Difficult-to-Manage Materials Survey Report

April 2024

Sustainable Materials Management Task Force
Materials Management Subcommittee

Association of State and Territorial Solid Waste Management Officials (ASTSWMO)

Acknowledgements

The Difficult-to-Manage Materials Report was prepared by the Sustainable Materials Management (SMM) Task Force within the Materials Management Subcommittee of the Association of State and Territorial Solid Waste Management Officials (ASTSWMO).

ASTSWMO is a non-profit environmental trade association representing the waste management and remediation programs within the 50 U.S. States, five Territories and the District of Columbia (States). ASTSWMO's mission is "to enhance and promote effective State and Territorial programs and to affect relevant national policies for waste and materials management, environmentally sustainable practices, and environmental restoration."

The mission of the SMM Task Force is to provide leadership and promote actions that reduce waste, conserve resources, prevent pollution, and foster sustainability through identifying recycling opportunities and partnerships and through the development and implementation of educational programs about recycling.

The SMM Task Force expresses its appreciation to all the States who provided input into the Difficult-to-Manage Materials Survey.

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Introduction

In June 2023, the Sustainable Materials Management (SMM) Task Force within the ASTSWMO Materials Management Subcommittee launched its Difficult-to-Manage Materials Survey to pinpoint products and materials that are of concern or causing issues in waste and recycling programs and to identify associated trends among States and Territories (States). For the purposes of the survey, "difficult-to-manage" was defined as an item that has reached the end of its useful life that presents difficulties to the public, State or local government, or the waste and recycling industry because of a lack of viable end markets, inherent difficulties in handling the material, a lack of collection or recovery infrastructure, or any combination thereof.

The SMM Task Force distributed the survey to all States to better understand which materials are causing issues. Thirty-nine (39) States responded to the survey. The report presents qualitative information gathered through responses.

The Task Force is using the survey results to inform where to focus its efforts and formulate an approach for addressing difficult-to-manage materials in the waste stream.

Ranking of Difficult-to-Manage Materials

The survey asked respondents to rank their top 5 difficult-to-manage materials in their State from among a list of 21 items across the country. [1]

The top 5 items were:

1. Batteries, Non-Electric Vehicle (EV) Lithium-ion
2. Tires
3. PFAS-containing products (including Aqueous Film Forming Foam)
4. Household Hazardous Waste
5. Plastics (respondents were asked to specify)

[1] The ranking was generated by the electronic survey tool used. The score is a weighted calculation. Items ranked first are given a higher value or "weight." The score, computed for each answer option/row header, is the sum of all the weighted values. Since survey limited the number of materials to rank to five, the answer options chosen as Rank of 1 were given a weighted value of 5 points; Rank 2 received a weighted value of 4 points; and so on down to Rank 5. Unranked items are given a score of 0 by the survey tool.

Figure 1 shows the ranking of each of the 21 items.

Item	Overall Rank	Rank Distribution	Score	No. of Rankings
Batteries, Non-EV Lithium-ion	1		67	16
Tires	2		64	18
PFAS-containing products (including Aqueous Film Forming Foam)	3		52	15
Household Hazardous Waste	4		49	15
Plastics (Please specify in Question 6)	5		47	19
Batteries, Electric Vehicle (EV)	6		38	11
Food Waste	7		34	13
Photovoltaic Solar Panels	8		33	18
Electronics	9		32	10
Other (please specify in Question 7)	10		22	9
Wind Turbine Blades	11		21	7
Batteries, Embedded	12		19	5
Batteries, Rechargeable	13		18	5
Mattresses	14		15	6
Shingles	15		13	5
Vaping Pens	16		13	5
Pressurized Cylinders	17		11	3
Scrap Metal	18		7	2
Textiles	19		6	3
Paint	20		3	2
Appliances	21		3	1

Types of Plastics

Respondents who selected "Plastics" were asked to specify the type of plastic that they found difficult to manage (e.g., film plastic, #1, #2, #3, #4, #5, #6, #7, un-numbered polycarbonate, etc.). Nineteen (19) respondents selected “Plastics”, and specified the difficult-to-manage types in their States as follows:

Types of Plastic	Number or Responses
#3-7 Plastics	4
Film and #3-7	3
#6 Plastic	2
Plastic film	2
#5 Plastic	1
Film and #'s 3, 4, 6, 7	1
Bags	1
Lack of #3-7 recycling options; microplastics and litter; need for clear, accurate communication/outreach.	1
Primarily non #1 and #2 plastics. There is a growing market for #5 plastics, but it is currently regional rather than Statewide.	1
Single-use plastic packaging and plastic food service ware.	1
Single-use plastics, black plastic and any other plastic items that cannot be collected and processed with other recyclable plastics.	1
Current practices at Materials Recovery Facilities (MRFs)/Plastic Recycling Facilities (PRFs) focus on shredding/grinding techniques to facilitate making marketable nurdles. Recent studies have shown that much of the original mass of collected plastics is lost as fine microplastic dusts which can become air and waterborne.	1
All	2

Other Difficult-to-Manage Materials Noted

An "Other" option was provided to allow respondents to indicate difficult-to-manage materials in their States they were not included on the list of 21 items provided in the survey. The following responses were received:

Material	Number of Responses
Glass	2 One respondent noted Glass, primarily due to the lack of processing infrastructure in regions of the State.
All Batteries	2 One respondent indicated Embedded, Lithium Batteries, Rechargeable, etc. are the State's number one ranking material. Another respondent indicated Batteries – all battery types.
Lithium ion batteries including EVs	1
Agriculture plastic	1
Cardboard - recycling facilities having difficulties finding end markets for cardboard over the past 6 months. One paper mill in the State closed last fall which put additional pressure on finding an end market for this material	1
Dioxin waste sludge in paper mill impoundment generated from Kraft process.	1
Hand Sanitizer	
Organics (including food waste, yard waste, pet waste, etc.)	1
Construction and demolition wastes	1

Mechanisms for Addressing the Top 5 Materials

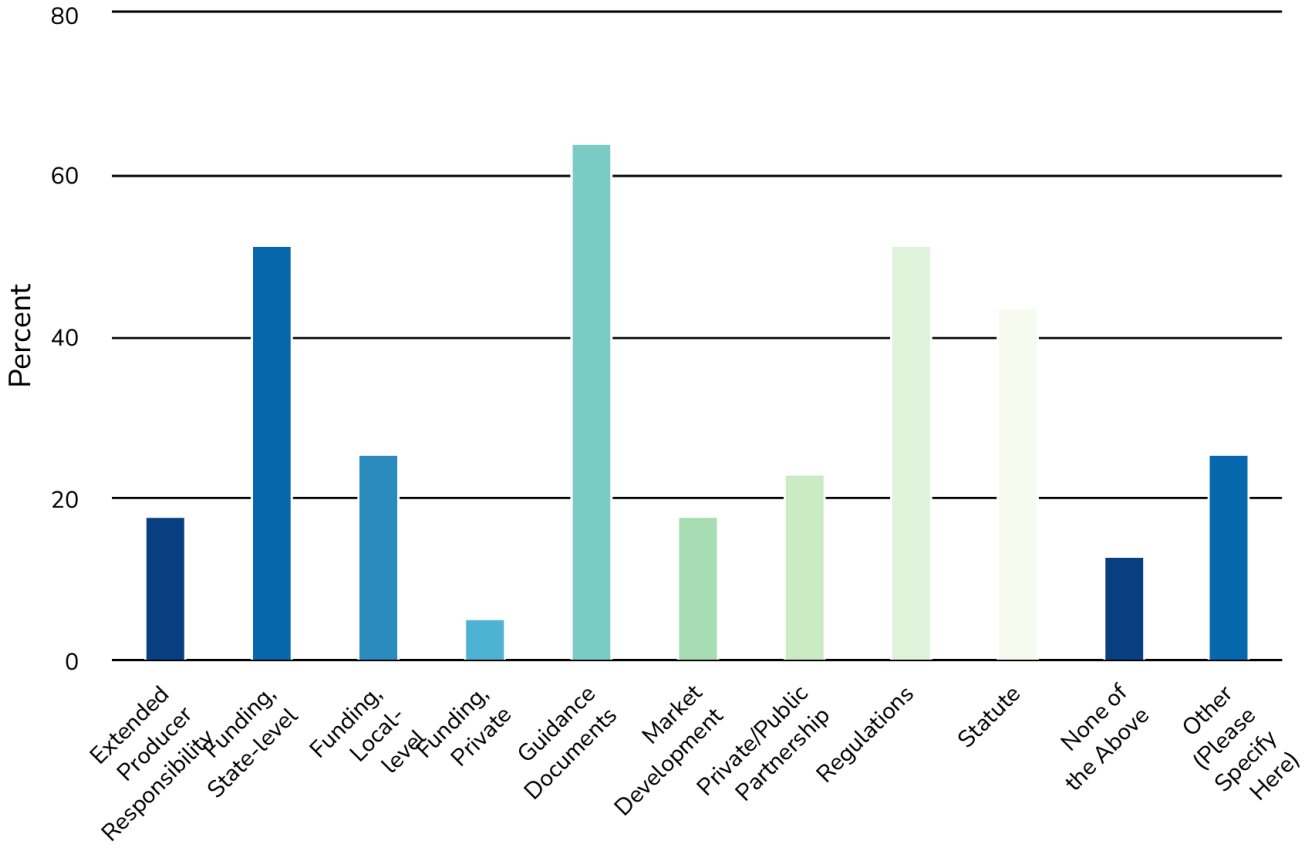
Respondents were asked if they were using particular mechanisms to address their top 5 materials. Respondents were allowed to select as many mechanisms as applicable. "None of the Above" and "Other" were additional options.

The funding mechanisms surveyed were:

- Extended Producer Responsibility (EPR)
- Funding, State-level
- Funding, Local-level
- Funding, Private
- Guidance Documents
- Market Development
- Private/Public Partnership
- Regulations
- Statute

"Guidance documents" received the highest number of responses, at 25. "Funding, State-level" and "Regulations" each received 20 responses. Seventeen (17) respondents selected "Statute".

Figure 2 below illustrates responses.



Item	Percent	
Extended Producer Responsibility	17.9%	7
Funding, State-level	51.3%	20
Funding, Local-level	25.6%	10
Funding, Private	5.1%	2
Guidance Documents	64.1%	25
Market Development	17.9%	7
Private/Public Partnership	23.1%	9
Regulations	51.3%	20
Statute	43.6%	17
None of the Above	12.8%	5
Other (Please Specify Here)	25.6%	10

The following table lists additional mechanisms not included as options in the survey that were provided by ten (10) respondents:

Other Mechanisms	Number of Responses
Education	1
Federal Funding through Solid Waste Infrastructure for Recycling (SWIFR) Grant	1
Grants for municipal and county recycling programs.	1
Have some State-level funding and specific regulations for tires. Statute - wholesaler or retailer of lead acid batteries must accept lead acid batteries and no landfills in the State may accept lead acid batteries for disposal. Also have State-level funding opportunities that could possibly address recycling of any of our identified problematic materials.	1
No, with the exception of rechargeable batteries (which underperforms due to its limited scope and lack of awareness). That is why they are our top five.	1
There is a study that addresses decommissioning and disposal of solar panels and wind power devices located in the State.	1
SMM/Circular Economy System Evaluation & Studies	1
These materials are problematic because the State does not have management strategies in place yet.	1
Outreach/webpages, recycling grants	1
Still evaluating possible solutions.	1

Top 3 Challenges/Problems in Managing Difficult-to-Manage Materials

Respondents were asked for the top 3 challenges/problems their State is facing regarding difficult-to-manage materials from among the following options:

- Collection Difficulties
- End Markets
- Funding
- Infrastructure
- Lack of Education
- Law/Policy
- Other (please specify)

The top 3 challenges identified were:

1. End Markets
2. Infrastructure
3. Funding

End Markets and Infrastructure tied with 27 responses each. Funding was noted by 18 respondents. Responses are shown in Figure 3 below.

Figure 3

Item	Overall Rank	Rank Distribution	Score	No. of Rankings
End Markets	1		61	27
Infrastructure	2		54	27
Funding	3		38	18
Collection Difficulties	4		27	15
Law/Policy	5		24	14
Lack of Education	6		20	10
Other please specify in Question 10	7		7	4

The four respondents who answered “Other” provided the following challenges/problems:

- All of the above: 2 respondents.
- Shipping issues for batteries: 1 respondent
- Battery fires: 1 respondent

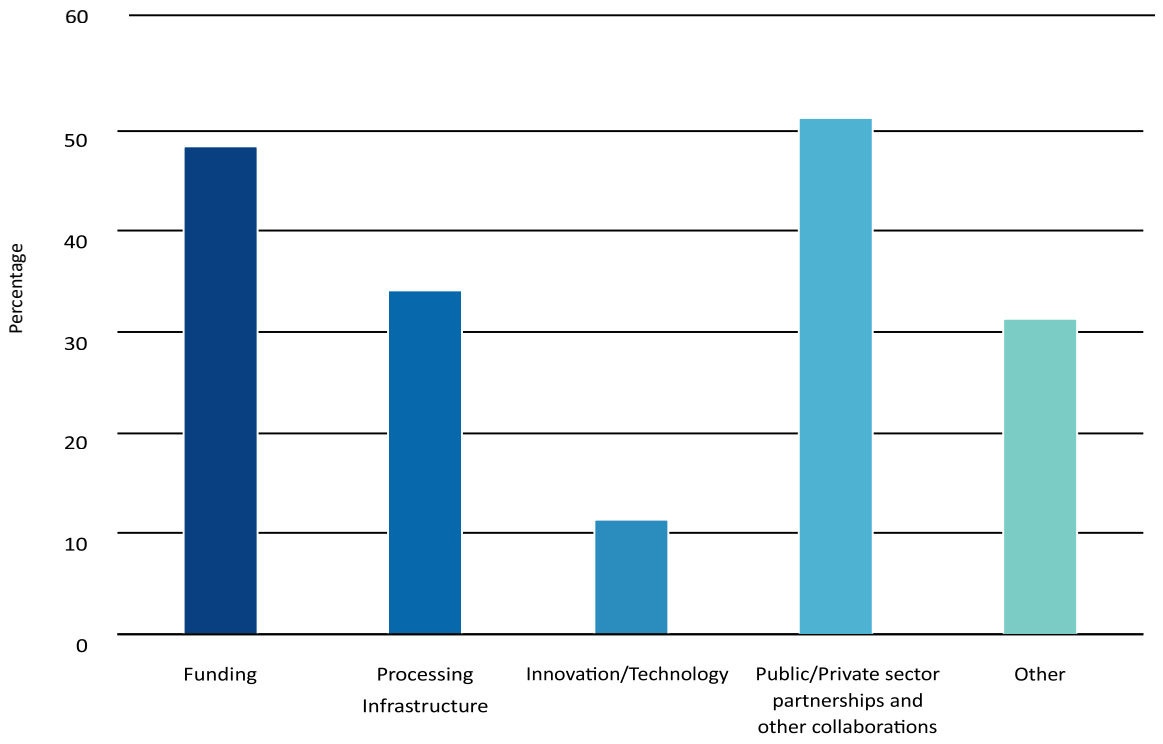
Existing Opportunities for Managing Difficult-to-Manage Materials

Respondents were asked to indicate some of the existing opportunities in their Region/State for managing difficult-to-manage materials. Respondents were allowed to select more than one opportunity from among the following options:

- Funding
- Processing Infrastructure
- Innovation/Technology
- Public/Private sector partnerships and other collaborations
- Other (please specify)

"Public/Private sector partnerships and other collaborations" was cited most often, with 18 responses, and was closely followed by Funding, which was noted by 17 respondents.

Figure 4 illustrates responses.



Item	Percent	Responses
Funding	48.6%	17
Processing Infrastructure	34.3%	12
Innovation/Technology	11.4%	4
Public/Private sector partnerships and other collaborations	51.4%	18
Other	31.4%	11

"Other" existing opportunities that were provided are listed below:

- Education Initiatives
- Education/Outreach (noted by two respondents)
- Evolving regulatory structure to enhance end-of-life standards for batteries.
- Federal, State, and local laws outlined in the respondent's information provided in the response to the question about assistance that would be helpful in managing difficult-to-manage materials.
- PFAS-containing products can go to a landfill for disposal currently in accordance with State regulations.
- Statewide contracts for management of problem material (HHW, electronics).
- The State provides information on the options for problematic materials management.

One respondent answered, "Not Applicable", and another respondent indicated there are no existing opportunities for their top 5 materials.

Assistance Needs for Managing Materials

In responding to what would be helpful for managing difficult-to-manage materials, markets, infrastructure, and funding were the areas of needed assistance most frequently cited, mirroring the top three challenges/problems respondents identified their States are facing. The full listing of responses is provided below:

- Policy and funding for collecting and managing the materials and end markets.
- Regional market development. If the ASTSWMO Sustainable Materials Management Task Force could create some sort of database on how other States are managing these problematic materials, that would be helpful.
- Learning what other States are doing, seeing where there will be increased market development.
- Having close end markets to economically recycle the materials rather than disposing the materials at landfills or other solid waste disposal facilities.
- A market or processor that will take the material.
- More in-State outlets and opportunities for market development as well as better coordination with neighboring States regarding outlets and market development would be beneficial. Additional guidance from the State agency and collaborations with other State organizations could help on multiple fronts, though agency staffing continues to present its challenges to these efforts.
- More end markets and infrastructure to manage the materials.
- Being a rural, low population State, transportation to end markets and lack of infrastructure within the State are some of the biggest challenges. It would be helpful to find a way to tackle those challenges taking into account a small regulatory staff and a lack of funding at both the State and local levels.
- The State lacks the infrastructure for many problematic materials. For example, while the State hosts a few recyclers for lithium-ion batteries, it lacks the collection and transportation infrastructures needed to get the batteries to those recyclers. If State or local governments are going develop that infrastructure, then we need more funding. Producer responsibility requirements would help. However, those requirements would need to be federally mandated for producer responsibility to be implemented in the State. There is no proposed legislation for new laws restricting disposal of materials.
- Facilities/end markets or grants/funding to incentivize facilities/end markets are needed to create infrastructure to recycle, reuse, or otherwise responsibly manage these waste types. For PFAS, the National Defense Authorization Act (NDAA) prevents incineration which limits disposal options. The U.S. Department of Defense (NDAA) and U.S. Environmental Protection Agency (EPA) need to work together to alleviate restrictions for PFAS waste.
- Funding for municipalities to manage this material, laws that put funding to work and require municipalities to collect (or the producers through an EPR program), education/outreach to municipalities to help them develop and keep ongoing collection programs, and education and transparency around textiles.

- While we have some State funding, and now some federal funding, it is certainly not enough to make major investments. For example, a State funding program does not have enough annual funding to make big investments in big compost or anaerobic digestion facilities that could help address some of the State's food waste/organics issues. While the State also has some examples of public/private partnerships, there certainly could be more across the State.
- More guaranteed funding (State and federal/HW), federal EPR programs, realistic regulatory clarifications that provide real disposal options (e.g., for vape pens).
- EPR, federal government guidance, private/public partnership.
- Product stewardship would be great but in its absence we could use more guidance, policy recommendations, and case studies.
- Creation of effective EPR programs for mattresses and tires, since dirty mattresses and tires continue to be abandoned on vacant city lots, rivers, and rural back roads.
- Federal guidance and regulation.
- Regulation at the federal level.
- Managing difficult materials by having disposal/reuse options that are realistic and attainable.
- Having a continued dialogue that discusses success stories with some of the hard-to-recycle materials is the best path forward. This would help States consider different viewpoints or how those operations may work under a different management strategy.
- Having a well-staffed solid waste bureau. Additional and timely sharing of educational materials. Staff having enough time to actually perform outreach in addition to other work.
- The State does not operate landfills or recycling programs, so this question isn't quite applicable. There are no State or local laws mandating recycling. All programs are operated on a voluntary basis by local/regional entities.
- More circularity thinking so that we already know the end before we begin.
- Increasing consumer/resident awareness of the importance of proper handling procedures for hard-to-recycle items is crucial. Collection opportunities may exist but if consumers a) don't know how to participate or b) are unaware of the importance of proper handling for hard-to-recycle materials in the first place, the effectiveness of those programs will ultimately suffer. Public/private sector partnerships would likely be the most effective mechanism to drive increased collections and/or reuse, however, most of those collaborations would need to be initiated by regulation/policy.
- From one respondent:
  - Recycling Infrastructure
  - End Markets
- From one respondent:
  - More collaboration with other States to develop lists of sites to send difficult-to-manage materials.
  - Nationwide guidance and lists of companies who manage difficult to recycle materials.
- From one respondent:
  - Infrastructure and education grants for small governments.
  - Regulation Development

- From one respondent:
  - National EPR programs for utility stakeholders seem to be needed for a source of funding.
  - Also, new metrics for handling problematic materials should be established for the circular economy.
- From one respondent:
  - Additional funding.
  - Product stewardship, but EPR laws have little chance of advancing in our State.
  - Voluntary stakeholder led initiatives to promote better disposal options and opportunities.
- From one respondent:
  - Funding and EPR laws for packaging, HHW, and other difficult-to-manage wastes.
  - Research and Development (R&D) for end-of-life management for renewable technologies.
  - Right to repair laws.
- From one respondent:
  - Dialog with the producers of products.
  - Consistent regulations and requirements from State to State.
  - End markets for the materials.
- From one respondent:
  - Product bans on PFAS products and on production/sales/use of certain plastic packaging into the State that is disruptive to recycling of packaging and organics recycling.
  - True producer funded EPR for HHW, batteries, tires, and packaging and printed paper. Include eco-modulating fees to disincentivize unrecyclable and disruptive plastic/plastic based packaging, and incentivize and support reuse and recycled content.
  - Minimum content standards for post-consumer recycled content for certain packaging and products to help develop circular markets.
- From one respondent:
  - Plastics – Truth in Labeling legislation on a national basis would be the most helpful. The main issue with plastics is confusion on what is and is not recyclable.
  - For food waste and mattresses, the most helpful thing would be infrastructure. We need somewhere to be successful and show proof of concept that could then lead to more growth in different parts of the country.
  - For solar panels, there needs to more research and more partnership with established e-waste collection and recycling companies. This may not be the top issue right now, but it will be very soon, and it could lead to huge environmental issues.
  - Similarly, for lithium-ion batteries, we need more education that can reach individual residents. They need to know the true consequences of mishandling this material.
- From one respondent:
  - Global plastics treaty limiting plastic production
  - Comprehensive EPR legislation at the federal level creating a unified framework for managing these materials would help create demand for the reclaimed materials, incentivizing their collection and recovery.
  - Expansion of reuse/refill opportunities for products packaged in materials determined to be problematic.

- Financial incentives or grants to States and Territories to expand collection and processing infrastructure for difficult-to-manage materials.
- Bans/labeling requirements on PFAS-containing products, propane cylinders, and vaping pens.
- Public service announcements on the environmental and economic downsides of participating in fast fashion. A malus fee could be imposed on "fast fashion" brands whose products are not sufficiently durable.
- Requiring store take-back and recycling of vaping pens. Require industry to create reusable alternatives to single-use vaping pens.
- Additional storage for tires should be established as markets are established, potentially through incentives or subsidization of commercial products that incorporate the material.
- The current recycling infrastructure for batteries needs to be strengthened and public awareness campaigns should be enacted to improve awareness of proper battery disposal.
- A regulatory framework that holds manufacturers accountable for end-of-life management of problematic materials should be established.

Elaboration of Responses and/or Additional Comments

Respondents were offered the opportunity to elaborate on their responses or provide additional comments. The following information was provided:

- Ranking is based on the current problems. HHW is the biggest issue as there are no collection points, no funding, and no laws addressing HHW. Therefore, a ton of HHW goes to the landfill. The State currently has a limited battery collection program for rechargeables only (and auto lead batteries). Fires have occurred at landfills attributed to batteries; the current battery program should expanded and funded. Pressurized cylinders are a collection issue and have blown up in State MRFs, however, they are considered packaging and will be part of the State's EPR/Packaging program so that should hopefully address them. Although we don't have a characterization study completed to show this (we are completing one in 2023), we believe food and textiles make up a large percentage of the disposal waste stream and there are currently no funding/laws/programs addressing either of them. Programs to get them out of the waste stream would go the furthest for meeting the State's waste diversion goals. Also, the "batteries" should be addressed more comprehensively as a group; imbedded and all battery types are an issue. After the top five priority –
  - Electronics - we currently have an e-waste program, but it needs to have its covered items list expanded and updated.
  - Solar Panels – the number of solar developments in the State and consumer use of solar panels, both individual residential and personal sized, is growing, but they haven't reached the waste stream in significant numbers yet. They should be addressed now before they become an issue.
- Implement full lifecycle planning for any new technology before being released into consumer marketplace.

- The State's answers are based on the materials we receive the most calls about or those that the waste industry has brought to our attention. Some of the materials listed in question 5 could become problematic in the future (such as wind turbine blades). Even the most universally recycled materials (paper, cardboard, aluminum cans) are still problematic since we recover small percentages of what is being generated. Small to mid-size businesses generate the largest portion of recyclables being disposed. Reaching those businesses is difficult, and their access to recycling services is limited. While the State has grant programs to support market development and infrastructure improvements, we receive more requests for assistance than we can fund.
- Tires are becoming increasingly difficult to manage in the State.
- Solar panels are still relatively new in widespread use in the State, but the few inquiries we have received regarding disposal show that there is a knowledge gap regarding disposal and a lack of available outlets that will start causing issues in the next several years. Propane tanks and other pressurized cylinders are a common subject on phone calls received from the public as scrap metal recyclers don't seem interested in accepting them and the public is not aware of how to render them safe for recycling. Electronics are better handled near the State's capital, but Statewide outlets are limited with only few management options available through State agency grants. The State agency issues local government solid waste and waste tire assistance grants to help manage HHW, bulky wastes, and waste tires. Waste tire recycling/research grants are also available to public and private entities to help find solutions for State-generated waste tires. In-State waste tire outlets have been scarce for some time; however, several current and prospective waste tire processors are working towards permitting a new facility in the State. Some public/private partnerships have also been helpful in parts of the State for helping to manage electronics.
- When discussing the difficult-to-handle material of plastics, #'s 3-7 are obviously the main issue as far as end markets go, however, there are still issues with the more recyclable 1's and 2's. For example, there are some companies that sell raw chicken in plastic trays that are marked with a #1 even though that type of #1 is not the kind that can be recycled with the #1 bottles. This mass confusion is our number one concern with ridged plastics. In addition to the top 3 challenges or problems with difficult-to-manage materials, collection for things like mattresses and batteries is an issue - how do you get people to handle these correctly.
- Problematic materials have unique infrastructure and fall outside of the standard recycling model for recyclables with recycling rate definitions such as managed by communities. Key stakeholders include power companies, auto companies, and technology developers.
- Funding is limited but has been useful in assisting local governments host HHW collection events.
- On a volume basis, food waste is a number one candidate due to loss of valuable fertilizer and production of methane contributing to global warming, however, for emerging incidents of spontaneous combustion in solid waste facilities due to lithium-ion batteries the industry is implementing programs to detect hot spots and extinguish fires from this common problem.

- In regard to the question about what would be helpful to managing difficult-to-manage materials, the State agency has seen an uptick in pyrolysis which takes certain materials and burns/destroys them to create energy. We believe we need more end markets that focus on a circular economy by utilizing materials at their highest value and promote reuse over burning materials.
- In the State recycling is handled at the local government level. It has become costly to recycle so many of our local governments struggle to maintain basic recycling. The difficult-to-manage materials are even more costly and these services are simply not provided at the local level.
- The question about existing opportunities for managing difficult-to-manage materials is ambiguous. Opportunities that should be developed include EPR for consumer products in general and for emerging/ recent technologies. The State has some EPR laws for specific products, but more are needed to lower the costs for disposal and ensure responsible management of potentially environmentally harmful product constituents.
- An additional problematic material is contaminated soils often called development soils, but not reaching the hazardous category. These soils are very prevalent and impact the ability to affordably redevelop properties and find affordable means of disposal.
- Solar panel disposal is an often-asked question. Also, our State has a lot of enforcement/compliance issues with automotive fluids/scrap yards.
- Although the State has no hand in the running of programs, we are aware of the barriers to them. There is a lack of infrastructure for collection programs. There are no MRFs in the State, therefore, materials must be shipped thousands of miles to recyclers. Other than #1 and #2 bottles, plastics collection and shipping result in a net loss to programs due to lack of value for the material. Many of our State's barriers come down to lack of funding for programs' operations and shipping costs.
- Cathode ray tube (CRT) televisions continue to be a difficult-to-handle material due to the financial burden implicit in their recycling. Based on existing recycling infrastructure, material composition, and the probability of an increase in materials nearing end-of-life, photovoltaic solar panels, EV lithium-ion batteries, and vaping devices should be front-of-mind in our discussions of hard-to-recycle materials.

Appendix A: Survey Questions

2023 SMM Task Force Difficult-to-Manage Materials Survey

1) Here are some difficult-to-manage materials across the country. Please select and rank by dragging your top 5 from the listed materials below:

_____Appliances

_____Batteries, Electric Vehicle (EV)

_____Batteries, Embedded

_____Batteries, Non-EV Lithium-ion

_____Batteries, Rechargeable

_____Electronics

_____Food Waste

_____Household Hazardous Waste

_____Mattresses

_____Paint

_____PFAS-containing products (including Aqueous Film Forming Foam)

_____Plastics (Please specify in Question 6)

_____Pressurized Cylinders

_____Photovoltaic Solar Panels

_____Scrap Metal

_____Shingles

_____Textiles

_____Tires

_____Tires

_____Vaping Pens

_____Wind Turbine Blades

_____Other (please specify in Question 7)

2) If you selected "Plastics", please specify (e.g., film plastic, #1, #2, #3, #4, #5, #6, #7, un-numbered polycarbonate, etc.)

3) If you selected "Other" please specify.

4) Are you addressing your top 5 materials through any of these mechanisms? Click all that apply.

[ ] Extended Producer Responsibility

[ ] Funding, State-level

[ ] Funding, Local-level

[ ] Funding, Private

[ ] Guidance Documents

[ ] Market Development

[ ] Private/Public Partnership

[ ] Regulations

[ ] Statute

[ ] None of the Above

[ ] Other (Please Specify Here): _____*

5) What are the top 3 challenges/problems your State/Territory is facing regarding difficult-to-manage materials?

_____Collection Difficulties

_____End Markets

_____Funding

_____Infrastructure

_____Lack of Education

_____Law/Policy

_____Other please specify in Question 10

6) If you selected "Other" please specify.

7) What are some of the existing opportunities in your Region/State for managing difficult-to-manage materials?

[ ] Funding

[ ] Processing Infrastructure

[ ] Innovation/Technology

[ ] Public/Private sector partnerships and other collaborations

[ ] Other: _____*

8) What would be helpful for you for managing difficult-to-manage materials?

_____

_____

_____

_____

9) Please use this space to elaborate on responses or provide additional comments