new desired behavior to divert and segregate plastics is difficult. Especially with larger companies, the production rates outweigh the ability to slow the production line down to enable segregation and takt time is often noted as being a barrier.
• **EQUIPMENT.** Sorting new streams requires collection containers throughout the plant, carts to move materials to the loading dock and gaylords, pallets, dedicated compactors and/or balers to prep materials for shipping. These are not typically readily available and are investments that need to be made either by the plant or their contractors.
• **QUANTITY.** Most plants observed do not generate truckload quantities of plastics on a frequent basis. Without that it requires additional steps to transport loose, less than truckload (LTL) quantities and work with a third party to aggregate and ship to markets. These extra steps will typically cost more than the value of the material, shifting the practice from a revenue generating activity to a cost that the plant must pay.

- **LACK OF WILLINGNESS TO ADD COST.** There is often an assumption that diverting materials results in revenues. As noted above, this is generally only the case when truckload quantities of materials are generated. While it may be possible with cardboard and pallets, it is not likely with most plastics in most plants. The best chance at cost neutral would be associated with end-of-life reusable rigid containers and source separated clear bags and wrap. There may also be opportunities to ride along with cardboard. In many cases, however, successfully diverting all plastics may be an added cost to the plant.

BEYOND THE PLANT
COST OF LOGISTICS • Transporting less than truckload quantities of materials adds significant costs to the system, which ultimately is born upstream by the waste-generating plants.
PROCESSING MATERIALS NOT DESIGNED FOR RECYCLING. • Presence of "prohibitives" or materials of which certain recyclers have zero tolerance. In particular, some chemical recyclers, which are a potential outlet for mixed plastics, have no tolerance for non-olefin plastics, including common materials found either in the reusable and expendable dunnage, such as PET and Nylon, and engineered resins found in plastic scrap, such as ABS. • Lack of transparency and reporting of downstream flow of materials. It is often a challenge to get downstream aggregation partners, such as MRFs, to provide information on the destination of recyclables collected from a plant. They may consider this competitive information and be unwilling to share it.
DEMAND FOR RECYCLED CONTENT • Low demand for recycled content limits market opportunities. Creating more demand pull by committing to buy back packaging with recycled content can open additional opportunities.

CONCLUSION

The automotive supply chain does many things well when it comes to environmental sustainability and materials management, but there are opportunities to do more with plastics dunnage and packaging that is currently not being reused or recycled. The goal is to use the sustainable materials management waste hierarchy as a guidepost to balance environmental, economic and behavioral elements and prioritize the most impactful interventions. There are non-trivial challenges that may present barriers improving the sustainable management of these materials. Some of these challenges can be overcome by better understanding the plastics in the waste stream and coordinating within the plant, among other plants and across the material recovery value chain to pursue the highest priorities. This guide describes a framework and approach that can be taken through this complex system to divert plastic waste and access recycling markets that reflect the highest, best use of those materials. Though there is no one-size fits-all approach to handling this plastic waste, this playbook can help Tier 1 suppliers and OEM plants to evaluate opportunities that fit their circumstance considering economic, environmental, and behavioral aspects, and outlines how clusters of plants may work together to overcome common barriers.

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[i] D5231 Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste https://www.astm.org/d5231-92r16.html

[ii] RRS analysis of historical data from recyclingmarkets.net