Illinois Materials Management & Recycling Opportunities

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Introduction

In early 2022, the Illinois Sustainable Technology Center (ISTC) began collaborating with Illinois EPA (IEPA) to identify on-going study needs associated with the Illinois Materials Management Advisory Committee (MMAC) Report that was submitted to the Illinois General Assembly in July 2021. The MMAC Report established the following statewide diversion goals:

- 2025: 40% diversion
- 2030: 45% diversion
- 2035: 50% diversion

IEPA commissioned ISTC to conduct a two-year study focused on researching large volume recyclable materials to better understand recycling and diversion efforts throughout Illinois and barriers and opportunities to further diversion. This study and report are focused on one primary question – Where should IEPA focus their efforts, resources, and funding to further divert these materials from the landfill?

ISTC began by reviewing and analyzing data from the MMAC report, primarily Table 2 on page 26 and Table 4 on pages 56-57. Data from these tables uses the material breakdown from the 2015 Illinois Commodity/Waste Generation and Characterization Study Update (IC/WGCS) and applies it to 2018 landfill generation data. As of 2024, this is the most up-to-date data on waste composition in Illinois. In conjunction with the Statewide Recycling Needs Assessment Act, the IEPA will be funding a statewide waste characterization study that identifies the annualized volume of individual materials generated in Illinois by geographic region of the state. This study will provide updated waste composition data that can be used in guiding materials management decisions.

Through collaboration with IEPA, the initial list of materials covered in this study was narrowed to include:

- Fiber (including paper and corrugated cardboard)
- Glass
- Metal (aluminum and other metals)
- Organics (including food scraps and yard waste)
- Plastics (including #1, #2, #5, & plastic film)
- Textiles

ISTC developed a set of standard questions to solicit feedback on the draft list. ISTC then identified and engaged a group of stakeholders, principally based on the organizations or individuals who contributed to or served on the MMAC. Below is a list of individuals with whom ISTC engaged.

*Table 1. MMAC stakeholders contacted by ISTC. **

Representative	Organization	Email
	City of Chicago	
	City of Chicago	
	City of Chicago	
	Champaign County Environmental Stewards	
	DuPage County	
	Illinois Environmental Council	
	Illinois Recycling Association	
	Jackson County	
	SWALCO	
	Tazelaar Recycling	
	Will County	
	City of Springfield	
	Coles County	
	Cook County	
	Homewood Disposal	
	Jackson County	
	Lakeshore Recycling	
	Republic Services	
	Waste Management	

* Grey boxes contained individual contact information that was removed in the public-facing version of this document.

Based on stakeholder feedback and further discussions with IEPA, the final list was narrowed down to five material categories. Fiber and plastic film were removed from the final list, primarily due to stakeholders thinking that further research was not warranted at this time (fiber) or due to complexity and lack of recycling options (plastic film).

- Organics (including food scraps and yard waste)
- Textiles
- Plastics #1, #2, & #5
- Metal (aluminum and other metals)
- Glass

Following the development of the final list, ISTC conducted research to better understand the state of recycling and diversion for each material. The remainder of this report consists of chapters for each of the five materials listed above and a sixth chapter for stakeholder engagement. While existing efforts, infrastructure, markets, etc. differ for each material (and thus the research conducted for each material), each material category has subchapters on:

- **Definitions** – Defining key terms used throughout the chapter.
- **Generation** – What data is available to better understand generation of each material?
- **Impacts on the environment and human health** – What are the impacts of allowing each material to end up in a landfill? What are the impacts of recycling each material?
- **Collection** – How are these materials collected for recycling?
- **Infrastructure** – What recycling infrastructure exists for each material?
- **End markets** – What end markets exist for this recycled material? What markets need to be developed or bolstered for each material?
- **Existing policy/regulations** – What policies and/or regulations exist in Illinois that govern the recycling process for each material? What policies or regulations could be put in place to increase the recycling and diversion of each material?
- **Existing goals** – What local, state, or national goals exist for the recycling and diversion of each material?
- **Existing funding opportunities** - What local, state, or national funding opportunities exist for the recycling and diversion of each material?
- **Existing education & resources** - What local, state, or national educational resources exist for the recycling and diversion of each material?
- **Solutions & Research Gaps** – What does research show are the best practices for recycling and diverting additional material from the landfill? What research gaps exist to better understanding challenges and opportunities to recycling each material?

The last chapter of this report summarizes the stakeholder engagement listening sessions that were held in June and July 2024. ISTC invited stakeholders to share input on barriers and opportunities to diverting each material and where IEPA support and investment would be most useful. Information on ISTC's recruitment methods and findings can be found in that chapter.

Glass

This chapter focuses on glass recovery through recycling (breaking it down, sorting it, melting it, and then molding it into new products) and reuse (countertops, creative repurposing, insulation, structural and non-structural fill, drainage and filtration medium, embankment material, and pipe bedding).

Definitions

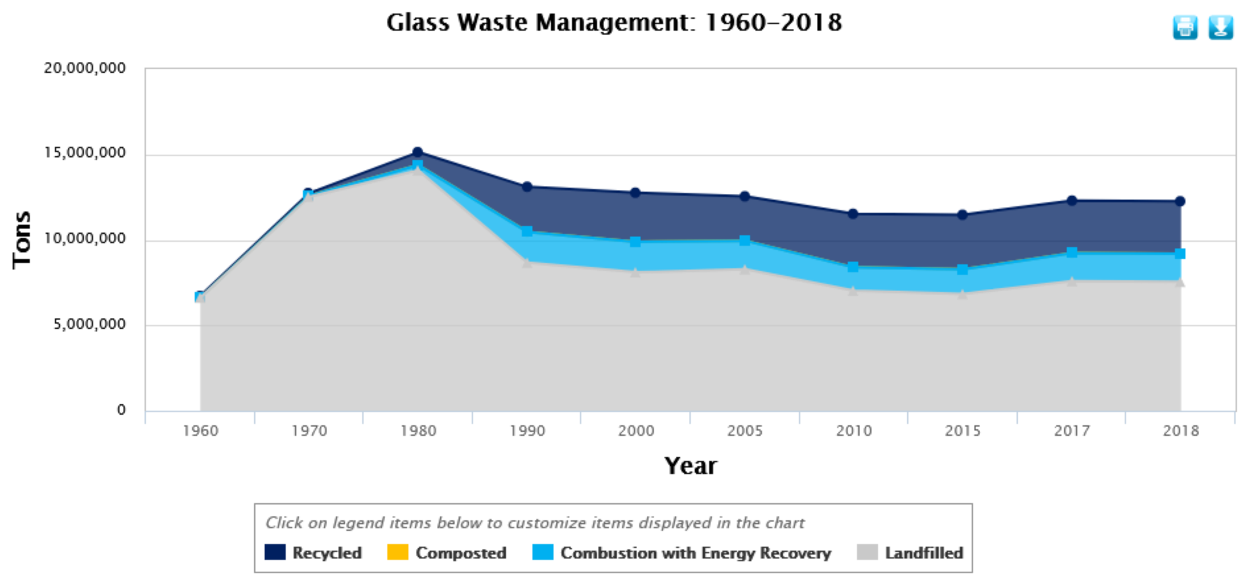
End markets for post-consumer glass are divided into recycling and reuse to reflect the difference in circularity of these processes. Glass is an infinitely recyclable material. Unlike plastic, it can be recycled endlessly without any loss in purity or quality if managed properly (GPI, n.d-b). Recycled glass retains its recyclability and a similar form/quality, while reused glass in some cases could be considered downcycling, because it cannot be easily recycled back into beverage containers. Instead, it might be used as aggregate in construction material (Knowles-Thompson, 2021). While still a recycled product and preferable to all-new materials, recycled glass aggregate (Andela Products, 2022) constitutes a different waste stream for post-consumer glass.

Generation

According to the 2015 Illinois Commodity/Waste Generation and Characterization Study Update, glass comprises 2.9% of the material disposed in Illinois landfills (CDM Smith, 2015, p. 3-10). That comes to 389,116 tons according to the 2021 Materials Management Advisory Committee report to the IL General Assembly, which ranked glass as the ninth largest material category disposed of in Illinois landfills (MMAC, 2021, p.26). The data in Figure 1 below shows that the percentage of glass getting recycled rose significantly from the 1960's but stalled beginning around 2000.

The Glass Recycling Foundation reports that only about a third of the 12.3 million tons of glass bottles, jars, and other containers produced in the U.S. every year are recycled. The remaining 9.2 million tons, the report said, end up in landfills. In 2018, the U.S. EPA reported that 5.2% of all landfilled material in the U.S. was glass, around 7.6 million tons (U.S. EPA, n.d.af).

Figure 1. Glass Waste Management in the U.S., 1960-2018. ([U.S. EPA](), n.d.af.)



Impacts on the Environment and Human Health

[Glass is 100% recyclable]() and can be recycled endlessly without loss in quality or purity (GPI, n.d-b). It is made from readily available domestic materials, such as sand, soda ash, limestone, and [cullet](), broken or refuse glass usually added to new material to facilitate melting in making glass (Merriam-Webster, n.d.).

Glass recycling minimizes environmental impacts associated with the mining of virgin sand and feldspar, such as soil erosion and air pollution. High-quality recycled glass cullet can be substituted for up to 95% of raw materials in the production process.

Recycled glass also reduces emissions and extends the life of plant equipment like furnaces. Recycled glass is always part of the recipe for glass. The more it is used, the greater the decrease in energy used in the furnace. [Energy costs drop]() about 2-3% for every 10% cullet used in the manufacturing process (Jacoby, 2019b). Using recycled glass is profitable in the long run because it lowers costs for glass container manufacturers and reduces energy emissions. Using 10% cullet in the manufacturing feed lowers CO_2 emissions by roughly 5%. For every six metric tons of cullet used in manufacturing, glassmakers can cut one metric ton of CO_2 emissions. (Jacoby, 2019b) (GPI, n.d.-b).

Glass manufacturers require high-quality recycled container glass to meet market demands for new glass containers. Low quality recyclable glass includes mixed color broken glass and glass that is broken down into very small or fine particle size.

Collection

In 2018, 39.6% of beer and soft drink bottles were recovered for recycling, according to the U.S. EPA. 39.8% of wine and liquor bottles and 15.0% of food and other glass jars were recycled, while non-container glass recycling rates were "negligible, at less than 5,000 tons or .05%." In total, 31.3% of all glass food and beverage containers were recycled in 2018. When including all glass products, only 25% were recycled (U.S. EPA, 2020a, p. 7). By comparison, approximately 74% of container glass is recycled in the EU-28 every year (Harder, J., n.d.).

The 2015 CDM Study reported that approximately 25.3% of glass is recovered in Illinois (CDM, 2015, p. 4-2). The Glass Packaging Institute reports that Illinois has an 8% recycling rate (GPI, n.d.-d) and an industry expert from Owens Illinois says anecdotally that the recovery rate is closer to 12-13%. The planned statewide recycling needs assessment can help verify these numbers.

The main issue locally is that collected glass has too much contamination mixed in due to single stream recycling. In single stream or mixed stream recycling systems, glass comes in a variety of shapes and sizes and glass fragments easily mix with paper and cardboard, which contaminates other recyclables and reduces the value of these products. Although non-beverage glass such as windows, plate (float) glass, ovenware, Pyrex, crystal, etc. are sometimes recyclable, they are manufactured through a different process and can't be recycled along with beverage glass. If these materials are introduced into the glass container manufacturing process, they can cause production problems and defective/imperfect end products.

Different recyclers prefer different colors of glass. Most bottle-to-bottle recyclers prefer clear glass because they can add color but can't easily remove it. Colored glass recyclers generally make a product in which color is less important, like fiberglass insulation. Separating recycled container glass by color allows the industry to ensure that new bottles match the color standards required by glass container customers.

Breakage isn't really a problem, because all recycled glass eventually gets broken into smaller pieces known as cullet, although broken glass is hard to handle leading up to the cullet stage. In general, recyclers don't want to devote storage space to glass or handle the volume of glass that gets broken while in their custody. Furnace-ready cullet must also be free of contaminants like metals, ceramics, gravel, and stones.

Table 2. Glass Collection Sites in Illinois.

Collector	Contacts/Locations
Area Recycling (MRF)	Pekin, IL
Burris Recycling Services (curbside)	Carbondale, IL/Murphysboro, IL

City of Chicago (curbside/drop-off)	Chicago, IL
Eagle Enterprises Recycling (curbside/drop-off)	Galva, IL
Flood Brothers (curbside/drop-off)	Multiple Locations, Chicagoland
GFL (Peoria Disposal Co) (curbside/drop-off)	Peoria, Morton, Chillicothe, Lincoln, IL
Grayslake Recycling Center (curbside/drop-off)	Grayslake, IL
Groot (MRF/curbside/drop-off)	West Chicago, IL
Henson Disposal & Recycling (curbside/drop-off)	Urbana, IL
Independent Recycling Services (multi-family)	Willowbrook, IL
Keep Northern Illinois Beautiful (drop-off)	*Machesney Park & Rockford, IL*
Kuusakoski Glass (CRT Glass) (community collection/drop-off	Peoria, IL
Lake Area Disposal & Recycling (MRF/curbside/drop-off)	Springfield, IL
LRS (MRF/curbside/drop-off)	Northbrook, Chicago, West Chicago DeForest, WI
Naperville, City of *(curbside/drop-off)*	*Naperville, IL*
Midwest Fiber MRF (MRF)	Bloomington/Normal (Normal – MRF), Decatur, Peoria, Springfield, Urbana, IL Terre Haute, IN
Prairieland Disposal and Recycling (curbside/drop-off)	Wauconda, IL
Resource Center (curbside/drop-off)	Chicago, IL
Sibelco (Formerly Strategic Materials, Inc.)	Chicago Ridge, IL
Tazewell County MRF (curbside)	Pekin, IL
Waste Management (MRF/curbside/drop-off)	Hodgkins, IL

Infrastructure

At the glass processing plants, recycled glass is cleaned and sorted to spec, then resold to glass container manufacturing companies for remelting into new food and beverage containers or into other glass markets. See table 3 for a list of key glass recyclers/processors and table 4 for key North American glass suppliers. Using data from Dun & Bradstreet, there are 166 “Glass and Glass Product Manufacturing” companies in Illinois under NAICS code 3272.

The glass recycling process from collection to remanufacture/reuse is costly. As of 2023, the cost of recycling glass is higher than the cost of new glass. The logistics involved in handling, storing, and transporting glass are complicated. Glass first goes to a materials reclamation facility (MRF) before it is moved on to the company that ultimately recycles or processes it. Transporting glass for recycling is more expensive compared to other recyclable materials like paper due to its weight and breakability, which is a worker safety issue. In Illinois, these final markets are far away, which further increases the cost. From a financial standpoint, there’s not much incentive for manufacturers to use recycled glass (Glass Paint, 2016).

Table 3. Key Glass Recyclers/Processors.

Recycler/Processor	Contacts/Locations
Ripple Glass (Processor)	Contact: Josh Boyer. MO-based company. Ripple Glass works with communities, campuses, etc. nationwide on glass drop-off sites. Note that as of Sept. 2022, SMI has acquired Ripple Glass.
Kuusakoski Glass (Processor)	CRT Glass. Plainfield, IL (HQ) and Peoria, IL
Sibelco (formerly Strategic Materials, Inc.) (processor/recycler) (largest glass recycler in North America)	Contact: Mickey Barry, located in Delavin, WI. He manages St. Paul; IA; MO; Delavin, WI; IN; and Chicago waste streams. SMI makes bottles, windowpanes, and abrasives. They don’t collect bottles and window glass together. See “Markets” section of SMI website.
Owens Illinois – Brockway Glass Containers (recycler)	Streator, IL; Contact: Robert (Bob) Hippert, Sustainable Strategy Leader for O-I North America Frank O’Brien-Bernini, vice president and chief sustainability officer for Owens Corning

Owens Corning (fiberglass insulation)	Kansas City, KS
Epic Glass Recycling	Little Rock, AR

Table 4. Key North American Glass Suppliers Identified by Niche *(Thomas)*

Niche	Company	Location*	Founded*	Company Size* (in number of employees)
Architectural and Decorative Glass	McGrory Glass	Paulsboro, NJ	1984	50-99
Architectural Glass	Viracon	Owatonna, MN	1970	1,200
Automotive	Belletech	Bellefontaine, OH	—	116
Decorative Glass	Gardner Glass Products	Wilkesboro, NC	1962	68
Food and Beverage	Owens-Illinois	Perrysburg, OH	1903	26,500***
Scientific Glass	ThermoFisher Scientific	Waltham, MA	1956	1000
Specialty Glass	Pegasus Glassworks Inc.	Sturbridge, MA	1997	55**
Smart Glass	Smart Glass Country	Vancouver, BC	—-	—-
Technical Glass	Technical Glass Products Inc.	Painesville, OH	1989	44**

Collection infrastructure is a challenge, particularly in rural areas of Illinois. The more urban areas in Illinois north of Interstate 80 have access to reliable glass collection and recycling, although the rural areas in that region do not. Currently. The southern two-thirds of the state lack the necessary infrastructure to collect and recycle large amounts of glass. However, private companies and community groups like the Champaign County Environmental Stewards are interested in developing collection infrastructure

In Champaign County. a **Hesnley Township** site is being considered as a host location for a concrete glass aggregation bunker, where glass would be stored for shipment to a glass processor (i.e., SMI). Local haulers are willing to take the glass they collect to this location. The site will be for collection of mixed bottles (all colors of glass bottles together). A special use permit for the single material collection is needed for this type of site in an agricultural setting and takes 4-6 months to obtain. The glass processor's hope is that the value of the glass will cover the cost of freight).

Conflicts of interest may exist when waste haulers and sorting-facility operators (MRFs) also own landfills. The MRF may carry contamination levels well above 25% on average, making it easier to justify sending glass to landfill, where the company gets paid by weight to dispose of the garbage. (Bornstein, 2018 ; Martin, 2019)

Glass is very hard on crushing equipment. Like sand, it is an abrasive and damages with blades and hammer mills. Some glass processors (SARCAN Recycling, for example) replace their glass crushers every year.

Glass cleaning systems, such as ones offered by Machinex, are designed to separate lightweight materials from broken glass and obtain a marketable mix of glass. The system uses a trommel, a cylindrical or conical revolving screen, and a combination of mechanical and air separation technologies to separate the glass from materials like lightweight plastic, paper and fines. These glass cleaning systems help sorting centers reduce their disposal costs and avoid sending glass to landfills. The cleaned glass can then be sold to manufacturers for use in new products, such as bottles, fiberglass, windows, and other glass products.

End Markets

Verified Market Research (2024) values the U.S. recycled glass market at USD 5.08 Billion in 2024 and is projected to reach USD 7.97 Billion by 2031, growing at a compound annual growth rate of 6.40% from 2024 to 2031. They segment the market into container glass, flat glass, fiberglass, abrasives, and fillers. They report that the container glass segment dominates the market because recycled glass is widely used in beverage, food, and pharmaceutical packaging and is supported by high recycling rates and sustainability efforts. However, the fiberglass segment is the fastest growing and is driven by rising demand in the construction and automotive industries.

The container and fiberglass industries collectively purchase and remelt 3.2 million tons of recycled glass annually (GPI, n.d.-b), which is remelted and repurposed for use in the production of new containers and fiberglass products. According to a 2020 article in Waste360 (Karadis, 2020), Glass container producers and fiberglass insulation manufacturers are setting higher recycled-content targets and need more recycled glass to meet them

Some recycled glass containers can't be to make fiberglass or manufacture new glass bottles and jars. This may be because there is too much contamination, the recycled glass pieces are too small to meet manufacturing specifications, or there is no nearby market for bottle-to-bottle recycling. This recovered glass is then used for non-container glass products. These secondary uses include tile, filtration, sandblasting, concrete pavements, and parking lots. Intact glass containers can be reused and refilled. For example, Oberweis Dairy collects, washes and reuses milk bottles (Stanpac, n.d.).

Glass Cullet can replace sand in most glass processing applications. It's most often used as:

- base or surface coat (when mixed with asphalt) for roadways and trails on soft soil
- an additive to clay for brick-making
- aggregate fill for water drainage and filtration
- filter media (glass bead resin) for water and other liquids
- spun glass fiberglass filaments for insulation
- "foamglass" (also known as foamed glass aggregate), which is a cellular form of glass used for insulating and moisture resistance. It's similar to other insulation and can also be used for oil spill cleanup. It is also becoming popular in the home construction industry for its ability to perform multiple functions and is most commonly used in residential applications for insulating slabs and as backfill. In February 2023, Aero Aggregates of Massachusetts, a subsidiary of Aero Aggregates of North America, received a $200,000 MassVentures START Phase II grant to build a container glass processing facility in Southbridge, Mass.
- "glasscrete", a cement-based composite which contains glass
- Solid surface countertops
- a growing medium in hydroponic systems for soil-less gardening
- landfill cover
- pressed glass, for tableware, giftware, and the like
- sand traps on golf courses
- glass mosaic tiles and synthetic marble
- utility bedding and back fill, particularly around underground pipelines and cables—it is easier to work with than sand when wet
- cement replacement when milled into pozzolan. Post-consumer glass can be milled into pozzolan and added to concrete in place of cement. In an article in Resource Recycling (Paben, 2023), Patrick Grasso, who helps run a company that recycles glass into pozzolan, cited research from the Oregon Department of Environmental Quality that significant greenhouse gas reductions with pozzolan. Grasso stated, "It's basically five times more impactful from a climate perspective to put glass into concrete, rather than going back to bottles and fiberglass. There are benefits to doing the others, but this is far more impactful." KLAW Industries in Binghamton, NY, a company that received a

$400,000 SBIR grant from U.S. EPA in 2022, is using a patent pending process (Pantheon) to generate pozzolan from waste glass which is then used as a partial replacement for cement used in concrete. Recycle BC has partnered with Progressive Planet in British Columbia to also mill waste glass to create PozGlass 100G (pozzolan). (Saskatchewan Waste Reduction Council, n.d.)

Pulverized glass is used as a base for unpaved roads when mixed with soft clay soil, an underlay for walking trails, in dirt parking lots to minimize dust, and for filtration.

Existing Policy/Regulations

Glass waste is not regulated in Illinois, except for cathode ray tube (CRT) glass (Ill. Admin Code, tit. 35 § 721.139). However, most county solid waste plans address waste glass and the need for recycling. Examples of local glass ordinances include Cook County, Chicago, Peoria County, Madison County, and the City of Springfield.

Container Deposit Systems ("Bottle Bills")

The Glass Packaging Institute released a 10-year plan to increase the U.S.'s overall glass-recycling rates to at least 50%. The plan calls for expanding bottle bill laws and commercial recycling programs, investing in glass collection and processing initiatives. As of April 2023, California, Connecticut, Hawaii, Iowa, Maine, Massachusetts, Michigan, New York, Oregon, and Vermont have adopted statewide bottle bills (GPI, n.d.-d).

There is currently no nationwide or Illinois bottle bill as of October 2024. S.B. 3127, The Break Free From Plastic Pollution Act (2023) included provisions for glass containers. It was read twice and then referred to the Committee on Environment and Public Works, where it languished.

In Illinois, S.B.85 State Beverage Container Recycling Refunds Act was introduced in the General Assembly in January 2023. The bill was referred to the Assignments Committee in June 2024 and is still waiting to be assigned.

Existing Goals

The 2015 CDM Study (2015, p. 6) found that 2.6% of Illinois' landfilled waste stream is glass bottles and jars. Some individual cities and counties (as well as companies, organizations, and institutions) have included glass in their overall diversion goals. Illinois' waste diversion goal for commonly recycled materials, including glass, set by the MMAC (2021, p. 54), is 40% by 2025, 45% by 2030, and 50% by 2035.

Existing Funding Opportunities

Currently the only funding opportunity specific to glass diversion is the program from the Glass Recycling Foundation. Eligible entities include nonprofit organizations, municipal, county, city, and state governments, glass collectors, and publicly owned/operated material recovery facilities.

Existing Education & Resources

There are many existing educational resources related to glass collection and recycling. They are produced and distributed by a variety of organizations including local, state, and federal governments, educational institutions, trade groups, and nonprofits. Resources are geared toward individuals, businesses, and organizations, as well as city, county, regional, state, or federal government agencies. Below are examples of these materials that target organizations in Illinois and more broadly.

Education resources for specific municipalities frequently come from local governments or nonprofits. Local governments may provide information on best practices to recover or recycle glass but are mainly using resources provided by the county.

There are educational resources on recycling hosted by Illinois county solid waste agencies, educational institutions, nonprofits and other organizations. Examples of counties and solid waste agencies providing guidance and/or education include Solid Waste Agency of Lake County, West Cook County Solid Waste Agency Recycling, and the DuPage County Waste page. These resources provide recycling information but there is usually little guidance or information specific to glass.

The Illinois EPA Materials Management page provides statewide guidance on recycling. There are also many organizations that support recycling throughout the state including:

- The Illinois Recycling Association (IRA)
- Illinois Counites Solid Waste Management Association (ILCSWMA)
- Seven Generations Ahead
- Illinois Sustainable Technology Center (ISTC) at the University of Illinois has a Zero Waste Illinois team within its Technical Assistance Program that works with organizations across Illinois on waste reduction and diversion.

The federal government and national organizations also provide information on reducing, recovering, and recycling glass. Examples include:

- U.S. EPA, Facts and Figures about Materials, Waste and Recycling - Glass: Material-Specific Data.

- [Glass Recycling Foundation]
- [Glass Packaging Institute]
- [Container Recycling Institute]
- [Zero Waste USA]
- [Solid Waste Association of North America]

Widespread consumer education about recycling is necessary. Little Rock, Arkansas has a good visual guide for consumers on what can and cannot be recycled.

Solutions/Best Practices

The Glass Recycling Coalition has developed a list of process goals and best practices for material recovery facilities to use when handling glass. They consider facility design, loaders and tipping floor, basic and advanced glass cleaning, and system maintenance.

To make glass recycling profitable, the volume recycled must increase. Deposit laws (a.k.a. Bottle Bills) may help improve collection volume and separation. States with container deposit legislation have an average glass container recycling rate of around 60%, while non-deposit states only reach about 24%. (Container Recycling Institute, n.d.-b). There is an additional economic benefit to these laws. beverage container deposit systems provide 11 to 38 times more direct jobs than curbside recycling systems for beverage containers (Morris & Morawski, 2011, p, 12). Collecting and landfilling 1,000 tons of glass bottles, plastic bottles and aluminum cans requires approximately 1.43 full-time-equivalent jobs while the same tonnage collected through a deposit-return recycling system creates more than 8 jobs. (Morris & Morawski, p, 30).

Separating glass at the curb can improve recycling rates and glass quality. Multi-stream or source-separated collection (as opposed to single-stream) requires consumers to separate glass from other recyclables and deposit them in glass-only collection bins. This approach demands a high level of consumer education and is considerably more expensive than single-stream collection but glass from multi-stream collection is much cleaner than what comes out of the single-stream collection systems. Multi-stream glass typically can be shipped directly to cullet processors. In addition, approximately 40% of glass from single-stream collection ends up being recycled into new products, compared with about 90% of glass from multi-stream systems (Jacoby, 2019b).

Charging consumers an extra fee to recycle glass may help offset the collection costs assumed by municipalities. A story from Little Rock Public Radio reported that "households within the city will pay a rate of $10.00 a month for curbside glass recycling pickup. That's in addition to the rate residents pay for other recycling services" (Kellogg, 2019). Other low-cost options include centralized drop-off points or less frequent glass pick-up.

Businesses and regions are even bringing self-serve traveling recycling dumpsters to neighborhoods that don't recycle glass. The Pennsylvania Resources Council set up a network of drop-off locations just for glass. Ripple Glass offers glass-recycling pickup in Illinois. Tammy's Piggly Wiggly, The Galena Territory, the City of Galena, Illinois and Ripple Glass teamed up to offer glass drop-off options for residents and visitors (Ripple Glass, 2020). These collection points allow for regular pickup and consolidation even in areas that are far from glass processing facilities.

Industry favors recycling programs that result in contaminant-free recycled glass because they are more likely to be recycled into new glass containers. While the curbside collection of glass recyclables can generate high participation and large amounts of recyclables, drop-off and commercial collection programs tend to yield higher quality recovered container glass.

Partnerships with not-for-profit organizations and private companies also help boost collection and recycling. According to the Glass Packaging Institute (n.d.-c), "glass manufacturers are encouraging glass bottle recycling in commercial settings, including bars, restaurants, wineries, hotels, and other on-premise locations. About 18% of beverages are consumed on premise and glass makes up to about 80% of that container mix. So these retail businesses are a good source of clean, high-quality recycled glass".

Notable glass recycling projects both within the state and nationally include:

- Glass Packaging Institute's Don't Trash Glass program
- Chicago
- Evanston
- Diageo North America
- University of Illinois Housing Dining Services Self-Funded Glass Recycling
- Chicago's WasteNot Residential Glass Service

Metals

This section explores how and where metals are generated, how they are processed, and best practices for recycling and diversion. Metal is diverted for recycling through many routes, including through manufacturing processes, household use, and metal scrap from larger items or appliances. A variety of approaches and technologies are necessary to keep these valuable resources available and ready to be recycled into new materials.

Definitions

Primary metals: Produced directly from ore/ the naturally harvested material.

Secondary metals: Produced from alloys or recovered from scrap or salvaged metal.

New scrap: Generated as part of industrial processing and manufacturing that precedes the creation of an end product. When metal is made into stock pieces like bars, rods, or sheets, trimmings, off-spec parts, and cuttings are left behind. New scrap is also produced when these stock pieces are processed again before taking their final form.

Old scrap: Generated when an item transitions from its useful life and becomes postconsumer material. Examples of this include cars and car parts, used appliances, household discards such as food or beverage cans, machinery, or metal recovered from commercial buildings. The metal material is recycled into scrap and reuse material streams.

Generation

Metals are different from plastics, glass, and other recyclables because they do not lose their intrinsic properties during recycling. They can be reused many times without loss of integrity, and can be considered a permanently available resource with a few caveats. Metals like copper, steel, and precious metals are infinitely recyclable because their properties do not deteriorate after being processed many times. Aluminum can also be recycled many times but is more susceptible to contamination from other metals, which eventually impacts its quality (Hilscher, 2017). Radioactive metals like uranium and plutonium are only recycled in specialized facilities that are licensed to handle them because of health risks caused by exposure to workers (U.S. EPA 2024). Metals containing lead and mercury can also pose health risks when recycling. Other metals like platinum require the use of toxic chemicals in the refining process, which limits their recyclability due to the associated hazards. Recovery and identification technologies make metal re-use and recycling increasingly efficient and feasible.

Recyclable and scrap metals are generated at manufacturing facilities, through household consumer use such as beverage or food cans, by discarding household items containing metal such as ladders and car parts, and construction and demolition processes. The Materials Management Advisory Committee (MMAC) Report details estimated tonnage of scrap metals generated in Illinois from 2018, as shown in Table 5. This table provides a breakdown of all metals found in the waste stream. Metals comprise 4.1% of the total waste stream. Other Ferrous metals are the most prevalent at 1.3% of the total waste stream (MMAC,2021, p. 214)

The data also shows that metals have a fairly high overall diversion rate, compared to other materials, the highest being Other Metal & C&D at 80% diversion followed by Other Ferrous at 53% diversion. By comparison, the highest diversion rates for other categories of materials featured in the report were 29% for recyclable glass bottles & jars, 59% for compostable yard waste, 34 % for clothing and 35% for #2 HDPE plastic containers. This indicates that most metals are diverted to be processed or recycled, rather than landfilled.

Table 5. Generation and diversion of metals in MSW, (MMAC, 2021).

Material	Diversion Rate	% Landfilled Waste Stream	IL Tons Generated 2018	IL Tons Disposed 2018
Other Ferrous	53%	1.3%	411,601	193,338
Ferrous Containers (Tin Cans)	26%	0.9%	183,495	135,462
Other Metal + Mixed C&D Metals	80%	0.7%	523,209	103,233
Aluminum Beverage Containers	39%	0.5%	123,653	75,247
Other Non-Ferrous	15%	0.4%	72,821	62,244
Other Aluminum	36%	0.3%	69,921	44,785

Note: This table compiles data from Table 4 (p. 57) and Table 17 (p. 214) of the MMAC report.

Another source of recyclable metal is scrap generated from construction and demolition projects (U.S. EPA, n.d.-u). Common recyclable C&D scrap metals include steel, copper, and brass. Steel and copper are 100% recyclable and are generated from the construction or dismantling of structures, bridges, dams, piers etc. Large quantities of metals can be extracted and diverted from these types of projects, as shown in Table 5 above. Illinois generated 523,209 tons of waste in the category Other Metal and Mixed C&D Metals in 2018. Of that waste, 80% was diverted for recycling.

Local drop-off facilities that manage household metals for recycling provide clean and reliable source material (feedstock) that can generate revenue for municipalities. Drop-off location data from the MMAC Report (pp. 180-205) was analyzed to determine the most widely accepted metal materials at these types of facilities in Illinois. Aluminum cans (75%), tin cans (56%) and steel cans (46%) were the most widely accepted metal recyclables. Following that were empty aerosol cans (37%), aluminum foil and trays (31%), and metal lids (19%). Items like empty paint cans and scrap metal are less likely to be collected at community drop-off facilities. This is because they are often contaminated or mixed with other materials like plastic which complicates recycling and provides a less valuable feedstock, which reduces the cost incentive for facilities to collect them.

Table 6. Number of drop-off facilities that accept each metal item for recycling.

Material	Number of Facilities that Accept Each Material	Percentage
Aluminum cans	44	74.58%
Aluminum Foil/ Trays	18	30.51%
Empty Aerosol Cans	22	37.29%
Scrap Metal	5	8.47%
Steel Cans	27	45.76%
Tin Cans	33	55.93%
Metals	8	13.56%
Empty Paint Cans	2	3.39%
Multi-Metal Cans	1	1.69%
Scrap Steel	1	1.69%
Metal Lids	11	18.64%
Metal Cans	4	6.78%

The U.S. Geological Survey's *2020 Minerals Yearbook: Recycling – Metals* (Sangine, 2024) provides an overview of the types and quantities of metals that are being recycled in the U.S., and the value that is maintained through that process.

Table 7: 2020 Recycling percentages from the U.S. Geological Survey

Comparison of Tons Recycled of Each Metal in 2020 and Value of that Metal				
Material	**Recycled (Tons)**	**Percentage**	**Value ($)**	**Percentage**
Aluminum	3,050,000	5.91%	$6,030,000	23%
Chromium	1,116,000	2.16%	$170,000	1%
Copper	858,000	1.66%	$5,420,000	21%
Iron & Steel	45,300,000	87.84%	$10,300,000	39%
Lead	1,030,000	2.00%	$2,080,000	8%
Magnesium	99,800	0.19%	$547,000	2%
Nickel	99,000	0.19%	$1,320,000	5%
Tin	17,500	0.03%	$309,000	1%
TOTAL	51,570,300	100.00%	$26,176,000	100%

Table 7 illustrates that the value of recycled metals varies according to type. Iron and steel generally have a lower overall value than aluminum, despite having a larger volume recycled.

In 2020, the U.S. exported nearly 21 million metric tons of scrap metals and imported 6.7 million tons of a similar composition of metal scrap (Sangine, 2024 p.61.5) . In 2022, the U.S. exported the most metals to (in order of largest volume of material), Mexico, Canada, China and India, and imported metals most often from Canada, China and Mexico (OEC, n.d.). The most common imports by the U.S. are steel and semi-finished steel, flat metal items in the form of sheets, and long metal items in the form or rods or bars. The US commonly exports precious metals and iron and steel waste. (U.S. International Trade Commission, 2021). This illustrates the complex nature of metals handling and recycling and reinforces how it depends both on the value of certain metals and the ability to obtain clean feedstock, which sometimes includes importing additional metal materials.

Another large source of recyclable metals come from electronics and electronic waste (e-waste) E-waste is a major source of metal and organic pollutants in the solid waste stream with nearly 50 million tons of material discarded globally each year (Osibanjo, O., Nnorom, I. C., Adie, G. U., Ogundiran, M. B., & Adeyi, A. A., 2016). These items require intensive processing to extract valuable metals and materials, which is often why these materials are sent overseas to be handled (Izatt, Hagelüken, 2016). Another consideration is the life span of renewable energy technology like solar panels and wind turbines which will need to be processed and dismantled for recycling when they reach end-of-life due to the amount of metal in their structures. The U.S.

Department of Energy (U.S. DOE EERE, 2023) estimated that there were 70,000 wind turbines in the U.S. in 2022 and they have an average life span of 30 years. Solar panels also contain metals and have a life span of 30-35 years. By 2030 it is estimated that up to 1 million tons of photovoltaic waste will be headed for landfills if proper recycling is not established and implemented (U.S. DOE SETO, n.d.).

Impacts on the Environmental and Human Health

Many parts of the metals manufacturing life cycle, from the initial mining and extraction to refining to final dismantling of finished products, have negative impacts on the environment, as well as worker health and the health of individuals who live near where these activities take place. In their article *"Metal Markets & Recycling Policies: Impacts & Challenges"*, Söderholm and Ekvall (2018) outlined the many risks of metal mining and extraction. There are significant costs associated with exploration, mining and primary refining, as well as high energy expenditure for the extraction and production of primary metals. The extraction of these primary metals leads to land degradation, air, and water pollution. Extraction also releases heavy metals and chemicals which leach into groundwater and may also be released into the atmosphere. It can be hard to quantify or regulate these impacts which, in turn, contribute to their negative impacts being more widespread. The authors state, "One reason for this could be a reluctance among policymakers to impose stringent regulation on industries that face intense competition in global markets. In addition, many regulations of downstream waste, such as taxes on waste disposal, are simply difficult to implement due to the regulators' inability to observe, measure, or monitor improper waste disposal behavior" (p. 266). In addition, mining companies are increasingly working in lower-grade and more remote mining locations, which further increases costs and energy use. These activities make secondary metals production a more attractive option.

Metals undergo additional processes like plating, finishing, and metalworking on their way to becoming usable products such as which can also contribute to health disparities in the communities in which they are present (Johnston & Cushing, 2020). Metalworking facilities are associated with elevated levels of lead, arsenic, cadmium and other environmental toxins. Johnston & Cushing's study found that road dust and sediment and the soil in parks and other public areas near metal processing facilities had higher levels of lead and manganese, which in turn impacts the blood lead levels of children in surrounding areas. Being exposed to higher levels of lead and manganese can also influence cognition in people who are exposed, with children being particularly vulnerable. Health impacts from contamination are often compounded by a lack of readily available healthcare. Allen, et al (2019) studied the community of North Birmingham, Alabama, which was home to heavy industry, as well as the 35th Avenue Superfund site. They stated, "North Birmingham's economic landscape has always had a symbiotic relationship with heavy industry, yet healthcare facilities, businesses, and home values have declined or completely disappeared from the once thriving area." (p. 10).

The heavy metals extracted for reuse when e-waste is recycled also poses a significant risk to human health. Extraction of microchips, capacitors, and other metal components can lead to workers being exposed to dust containing heavy metals. These exposures can lead to issues in blood composition, lung, kidney, and heart issues and nervous system damage (Leung, Duzgoren-Aydin, Cheung & Wong, 2008).

A study by Knobel, et al (2023) found that individuals of lower socioeconomic status are more likely to be exposed to higher levels of fine particulate matter ($PM_{2.5}$) and that the metal processing industry is a common source of these emissions. An analysis by Jones et al (2022) found that "areas with a higher population of minorities have an increased exposure to heavy metal contamination in their environments. Though, on a lesser scale, there is also significant risk of select heavy metals for poverty-stricken areas. Path analyses also revealed that these relationships were mediated by proximity to emissions sources, confirming the pathways of SES/race -> proximity to emission sources -> soil–metal contamination"" (p.7). These studies show that minorities and individuals of lower socioeconomic classes are more likely to be exposed to particulate matter and heavy metals, which in turn impacts their health and environment.

In 2022, the community in Chicago's Pilsen neighborhood fought against the opening of a scrap metal recycling facility operated by SIMS Metal. The neighborhood is a dense and predominantly Latinx community which is already surrounded by industrial facilities, major highways and railyards (University of Chicago School of Public Health, 2022). The facility opened in 2023 despite pushback from the community and is required by the U.S. EPA to monitor their air pollutant levels (Gonzalez, 2022). In early 2023, a fire occurred at the facility which again frustrated community members and raised concerns about health impacts associated with proximity to the facility (Savedra, 2023). Sims submits monthly reports to U.S. EPA which includes air monitoring, quality assurance, and facility operational data. The agency reviews the monthly submittals and routinely follows up with Sims as questions arise during data review. The agency also compares the reported PM10, metals and VOC data to health benchmarks, including the National Ambient Air Quality Standards (NAAQS) and Minimum Risk Levels (MRLs). EPA reports that the monthly data continue to show metals and VOC concentrations below levels that cause short- or long- term health impacts (U.S. EPA, 2024). The Sims Metal case shows that better facility monitoring and public transparency can build trust in the communities where such facilities are constructed. If testing finds levels of pollutants that impact the health of community residents, the facilities should be held accountable and be required to remediate issues before resuming production.

With existing technologies, it is difficult to completely prevent health impacts on communities located near processing facilities and mining locations. Metal refining, processing, and recycling of secondary metals lowers environmental impacts and energy intensity when compared with extraction and mining of primary metals (Hagelüken, Shin-Lee, Carpentier, & Heron, 2016).

By obtaining feedstock from secondary sources, companies can save money and improve circularity. Transportation costs and their associated climate impacts are also lower because materials do not need to travel as far to be processed. Landfilling or incinerating metals destroys valuable raw materials and increases air, land and water pollution. It is much more beneficial to keep metals in the value chain rather than extracting primary metals, which are finite resources.

Collection

Metals for recycling can come from many sources such as scrap facilities, residential recycling, e-waste and manufacturers among others. Hagelüken (2014) states, "[collection] can be organised by national or municipal take back schemes, original equip-ment manufacturer (OEM) systems, commercial or charity organisations and involves logistical companies. Collection generally takes place on a local or regional level and commonly involves small and medium enterprises (SMEs)."

Scrap metal comes in many forms, which are then categorized as new or old scrap (Copper Development Association, n.d.) to indicate how it was generated. New scrap comes from industrial processing and manufacturing that precede the creation of an end product. These could include trimmings, off-spec parts, and cuttings when metal is made into bars, rods or sheets, and when those stock pieces are further processed before taking their final form. Old scrap refers to secondary metal that comes from consumer products that reach the end of their life cycle. Materials in this category include cars and car parts, used appliances, machinery, and metal recovered from commercial buildings. These materials are recycled into scrap and reused. Old scrap undergoes further processing, which include dismantling, and pre-processing such as shredding. These processes occur both locally and regionally and can include manual and mechanical processes to prepare metals for further recycling and recovery. Pre-processing procedures are especially important when recovering specialty metals and need to be aligned to maintain the integrity of that metal and minimize material losses (Izatt, Hagelüken, 2016).

Metal Refining and Recovery

The technologies listed below are used to identify metal compositions at their elemental level, which makes it easier to valuable concentrations of precious metals. Metal refining facilities use these technologies because they often deal with higher value scrap that includes precious metals from sources like jewelers, pawn shops, dental offices, coin shops, aerospace and automotive manufacturers, e-scrap, medical device manufacturers and crematoriums.

Some technologies used to identify elemental makeup and composition in the metals recycling process include:

- XRF (X-ray fluorescence spectroscopy): a non-contact, non-destructive technique used to measure elemental composition, elemental concentration per unit area, and film thickness. Due to its acute element sensitivity, it is particularly useful for identifying trace elements. (Ask A Scientist Staff, 2020).

- Fire Assay: the industry standard process for obtaining gold and platinum group element (PGE) concentrations from high-grade ores (Anglo American, n.d.).
- Atomic Absorption: a technique for measuring the concentrations of metallic elements in different materials. As an analytical technique, it uses electromagnetic wavelengths, coming from a light source. Distinct elements will absorb these wavelengths differently (Agilent, n.d.-a).
- Gravimetric Analysis: a class of lab techniques that uses changes in mass to calculate the amount or concentration of an analyte. One type of gravimetric analysis is called volatilization gravimetry, which measures the change in mass after removing volatile compounds (Editors of Encyclopaedia Britannica, 2022).
- ICP/ ICP-OES (Inductively Coupled Plasma-Optical Emission Spectroscopy: an analytical technique used to determine how much of certain elements are in a sample. The ICP-OES principle uses the fact that atoms and ions can absorb energy to move electrons from the ground state to an excited state (Agilent, n.d.-b).
- Cyanide Stripping: The process of carbon desorption by which the metal cyanide complexes are put into solution. The gold and silver values then being recovered from the solution by electrowinning or by zinc precipitation (Altmayer, 2023).

Industrial facilities also have processes for recovering metals onsite. Hagelüken (2014) explains that steel plants recover ferrous metals, while aluminum is recovered in refineries and re-melters. Copper, lead, nickel, and precious metals are recovered in modern integrated smelter-refiners (p. 52). Due to the complexity of the metal recycling value chain, metals can be recovered from many locations. Metals need to be sent to facilities that can process them correctly.

Infrastructure

The MMAC report identified 154 scrap metal recycling sites in Illinois as of 2019 (MMAC, 2021, p. 207). Most of these facilities are located in northeastern Illinois. Very few are located on the northwest side of Illinois and in the southeastern corner of the state. Scrap metal comes in many forms, compositions, and alloys, each of which requires different technologies to properly separate metals for recycling and reuse. Seventy drop-off facilities across the state accept various types of metal for recycling, including scrap and tin and aluminum cans (p.180). These drop-off locations also commonly collect plastics, paper, and other recyclable materials. Facilities also vary in what types of materials they accept, which means that recycling options differ by location. ISTC's focus group discussions with industry professionals revealed that consumers are unwilling to travel long distances to recycle larger items like appliances and financial incentives to recycle them are often lacking, so they often get landfilled instead. It is clear that the state needs more scrap collection and processing facilities that allow public drop-off. In regions with fewer drop-off options, community scrap metal collection events could also fill this gap.

End Markets

Hagelüken, et al (2016) state, "Recycling saves up to 20 times the energy needed to produce metals and reduces the impact on water, air, soil, and the biosphere" (p. 244). This creates cost and environmental incentives to limit primary metals mining in favor of sourcing recycled metals. Though large volumes of alloys are available for recycling, there are often strict limits on their composition which makes it difficult to use them without modification.

Though use of recycled metals is increasing, the largest categories of use include construction, durable goods and machinery, all of which have long lifetimes of use as compared to smaller consumable goods. This in turn leads to less material being available for recycling sine the material is tied up for the lifespan of the larger items. This helps illustrate that there is much potential for recycled metals to assist in future construction, processing and production, though a challenge is that available stock of recycled metals must be available for them to be reincorporated into the production stream. This means that more local collection and processing infrastructure would be necessary to assist in collecting, processing and dismantling these larger items and ensuring availability of that material for future uses.

Söderholm & Ekvall (2020) discuss the relationships between prices and supply in the secondary metal market. They point out that current supplies depend on past construction and consumption patterns. They state, "…what is recycled from the stock of old scrap in one period is not available for recycling in the next period. This implies that the constraint imposed by the availability of old scrap could be more binding in the long run compared to the short run" (p. 260). They emphasize that secondary markets for recycling have existed for nearly as long as these materials have been used, typically without policy intervention. The global secondary market developed because scrap metal has value and supply and demand in these markets determine their prices. Steel, copper, and aluminum generally have high value as scrap, so recycling of those materials is persistent. They also address a factor that can hamper the use of recycled materials. If a company manufactures a product in a way that increases the cost for downstream processors, it is less likely to be recycled. This could include using certain pigments, paints or alloys that are expensive and difficult for processors to remove. Recyclers have no way to incentivize manufacturers to change the design of their product. They state, "In practice, it is difficult for policy-makers to attain a first-best outcome in addressing this market failure, e.g., since product-specific taxes that vary with the degree of recyclability are difficult (and costly) to implement. Producer responsibility schemes could address product design issues, e.g., removing—or reducing the weight of—packaging materials. Still, strong incentives for more efficient design of products for recycling could require that owners of recycling facilities keep track of exactly which firms' products they are recycling" (p. 267).

There are strong secondary markets for specific metals due to their prevalent use in industries such as transportation and electrical components manufacturing. Aluminum is often recycled in industries like automotive manufacturing, aerospace and shipping (Mahfoud, Emadi, 2009). Companies in these sectors are using aluminum more often because of it reduces vehicle/product weight, which reduces transportation costs and can also lead to more efficient vehicles/products. Recycling aluminum from scrap uses ~15 times less energy than producing primary aluminum. The mining and processing of [primary aluminum] is energy intensive because of the processing needed to turn bauxite into aluminum ore. Recycling aluminum is done through smelting which results in 95% energy savings and 92% fewer CO_2 emissions (AMC Aluminum, n.d.). Fu, Ueland & Olivetti (2017) explain two primary reasons why copper recycling is desirable from an environmental perspective, "First, copper is relatively scarce compared to other industrial metals: by one metric, the static depletion index, the time to exhaust current reserves is only about 40 years, while ore grade for copper, is 0.2–5 % (recent values less than 0.45). Second, as is typical for metals, copper production from secondary sources requires less energy than that from primary sources: for some grades of copper secondary production reduces energy needs by 85% compared to primary production." (p.119). They estimate that approximately 33% of the copper consumed worldwide comes from secondary sources, either by being used in a product or collected as waste during the manufacturing process. Copper currently used in buildings, infrastructure, consumer products, transportation and industrial uses could eventually be recycled into electrical wires and plumbing pipes (Venditti, 2023). While the fraction of secondary versus primary (derived from ore) copper has stayed between 30 and 40% over the past 40 years, in absolute terms the use of copper from secondary sources has tripled over the same period.

Existing Goals

There were no existing goals uncovered relating specifically to metals.

Existing Funding Opportunities

Cook County Business Reducing Impact of the Environment (BRITE) Program: Dry-cleaning facilities, auto body or auto repair shops, metal finishers, metal fabricators, or food and beverage manufacturers can apply to receive an assessment that enables the facility to then apply for grant funding.

Existing Education & Resources

Current educational information regarding metal recycling is distributed to individuals through municipal chains or regional resources. This can be through recycling websites for the city or town, or regional resources such as the Illinois Deportment of Central Management Systems which provides information about household and electronics recycling and the Illinois Recycling Foundation which provides guides and resources for curbside recycling programs as well as drop-off facilities which accept metal items. As metals can take so many forms, there are not many generalized resources available to assist in their recycling for residents of the state as a whole. Scrap metal recyclers often provide helpful guides on their websites as to the type of metals accepted to ensure streams are clean and valuable and as free from contamination as possible.

Solutions/Best Practices & Research Gaps

A literature review by Söderholm & Ekvall (2019) identified several options which could increase the collection of clean metal streams and encourage manufacturers to use greater amounts of recycled content in their products and lead to more a robust sorting and processing infrastructure throughout the state. The first of these are tradable recycling credit schemes:

> This type of policy imposes a minimum share (or level) of recycled content in a particular material and allows trading between the responsible firms to reduce (minimize) the cost of achieving this level. The specific design of this policy could vary, but we consider the case in which the credits are awarded to the companies that recover the recycled material, and then offer it to various product manufacturers. The manufacturers of the products containing the material would in this case be required to comply with a given recycled-content target. These could do the recycling themselves or they could purchase credits from others who have recycled more than their own obligation. (p. 261)

This policy sets a recycling standard within industries and encourages increased recovery of secondary metals which in turn helps the companies reduce costs and increase profits and the use of recycled materials at their own business and others. Credits of this nature can also be retired, which means it is taken off the market once it is purchased and the emissions that it represented are no longer available to be accounted for. For example, a company that is not producing excess emissions could purchase a credit because they want to remove it from the market rather than cover existing pollutants being released. This can help reduce the availability of credits, which drives up the cost of existing credits which in turn helps motivate companies who may what to offset their emissions in that way to implement more efficient or less polluting processes.

Söderholm & Ekvall (2019) also evaluated the effectiveness of a virgin materials tax, which levies a tax on each unit of primary material supplied and increases the likelihood that companies would substitute secondary materials. The authors also studied recycling subsidies, which "may come in many different forms, either as direct support to secondary material generation and/or as support to various types of infrastructures lowering the cost of collecting used products and materials" (p. 264). Subsidies range from government investment in recycling infrastructure like collection and sorting equipment to policies that require industry to be responsible end-of-life packaging materials management. Ten states currently have bottle bill laws. The National Conference of State Legislatures explains the process:

> When a retailer buys beverages from a distributor, a deposit is paid to the distributor for each container purchased. The consumer pays the deposit to the retailer when buying the beverage, and receives a refund when the empty container is returned to a supermarket or other redemption center. The distributor then reimburses the retailer or redemption center the deposit amount for each container, plus an additional handling fee in most states. Unredeemed deposits are either returned to the state, retained by distributors, or used for program administration. (NCLS, 2020).

Aluminum and steel cans are included in these programs, which not only reduces the need to harvest primary metals but also lowers costs and processing time for producers by collecting cleaner streams of materials.

Scrap Metal Best Practices

Increased reporting and documentation, more efficient processing equipment, and harvesting valuable resources from construction and demolition projects are all best practices for managing secondary metals. Regarding best practices for scrap metals, scrap metal facilities in Illinois are not required to report details on the breakdown of feedstock sources, content composition, and tonnage collected and processed each year. Oregon state law requires any operation that handles post-consumer recoverable materials to complete a survey each year to report the amount of material collected, where the waste originated, the companies they received transfers from, and where the materials were marketed. Companies that handle only scrap metal are not required to report, but many do report voluntarily (Oregon DEQ). This information helps identify diversion within the state and identify whether materials are being used locally or traveling greater distances to be processed, which can help identify need for additional facilities.

Another practice that will assist in greater metal scrap recovery and efficiency is moving away from older furnace methods by installing furnaces with more advanced technology to melt metals at recovery facilities. Electric arc furnaces (EAF) are one example. They use scrap as the main source of input and harmful carbon dioxide emissions reduce by half when ferrous scrap is used as a raw material (Sanders, 2020).

Harvesting and recycling or reusing valuable metal from construction and demolition scrap is another practice that can reduce the need to mine primary metals and keep metal stock local for processing. Steel, copper and brass are often found during demolition of most structures. Steel and copper are 100% recyclable. Brass is 90% recyclable because it needs to go through additional processing to separate the copper and zinc that it is comprised of. Steel can be recycled and reused in a variety of car parts as well as in canned goods, furniture, steel beams, and railroad tracks. Many heating systems, rainwater systems, electrical wiring, cladding, and roofing contain copper. It can be recycled for use in electrical systems and plumbing as well as in vehicle lights and computers, coins, and musical instruments. Brass is most often used for door knobs, latches, and locks in construction projects. The scrap can be recycled into zippers, costume jewelry, pipes, nuts and bolts, and musical instruments.

Separate Technologies/Best Practices

Many sorting technologies can be used to separate metals from recycling streams, whether the material is from household single stream collection, scrap metal from old appliances or construction, or scrap from manufacturing processes. Metals need to be identified and placed into the correct stream before they can be recovered and recycled. Technologies for identifying metals use sensors, x-rays, and magnets to ensure that they are placed in the proper recycling streams and ensure that the metals retain their value.

An article in Waste Management World ("New technology in metal recycling", 2021) describes sorting technologies used at metal recycling and recovery facilities. They include:

- **Fully automated waste sorting robot**: In 2011, Finnish company Zen Robotics introduced the first fully automated waste sorting robot. It uses metal detectors, 3D laser technology, and spectroscopic imaging to improve the precision of sorting materials. Cameras detect specific materials such as glass, cans etc. and robotic components on conveyor belts will place materials in their respective bins. This technology helps reduce manual sorting and sort materials in a more rapid and accurate manner.
- **AI Optimized sorting robot**: The Heavy Picker is a sorting robot specifically created for metal and has since been optimized for using AI.
- Norwegian company TOMRA specializes in recycling aluminum using **X-TRACT series of technology**. This uses electrical x-rays that generate broadband radiation which strikes an X-ray camera that uses two sensors with different light sensitivities to determine the atomic density of the material in question. Helps understand metal composition and aid in material reuse and recycling. Daughter company TOMRA-Sorting introduced a Laser Object Detection system which can increase detection accuracy of specific materials.
- **X-Ray Fluorescence Spectroscopy (XRF)**: Austrian company Redwave uses X-ray fluorescence spectroscopy (XRF) technology. XRF is a non-destructive analytical technique used to determine the elemental composition of materials (Ask A Scientist, 2020). This was originally designed for glass sorting but has since been adapted for metal

sorting which helps produce high quality metals to be sold profitably. The technology is not impacted by moisture or surface impurities which have been issues for other technologies.

- **X-Ray Sorting**: Sort materials based on their atomic density. There are two different types including: "The X-ray radiation sorting method sorts materials by using characteristic spectral lines generated by excitation after receiving X-ray irradiation. Also, the X-ray absorption separation method separates different materials by different X-ray absorption coefficients of a specific wavelength and energy."
- **Laser-Induced Breakdown Spectroscopy (LIBS)**: Hand held LIBS devices have been used since 2015 to chemically analyze metals for recycling, especially light metals such as aluminum and magnesium. This helps recyclers dealing with heavy loads or space constraints as the laser guns can analyze materials in seconds. Another benefit is that it is a no contact method and there is no sampling necessary.

Other technologies include:

- **Induction Sorting**: Pre-Sorted bulk material is fed over a conveyor belt with metal detectors (coils with a defined inductance) and if the detectors recognize metals below on the conveyor belt, they use compressed air to blow it off of the line into collection containers. (Recycling Inside, n.d).
- **Eddy Currents**: For piles or loads of recyclables that contain a mixture of materials, eddy current separation streams electrical currents across the materials which attracts and lifts all metals, including metals that are not magnetic (Recycling Inside, n.d).
- **Magnets**: For ferrous materials (Zore's Recycling, 2020), this helps with an initial sort and leaves non-ferrous or magnetic materials to sort further. Magnets are also used in the mining industry to remove metal contaminants. Magnetic separators (Recycling Inside, n.d) usually consist of a mounted electromagnet that hovers above material, but could also be a tube that materials pass through. These are usually found along assembly lines to attract ferrous materials such as tin, iron, steel and more.

Case Studies

The article "Recycling of (Critical) Metals" showcases a few brief case studies regarding recycling applications for Platinum Group Metals (PGMs) such as platinum, palladium and rhodium to name a few. The cases studies can be found on pages 59-61 (Hagelüken, 2014). Other case studies resources include:

- Cook County's Businesses Reducing Impact on the Environment (BRITE) Program.
- Illinois Department of Central Management Services Recycling Programs
- Illinois Recycling Association
- Publications from the Copper Development Association

Organics

According to the U.S. EPA wasted food scale (U.S. EPA, n.d.-ac), several steps should be taken to avoid wasted food prior to organics recycling including source reduction, feeding hungry people, feeding hungry animals, and leave it unharvested. There are some references in this chapter to organic waste reduction and recovery, but the primary focus is on recycling through composting and anaerobic digestion.

Definitions

The term "organics" is not defined by federal or Illinois law. In the 2021 *Illinois Materials Management Advisory Committee Report to the General Assembly* (MMAC 2021), "organic material" was defined as "any material that is biodegradable (can be broken down into carbon dioxide, water, methane, or simple organic molecules by micro-organisms and other living things) and comes from either a plant or animal" (p. 16). The Illinois Environmental Protection Act (415 ILCS 5/ et seq.), defines several terms relevant to this chapter including:

- **Organic waste**: Food scrap, landscape waste, wood waste, livestock waste, crop residue, paper waste, or other non-hazardous carbonaceous waste that is collected and processed separately from the rest of the municipal waste stream. (415 ILCS 5/22.34)
- **Food scrap:** Garbage that is capable of being decomposed into compost by composting, separated by the generator from other waste, including, but not limited to, garbage that is not capable of being decomposed into compost by composting, and managed separately from other waste, including, but not limited it, garbage that is not capable of being decomposed into compost by composting. (415 ILCS 5/3.197)
- **Compost**: The humus-like product of the processing composting waste, which may be used as a soil conditioner. (415 ILCS 5/3.150)
- **Composting**: The biological treatment process by which microorganisms decompose the organic fraction of waste, producing compost. (415 ILCS 5/3.155)
- **Landscape waste**: All accumulations of grass or shrubbery cuttings, leaves, tree limbs and other materials accumulated as the result of the care of lawns, shrubbery, vines and trees. (415 ILCS 5/3.270)

For the purposes of this report, the term organics is used to refer to landscape waste (as defined above) and food waste, as defined on the Illinois EPA's web page on food waste: "Food waste is defined as all food, solid or liquid, that is discarded. This includes the organic residues, food scraps, or edible food that has been thrown away for any reason" (IEPA, n.d.-e)

Anaerobic digestion is used throughout this chapter and is defined by the U.S. EPA in the *2019 Wasted Food Report* (U.S. EPA, 2023, p. 38) as breaking down material via bacteria in the absence of oxygen. This process generates biogas and nutrient-rich matter. The same report defines codigestion as simultaneous anaerobic digestion of food loss and waste and other organics material in one digester.

Another term commonly used in the organic waste dialogue is food loss and waste (FLW). According to the U.S. EPA and USDA *National Strategy for Reducing Food Loss and Waste and Recycling Organics* (The White House, 2024), food loss and waste is defined as "food produced for human consumption that leaves the human food supply chain for any reason (and is not ultimately consumed by humans)" (p.5). The report also defines:

- Food loss: food produced for human consumption that leaves the human food supply chain for any reason (and is not ultimately consumed by humans) between production up to, but not including, the retail sector.
- Food waste: as food produced for human consumption that leaves the human food supply chain for any reason (and is not ultimately consumed by humans) at the retail, food service or household sectors. (p.5).

Generation

The most recent waste characterization study done in Illinois was the 2015 Illinois Commodity/Waste Generate and Characterization Study Update (ICWGC) conducted by the Illinois Recycling Association. It was followed by the MMAC Report, published in 2021. In the MMAC report, waste composition from the 2015 ICWGC was applied to total tonnage of material sent to landfills in 2018 to provide an updated review of the top 50 materials in the Illinois waste stream, which represented 96% of total waste. The MMAC report found that in 2018 food scraps were the largest material stream (by weight) in Illinois landfills at 2,637,076 tons. Compostable yard waste was the third largest at 390,559 tons. Other organics was the 13th largest at 337,711 tons (MMAC, p. 26). In late 2023, the IEPA was awarded a Solid Waste Infrastructure (SWIFR) grant from the U.S. EPA and will produce a new statewide waste characterization study that will provide an updated data set.

The ReFED Food Waste Monitor (ReFED, 2022) also provides food waste estimates by state. ReFED provides data from multiple sources about the amount of:

- surplus food tons generated,
- dollars in value of surplus food,
- food waste tons generated,
- metric tons of CO2e released as a result of surplus goods,
- gallons of water wasted as a result of surplus foods, and
- meals that went unsold or uneaten as a result of surplus food across the country.

State-specific data can be filtered by year, sector, food type, and destination. ReFED estimates that 2.34 million tons of food waste tons were generated in all sectors in Illinois in 2023.

When looking at food waste on a national and global scale, the most current resources include:

- U.S. EPA's *2019 Wasted Food Report* (U.S EPA, 2023), which provides a breakdown of food waste in the United Stated by sector and the percentage of food waste managed via various pathways;
- U.S. EPA's 2021 report From Farm to Kitchen: The Environmental Impacts of U.S. Food Waste (Jaglo, Kenny,& Stevenson, 2021), which includes a literature review of food loss and waste studies; and
- The United Nations Food Waste Index Report 2024 (UNEP, 2024), which provides global food waste estimates and guidance on measurement at the retail, food service, and household sectors.

These reports do not specifically separate pre-consumer food waste (wasted food that occurs in the production phase and is never seen by the consumer) from post-consumer food waste (wasted food from the end-user/consumer) they can be identified based on the stage in which food becomes waste.

Impacts on the Environment and Human Health

The primary threat to both the environment and human health comes from greenhouse gas emissions, not only from landfilled organic waste but also from the associated energy required to grow, harvest, transport, and store wasted food.

Organic waste that decays anaerobically in a landfill produces methane, a greenhouse gas more than 28 times more potent than carbon dioxide (U.S. EPA, n.d-k) and a significant contributor to climate change. The 2021 MMAC report estimated that diverting all food scraps and yard waste from the landfill could reduce greenhouse gas emissions by an estimated 1,898,695 and 109,375 MTCO2e respectively each year (p. 214)

Aside from these estimates, there are no known data sets to quantify emissions or emissions reduction potential from organic waste in Illinois. Nationally, U.S. EPA's 2023 report, *Quantifying Methane Emissions from Landfilled Food Waste* (Krause, et al, 2023) was the first attempt to quantify emissions from food waste in municipal solid waste (MSW) landfills at the national level. Findings from the study show that an estimated 58% of fugitive methane emissions from MSW landfills are from food waste and 61% of methane generated by food waste in landfills avoids collection by landfill gas collection systems due to its decay rate (p. 9). While overall fugitive emissions (emissions leaked from landfills that escape landfill gas collection systems) are decreasing, methane emissions from food waste in landfills are increasing.

ReFED's October 2024 report, *The Methane Impact of Food Loss and Waste in the United States* (Ringland et al, 2024) notes that 14% of total U.S. methane emissions came from surplus food in 2022 (p. 1).

There are several tools to help quantify greenhouse gas emissions and potential savings. These include the EPA GHG Emissions Factor Hub (U.S. EPA, n.d.-j), the EPA WARM (Waste Reduction Model) (U.S. EPA, n.d.-c), and the IFC Food Loss Climate Impact Tool (IFC, n.d.).

Food loss and waste has other environmental impacts beyond greenhouse gas emissions. The 2021 U.S. EPA report *From Farm to Kitchen: The Environmental Impacts of U.S Food Waste* (Jaglo, Kenny, and Stephenson, 2021), looks at the environmental footprint of food loss and waste and the benefits that can be realized through waste reduction. The report notes that each year, food loss and waste embodies:

- 140 million acres of agricultural land - an area the size of California and New York combined
- 5.9 million gallons of blue water - equal to the annual water use of 50 million homes
- 780 million pounds of pesticides
- 14 billion pounds of fertilizer - enough to grow all the plant-based foods produced each year in the Unites States for domestic consumption
- 664 billion kWh - enough energy to power more than 50 million homes for a year
- 170 million MTCO2e GHG emissions (excluding landfill emissions) - equal to the annual CO2 emissions from 42 coal-fired power plants (p. 53)

Even when organics are diverted from the landfill, chemical and plastic contamination can still pose a threat to the environment and human health. Two U.S. EPA reports released in 2021 shed light on these issues – *Emerging Issues in Food Waste Management: Persistent Chemical Contaminants* (ICF Inc., 2021b) and *Emerging Issues in Food Waste Management: Plastic Contamination* (ICF Inc., 2021c). The Persistent Chemical Contaminants report details the risk of contaminating compost (and thus the environment and human health) with per- and polyfluoroalkyl substances (PFAS), pesticides, and other chemical contaminants. The Plastic Contamination report reviews the primary sources and levels of plastics contamination in food waste streams, as well as the risks posed to the environment and human health. More information from these reports can be viewed in the Solutions & Research Gaps section of this chapter.

Removing food waste from landfills also has the potential to address environmental injustices in communities that have been adversely affected by the current waste management system. The 2024 *National Strategy for Reducing Food Loss and Waste and Recycling Organics* (The White

House, 2024a) notes that there are "opportunities, especially in communities with environmental justice concerns, to build community-scale organics recycling infrastructure; better feed those in need; reduce pollution; create jobs and business opportunities; and use compost made from recycled organic waste, including food, to support green infrastructure and build healthier soil across communities (p. 7)" Stakeholder engagement is critical to better understand local challenges and opportunities for organics diversion in these communities.

Collection

Many residents and businesses throughout Illinois manage their organics waste on their own property. They mulch, compost, burn, and leave grass clippings and leaves instead of raking, although local ordinances to burn landscape waste may vary. When not managed on-site, options include municipal and/or private collection and processing services, which may be available year-round or only seasonally.

Due in part to Illinois' 1990 ban on landscape waste entering landfills, landscape waste drop-off and collection programs are prevalent in the state. While there are no known statewide lists, directories, or maps of services, most municipal websites and solid waste management plans detail options for their residents. Landscape waste transfer stations and compost facilities may allow public drop-off or may work only with licensed landscape companies. It is common for landscape waste programs in Illinois to be seasonal with no service during the winter months. According to the 2022 U.S. Census Bureau County Business Patterns (2022a) data set, Illinois has 5,027 landscaping services companies (NAICS 56173) that employ 22,314 people.

Collection options for food waste are significantly less prevalent. Most available services are located in the Chicagoland area. Options include drop-off points, curbside collection, and specialty events. The most complete directory of food scrap collection throughout Illinois was put together by the Illinois Food Scrap & Composting Coalition (IFSCC). The Illinois Food Scrap Municipal Programs and Drop off Locations (n.d.-d) spreadsheet shows:

- Thirty-eight (38) drop-off points located in 14 municipalities spanning seven counties (Cook, DuPage Lake, Madison, McLean, Peoria, and Tazewell). Most of the programs are municipally run and free to their residents, although some are run by private entities and charge a fee for participation. Thirty-six (36) of the 38 drop-off points are open year-round. Not all locations accept the same types of food waste.
- Seventy-two (72) municipalities offer some type of curbside collection service. These municipalities span six counties in the Chicago area (Cook, DeKalb, DuPage, Kane, Lake, and McHenry). Of these, 66 are only offered seasonally. Although some programs are free to residents, some charge residents an additional fee on their city bill or by requiring residents to purchase stickers to adhere to their collection bins. The majority (65) are

“ride along” programs, which allow residents to add food scraps to their yard waste containers.

Other publications that provide an overview of food waste collection programs and service providers in Illinois include:

- A 2023 Biocycle survey titled “Residential Food Waste Collection Access in the U.S.”, which found that there are 50 residential food waste collection programs in Illinois that serve an estimated 610,500 households, although detailed information on type of location is not provided. (Goldstein, Luu & Motta, 2203b)
- The Cook County Solid Waste Management Plan 2024-2029 (2024))reported that of the 131 municipalities that make up Cook County (excluding Chicago), 121 have a standalone yard waste program, seven have a standalone food waste program, and 18 have a comingled yard and food waste program. There are 111 municipalities with no food scrap related program available to residents. Of the 131 municipalities that make up Cook County (excluding Chicago), 121 have a standalone yard waste program, 7 have a standalone food waste program, and 18 have a comingled yard and food waste program. There are 111 municipalities with no food scrap related program available to residents. (p. 52)
- IFSCC’s Haulers & Compost Processors spreadsheet (n.d. -d) identifies 10 private haulers that provide residential food waste pickup services and 15 that provide commercial services. Many of the haulers providing services to residents do so through municipally run programs, although some also provide separate subscription services to residents.

In addition to drop-off and curbside collection programs, there are also limited specialty collection events for food waste. The largest and best documented example are the pumpkin smash events held throughout Illinois between 2014-2023, which encourage residents to drop off and smash their pumpkins for composting instead of sending them to the landfill. Nonprofit Scarce and the cities of Wheaton and Elmhurst hosted the first pumpkin smash in 2014 and similar events grew to 95 sites across Illinois in 2023. According to Scarce, pumpkin smash events have diverted over 1,253.6 tons of pumpkins from the landfill and reduced greenhouse gas emissions by an estimated 926.9 tons of CO_2e since 2014 (Scarce). Additional examples of limited specialty food waste collection events include those hosted by nonprofit and community organizations, although a complete list of these events has not been created.

Infrastructure

Organics processing infrastructure can take many forms. The U.S. EPA Approaches to Composting (n.d.-w) page categorizes several models, including backyard/home composting, community composting, on-site composting at businesses, schools, or institutions, municipal composting, commercial and industrial composting, and on-farm composting (. Within these models, U.S. EPA lists various composting methods including static pile/bin with passive or active aeration, windrow, in-vessel, and vermicomposting (worm composting). U.S. EPA separately lists Types of Anaerobic Digesters (U.S. EPA, n.d.-b) as stand-along digesters, on-form digesters, and digesters at water resource recovery facilities.

The Illinois EPA directory of permitted compost facilities (IEPA, n.d.-a) shows 49 facilities across the state of Illinois. These facilities best fit the models of municipal, commercial and industrial, or on-farm composting. Just over half the facilities are in Illinois EPA Region 2, which includes ten northeastern Illinois counties. The breakdown of permitted facilities by region is shown in Table 8.

Table 8. Permitted Compost Facilities in Illinois by EPA region (Illinois EPA).

Illinois EPA Region	**Number of Permitting Compost Facilities**
1	6
2	25
3	5
4	5
5	1
6	6
7	1

The MMAC report (MMAC, 2021) also maps these facilities (p. 44) and notes that six are listed as private compost facilities that do not accept outside material and that only six of these facilities (not the same six) reported accepting food scraps in 2019. This report also maps landscape waste transfer stations (p. 42). The report shows a total of 61 transfer stations with the overwhelming majority (49) located in region 2.

Additional sources that detail composting facilities in Illinois include:

- Illinois Food Scrap & Composting Coalition (IFSCC, 2024) has compiled a list of 49 compost facilities, each with an address and contact information. Some sites also list additional information such as months in operation, accepted materials, and markets where their finished compost is sold.

- The U.S. Composting Council has a directory of compost facilities certified under their Seal of Testing Assurance (STA) Program. The requirements for becoming STA certified include meeting the U.S. Composting Council's definition of compost; staying in compliance with federal, state, and local regulations and permitting; and using CTA Certified Compost approved labs for testing finished product. The U.S. Compost Council lists five approved facilities in Illinois, four of which accept food scraps. (U.S. Composting Council, n.d.-c)
- Biocycle conducted a nationwide survey of composters released in 2023 titled "Biocycle nationwide survey: Residential food waste collection access in the U.S." (Goldstein, Luu, & Motta, 2023a)(Goldstein, Luu, & Motta, 2023b). While this survey does not give specific information by state, they do note that there are six food waste facilities located in Illinois.

In addition to large-scale composting operations, Illinois also uses community composting. The Institute for Local Self Reliance (ILSR) defines community composting as ""small-sized and locally based" and lists examples of backyard, block, neighborhood, schoolyard, and community-level composting (ILSR, n.d.-c). ILSR provides a map and shows nine community composters in Illinois. Many of these entries overlap with composters listed in the above resources. One example of an organized community composting effort is the City of Chicago Community Composting Pilot Program (City of Chicago, n.d.-a). In 2021, six community gardens began allowing select participants to drop off food scraps to be composted and used onsite. When looking at at-home composting methods, there are no known sources that document the type or amount of composting equipment across Illinois.

There are also anaerobic digestion facilities throughout Illinois. These facilities may be designed to handle wastewater sludge, manure or other agriculture products, food waste, or a combination of these wastes (codigestion). They are not typically used to process landscape waste. There are a few resources that detail the location and type of anaerobic digestion facilities including:

- The Water Environment Federation provides a map (WEF, n.d.) of all water resource recovery facilities with operating anaerobic digestion facilities, although they do not list accepted feedstock. This map lists over 100 facilities throughout the state.
- U.S. EPA Anaerobic Digestion Facilities Processing Food Waste in the United States (Schroeder, 2023) provides information from facilities that returned surveys. The survey reported that Illinois contains:
- Zero (0) "Stand-Alone" anaerobic digestion facilities that accept food waste (p. 9)
    - There is one known stand-alone facility in operation in Illinois and that is Green Era located in Chicago, Illinois. This facility was not in operation at the time of the survey.
- Zero (0) "On-Farm" anaerobic digestion facilities that accept food waste (p. 9)
    - Three (3) "Waste Resource Recovery Facilities (WRRF)" with anaerobic digestion facilities that accept food waste (codigestion). These three facilities are:
        - Danville Sanitary District in Danville, Illinois

        - Downers Grove Sanitary District Wastewater Treatment Center in Downers Grove, Illinois
- Urbana & Champaign Sanitary District in Urbana, Illinois (p. A2)

End Markets

Finished compost and digestate from anaerobic digestion requires robust end markets to ensure stability of the industry. Other than discussions with individual composters (detailed in our stakeholder engagement section), there is extremely limited information about the strength of compost or digestate end markets in Illinois. Below is an outline of known end markets, as well as barriers sand opportunities for expanding those markets.

In 1993, the U.S. EPA released a Markets for Compost Report (U.S. EPA 1993) (a condensed summary report (U.S. EPA OSWER, 1993) is also available). While this report is over 30 years old, the details and analysis are still relevant today. The report breaks down the primary end markets for finished compost into the categories of Agriculture, Landscape Industry, Nursery Industry, Public Agencies, and Residential.

The report also details factors important to each end market, including compost specifications, testing requirements, distribution, and polices and summarizes barriers to developing these markets and opportunities to mitigate or overcome barriers. See Table 9 below.

Table 9. Economic Barriers and Opportunities to Compost End Markets (U.S. EPA, 1993, p. 5-1-6-9).

Economic Barriers	**Economic Opportunities**
Failure to identify potential markets	Diversification of compost products to meet the needs of specific markets
Cost pressures from competing products	Compost must be shown to be of equal or greater benefit and value to compete with other products
Transportation costs	Find local markets to reduce transportation costs
Post-processing costs	Financially incentivize the use of compost
Impacts of competing product capital investment	

Noneconomic Barriers	Noneconomic Opportunities
Compost quality assurance	Quality assurance - testing, standards, product guarantees, labeling specifications. Collaborate with professional groups to influence product acceptance, work with university agricultural, cooperative extension services, and soil and water conservation districts
User attitudes	Developing and maintaining favorable user attitudes, education on compost benefits, enhancing recognition factor, technical assistance
Location of markers with respect to compost operations	Distribution centers
Access to transportation routes	
Comparative availability of compost	
Product procurement policies	Procurement policies that favor compost use
Restrictions on compost use and legal constrictions	Removing conflicting or restrictive legal and regulatory constraints

*The EPA report did not match up barriers with specific opportunities. ISTC matched them up in this table to illustrate potential opportunities and for ease of reading.

Similar studies and articles add to and further refine the list of potential end markets. A 2024 article written in BioCycle by Craig Coker (2024), an organics consultant and co-owner of a compost facility in Virginia breaks down traditional markets vs. emerging markets and dollar markets (higher unit price potential, but lower volume sales expectations) vs. volume markets (large product volumes, but lower unit cost and willingness to pay). See Table 10 below. The article discusses barriers to compost market development including physical/chemical contamination challenges, economic barriers, societal barriers, as well as market stimulation models that have been used across the country. A paper released by the Composting Consortium and Closed Loop Partners titled "Unleashing the Economic and Environmental Potential for Food Waste Composting in the U.S." (p. 46) dives further into these barriers and end markets.

Table 10. Markets for Finished Compost, Traditional vs. Emerging (Coker, 2024).

Traditional Dollar Markets	**Emerging Dollar Markets**
Landscaping	Stormwater quality management

Turfgrass	Green roofs
Agriculture (organic)	Sports turf
	Urban tree soil media
Traditional Volume Markets	Emerging Volume Markets
Landscaping (large projects)	Sediment and erosion control
Agricultural (traditional)	Landfill closure/alternative daily cover
Agriculture (specialty)	Restoration/remediation
Containers horticulture	Soil amendment for carbon sequestration/climate action plans
Engineered compost-soil blends	Soil organic matter minimum programs
	Deep soil profile rebuilding in redevelopment
	Biochar-amended compost products

Additional papers that dive into specific solutions for developing compost markets include:

- The Zero Food Waste Coalition's state toolkit (2023) which introduces policies to bolster compost end markets including procurement guidelines for local and state governments as well as incentivizing compost application through ensuring accessibility, prioritizing marginalized producers, utilizing established compost standards, prioritizing compost made with food scraps, and allocating funding to purchase finished compost.;
- Seven Generations Ahead's Analysis of the Barriers and Opportunities for the Use of Compost in Agriculture (2018), which looks at strategies to specifically increase the application of compost on mid and large-scale farms including farms outsourcing on-farm compost productions, government incentives to encourage on-farm composting, simplifying regulations for on-farm composting, using quality assurance labels related to compost for agricultural use, and engaging extension services that are trusted by farmers for education.

Although composting and anaerobic digestion both use organic waste as feedstocks, they produce different products. Composting produces finished compost while anaerobic digestion produces digestate and biogas. A 2024 white paper from the US Composting Council, *Compost and Digestate: Dispelling the Confusion* explains the key differences in the end products and how they can be used, "Compost is a soil improver containing all the attributes that promote soil health with the capacity to sequester carbon and provide nutrition, while digestate is the better choice for fertilization primarily due to its high N value" (p. 5).

Most end market research in the organics diversion field is on finished compost. However, several recent papers describe opportunities for market development of products produced through anaerobic digestion. A study conducted by the Composting Consortium and Closed Loop Partners entitled "What Role Can Anaerobic Digestion Play in Processing Compostable Packaging" (2024c) provides an overview of the end market opportunities for these products. Once purified, biogas can be used to power on-site operations or compressed into renewable natural gas (RNG) and sold into the natural gas system. Digestate can be used directly on agricultural crops or separated into liquids and solids. The liquids may have value as fertilizer, while the solids need to be further processed (e.g. composting or used to produce biochar) prior to application as a soil amendment. The study notes the lack of current end markers for digestate in the United States and describes what can be learned from European markets, including using hybrid anaerobic digestion, creating industry collaborations, and establishing digestate standards.

A 2024 study by Dhull, et al notes the need for end market development for digestate and quality monitoring and training programs. The American Biogas Council has developed a voluntary certification program to address these challenges. The Digestate Certification Program (ABC, n.d.) certifies labs to quantify, characterize, and communicate the physical and chemical qualities of digestate. There are currently only two labs certified to test digestate, located in California and Ontario Canada. The program is seeking additional labs for participation.

Existing Policy/Regulations

As noted in the stakeholder engagement section, policy and permitting regulations present both challenges and opportunities to advance organics diversion in Illinois. A review of policy and regulations in Illinois is summarized below.

Most recently, Illinois passed the Large Event Facilities Act (415 ILCS 190/), which will require recycling and composting by large event facilities with a capacity of 3,500 or more starting in 2025. Compost will only be required if there is a compost facility located in the same county.

IEPA provides several summary documents of existing regulations including:

- A Summary of Regulatory Requirements for Compost Facilities (2016), which provides an overview of permitting required for compost facilities, landscape composting facilities, and anaerobic digestion facilities.
- Organic waste composting is regulated under 35 Ill. Adm. Code Part 807.

    - A compost facility (that accepts food scraps) is considered a pollution control facility and must be cited/regulated as such.
    - Local siting approval is required, unless the facility operates within the exemptions outlined in Section 3.330(a)(19) of the Environmental Protection Act.
- Landscape waste composting is regulated under 35 Ill. Adm. Code Parts 830, 831, and 832.
    - Facilities that compost landscape waste are exempted from local siting requirements.
- An anaerobic Digester permit is required if the finished product is sold and meets the definition of compost.
- Compostable Waste Collections (IEPA, n.d.-b) - Compostable waste collections can be conducted under local approval without having to obtain a waste permit from the Illinois EPA, as long as certain requirements are followed. Collections can be operated as either one-day collection events or as permanent drop-off locations. Individuals or organizations wishing to host a compostable waste collection must obtain approval in writing from their local municipality, or their county in unincorporated areas, and must conduct the collection in accordance with Sec. 22.55 of the Environmental Protection Act (415 ILCS 5/22.55) and any conditions imposed by the approving county or municipality. Specific requirements for these collections can be found in the link above.
- One-Day Collection Events (IEPA, n.d.-k) - One-day compostable waste collections are addressed in Section 22.55, subsection (d-5) of the Illinois Environmental Protection Act. Specific requirements for can be found in the link above.
- Permanent Collection Points (IEPA, n.d.-n) - Permanent compostable waste collections are addressed in Section 22.55, subsection (d-6) of the Illinois Environmental Protection Act. Specific requirements can be found in the link above.
- Open Burning (IEPA, n.d.-l) - The Illinois Pollution Control Board (Board) (35 Ill. Admin Code 237) and the Illinois Environmental EPA or regulate open burning. Regulations related to organics include:
    - If you live in any town or within a mile of a town with a population of 1,000 or more, it is illegal to burn anything except landscape waste, although local ordinances may limit the burning of landscape waste. Landscape waste is only allowed to be burned on the premises where it is generated so long as a local ordinance does not limit the burning of it.
    - Open burning of commercial/trade waste by business, industry and government institutions is illegal in the State of Illinois, with the exception of landscape waste generated on the property or agricultural waste under limited circumstances. Local laws may limit open burning of landscape waste.
    - Waste that can never be burned includes food and associated packaging.

Below are some additional resources that highlight Illinois organic waste policies.

- The Illinois Food Scraps and Composting Coalition (IFSCC) developed a summary titled, Compost-Related Legislation in Illinois 2010 – Present(IFSCC, n.d.-b) This organization also convenes a monthly policy subcommittee which tracks active legislation related to composting and organics diversion.
- The ReFED Policy Finder reviews policies in each state related to organic waste prevention, rescue, and recycling. In Illinois, these include (ReFED, n.d.-b):
  - Animal Feed - It is unlawful to feed livestock any animal-derived or vegetable waste. Exceptions apply for individuals feeding their own household waste to their own animals. This is rated as a "negative policy" by ReFED; a policy that restricts the use for wasted food for animal feed.
  - Organic Waste Recycling - Illinois does not have any organic waste bans or waste recycling laws that bear on food waste. This is rated as "no policy" by ReFED.
- The Natural Resources Defense Council (NRDC) developed the Illinois Food Waste Policy Gap Analysis and Inventory (Center for EcoTechnology, 2021) to summarize existing policy and policy opportunities to further food waste reduction and diversion.

A comprehensive national food waste legislative tracker developed by Divert (2024), The Zero Waste Food Coalition, and the Harvard Law School Food Law and Policy Clinic informs and educates policymakers and consumers on food waste policy across the country.

Existing Goals

Although individual cities or counties (as well as companies, organizations, and institutions) may have organics diversion goals, there is no statewide goal. The MMAC Report (MMAC, 2021) provided recommendations on statewide landfill diversion goals, though there were no specific metrics related to organics. Nationally, the U.S. Department of Agriculture (USDA) and U.S. EPA announced the U.S. 2030 Food Loss and Waste Reduction Goal (U.S. EPA, n.d.-aa) the first-ever domestic goal to reduce food loss and waste. This goal is measured based on a 2016 baseline to align with the global goal set by the United Nations Sustainable Development Goal (SDG) Target 12.3 (One Planet Network, n.d.) The U.S. EPA notes that there is no baseline for food loss, which occurs in production and up to (but not including) retail level.

In October 2024, Seven Generations Ahead and the Illinois Food Scrap & Composting Coalition released a review of Food Waste Reduction and Composting in Illinois County Solid Waste Management Plans. The review did not find any Illinois counties that have specific organics diversion goals. However, there were at least nine county solid waste management plans that discussed or recommended organic waste reduction and/or recycling (one of those plans covers six counties).

One example of a food waste specific goal is called out in the 2024 Priority Climate Action Plan For the Chicago Metropolitan Statistical Area developed by the Metropolitan Mayors Caucus and the Chicago Metropolitan Agency for Planning. The goal, called a "measure" in the report, is to "Divert nearly 20% of food waste generated in Cook County annually (over 311,000 tons) by establishing food waste reduction, collection, and anaerobic digestion programs" (p. 41). This is listed as a 0-5+ yrs measure and listed as part of one of the priority GHG reduction strategies, "Increase Composting and biological treatment of waste. Utilize energy and biosolid by-products".

There are also examples of local municipalities setting goals related to organics, all of which are members of the Metropolitan Mayors Caucus. The Village of Brookfield's Sustainability Plan (2024) has a goal to "reduce organic waste through composting organics" (p. 21). Actions listed to achieve this goal include drafting sustainable landscape policies, encouraging backyard composting, incorporating food scrap collection into village contracts, introducing new ordinances, and securing funding. Other examples of goals and strategies to address organic waste can be seen in the City of Aurora 2019 Sustainability Plan, the Village of 2023 Downers Grove Report on Greenest Region Compact, Grayslake 2017 Sustainability Plan, and the 2019 Hoffman Estates Sustainability Plan.

Existing Funding Opportunities

While Illinois has offered materials management and composting grants in the past, there are currently no known funding opportunities specific to organics diversion coming from the municipal, county, or state level in Illinois. While some federal grants may cover organics diversion initiatives, the largest funding source dedicated specifically to organics is the USDA Composting and Food Waste Reduction Cooperative Agreements (2024). The USDA also offered the Fertilizer Production Expansion Program (2022) and the Food Loss and Waste Training and Technical Assistance Grant (SARE, 2024), but is unknown if there will be additional rounds of funding. Examples of state/county/municipal governments beyond Illinois that provide funding related to organics diversion including Alachua County Florida rebates for soil amendments in new construction (2024) and the Colorado Department of Public Health and the Environment's (CDPHE) Recycling Recovery and Economic Opportunities (RREO) Grants.

There are also funding opportunity databases dedicated to organics reduction, recovery, and diversion including:

- Federal Grants Database compiled by ReFED and the Natural Resources Defense Council (NRDC).
- Composting Funding Opportunity Resources compiled by the Institute for Local Self-Reliance (ILSR) (Spector, 2024).

Several municipalities in Illinois have provided backyard compost bins or finished compost at a reduced cost or free of charge. They include the City of Chicago, the Village of Glen Ellyn, the City of Highland Park, and the Village of Arlington Heights.

Existing Education & Resources

Numerous resources on organics reduction, recovery, and recycling are produced and distributed local, state, and federal governments, educational institutions, trade groups, and nonprofit organizations. They are developed for residents, business and organizations, or institutions at either the municipal, county or regional, state, or national levels. This is not an exhaustive list. Instead, it provides examples of the types of educational resources that exist in Illinois and nationally.

Education resources geared toward specific municipalities frequently come from local governments or nonprofits and are primarily located in the Chicagoland area. Local governments may provide information on best practices to reduce, recover, or recycle organics, but are mainly educating residents on resources provided by the county. Examples include the City of Evanston Climate Action Compost Your Food Waste page, the Village of Oak Park CompostAble Program page,and the City of Highland Park Compost page. Go Green Illinois, a network citizen environmental groups with 36 chapters across northern Illinois, also provides a variety of resources to the residents in their communities, including education materials and presentations on organic waste reduction, recovery, and recycling.

There are also educational resources hosted by Illinois county solid waste agencies, educational institutions, or nonprofits and other organizations. Examples of counties and solid waste agencies providing organic waste education include Peoria County Composting, Solid Waste Agency of Lake County Composting, Solid Waste Agency of Northern Cook County Composting, West Cook County Solid Waste Agency Recycling, and DuPage County Waste. These pages have some original content, but most detail services available to county residents and point to educational resources produced by other organizations. Outside of government entities, educators include:

- University of Illinois Extension's Cook County Unit Compost Ambassador Training Program
- The Foodservice Packaging Institute CompostAble Chicago report
- Nonprofit Scarce, located in Addison Illinois, which offers a variety of education content, classes, and programs
- Nonprofit Ecology Action Center, located in Normal Illinois, which provides guidelines on how to build a backyard compost pile.

The Illinois EPA Materials Management page hosts Food Waste and Composting pages that provide facts, tips, and ideas for reducing food waste generation, recovering and donating excess food, and composting anything remaining. There are also many organizations that work on food waste throughout the state including:

- The Illinois Food Scrap & Composting Coalition (IFSCC) provides education and resources on composting 101, how and why to start composting, and where to buy finished compost and how to use it.
- The Illinois Recycling Association (IRA) - hosts educational webinars on a variety of topics as well as provides resources and publications. Some of the resources are focused on organics reduction & diversion and have been linked to in various sections of this document. A notable resource that is not mentioned elsewhere in this document is the Composting in Prison (Productive Prison Landscape Group, 2014) report.
- Illinois Counties Solid Waste Management Association (ILCSWMA) convenes solid waste management professionals for networking and education. The 2024 conference featured sessions on the National Strategy for Reducing Food Loss & Waste and Recycling Organics.
- Seven Generations Ahead is a non-profit that provides education and resources on sustainability topics including food waste reduction and composting. Much of their work with composting is done in collaboration with the Wasted Food Action Alliance & the Illinois Food Scrap & Composting Coalition. Relevant publications include Food Waste Reduction Toolkit for Illinois Schools (2022), Residential Food Scrap Composting: A Guide for Illinois Municipalities (2020) (2020), and *Food Waste Reduction and Composting in Illinois County Solid Waste Management Plans* (2024), which was done in collaboration with the Illinois Food Scrap & Composting Coalition.
- Wasted Food Action Alliance (WFAA) is coordinated by Seven Generation Ahead. WFAA brings together "a diverse set of organizations helping build a unified approach towards reducing wasted food and leveraging it to benefit our region." The WFAA Resource Directory provides resources for households, event venues, institutions, and businesses. It also provides policy & strategy resources at the local, state, and federal levels.
- University of Illinois Chicago, Energy Resources Center, Community Hauling & Anaerobic Digesters (TEACH AD) aims to "help communities and water resource recovery facilities in the Midwest region divert food waste from landfills by providing education and no-cost technical assistance to explore the increased adoption of anaerobic digestion and renewable energy biogas technologies." They provide technical and educational assistance to qualifying facilities, including water resource recovery facilities, municipal food waste digesters, community-based digesters, and food processing (on-farm) digesters.
- Illinois Sustainable Technology Center (ISTC) at the University of Illinois has a Zero Waste Illinois team within its Technical Assistance Program that works with entities across

Illinois on waste reduction and diversion. Projects frequently involve organics reduction and diversion efforts and recommendations.

There are also many units of government and organizations providing education and resources on reducing, recovering, and recycling organic waste to individuals and entities across the country. Some of the most notable organizations and resources include:

- U.S. EPA, Sustainable Management of Food. This site provides resources to understand the issue of wasted food, and resources for businesses, organizations, individuals, and communities. The Tools for Preventing and Diverting Wasted Food guide provides several tools including two Social Marketing Campaign Toolkits, the Excess Food Opportunities Map, Food Waste Assessment Guidebooks, Activity Books, and numerous webinar recordings. U.S. EPA also manages the AgSTAR program, which provides training resources and assists those implementing anaerobic digesters.
- The Natural Resources Defense Council (NRDC) provides education and resources on sustainability topics including Agriculture & Food. Two relevant tools include: Save The Food Campaign which addresses food waste at the household level, food waste and cost estimators, shopping strategies, meal prep plans, recipes, and proper storage techniques; and Tools for Cities, which includes a policy and program toolkit, communications and partnership guide, introduction to baselining food waste generation and food rescue potential, food scrap recycling assessment guide, and a guide for funding food scrap recycling.
- The Institute for Local Self-Reliance (ILSR) provides education and resources on a variety of sustainability topics, including Composting for Community. Some relevant resources include a Composter Training Program, Community Composting Webinars, Composting for Community Map, Composting for Community Podcast, and a Policy Library.
- Food Waste Prevention Week (FWPW) takes place in April each year and brings together partners across the county. FWPW provides partners with resources to learn about food waste as well as tools to help spread the word. In addition to their partner toolkit, they also have resources geared towards individuals and households, schools, sports teams, and libraries and resources on how to host an in-person FWPW event.
- The U.S. Department of Agriculture's Food Loss and Waste site provides resources geared toward farmers, businesses, consumers, schools, as well as funding opportunities. USDA also organizes and reports on the U.S. Food Loss and Waste 2030 Champions, businesses and organizations that have made a public commitment to reduce food loss and waste in their own operations by 50% by 2030.
- ReFED provides many tools and resources to better understand generation, measure impact, uncover solutions, uncover funding, and monitor policy. ReFED also has reports and action guides and provides opportunities for individuals and organizations to engage and collaborate through their Food Waste Action Network, which includes lists of solution

providers, Food Waste Funder Circle, webinars, and a yearly Food Waste Solutions conference.

- The Solid Waste Association of North America (SWANA) is a professional organization serving members including the professionals who are designing, building, and operating composting systems; managing collections of organics; designing and implementing communications; marketing end products; and providing other essential functions that will be key to the implementation of the National Strategy. SWANA hosts training courses on managing composting programs as well as supplies resources and best practices to members.
- Zero Waste USA is a nonprofit organization with the goal of inspiring communities to embrace and achieve Zero Waste. Zero Waste USA has a variety of zero waste resources and toolkits geared toward communities and businesses that educate and provide action plans involving organics.
- The US Composting Council provides information on uses and benefits of finished compost.
- The Compost Association of Vermont provides an On-Farm Composting Toolkit to support better composting on farms.
- Closed Loop Partners coordinates a Composting Consortium, bringing together stakeholders from across the industry. This group has put together several important educational resources including *How Organics Diversion Can Help Achieve Zero Waste Goals: A Blueprint for Scaling Collection and Composting Infrastructure,* crafted to educate municipalities on developing and scaling food scraps collection and compost infrastructure; Municipal Partners Platform, a platform to connect municipal leaders with research and resources on starting and expanding organics collection and infrastructure; and Composter Innovator Program, a program that brings composters together to discuss and learn about topics such as contamination, policy, financing, and scaling operations.
- The U.S. Plastics Pact *Design for Compostability Playbook* is a guide for decision making on compostable products to encourage alignment of items brought to market with the developing organics collection and processing system in the U.S.. The report reviews certifications, regulatory considerations, product design, labeling, and considerations for compost processors.
- The Compost Research & Education Foundation provides education and resources to both the public and the composting industry. A few of their programs include The Compost Operations Training Course, and The Compostable Field Testing Program, a tool to standardize field testing methods and provide composters with an open-source database of disintegration results from composters in North America.
- Food Loss + Waste Protocol is a collaboration of seven expert institutions that provide many resources including a food loss and waste value calculator, a food waste atlas that educates governments and companies on the sources of food loss and waste, and a suite of case studies.

Solutions & Research Gaps

According to the MMAC Report (MMAC, 2021), Illinois diverted an estimated 1% of food scraps and an estimated 59% of compostable yard waste in 2018, leaving ample room for improvement (p. 214). Illinois is a large state with dense urban centers and entirely rural areas. In 2020, Illinois Primary Health Care Association published a map that classified counties in the state as rural or urban. They determined that Illinois is comprised of 19 urban counties and 83 rural counties. While curbside collection and centralized composting and anerobic digestion may make sense in urban counties, backyard composting and drop-off facilities may be more successful in the rural counties. Drop-off centers could also be utilized in urban centers as an introduction to food waste recycling and as a way to service multi-unit buildings because they are frequently opt-in programs and limit contamination. Cities that have implemented drop-off sites to divert food waste from landfill include Chicago, Bloomington-Normal, Arlington, VA, Coconut Creek, FL, and Manchester, CT, among others.

Solutions to diverting food and yard waste from the landfill can be found throughout this chapter. At a higher level, solutions for organic waste follow the *National Strategy for Reducing Food Loss and Waste and Recycling Organics* (The White House, 2024a) and the EPA Wasted Food Scale (n.d. -ac). Following these recommendations will yield the greatest environmental, social, and financial benefit and ensure the food is going to its highest and best use or that waste is not generated in the first place. Preventing wasted food and feeding hungry people and animals are critical strategies to reduce food waste, but this section will focus on solutions to dealing with organics once they are no longer fit for consumption. There are two objectives in the national strategy that discuss organics recycling:

- Objective 3: Increase the recycling rate for all organic waste (pp. 20-25). Strategic actions include:
  - Support the development of additional organics recycling infrastructure through grants and other assistance for all communities, especially those that are underserved.
  - Expand the market for products made from recycled organic waste.
  - Enhance support to advance de-centralized (i.e., community-scale, on-farm and home composting) organics recycling.
  - Build, refine, and share tools and data to aid decision-making about infrastructure investments, waste management policies, and waste management pathway destinations (e.g., composting, anaerobic digestion, landfill).
  - Address contamination in the organic waste recycling stream.
- Objective 4: Support policies that incentivize and encourage the prevention of food loss and waste and organics recycling (pp. 25-27). Strategic actions include:
  - Support international policymakers aiming to build more circular economies.
  - Support federal, tribal, territory, state, and local policymakers aiming to build more circular economies.

Additional EPA reports that measure the significance of following the steps of waste food scale include *From Farm to Kitchen: The Environmental Impacts of U.S Food Waste* (Jaglo, Kenny & Stephenson, 2021) and From Field to Bin: The Environmental Impacts of U.S. Food Waste Management Pathways (Kenny, et al, 2023a).

Several existing reports outline solutions for organic waste diversion in Illinois. The 2015 *Task Force on the Advancement of Materials Recycling Report* focuses on the need to review permitting and regulatory changes for compost and anaerobic digestion facilities. The 2021 MMAC Report recommends a statewide education campaign, administering grants for new and existing compost facilities, and conducting a yearly survey of compost facilities to obtain updated information about materials accepted in different parts of the state. The MMAC report also outlines several recommendations that county solid waste management plans can include to begin and/or strengthen organic waste recycling programs. Additionally, a compost summit hosted by University of Illinois Extension (in conjunction with ISTC) resulted in A Report on the May 2023 Compost Summit (Pereira, 2023). Seventy-nine stakeholders brainstormed, discussed, and ultimately voted on the top solutions to growing a culture of composting in the region. See Table 11 below for a summary of top actions.

Table 11. Top Action Priorities from the 2023 Chicagoland Compost Summit. Action Priorities were summarized for readability. Please see the report for more detail on each action.

Action Priorities from the 2023 Chicagoland Compost Summit		
Education	**Policy**	**Infrastructure**
Hauling contracts	Review permitting to support decentralized infrastructure	Incorporate compost specs into large construction projects
Compost as remediation at brownfield sites	Food waste ban on large generators	Tax incentives for landscape waste facilities to take food scraps
Working with schools – advocate for sustainability staff and composting curriculum	Change definition of yard waste to include all organics	Compost quality standards & testing
Working with schools – hands-on training for teachers	Require the use of compost for state agency projects	Identify, map, and share compost locations

Create free & accessible resources	Rewrite definition of litter	Subsidize composting
Provide technical assistance on composting and the use of finished compost	Enforceable policies	Engagement and outreach with private sector

While not specific to Illinois, similar events have been hosted elsewhere in the U.S. with different scopes and stakeholders. An event was hosted John Hopkins University in 2019 that culminated in Post-Event Report, Wasted Food and Sustainable Urban Systems: Prioritizing Research Needs (Neff, Roe, & Siddiqui, 2019). Attendees voted to determine 11 top rated approaches to reducing wasted food. One specific approach that stands out and was not specifically called out at the Chicagoland Compost Summit is "Training and engagement of frontline actors in the food system" (p. 15). All 11 approaches can be reviewed in Table 4, page 15 of the report. The U.S Composting Council's *Improving the Circularity of Compostables & Compost* initiative hosted an event in September 2024 that led to a Common Ground Agenda (2024b). It laid out ten actions including creating an adaptable toolbox for use and implementation for all market segments to increase demand of compost, identify, develop, and improve technologies to eliminate contamination, and develop a national educational campaign on composting.

Two additional Illinois specific reports that outline barriers and strategies for reducing wasted food and keeping it out of landfills include the *Food Scrap Composting Challenges and Solutions in Illinois Report* published in 2015 by Seven Generations Ahead on behalf of the Illinois Food Scrap & Composting Coalition and the *Illinois Food Waste Action Plan* published in 2021 by Seven Generations Ahead and members of the Wasted Food Action Alliance (including ISTC). The first report provides an overview of existing infrastructure, the benefits and importance of composting, model policies and programs, compost quality standards and economic potential, as well as challenges and solutions to strengthening the compost industry in Illinois. The full list of challenges and solutions appears in in Table 12. The second report focused on three priority solutions:

- Promote and connect waste food prevention, rescue, and recycling services and programs.
- Actively support food system stakeholders to reduce waste food with targeted food waste reduction education and activities.
- Develop and support policy addressing wasted food prevention, rescue, and recycling.

Table 12. Challenges and Solutions to Strengthening the Illinois Compost Industry. Please note that solutions were summarized for readability. Please see the full report above for more detail on these solutions.

Challenge	Solution
Need for education	Conduct economic analysis
	Conduct education on benefits of food scrap composting
Low landfill tipping fees	Restructure the cost of sending material to landfills through policy
Lack of demand for composting	Enact state policies to increase demand for food scrap composting
	Incentives and tax breaks for food scrap composting
Lack of composting infrastructure	Revise Illinois compost site regulations and composting site permitting process
	Map infrastructure and develop strategy for increasing facilities
	Expand pilot program that allows existing yard waste transfer stations to accept food scraps and incentivize new transfer stations
	Market acceptance of food scraps to waste treatment facilities with anaerobic digestion and stand-alone anaerobic digesters
	Develop training for compost sites and yard waste transfer stations to being to accept food scraps
	Certification and development of more compost site operators
	IEPA reporting on data from licensed compost facilities
	Continue and expand composting grant programs
Contamination of food scraps	Provide grants and education for food scrap generators
	Pass legislation requiring food sold in Illinois to have paper labels
	Facilitate education and communication between food scrap generators, haulers, and compost sites
	Support development of national standards for labeling

Lack of end markets for compost	Develop marketing strategy including education, advocacy, and policy
	Require state and government agencies to include a 30% minimum compost requirement as part of any public sector projects
	Grant funding for “buy local compost” education
	Develop a consumer-targeted composting media campaign
	Incentives that encourage use of compost within farming operations

A useful tool to compare solutions for reducing and diverting food scraps from the landfill is the ReFED Solutions Database. This tool models and provides analysis of more than 40 solutions and can be filtered by impact metrics, stakeholder groups, food types, capital types, and state within the United States. This tool identified the top five solutions to diverting the most tons of food waste (among all stakeholders, all food types, and all capital types) in Illinois as:

- Centralized composting
- Centralized anaerobic digestion
- Co-digestion at wastewater treatment plants
- As noted in the infrastructure section, this is currently happening at three facilities in Illinois - Danville, Downers Grove, and Urbana (EPA). The Water Environment Federation lists over 100 anaerobic digestion operations across Illinois, which leaves ample room for growth of codigestion as a solution to organic waste management.
- Manufacturing line optimization
- Consumer education campaigns

Each of these solutions can be analyzed further to review challenges, necessary stakeholder actions, and financial and impact metrics.

One of the primary barriers restricting the growth of food waste recycling in Illinois and beyond is contamination, particularly plastic contamination. A 2024 report by Closed Loop Partner’s Center for the Circular Economy & The Composting Consortium titled *Don’t Spoil the Soil: The Challenge of Contamination at Composting Sites* (Barry et al, 2024) details their work with ten composting facilities across the country to measure and better understand plastic contamination. The study summarizes economic challenges with contamination including extra time and labor costs for compost facilities; environmental challenges like plastic contamination threatening the safety and quality of finished compost; and social challenges like contamination discouraging yard waste compost facilities from accepting food yard and limiting the compost industry’s role in contributing to a circular economy for food waste. The report outlines solutions including:

- policy and financial drivers;
- education and labeling to reduce consumer confusion about compostable packaging;
- continued education on the value of compost and healthy soil; and
- future research and innovation on mitigation techniques.

The U.S. EPA report *Emerging Issues in Food Waste Management: Plastic Contamination* (IFC, Inc., 2021c) also explores the impacts of plastic contamination on food waste recycling. This report also details solutions that prevent plastic contamination and includes:

- education and outreach campaigns targeting consumers, food service providers, and processors;
- cart-tagging programs by haulers and local jurisdictions;
- well-defined hauler contracts;
- stakeholder meetings with supply chain vendors, commercial end users, and cities;
- efforts by the food industry to reduce the use of single-use plastic packaging; and
- local ordinances and bans on specific plastic items, such as non-compostable produce stickers.

In October 2024, a meeting was hosted jointly by the Canadian Produce Marketing Association and the Compost Council of Canada brought together stakeholders to accelerate the transition to certified compostable produce stickers. An action plan is set to be released by the end of 2024.

Another contamination of concern is chemicals, particularly per- and polyfluoroalkyl substances (PFAS), a category of more than 4,700 substances also known as "forever chemicals" because they do not break down naturally. This is still an emerging field of research and there are currently no state or national standards on allowable levels of PFAS in finished compost or digestate from anaerobic digestion. The U.S. EPA report *Emerging Issues in Food Waste Management: Persistent Chemical Contaminants* (IFC Inc., 2021b) notes that biosolids-based products (i.e., treated biosolids, composted biosolids) have the highest concentration of PFAS, followed by food waste compost, yard waste compost, and then other organic composts. Data suggests that food waste streams may be a primary contributor of PFAS in compost, most notably meat and seafood. The report recommends strategies to mitigate risks from PFAS in compost and digestate including upstream solutions such as:

- phase-outs and bans,
- feedstock restrictions (as data becomes available on types of feedstocks that are likely to have higher levels of chemical contamination),
- restricted uses for composts and digestates with higher levels of contamination such as landfill cover and roadway projects rather than farmland, and
- concentration limits that pose no risk or an "acceptable" level of risk.

It should also be noted that PFAS enters the human food chain and the human body in numerous ways and many contain far more PFAS than compost including the dust in your home, foodservice cookware, lipstick, take-out food packaging, and more (Brown, 2024).

Another barrier to organics diversion is efficient collection of organic waste. One potential solution is pre-processing organic waste onsite in homes or businesses. Examples of pre-processing technologies include grinders, biodigesters, pulpers, dehydrators, and aerobic in-vessel units (IFC, Inc. 2021a, ii). A 2022 study conducted by the City of Nelson (British Columbia, Canada) titled Organics Diversion: Summary of Feasibility Study for Residential Pre-Treated Organics Diversion Program found that pre-treatment could reduce more GHGs and divert more waste than a weekly curbside organics program and be more cost effective. The study noted that while curbside collection may be an efficient solution for urban centers, pre-treatment options might make sense for rural areas. One challenge pointed out by the study is the use of pre-treated organic waste, which is not stabilized compost. The City of Nelson provided some guidance on how it can be applied in home gardens, but also provided drop-off locations for the material.

Biocycle recently published an article (Alexander, 2023) and a study (Alexander, 2024), discussing the confusion and challenges with pre-processing technologies and the differences between the product coming by these technologies in comparison to stabilized compost. Locally, Illinois State University provides an example of pre-processing organic waste. All food waste generated in dining halls is sent through a grinder and pulping system, creating a drier, lighter weight material which is then picked up and taken to a compost facility for further processing.

One solution rarely mentioned in any of the previous reports and studies is the ability for anaerobic digestion facilities to handle some streams of food waste that pose challenges for the composting industry. De-packaging equipment often found at stand-alone anaerobic digestion facilities can provide a solution for large scale food manufactures and processers that do not have the time or labor to de-pack food that is wasted or deemed unfit for consumption/sale. Green Era in Chicago provides an example of this solution at work.

While this chapter focuses on food waste and yard waste, it should be noted that various types of compostable packaging continue to enter the market. While anaerobic digestion may be a fit for de-packing food and setting the packaging aside for recycling or landfilling, it may not be a solution for compostable packaging. A study conducted by The Composting Consortium and Closed Loop Partners, *What Role Can Anaerobic Digestion Play in Processing Compostable Packaging?* (2024b) notes that “based on current market drivers, pre-processing methods, and prevalent technologies, current large-scale U.S. AD infrastructure is ill-equipped to handle compostable packaging at scale” (p. 22).

While there are many strategies to reduce and divert wasted food, there are also several reports that focus on missing information and areas for additional research.

- Closed Loop Partners & Composting Consortium's Breaking it Down: THe Realities of Compostable Packaging Disintegration in Composting Systems calls for further research on testing compostable packaging at compost facilities (Luu, et all, 2024).
- A 2021 U.S. EPA report, From Farm to Kitchen: The Environmental Impacts of Food Waste (Jaglo, Kenny, & Stephenson, 2021) identifies 12 areas that need further research. Examples include improved precision of food loss and waste estimates, deepening our understanding of food loss and waste drivers, and evaluating the effectiveness of policy and program options to reduce food loss and waste.

A 2023 U.S. EPA report, From Field to Bin: The Environmental Impacts of U.S. Food Waste Management Pathways (Kenny et al, 2023a) examines ten areas where further research is needed. These include environmental impacts of understudied pathways like upcycling and land application, methane generation from waste food in the sewer, and benefits of replacing peat with compost, digestate, or biosolids.

- A 2021 U.S. EPA report, Emerging Issues in Food Waste Management: Persistent Chemical Contaminants, calls for further research in 9 areas including the development of a multi laboratory-validated analytical method to detect PFAS in solids, transformation of PFAS during composting and anaerobic digestion, and long-term impacts of PFAS after land application.
- A 2021 U.S. EPA report, *Emerging Issues in Food Waste Management: Plastic Contamination* (ICF, Inc., 2021b) calls for further study in nine areas including research to determine impacts of technologies (shredders, grinders and de-packagers) on the level of plastic contamination, identifying the most effecting strategies to prevent plastic contamination in food waste streams, assessing exposure and potential risks to human and environmental health from land application of plastic-contaminated compost and digestates.
- A 2021 U.S. EPA report, U.S. EPA, *Emerging Issues in Food Waste Management: Commercial Pre-Processing Technologies* (ICF, Inc, 2021a) identifies eight areas for future research including impacts of "wet" pre-processing outputs on municipal sewer systems and waste water recovery facilities, fugitive methane emissions from sewer conveyance, and land application of dehydrated food waste.
- *Current and Prognostic Overview of Digestate Management and Processing Practices, Regulations and Standards* (Dhull Et al., 2023) identifies for the need for further research on procedures for testing and quality assurance mechanisms of digestate and their applications.
- A 2024 study conducted by The Composting Consortium and Closed Loop Partners, *What Role Can Anaerobic Digestion Play in Processing Compostable Packaging?* calls for additional research on the efficacy of anaerobic digestion with various compostable materials.

Additional resources that look specifically at policy solutions to diverting food waste form landfills include:

- The Zero Food Waste Coalition, *Achieving Zero Waste: State Policy Toolkit* (2023)
- Institute for Local Self-Reliance, Waste to Wealth Policy Library (n.d.-b)
- Closed Loop Partners, *Why Composting is a Triple Win for States: On Budget Savings, Soil Health, and Climate* (2024c)
- National Resource Defense Council, *Illinois Food Waste Policy Gap Analysis and Inventory* (Center for EcoTechnology, 2021)
- The Global Food Donation Policy Atlas, *National Food Waste Donation Strategies* (Plekenpol, Broad Lieb, & Findley, 2024) and *Emissions, Environmental, and Food Waste Reporting Policies* (Plekenpol, Broad Lieb, & Norton, 2024)

Plastics

This chapter focuses on the generation, collection, recycling, and end markets for rigid PET, HDPE, and PP plastics, which were chosen based on conversations with the IEPA and stakeholders involved in the Materials Management Advisory Committee (MMAC) Report to the General Assembly in 2021. *However, some of the information below related to environmental and health impacts, policy, goals, and environmental justice (EJ) apply more broadly to all types of plastics.* Overviews of human and environmental health impacts; existing and proposed policies; relevant state, national, and global goals; and best practices are also included, along with examples of funding opportunities and educational materials to support improved recycling. Additional resources associated with these topics can be found in a public Zotero group library entitled "Plastics Impacts, Reduction, & Diversion," compiled and maintained by the Illinois Sustainable Technology Center (ISTC) Technical Assistance Program (TAP).

This chapter does not address thermoset plastics (aka thermoplastics), which are difficult to recycle (Frankling-Cheung, n.d.). Although flexible plastics and plastic film are not covered in this report, some forms (e.g, single-use retailer bags) can be made from HDPE. This chapter focuses on rigid, non-film resins #1, #2, and #5 where such specific information is available, but in many cases information for HDPE will not be broken out by rigid vs. film/flexible plastic.

Textiles made from plastic polymers including PET (especially fleece made from recycled bottles) and PP are also common. According to the UN Environment Programme (UNEP) (2019) about 60% of material made into clothing is plastic. However, this chapter will not address polymers in textiles except when relevant to end markets, solutions, or research gaps.

Management of "plastics" will sometimes overlap with management of other material categories. In fact, plastics will often be a contaminant within other material streams (e.g., bits of plastic food packaging within organics streams at composting facilities, plastic within glass coming from MRFs, etc.).

Definitions

Under Illinois law (30 ILCS 500/45-23), "plastic" is a synthetic material made from linking monomers into polymer chains that can be molded or extruded at high heat and retain their shapes throughout their life cycle. A "plastic container" is a device "used to contain or protect merchandise ultimately intended for retail sale, or to contain waste for disposal," and a "recyclable plastic container" is made of only one type of plastic and has an effective recycling market in Illinois.

Plastics are composed of monomers (Editors of Encyclopaedia Brittanica, 2020), which bond to form polymers (Editors of Encyclopaedia Brittanica, 2024). The 2015 Illinois Commodity/Waste Generation and Characterization Study Update (IC/WGCS) (CDM Smith, 2015) and the 2018

MMAC report contain definitions of these materials previously used in Illinois waste characterization. The following definitions are derived from U.S. EPA (U.S. EPA WasteWise, n.d) guidelines and an infographic on plastics by Compound Interest (Brunning, 2015).

- Polyethylene terephthalate (PET/PETE; #1): A lightweight polymer of varying rigidity common in beverage bottles, packaging, and textiles (e.g. polyester).
- High-density polyethylene (HDPE; #2): Used in bottles for milk, juice, and household products like cleaners due to its chemical, physical, and thermal resilience. Not to be confused with low-density polyethylene (#4) which is usually film.
- Polypropylene (PP; #5): Found in packaging, fibers, and automotive parts.

Other plastic terms include:

- According to Leslie et al (2022), " 'Microplastic' is a term for plastic particles for which no universally established definition exists. In the literature, microplastic is often defined as plastic particles up to 5 mm in dimensions with no defined lower size limit (e.g. Arthur et al., 2009; GESAMP, 2015; ECHA, 2019). 'Nanoplastic' is a term for plastic particles in the submicron range, <1 μm. In the nanotechnology field, 'nanoplastic' may refer to engineered particles <100 nm, i.e. the nanotechnology application size limit" (p. 1)

The following terms related to chemical hazards are defined in *State of the Science on Plastic Chemicals: Identifying and addressing chemicals and polymers of concern* (Wagner et al, 2024, p.8), discussed in the "Impacts on Environmental & Human Health" section of this chapter.

- **Persistence:** Long term presence of a chemical in the air, water, soil, or an organism.
- **Bioaccumulation:** The potential of a chemical to stay and accumulate (i.e., build up) in wildlife and humans.
- **Mobility:** The potential of a chemical to spread in fresh- and drinking water systems.
- **Toxicity:** The potential of a chemical to cause harm to living organisms.

The following terms related to plastic recycling methods are defined in *State of the Science on Plastic Chemicals: Identifying and addressing chemicals and polymers of concern*, *(p. 69)* and a blog by Nexanteca (Dolan, 2022).

- **Mechanical Recycling-Product to Product**: A closed product-recycling chain where plastics are shredded, melted, pelletized, and remolded into a similar product (e.g., bottle to bottle).
- **Mechanical Recycling-Product to Pellet**: Recycled plastics are sorted by polymer type and shredded, pelletized, and remolded to a different product.
- **Chemical Recycling (aka chemical depolymerization)**: Chemical processes break down polymer chains into monomers (atoms or small molecules that can bond together

to form more complex structures) and oligomers (polymer fragments). May also refer to "Advanced Recycling," see below.

- **Thermal Conversion** (aka thermal depolymerization): Plastic is pyrolyzed (medium/high temp) or gasified (high temp), and turned into fuel and naptha, which may be distilled to make plastic monomers or burnt for energy.
- **Solvent-based recycling (aka solvent purification):** Plastic is dissolved in solvent, separated from additives and impurities, and re-pelletized and remolded without changing their chemical structure. Different types of polymer chains can be separated from each other for cleaner product.

The terms "advanced," "tertiary," or "molecular" recycling are sometimes used synonymously with chemical recycling. This document uses the broadest definition of advanced recycling by encompassing solvent-based recycling, chemical depolymerization, and thermal conversion. See "What is Chemical Recycling" (Green Rose Chemistry, n.d.) and "Solvent-based purification – A good fit between mechanical and chemical recycling" (Dolan, 2022) for further details. See also "Impacts on Environmental & Human Health" in this chapter.

Generation

Appendix H of the MMAC report (MMAC, 2021, pp.214-218) shows the generation of rigid PET, HDPE, and PP in Illinois as of 2018. The data for plastics appears in Table 13 below. The MMAC report notes that due to a lack of annual reporting protocol, Illinois lacks the data to reliably report past or present generation or diversion rates (p.23). The MMAC used waste generation and diversion data from the 2015 Illinois Commodity/Waste Generation and Characterization Study (IC/WGCS) (CDM Smith, 2015) along with 2018 landfill data to create diversion and recovery rates for 2018 (IEPA, 2018). GHG impact factors were calculated using the U.S. EPA WARM model (U.S. EPA, n.d.-c). "IL Disposed Tons" refers to materials disposed in Illinois landfills.

Table 13: Estimated Generation & Disposal Information for Rigid PET, HDPE, and PP in IL in 2018 (adapted from MMAC Report, Appendix H, as defined in the IC/WGCS, Appendix A, Work Plan, where they are listed as "Notes/Examples" in the "IRA Proposed Material List" table.)

Rank (by weight) of IL Landfilled Material in 2018	Material Category	Status of Recycling Programs in IL	Diversion rate (2018)	IL Generated Tons (2018)	IL Disposed Tons (2018)	GHG Impact mTCO2 Reduction Potential

10	Other Rigid Plastic Products*	Established Program	18%	465,844	383,839	(403,031)
17	Other Plastic*	Pilot Programs	1%	285,646	283,779	(297,968)
29	#1 PET Bottles/Jars	Established Program	9%	182,363	165,564	(193,710)
33	Plastic C&D Materials*	Pilot Programs	58%	342,153	144,422	N/A
37	#3-#7 Other – All*	Limited Programs	1%	104,863	103,619	(108,800)
47	#2 HDPE Bottles/Jars – Clear	Established Program	35%	92,084	59,605	(69,738)
48	#2 HDPE Bottles/Jars – Color	Established Program	35%	85,202	55,088	(64,453)
51	#1 Other PET Containers	Established Program	9%	51,131	46,403	(54,291)
71	#2 Other HDPE Containers	Established Program	36%	5,961	3,845	(4,499)

** These material categories are listed because items included in their definitions can be made of rigid PET, HDPE, and PP. Because these categories are composed of multiple resin types, we cannot know the percentage generated or disposed constituted by rigid PET, HDPE, or PP.*

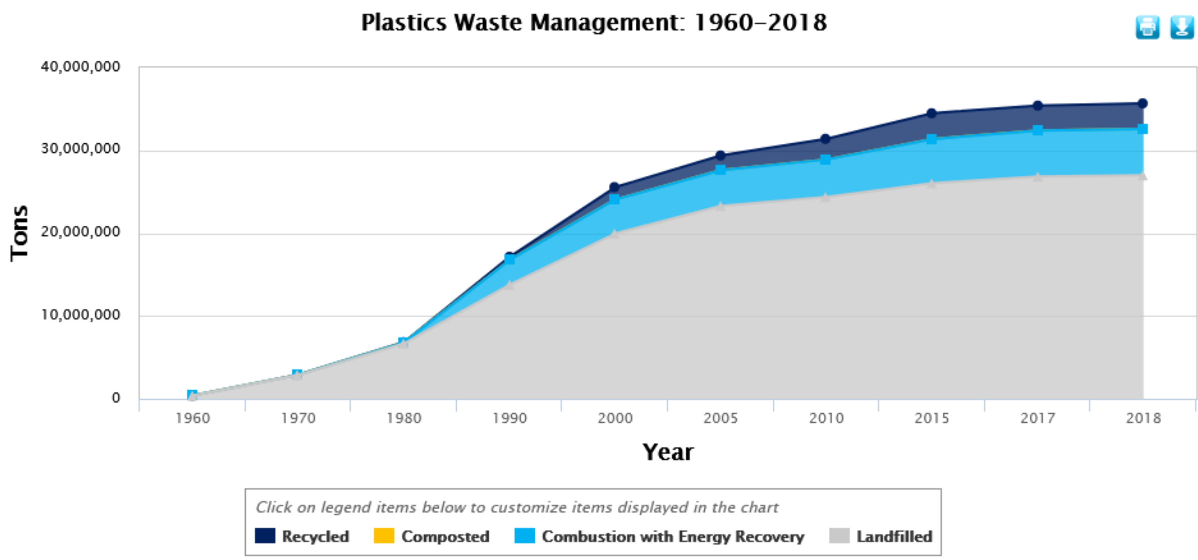
The U.S. EPA Recycling Infrastructure and Market Opportunities Map (U.S. EPA, 2022) highlights existing infrastructure, generation, per capita generation, recycling of post-consumer material, and other relevant market factors for a wide variety of recyclable materials including HDPE bottles, PET bottles, other rigid PET, PP containers, and rigids #3-#7.

General information (U.S. EPA OLEM, n.d.) on this map and details of its technical methodology (U.S. EPA OLEM, 2023) are available on the EPA website. Data will support solutions mentioned later in this chapter.

National Data

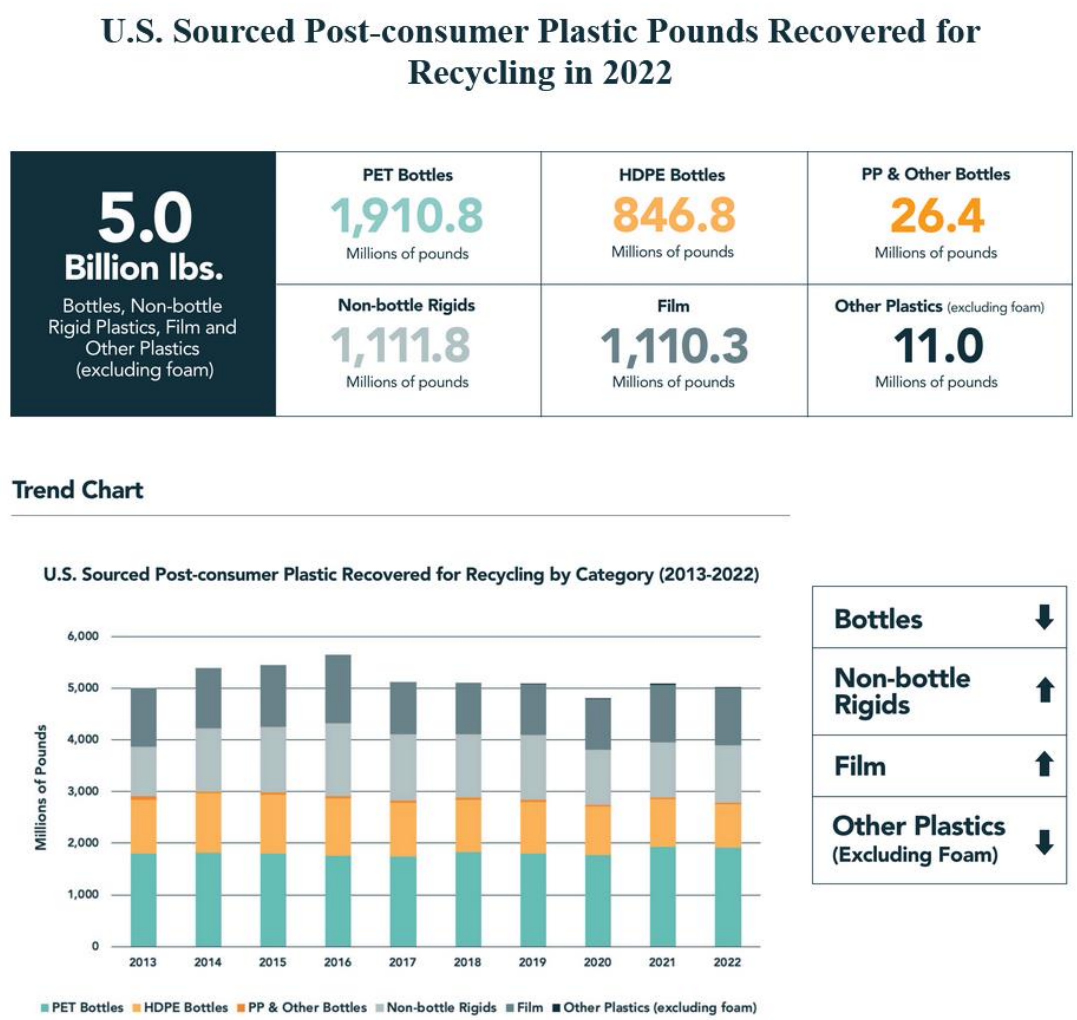
The U.S. EPA grouped all resins and forms of plastics together for generation estimates. In 2018, they estimated (U.S. EPA, n.d.-n) that the U.S. generated 35,680,000 tons of this mixed plastic in MSW only, not including Industrial, Commercial, and Institutional waste. Of that generated waste ((U.S. EPA, n.d.-r), 26,970,000 tons of "plastics" (mixed) were sent to MSW landfills; 3,090,000 tons (or 6,180,000,000 lbs.) of plastics were recycled in the U.S. in 2018, and 5,620,000 tons were disposed via combustion with energy recovery (see Figure 2 below). This data is not specific to rigid PET, HDPE, or PP. It is included to provide national context. In describing its material-specific data for "plastics," U.S. EPA states that in 2018, 29.1% of PET bottles and jars and 29.3% of HDPE natural bottles were recycled.

Figure 2. U.S. Plastics Waste Management 1960-2018 from U.S. EPA Advancing Sustainable Materials Management: Facts and Figures Report (U.S. EPA, n.d.-r)



The Association of Plastics Recyclers 2022 U.S. Post-Consumer Plastic Recycling Data Dashboard study, conducted by Stina Inc. (Stina, Inc., 2024) indicates that in 2022, 1,910.8 million lbs. of PET bottles, 846.8 million lbs. of HDPE bottles, 26.4 million lbs. of PP and other bottles, and 1,111.8 million lbs. of non-bottle rigid plastics were recovered for recycling (see Figure 3 below). This data includes all material destinations throughout North America (defined as US, Canada, and Mexico) and overseas. The total of 5 billion lbs. of plastics recovered for recycling in 2022 indicates a downward trend from the U.S. EPA 2018 referenced above, though there may some differences in data collection methodologies. The 2022 Stina, Inc. data indicate that 6.3% of the US-sourced plastics recovered were exported overseas, while 93.7% went to destinations within North America.

Figure 3. U.S. Sourced Plastics Recovered for Recycling. (Stina, Inc., 2024)



Impacts on Environmental & Human Health

According to the Minderoo-Monaco Commission on Plastics and Human Health (Landrigan et al, 2023), global annual production of plastics reached 460 million metric tons in 2019, and is expected to triple by 2060.

Geyer, Jambeck & Law (2017) estimated that " as of 2015, approximately 6300 Mt of plastic waste had been generated, around 9% of which had been recycled, 12% was incinerated, and 79% was accumulated in landfills or the natural environment. If current production and waste management trends continue, roughly 12,000 Mt of plastic waste will be in landfills or in the natural environment by 2050" (p.1).

U.S. EPA (n.d.-a) estimates that plastic waste generated in the U.S. "has grown continuously since 1960, with the greatest increases occurring between 1980 and 2000. Plastic waste generated in the U.S. increased from 0.4% of total municipal solid waste in 1960 to 12.2% in 2018, reaching 13.2% in 2017." Given this tremendous volume of material, recycling alone is not an adequate management strategy. As indicated in the "Policy/Regulations" and "Existing Goals" sections below, national and global efforts to address plastic waste and pollution recognize the need to consider ways to simultaneously reduce non-essential plastic production and consumption.

This section on impacts on environmental and human health is extensive but not exhaustive. Plastics production and recycling carry complex and serious risks. Further research is needed on health and environmental impacts as well as recycling and source reduction solutions. One potential way to support source reduction is fostering participation among Illinois stakeholders in the U.S. Plastics Pact, a consortium that works with its members to take measures to eliminate problematic and unnecessary resins, components, and formats and accelerate progress toward a circular economy for plastic packaging in the United States. Their Problematic and Unnecessary Materials List (2024d) states, "Plastic packaging items, components, or materials where consumption could be avoided through elimination, reuse or replacement and items that, post-consumption, commonly do not enter the recycling and/or composting systems, or where they do, are detrimental to the recycling or composting system due to their format, composition, or size" (p.2). Though not specifically focused on human and environmental health, the list does include intentionally added PFAS and may be updated over time to include other potentially hazardous additives. Additional suggestions for source reduction will be discussed later in this chapter.

Additional materials pertaining to the environmental and human health impacts of plastics recycling can be found in the previously referenced public Zotero group library, "Plastics Impacts, Reduction, & Diversion."

Environmental Plastic Pollution

The United Nations Environment Programme (UNEP) (n.d.-b) estimates that 19-23 million metric tons (Mt) of plastic waste enters aquatic environments (e.g. rivers, lakes, oceans) every year. This waste consists mainly of containers and packaging including single-use products and excludes plastic waste from other sources, such as agricultural plastics. U.S. EPA (U.S. EPA Research, 2024) notes that plastic waste can intentionally or unintentionally enter the environment throughout the product lifecycle. The agency lists the following sources of plastic pollution:

- Resin pellets leaking during plastic production.
- Mismanaged waste (e.g., waste collected but improperly or illegally disposed of or waste that is not collected in areas where solid waste management services exist).
- Litter (e.g., items discarded in the environment).

- Abrasion (e.g., “wear-and-tear”) and losses of microplastics.
- Industrial and marine activities.
- Catastrophic events.
- Urban and stormwater runoff.
- Washing machine wastewater.

All these sources apply to PET, HDPE, and PP (rigid or otherwise), including washing machine wastewater, because PET encompasses polyester used in textiles.

Wildlife can be acutely and/or chronically harmed. Ingestion of plastics can block or damage intestines, often resulting in death. The Earth.Org article “*Detrimental Impacts of Plastic Pollution on Animals*” (Lai, 2022) provides an overview of impacts on marine and land animals, including humans.

When plastic accumulates in the natural environment, it does not disappear over time. Instead it breaks down into smaller and smaller pieces, ultimately becoming microplastics or nanoplastics as defined in Definitions above. These tiny particles can accumulate in wildlife and in humans.

The National Oceanic and Atmospheric Association (NOAA) (2022b) reports that microplastics have been found worldwide, even in protected areas, and have been documented in sea ice in the Arctic and on the ocean floor. Santos et al (2021) reported that more than 1,500 species of wildlife in marine and terrestrial environments are known to ingest plastics. Dziobak et al. (2024) reported the first evidence of marine mammals inhaling plastic particles, in the form of microplastic in the exhaled breath of 11 wild bottlenose dolphins off the coasts of Louisiana and Florida. Humans also regularly ingest and inhale plastics (Zhu et al,2024). Plastic particles have been found in human breastmilk (Ragusa et al, 2022), placentas (Ragusa et al, 2021), lungs, small intestines, large intestines, tonsils (Zhu et al, 2024), and testicles (Hu et al, 2024), as well as livers, kidneys, and brains (Campen et al, 2024). Leslie et al (2022) conducted a study involving analysis of blood from 22 healthy volunteers found that 17 of them (approximately 77%) had plastic particles in their blood. Of the resins focused upon by ISTC for this report, PET and PE were measured in amounts above the limits of quantification (LOQ; lowest concentration of a substance that can be measured accurately and precisely with a given analytical procedure) in the blood samples; PP was present but below the LOQ.

The impacts of plastic particles on environmental and human health are not fully understood and to say “additional research is needed” is an understatement. An April 25, 2023, article in BioCycle written by Craig Coker outlines what is known about microplastics pollution (MP) and identifies research gaps related to human and environmental health. Regarding soil health, Coker writes “Microplastics in soils have been found to increase soil aeration, water repellence and porosity but to decrease soil bulk density and aggregate sizes (e.g., Kim et al., 2021; Qi et al., 2020)." Microplastics pollution also influences the flow of nutrients in and water content of soil. Illustrating that plants as well as human and non-human animals are impacted, Coker explains that microplastics can adhere to seeds and roots, negatively impacting seed germination, root elongation, absorption of water and nutrients, and plant growth. He writes that plastic particles absorbed by roots can move to stems, leaves, and fruits (Wang, 2022). This means that food crops may be stunted or contaminated by plastic pollution. For example, researchers at the University of Catania, Italy, have found plastic particles in fruit and vegetables like carrots, lettuce, apples, and pears (Oliveri Conti et al, 2020). Coker also cites studies indicating that soil microorganisms are affected by microplastics. He states, "There are effects on species dominance, diversity and richness reported in the literature (e.g., Blöcker et al., 2020; Fei et al., 2020; Ren et al., 2020) and MPs have also been found to cause oxidative stress and abnormal gene expression in earthworms (which can consume and transport MPs) (Cheng et al., 2020)."

Microplastics and Chemicals in Food and Beverage Packaging

Exposure to chemicals and microplastics associated with food and beverage packaging is an important concern for human health. A 2019 study by Winkler et al. involving PET bottles and HDPE caps showed that microplastics are present in bottled water, that opening and closing bottles increases the presences of microplastics in the bottled water, and that frequent use of the same plastic bottle increases chances of microplastic ingestion. Stevens et al published a study in March 2024 that found endocrine- and metabolism-disrupting chemicals in single-use and reusable plastic food contact articles made of seven polymer types, including PET, HDPE, and PP, across five countries. Some of these chemicals are intentional additives, like plasticizers and stabilizers, while others may have been formed by side reactions, impurities in the starting ingredients, or the degradation of a plastic container over time. McPartland et al (2024) showed that plastic particles can interact with cell signaling receptors.

The 2024 report "*State of the Science on Plastic Chemicals: Identifying and addressing chemicals and polymers of concern*" (Wagner, et al) (Hereafter referred to as "State of the Science,") synthesizes publicly available evidence on chemicals potentially used or present in plastic materials and products. The authors note key knowledge gaps and blind spots, saying that based upon their findings**,** many plastic chemicals cannot be adequately assessed or controlled because they lack publicly available and verifiable information on chemical identities, functions, production volumes, uses, or hazards (p. 24 and p. 38). Over 9000 (~60%) of the 16,325 potential plastic chemicals lack publicly available information on their origins or uses in plastics in the public domain (p. 24). Most (>10,000) lack hazard information. Only one compound has been fully assessed for all hazard properties (p. 38).

Regarding the resin types focused upon by ISTC for this report, the authors said, "More than 100 chemicals of concern are released from PET, PP, and PE. In PET, 292 chemicals of concern are known to be used, 329 have been detected, and another 143 compounds are released. In PP, 253 hazardous chemicals are used, and scientific studies have demonstrated that another 107 and 197 chemicals are either detected in or leach from the polymer. For PE, 399 hazardous compounds have market information for their use, and 136 and 187 chemicals have scientific evidence for their presence and release, respectively. Interestingly, only 42 (PET), 76 (PP), and 56 (PE) chemicals of concern have been analyzed in these polymers but were not detected. Taken together, this provides strong evidence that many chemicals in these polymer types can be released and have, thus, a high exposure potential" (p. 60).

A 2024 paper (Trasande & Krithivasan et al, 2024) determined the relative role of plastics in diseases, then estimated their attributable disease burden and costs in the United States in 2018 to be $249 billion, or between $226 and $289 billion. Most of these costs were due to PBDE, phthalates, and PFAS.

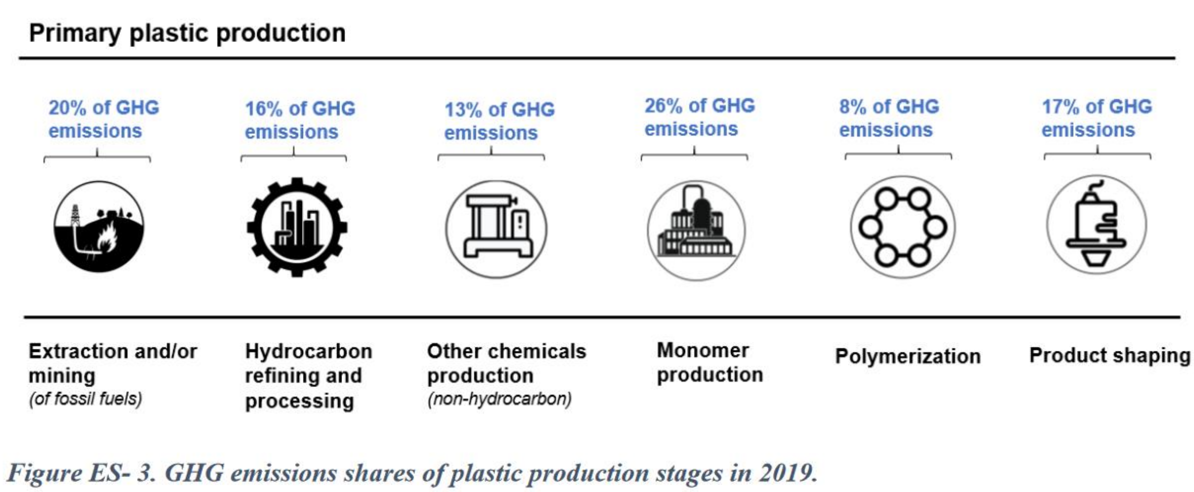
Greenhouse Gas Emissions

Plastic pollution can also generate greenhouse gases. A 2024 report published by the Lawrence Berkeley National Laboratory (Karali, Khanna & Shah, 2024) stated:

> Our estimates show that GHG emissions from plastic production (from extraction of fossil fuels to shaping of the final product) could amount to the equivalent of 2.24 GtCO2 e in 2019, representing 5.3% of total global GHG emissions (excluding agriculture and land use, land-use change and forestry (LULUCF)).4 In comparison, the global aviation sector generated 0.6 GtCO2 of CO2 emissions in 2019, while the global transport sector, including aviation, generated a total of 8.3 GtCO 2 in 2019. (p. 3)"

The researchers found that around 75% of the greenhouse gases generated in plastics production are released before polymerization and shaping of plastics, generally from fossil-fueled heating and electricity. Twenty-one percent (21%) and 15% of emissions come from PET (#1) and PP (#5) respectively. They state, "At 4%/yr growth, emissions from primary plastic production would increase more than three times to 6.78 GtCO2e, accounting for 25-31% of the remaining global carbon budget for limiting global warming to 1.5°C" (p. 1).

Figure 4. GHG Emissions Shares of Plastic Production Stages in 2019 (Karali et al., 2024,, p. 5).



Hazards associated specifically with recycling of plastics and recycled plastics

The magnitude of emissions associated with primary plastic production supports the case for recycling plastic and using post-consumer recycled (PCR) plastics in products rather than virgin plastics. Improving collection and diversion of plastics from landfills is also important due to the dwindling capacity of the 36 permitted IL landfills. Illinois EPA's *Illinois Landfill Disposal Capacity Report – 2023*, released in July 2024, estimated landfill capacity in the state to be approximately 32 years. In a presentation for the 2024 Illinois County Solid Waste Management Association (ILCSWMA) conference, Matthew Loula of Geo-Logic Associates (formerly APTIM) reported the total landfill capacity in Illinois was approximately 21 years. This estimate perhaps incorporates data collected since calendar year 2023. Plastics recycling, however imperfect, must be seen as a preferable alternative to landfilling.

There are hazards associated with plastic recycling and with recycled plastics (addressed below) that need to be studied and considered as the state works to foster improved plastics recycling and diversion. These efforts work in concert with reduced plastics use. This will be reflected in national plans and global treaties discussed in the "Policy/Regulation" section later in this chapter.

Environmental Justice

According to the Minderoo-Monaco Commission on Plastics and Human Health (Landrigan et al, 2023), "The adverse effects of plastics and plastic pollution on human health, the economy and the environment…disproportionately affect poor, disempowered, and marginalized populations …whom had little to do with creating the current plastics crisis and lack the political influence or the resources to address it" (p. 4). The data related to collection and processing infrastructure contained in the MMAC Report (discussed below in the "Collection & Processing Infrastructure in IL" section) should be compared with data from U.S. EPA's EJ Screen tool (unofficial mirror here, compiled by the Public Environmental Data Project in January 2025) and/or IEPA's EJ Start mapping tool to determine where such infrastructure occurs in disadvantaged communities. This is in line with Objective D2 from the U.S. EPA National Strategy to Prevent Plastic Pollution (U.S. EPA, 2024a), "Support state, local, Tribal and territorial governments in their efforts to improve waste management to avoid adverse human health and environmental impacts, especially for communities with environmental justice concerns" (p. 30). This national strategy will be discussed further in the "Policy/Regulations" section later in this chapter.

Collection & Processing Infrastructure in Illinois

When discussing infrastructure, it's important to remember that "some infrastructure has no unifying definition such as material recovery facilities, consolidation facilities, and collection drop-offs" (MMAC, 2021, p. 32). Material recovery facilities (MRFs) handle both collection (receiving materials from consumers and businesses via haulers) and processing (through material separation, cleaning, and preparation for transport to recycling or manufacturing facilities).

As shown in Table 13 above, the MMAC found that collection programs for PET and HDPE are well-established in Illinois. Collection programs related to PP encompass pilot, limited, and established programs. For all materials, collection programs "vary depending on geography, volume, material, and investments. Drop-offs, recycling centers, curbside, and one-day collection events are only some of the examples of collection programs. New programs are continuously being developed both in the private and public sector" (p.54). The committee also discusses the lack of infrastructure in certain regions of Illinois and the financial challenges with operating facilities with higher unit costs due to lower waste generation (p. 50). The lack of collection infrastructure in less populous areas of the state will pose a persistent challenge to increasing collection of rigid PET, HDPE, and PP, as well as other materials. See the Challenges & Solutions/Best Practices section below, as well as the chapter on Stakeholder Engagement for further discussion and additional barriers.

Nearly all curbside collection and multi-material drop-off programs include PET and HDPE because these commodities are in high demand for packaging and other products regardless of market fluctuations. Many programs that list "plastics" among their accepted items also accept PP. As part of the aforementioned waste characterization study/recycling needs assessment, a more accurate and up-to-date characterization of collection and processing infrastructure is forthcoming. The following information is a starting point for the chosen recycling needs assessment consultants to verify and expand upon.

Relevant Figures and Supporting Appendices from the MMAC Report

- Figure 8 (p. 41) is a map of Municipal Solid Waste Transfer Stations in Illinois. Reflecting the point that infrastructure is more readily available in populous areas, there are more waste transfer stations in IEPA Region 2 (northeast corner of state). Appendix G.2 (pp. 166-169) provides location details; there 76 total transfer stations.
- Figure 10 (p. 43) is a map of Construction & Demolition Recycling Sites in Illinois, relevant because C&D waste is highly heterogenous; many plastic C&D materials may be composed of rigid PET, HDPE, or PP (Pivnenko, 2018). Most sites are in Illinois EPA Region 2. Detailed location information is available in Appendix G.4 (pp. 172-174). 53 total sites are listed.
- Figure 12 (p. 45) is a map of MRFs and Consolidation Facilities in Illinois, where a "consolidation facility" is defined as "A facility where recyclable materials are combined and temporarily stored for later shipment to a materials recovery facility for processing" (p. 14). Appendix G.6 (pp.178-179) provides names and addresses for these facilities. There are 40 facilities listed. These do not pertain exclusively to plastics or the other materials of focus for this report. Any location described as a "single stream MRF" (16 of the 40) would be likely to accept at least one of the plastic resin codes targeted for report.

Consolidation facilities may or may not deal with plastics. Some company names may be misleading so accepted materials for all listed facilities should be verified, e.g., according to their website, "Loop Paper Recycling, Inc." accepts a variety of materials, including rigid PET, HDEP, and PP.

- Figure 13 (p. 46) is a map of drop-off facilities in Illinois (79 total), including sites that collect common recyclable materials, electronics, and food scraps. Appendix G.7 (pp. 180-205) includes detailed location information including websites and materials accepted, if available. An analysis of "materials accepted" in Appendix G.7 indicates 30 specific mentions (by acronym or resin code number) of PET, 30 mentions of HDPE, 24 mentions of PP. These mentions do not represent separate facilities because most facilities accept multiple resin types. An additional 26 facilities list some relevant generic term (e.g. "household containers," "plastic containers," "plastic bottles," etc.). The use of imprecise descriptors may be an attempt to reduce confusion. Participants in our plastics-focused listening session asserted that residents are not aware of the different plastic resin types. A list of materials accepted was not available for three of the 79 facilities.

Additional Collection Information

IEPA Beyond the Bin Map

IEPA's interactive ARC GIS map allows citizens to locate recycling locations in their area. Users can select "Plastics" from the "Choose Recycle Materials" drop down menu. If they do not specify a location/zip code, the map will show all locations for Illinois. The Beyond the Bin Map is not completely accurate. For example, no recycling locations are included for Champaign County, although there is at least one drop-off facility in that county that accepts plastics #1-7 (Illini Recycling, which is also included on Figure 13 from the MMAC report).

Collection Rates

The Recycling Partnership report *State of Recycling: The Present and Future of Residential Recycling in the U.S.*"(Appel et al, 2024) indicates that in Illinois 85% of single-family households have access to recycling (75% curbside and 10% via drop-offs). Among multifamily households, 41% have access to recycling. Overall, 74% of Illinois households have access to recycling while 26% have no access (p. 11). Figure 10 (p. 18) indicates that nationwide, where these materials are accepted by community programs and for households participating in curbside recycling, the following are captured for recycling:

- 55% of PET bottles;
- 43% of non-bottle PET;
- 59% of HDPE bottle and jars; and
- 30% of PP.

The report also indicates that the residential recycling rate (for all materials in Illinois, is only 23% and that 1.5 million tons pers year of potentially recyclable material (all, not just plastics) are lost. Looking at Illinois residential recycling rates by commodity (Figure 18, p. 28), the Recycling Partnership indicates a recycling rate of 23% for PET bottles, 11% for non-bottle PET, 29% for HDPE natural (non-colored) bottles and jars, 26% for HDPE colored bottles and jars, and 11% for PP.

Table 14. Recycling Rates for Various Plastic Resin Types in Illinois and the U.S.

	PET Bottles	**Non-bottle PET**	**HDPE Natural Bottles & Jars**	**HDPE Colored Bottles & Jars**	**PP**
Illinois Average	23%	11%	29%	26%	11%
U.S. Average	27%	8%	26%	22%	8%
U.S. Curbside	55%	43%	59%		30%

U.S. EPA Recycling Infrastructure and Market Opportunities Map—Plastic Recycling Infrastructure

The U.S. EPA Recycling Infrastructure and Market Opportunities Map highlights existing infrastructure, generation, per capita generation, recycling of post-consumer material, and other relevant market factors for a wide variety of recyclable materials including HDPE bottles, PET bottles, other rigid PET, PP containers, and rigids #3-#7. This tool can be used to find recycling infrastructure and download relevant EPA map and contact data across the U.S. ISTC used this list to find stakeholders for focus groups, including the 12 Illinois plastic recycling facilities listed on the tool as of writing and many more near Illinois's borders (U.S. EPA OLEM, 2024).

This information is likely incomplete. In a spreadsheet downloaded from the map (U.S. EPA, 202b), the facilities are classified as NAICS 562920, the code for "Materials Recovery Facilities." As mentioned previously, the MMAC report listed 40 MRFs within Illinois. Plastics processing could also be classified with other NAICS codes, such as 423930-13 (Plastic Recycling-Wholesale) and 325211 (Plastics Material and Resin Manufacturing, which could apply to producers of PCR-content plastic feedstocks). Businesses may also be classified under more than one NAICS code depending on the variety of processes they perform.

Additional Sources of Information on Plastics Processing Infrastructure

- Thomas Net online list of companies in Illinois providing plastic recycling services: This list includes 33 companies.

- Illinois Recycling Foundation/Illinois Recycling Association Online Member Directory: Only two listings self-identify as plastic recyclers: Fortune Metal (Midwest) LLC and NGA Recycling. Many of the listings are for haulers or local government contacts and may be useful for verification of collection program status.
- Association of Plastic Recyclers member directory: Not publicly available but part of their Member Hub accessible only to members.
- APR/Stina Sort for Value Tool: Maintained by the Association of Plastic Recyclers (APR) and Stina, Inc., this tool allows MRFs to view the matrix of materials using default pricing or their own pricing/costs. The tool can support expansion of collection and processing infrastructure by helping MRFs assess the economic feasibility of various types of plastics.
- LRS 2023 Sustainability Report: Released in October 2024, this report indicates the company recycled 10,054 tons of plastic in 2023. As an update for Illinois infrastructure information outlined above, this report highlights the opening of The Exchange, its Chicago MRF which processes 500 tons a day. They also report receiving a grant from The Recycling Partnership and The Carton Council to purchase an optical sorter for cartons and PP materials to improve recovery efforts. Highlights of advanced sorting technology at The Exchange could be a model for upgrades to other facilities throughout the state and assist with funding.
- Rumpke Recycling & Resource Center, Columbus, OH. Jeff Synder presented an overview of this facility at the 2024 ILCSWMA conference. See "Rumpke opens largest MRF in North America," (Mann, 2024) a Waste Today article that describes this MRF as the "largest and most technologically advanced recycling facility in North America...with the ability to process up to 250,000 tons of recycling materials per year from more than 50 Ohio counties." Like The Exchange, this facility could also be a model for potential upgrades or new facilities.
- As noted previously, further resources can be found in the public Zotero group library entitled "Plastics Impacts, Reduction, & Diversion," compiled and maintained by the Illinois Sustainable Technology Center (ISTC) Technical Assistance Program (TAP).

End Markets

In order to improve circularity of post-consumer recycled (PCR) materials, there needs to be demand for those PCR materials within the market. Market demands are influenced by: local, national, and international policies; manufacturing processes and technical requirements/differences in quality of virgin vs. PCR materials; virgin material pricing; and overall demand for raw materials. Policies that impact demands will be discussed in further detail in the "Policy/Regulations" section. This section focuses on the other potential market influences and summarizes potential end markets for recycled rigid PET, HDPE, and PP. This list is not be exhaustive. Additional examples will be added to the "Plastics Impacts, Reduction, & Diversion" online Zotero library.

Virgin vs. PCR Material Pricing and Market Volatility

As long as oil prices are relatively low, virgin petroleum-based plastics will be less expensive than PCR plastics as industrial feedstocks because PCR prices include bale prices and the costs of processing the material. In the plastics listening session held by ISTC, the relatively cheap production costs of virgin plastics compared to PCR plastics was cited as a key barrier to improved recycling. In the July 2019 issue *of Resource Recycling*, Stina, Inc. (formerly More Recycling) stated, "Historically, companies have used post-consumer resin (PCR) because it was a lower cost feedstock than virgin. In recent years, however, pricing for virgin plastic (mostly "wide spec" resin) has fallen below that of PCR (mostly high-quality PCR that is suitable for food contact). Developing PCR that can compete with virgin resin, in terms of performance or consistency in specifications, requires significant cost in handling and processing…For PCR to become a more attractive option, drivers beyond price will need to be taken into account by resin purchasers." A summary of the price per pound comparison from the article is in Table 15 below.

Table 15: Stina, Inc. Comparison of Cost of PCR vs. Virgin Resins

Material	Cost to Source Bales or Virgin Pellets	Handling & Transport Costs to make PCR feedstock equivalent to Virgin	Cost of Processing & Yield Loss	Total Price Per LB
PCR Color HDPE *(color sorted)*	$0.14	$0.16	$0.25	$0.55
PCR Color HDPE	$0.14	$0.16	$0.20	$0.50
PCR Natural HDPE	$0.22	$0.16	$0.20	$0.58
PCR Natural HDPE *(food grade)*	$0.22	$0.16	$0.25	$0.63
Virgin HDPE Spot Price	$0.51	N/A	N/A	$0.51

In July 2020, US EPA released a report summarizing historical recycled commodity values nationwide from 1990 to 2018, normalized to 2018 dollars. The report focused on known market prices for PCR paper, glass, plastics, steel, and aluminum cans. This analysis revealed that except for glass and natural HDPE, all recycled materials experienced a downward trend over this time. The MMAC report (pp. 28-29) summarized average Midwest commodity prices for plastic containers from May 2011 to May 2021 using data obtained from Recycling Markets Limited. All plastic container commodity prices showed an increase beginning in June 2020 though they had declined steadily over the preceding decade. However, in the summer of 2023, recycled natural HDPE prices "plummeted to levels not seen since 2019," as Colin Staub reported in Plastics Recycling Update (2024), citing factors outlined by market analyst Emily Friedman. pp. 28-29) summarized average Midwest commodity prices for plastic containers from May 2011 to May 2021 using data obtained from Recycling Markets Limited. All plastic container commodity prices showed an increase beginning in June 2020 though declined steadily over the preceding decade. However, in the summer of 2023, recycled natural HDPE prices "plummeted to levels not seen since 2019," as Colin Staub reported in Plastics Recycling Update (2024), citing factors outlined by market analyst Emily Friedman. This article points out the cyclic nature of recycled resin markets. "As demand rises for recycled resin, prices increase alongside it, until they reach a point where the premium is unsustainable. Then, 'the market crashes and we start back over again.'" Friedman also noted that PCR PET is now not only competing with virgin counterparts but also with imported PCR PET. Lower labor costs for overseas recycling operations coupled with downward trends in freight rates mean that imported PCR feedstocks may often be cheaper than US-sourced PCR feedstocks.

Varying Qualities and the Problem of Additives

Plastic quality and integrity degrades with each time the material is recycled, limiting the potential uses for the resulting recycled material and its continued recyclability (Franklin-Cheung, n.d.). In addition, a wide variety of chemical additives may be present in plastics, which makes it challenging to recycle them together even within the same resin type. For example, colored PET beverage bottles cannot be recycled with clear beverage bottles. Aside from complications related to meeting desired end use specifications, chemicals of concern present in PET, PP, and PE (including both high and low density) products will be present in PCR pellets and products made PCR content, and additional compounds may be added or generated during recycling (see State of the Science on Plastic Chemicals, p. 69). Uses of PCR plastics in certain types of end markets, such as food-contact products and packaging, is advisable only where extremely clean and tightly managed collection programs are in place (e.g. plastic beverage bottles produced by one manufacturer/for one specific brand specification separately collected and used to create new beverage bottles by the same manufacturer/for the same brand specifications).

Demand for PCR PET, HDPE, PP and Potential End Markets

As can be seen from the material category definitions for MMAC materials listed in Appendix A in the IC/WGCS report, PET, HDPE, and PP are frequently used in packaging for food, personal care products, pharmaceuticals, household chemicals, and a wide variety of other household products, including office supplies and outdoor furniture. In building and construction, some plastic pipes may contain PP or HDPE. Construction product materials are widely available (Pivnenko, 2018) and may also include PET in some applications.

Global demand for recycled plastics is expected to grow. According to Claight Corporation's Expert Market Research (2024b), "The global recycled plastics market size stood at a value of USD 44.71 billion in 2023. The industry is estimated to witness a compound annual growth rate of 6.1% during the forecast period of 2024-2032... [the] (PET) segment accounted for the most significant market share in 2020" with "increased uses of recycled plastics in the manufacturing of containers, automobile parts, shoes, and luggage, among others... [the] non-food contact packaging segment dominated the recycled plastics market and is expected to continue its dominance over the forecast period... [and] the plastic bottles segment is estimated to account for the largest market share as they are used in numerous applications such as storing carbonated drinks, medicines, and oils, among others."

A Grandview Research forecast for recycled plastics focused on 2024-2030 states, "The polyethylene segment led the market with the largest revenue share of 26.0% in 2023. This high share is attributable to the rising demand for packaging material in consumer goods, food & beverage, industrial and various other industries...The growth of automotive, packaging, building & construction is expected to drive the demand of recycled polypropylene over the forecast period. In terms of application, the packaging segment led the market with the largest revenue share of over 37.4% in 2023. The market growth in the region is driven by the high demand for building & construction products, consumer goods, and electrical & electronics, especially from China, India, and Southeast Asia...Furthermore, properties of recycled plastics such as lower carbon footprint and low cost in comparison to virgin plastics are aiding the demand for recycled plastics."

(Smith, 2024a) summarized a report from Netherlands financial services company RaboResearch, which indicated that companies may re-evaluate their targets for PCR content in products. These targets have helped drive demand for recycled plastics in the U.S. and Europe but PCR production would need to increase as much as fivefold to meet those goals. In the face of this mismatch between supply and demand, report authors say end users may shift their focus more broadly to carbon emissions targets or push target dates for packaging PCR goals out for five or more years. This suggests that demand for PCR may at least temporarily decline unless collection infrastructure and recyclable material capture rates increase quickly.

U.S. EPA Recycling Infrastructure and Market Opportunities Map

The U.S. EPA Recycling Infrastructure and Market Opportunities Map can also be used to identify potential primary and secondary end markets for recycled materials. Data downloaded in April 2024 showed 180 Illinois entries for primary markets (U.S. EPA, 2021b) and 189 Illinois entries for secondary markets (U.S. EPA, 2021c).

PCR Content Certification Programs & Standards

PCR content certification programs and recycled content standards could be used to encourage PCR use among Illinois manufacturers while also boosting the credibility of PCR content products among consumers. Recyclers/processing facilities that produce PCR plastic pellets may also benefit by confirming the conformity of their products to certain standards and perhaps providing a competitive edge. The list below includes examples of such programs which IEPA may wish to explore and promote as part of efforts to improve collection and use of recycled plastics in Illinois. The U.S. Plastics Pact PCR Certification Principles (n.d.-c) may be used to evaluate certification schemes in order to maximize PCR's positive impact. The evaluation guidelines include:

- Support for the Ellen MacArthur Foundation's Global Commitment for a New Plastics Economy;
- Compliance with relevant national and international laws and conventions;
- Standards consistent with ISO definitions for recycled materials (ISO 14021:2016(E) for pre- and post- consumer material;
- Transparent goals and claims;
- Standards should be science-based and adaptable to national/regional needs;
- A focus on minimizing or eliminating negative environmental and social impacts while creating positive ones;
- Meaningful and equitable stakeholder participation;
- Transparency;
- Third-party certification and accreditation;
- Conflict resolution; and
- Continuous improvement.
- SCS Global Services Global Recycled Standard (GRS). This is "a voluntary product standard for tracking and verifying the content of recycled materials in a final product. The standard applies to the full supply chain and addresses traceability, environmental principles, social requirements, chemical content and labeling.
- Recycled Material Standard Plastics Module (focused on resins in packaging) and Plastic Material Classification. A project of the non-profit GreenBlue, the Recycled Material Standards (RMS) were developed through a multi-stakeholder consensus process and focus on clear rules, definitions, and guidelines to create an even playing field among competitors and a strong assurance mechanism for brands and consumers.
- Association of Plastics Recyclers (APR) PCR Certification. This is a third-party assessment and verification that recycled content (plastic pellets or flake) comes from post-consumer sources. Companies choose from a selection of endorsed certification bodies to audit their process. The APR PCR Certification Program has three components:
    - APR endorses third-party companies to conduct certification process.

  - Reclaimers hire these companies to conduct audits and, if successful, issue certifications.
- APR promotes certified PCR.

See also the U.S. Plastics Pact R&D/Quality Assurance Resources, which includes quality assurance considerations for mechanically recycled PCR, information on using PCR in food grade applications, working with converters, and guidance regarding on-pack labeling. This is part of the Pact's PCR Toolkit (see "Directories of PCR-content Products" below for additional details).

Directories of PCR-content Products & PCR plastics

Raising awareness of PCR-content products/pellets and their suppliers may foster long-term demand for PCR materials. Below are some examples of PCR directories.

- **Association of Plastics Recyclers (APR) Directory of Certified PCR**. This directory can be filtered by resin type (PET, HDPE, PP, LDPE, or LLDPE). As of the writing of this chapter, none of the listed certified locations for PET, HDPE, or PP were located in Illinois.
- Stina, Inc. maintains the **Buy Recycled Products Directory**, which focuses on materials containing PCR plastics sold within the U.S. or Canadian markets. PCR content must be greater than 0%, but other than that there is no minimum PCR requirement. The directory often relies upon company advertising claims and other public or directly provided information on PCR content. If PCR content is verified by a third-party certification program, it is included in the product's entry. If a product does not have third-party certification of PCR content, the company must provide a current materials reclaimer from which they are purchasing PCR materials.
- **U.S. EPA's Comprehensive Procurement Guidelines (CPG) Product Supplier Directory** is not focused on plastics but includes products containing PCR plastics. The directory can be searched by keyword, sorted by product type, or filtered by state/country.
- **U.S. Plastics Pact PCR Toolkit**. The toolkit includes "Procurement & Purchasing Resources" that can assist with finding a PCR Supplier, purchasing PCR direct from a supplier or through a converter, pricing considerations, and contract considerations. It also includes "R&D/Quality Assurance Resources," "Brand, Sustainability & Government Affairs Resources," and a section on "Why and how to buy products with PCR."
- **SCS Global Certified Green Products Guide.** Not focused exclusively on plastics or PCR content, this tool includes a filter for "Recycled Content" and the results include products with PCR plastics content.

Notes of Caution

The use of PCR for food-contact products and packaging is advisable only where extremely clean and tightly managed collection programs are in place. Even if PCR is prioritized for non-food-contact products, additional research is needed to assess potential hazards associated with all plastic containing products. Regarding the use of PCR plastics in construction materials, John Bleasby noted in an October 7, 2024 article for Daily Commercial News by ConstructConnect, "A 2023 study (Cirino, et al) reviewed over 100 articles outlining the efforts made from 1992 to 2022 by businesses, materials scientists, institutions and other interested stakeholders to include plastic waste into building materials and infrastructure." While most articles supported this idea and emphasized the positive social, environmental and human health impacts it could have, others expressed doubts about this use. which could be considered greenwashing. The study's authors also pointed out that many of studies they reviewed overlooked production of micro- and nanoplastics as a key impact of processing and using waste plastics. The authors concluded that more research is necessary to determine if using plastic in this way is environmentally beneficial.

Policy/Regulations

The following policies, regulations, strategies and plans related to plastics reduction and management in this section should be considered when evaluating improvements for sustainably managing plastics in Illinois. Additional relevant materials are included in the public Zotero group library "Plastics Impacts, Reduction, & Diversion." Although this chapter focuses on rigid PET, HDPE, and PP, Illinois legislation related to other plastics is mentioned because they indicate a political climate open to additional similar regulations.

Illinois—Local Governments

City of Chicago Single-Use Foodware Ordinance. Effective January 18, 2022, requires that food dispensing establishments, for any delivery or take-out order, provide single-use foodware only upon request from the customer or at a self-service station.

From Reducing the Use of Plastic Bags: Five Lessons from Illinois Communities with Plastic Bag Laws: "As of June 2020, five Illinois municipalities – Chicago, Evanston, Oak Park, Woodstock, and Edwardsville – have passed laws designed to curb the use of plastic bags. Evanston is the only Illinois community with a definitive ban on single-use plastic bags. The other four municipalities discourage people from using plastic bags through a 7 or 10-cent/bag fee. Chicago initially introduced a plastic bag ban in 2014, but it was repealed and replaced with a fee in 2016. As concerns about the environmental impacts of single-use plastics spread, many communities in Illinois are considering adopting similar laws, and Illinois legislators have proposed state-level legislation focused on plastic bags and single-use plastic cutlery, straws, and Styrofoam."

Lake County Single Use Plastics Policy. Lake County implemented a program in 2023 that prohibits the purchase, sale and distribution of single-use plastics of food service items within County government operations, which includes cafeteria operations, coffee kiosk and vending machines at all County government sites. The National Associations of Counties (NACo) awarded the county their Achievement Award for implementing this policy.

Illinois—Statewide

The Illinois General Assembly website has the entire text of Illinois' Environmental Safety statutes (415 ILCS et seq.) on their website. The Illinois Recycling Foundation/Association has a summary of the three primary recycling and waste reduction laws in Illinois (the Illinois Solid Waste Management Act, the Illinois Solid Waste Planning and Recycling Act, and the Illinois Environmental Protection Act.

The MMAC recommended a standardized, detailed format for county solid waste management plans required by the Solid Waste Planning and Recycling Act (415 ILCS 15/1 et seq.). As local governments choose to comply with this recommendation and/or when this recommendation becomes an established requirement, county solid waste management plans will become tools to assist IEPA and other stakeholders to improve source reduction, collection, and diversion through recycling or other means for plastics and other materials.

Statewide Recycling Needs Assessment Act (415 ILCS 180). Passed in July 2023, this act provided for the IEPA to appoint a council and consultant to draft, amend, and finalize a comprehensive assessment of needs, current conditions, and costs of recycling, to be submitted to the General Assembly by December 1, 2026.

Large Event Facilities Act (415 ILCS 190). Passed in August 2024, this act requires that on and after January 1, 2025, event facilities with a maximum legal capacity of 3,500 persons or more must offer public recycling and composting.

Illinois – Proposed, Not Passed

Small Single-Use Plastic Bottle Act (415 ILCS 195). Requires that hotels with 50 or more rooms cannot offer small single-use plastic personal care product bottles as of January 1, 2026.

SB 0085 (Bottle bill, proposed, referred to Assignments 6/26/2024). Would establish a Distributor and Importer Responsibility Organization to implement a beverage container recycling redemption refund program issuing redemption refunds to consumers for beverage containers. Includes labeling, reporting, and enforcement provisions and sets performance targets.

HB 3205 (Bottle bill, proposed, as of 3/20/24, re-assigned to Rules Committee). Requires every (glass, plastic, aluminum, etc) beverage container sold in Illinois to have a deposit and refund value, with other provisions for special cases.

HB 2376 (Foam foodware ban, proposed, as of 5/5/2023, re-referred to Assignments). Amends the Environmental Protection Act to ban retail establishments from selling or distributing disposable food containers made in whole or part from polystyrene foam, with some exceptions. As of fall 2024, environmental groups like the Illinois Environmental Council and the Coalition for Plastics Reduction support such a ban.

HB 4448 (Plastic bag ban, proposed, as 1/16/24 referred to Rules Committee) and SB 2211 (Plastic bag ban, proposed, as of 2/10/23). Two bills in the Illinois House and Senate that amend the Solid Waste Planning and Recycling Act to ban sale and use of single-use plastic bags in grocery stores and food service businesses. Also bans single-use paper bags in grocery stores.

SB 2705 (PFAS product ban, proposed, as of 1/10/24 referred to Assignments). Amends the PFAS Reduction Act to require all that manufacturers of products with intentionally added PFAS must submit information to the Illinois EPA on or before January 1, 2026. Restricts the sale of most products with intentionally added PFAS (such as personal care, toys, food packaging, cookware, cleaning products, carpets and rugs) starting January 1, 2025, with a fee for infractions. Note that this legislation does not address non-intentional PFAS.

National

The National Academies of Sciences, Engineering, and Medicine (NASEM)'s 2021 report *Reckoning with the U.S. Role in Global Ocean Plastic Waste* and the 2024 Environmental Law Institute (ELI)'s 2024 report *Existing U.S. Federal Authorities to Address Plastic Pollution: A Synopsis for Decision Makers* discuss potential interventions on global plastic pollution and policy levers that allow federal agencies and commissions to assert these changes. These include chemical bans, clarifying definitions, and updating regulations and thresholds to reflect current science. The intervention areas described in the NASEM report and carried through the ELI report include reducing pollution, innovating product design, decreasing waste generation, improving waste management, capturing plastic waste from environments, and minimizing ocean disposal.

The extensive ELI report outlines all existing federal agencies (e.g. U.S. EPA, Executive Office of the President), acts (e.g. Pollution Prevention Act, Resource Recovery and Conservations Act, Save Our Seas 2.0 Act of 2020), and programs (e.g. Safer Choice Program, Marine Debris Program) relevant to addressing hazards associated with plastics throughout their lifecycle. This section summarizes key federal policies related to sustainable plastics management. The ELI report does a deeper dive into these and related policies.

U.S. National Recycling Strategy (U.S. EPA, 2021a)

This strategy is aligned with and supports implementation of the National Recycling Goal (U.S. EPA, n.b.-ab) to increase the recycling rate to 50% by 2030. The Strategy is organized by five strategic objectives, with underlying actions, to create a more resilient and cost-effective national recycling system:

- Objective A: Improve Markets for Recycling Commodities.
- Objective B: Increase Collection and Improve Materials Management Infrastructure.
- Objective C: Reduce Contamination in the Recycled Materials Stream.
- Objective D: Enhance Policies and Programs to Support Circularity.
- Objective E: Standardize Measurement and Increase Data Collection.

These objectives align and overlap with several objectives laid out in the National Strategy to Prevent Plastic Pollution (discussed below) as well as the recommendations made in the Illinois MMAC Report (pp. 54-68).

U.S. EPA National Strategy to Prevent Plastic Pollution (U.S. EPA, 2024a)

The *National Strategy to Prevent Plastic Pollution: Part Three of a Series on Building a Circular Economy for All* provides an ambitious, equitable approach to reducing and recovering plastics and other materials, as well as preventing plastic pollution from harming human health and the environment. The strategy includes the following objectives:

- Objective A: Reduce pollution from plastic production
- Objective B: Innovate material and product design.
- Objective C: Decrease waste generation
- Objective D: Improve waste management
- Objective E: Improve capture and removal of plastic pollution
- Objective F: Minimize loadings and impacts to waterways and the ocean

Mobilizing Federal Action on Plastic Pollution: Progress, Principles, and Priorities.(Interagency Policy Committee on Plastic Pollution and a Circular Economy, 2024). See also fact sheet (The White House, 2024b). This report, released after the ELI report, outlines existing and new federal actions to reduce the impact of plastic pollution throughout the plastic lifecycle and calls for collaborative action to address the challenge. The report features the Biden-Harris administration's goal of replacing all single-use plastic with reusable, compostable, and highly recyclable products.

The U.S. Plastics Pact is a consortium founded by The Recycling Partnership and World Wildlife Fund, launched as part of the Ellen MacArthur Foundation's global Plastics Pact network. Companies, governments, nonprofits, and public-sector organization participants (known as "Activators") work together on the Pact's targets of plastic design and circularity; consensus among these stakeholders may be used to predict acceptance or resistance to various types of legislation. The *U.S. Plastic Pact Roadmap 2.0*, released in June 2024 and described in "Existing Goals" below, includes five targets to address plastic waste at the source.

Association of Plastics Recyclers (APR) Policy Priorities. This key industry association identifies three main policy priorities, which may be used to predict acceptance or resistance to legislation among industry representatives. Additional details, including information on APR's work on EPR laws and recycled content requirements, their design guide for plastic recyclability, their position on bottle bills, and their support of federal-level policies, the global plastics treaty, and policies related to a national labeling standard and circularity of non-packaging plastics can be found on their website.

- Design: "Harmonized design standards can help reduce consumer confusion and increase participation in recycling, streamline processing, and deliver higher quality recycled plastics."
- Collection: "Extended Producer Responsibility (EPR) laws provide the needed funding and coordination to scale local recycling programs. Bottle deposit programs incentivize recycling and reduce litter for beverage containers."

Other U.S. States

The following are a few specific examples of recent proposed or passed legislation from other U.S. states. These may be useful for Illinois legislators looking for ways to make the state more sustainable.

Minnesota PFAS Ban passed May 2023 under Amara's Law (Minn. Stat. § 116.943). Bans sale of products with intentionally added PFAS in 11 consumer product categories. Also bans intentionally added PFAS in food packaging. Unintentional PFAS is not covered in these laws.

WA minimum recycled content law, passed May 18, 2021. An article from Waste Dive summarized the law (Quinn, 2021b). Bans EPS (also known as styrofoam) in several products, requires more recycled content in some plastic items, and calls for single-use food service ware to only be provided on request. In 2024, PackagingDive reported (Quinn, 2021a) that WA had fined 35 companies a total of $415,554 for failure to comply.

CA Plastic Pollution Prevention and Packaging Producer Responsibility Act (SB54), passed June 30, 2022. This law requires that by 2032 the state cuts single-use plastic in packaging and food ware by 25%; recycles 65% of single-use plastic packaging and food ware; and ensures that 100% of single-use packaging and plastic food ware is recyclable or compostable.

For Further Information on U.S. Bills

- Waste Dive's searchable online list of recycling bills allows users to filter by state, policy type, year (it goes back to 2022), material type (categories relevant to this chapter include "plastic" and "packaging"), and bill status. The database only includes policies reported upon by Waste Dive. See also this January 29, 2024 Waste Dive article (Quinn, 2024a) on EPR, bottle bills, and right-to-repair legislation trends in the U.S.

- Stina, Inc.'s Recycling Activity Map is a helpful tool that highlights efforts for "regulation," "technical assistance," "promotion," and "financial support" across the U.S.
- The Bottle Bill Resource Guide website, a project of the Container Recycling Institute, includes an "Existing Programs" section with subsections on the USA, Canada, Australia, Worldwide, and a National Bottle Bill. The USA subsection allows users to compare all U.S. states with a bottle bill or view information specific to one of the 10 current bottle bill states. This tool is also an educational resource because it also includes information geared toward the public, such as the benefits of bottle bills, myths vs. facts, etc.

Global & International

In March 2022 at the UN Environment Assembly (UNEA-5.2), a resolution was adopted to develop a treaty (hereafter referred to as "the Global Treaty") related to plastic pollution. The Global Treaty will be a legally binding agreement with the goals of ending plastic pollution and protecting human and environmental health. It is currently under development by an Intergovernmental Negotiating Committee (INC) but negotiations broke down during the fifth session of the International Negotiating Committee (INC-5) and the resolution was not finalized.

In a November 18 article, Grist (Winters, 2024) reported that the Biden Administration backtracked from supporting a cap on plastics production as part of the UN global plastics treaty.

Other International Examples

On April 24, 2024, the European Parliament adopted the *Packaging and Packaging Waste Regulation (PPWR)* to replace the Packaging Directive 94/62/EC. As reported by Dentons (2024), PPWR requires that packaging be designed for recyclability and reuse/refill/return, made of specific percentages of PCR plastic content, not contain PFAS in food contact packaging. The regulation also limits green claims, bans some single-use packaging, and establishes national packaging registers, extended data reporting obligations, and extended producer responsibility, among many other regulations.

For additional international examples of plastics-related policy regulations across the plastic lifecycle, see the Plastic Pollution Coalition's Global Plastic Laws Database or its overview.

Existing Goals

Many of the policies and regulations described in the proceeding section include goals that will not be discussed here except for a few key national goals.

The U.S. National Recycling Goal (not specific to plastics) is to increase the national recycling rate to 50% by 2030. The MMAC diversion goals are slightly more conservative and perhaps more realistic/achievable. The latest MSW data from U.S. EPA (from 2018) indicated a 32.1% recycling and composting rate (U.S. EPA, n.d.-n). Related to the National Recycling Strategy, the Circular

Economy Implementation Plan Online Platform (U.S. EPA, n.d.-d) could be something that IEPA would like to monitor.

U.S. EPA National Strategy to Prevent Plastic Pollution (U.S. EPA, 2024a)

The *National Strategy to Prevent Plastic Pollution: Part Three of a Series on Building a Circular Economy for All* provides an ambitious, equitable approach to reducing and recovering plastics and other materials, as well as preventing plastic pollution from harming human health and the environment. Find more details about the strategy in the previous section.

Mobilizing Federal Action on Plastic Pollution: Progress, Principles, and Priorities (Interagency Policy Committee on Plastic Pollution and a Circular Economy, 2024). Released by the Biden Administration in July 2024. Introduces a goal to phase out federal procurement of single-use plastics from food service operations, events, and packaging by 2027, and from all federal operations by 2035. This commitment builds on President Biden's Executive Order on Catalyzing Clean Energy Industries and Jobs through Federal Sustainability and the President's Federal Sustainability Plan, which directs the federal government to achieve net-zero procurement by 2050, including by phasing out procurement of single-use plastic products. Meeting the new goal by selecting reusable, compostable, and highly recyclable products in lieu of single-use plastics in food service will further agencies' obligations under the Executive Order.

U.S. Plastic Pact Roadmap 2.0 (U.S. Plastics Pact & The Recycling Partnership, 2024)

This is an update from the consortium's original "Roadmap to 2025." In a press release (U.S. Plastics Pact, 2024e), Emily Tipaldo, Executive Director, said, "The current reliance on virgin plastics is unsustainable. Roadmap 2.0 aims to make a tangible difference by changing how we design, use, and reuse plastics. The focus is on practical, achievable steps companies can take to contribute to a circular economy." Roadmap 2.0 carries forward unfinished targets from the Roadmap to 2025 and focuses on five new targets:

- Target 1: Eliminate all items on the Problematic and Unnecessary Materials List and reduce the use of virgin plastic by 30% by 2030. The Pact defines "problematic and unnecessary materials" as "Plastic packaging items, components, or materials where consumption could be avoided through elimination, reuse or replacement and items that, post-consumption, commonly do not enter the recycling and/or composting systems, or where they do, are detrimental to the recycling or composting system due to their format, composition, or size."
- Target 2: Design and manufacture 100% of plastic packaging to be reusable, recyclable, or compostable.
- Target 3: Effectively recycle 50% of plastic packaging and establish the necessary framework to recycle or compost packaging at scale, including goals of:
    - PET, PP, and HDPE bottles: 70%

  - PET and PP non-bottle rigids: 50%
  - HDPE non-bottle rigids: 30%
  - PE, PP, and mixed PO film: 30%
- Target 4: Achieve an average of 30% postconsumer recycled content or responsibly sourced biobased content across all plastic packaging, including goals of:
  - Beverage bottles (PET, HDPE, PP) have a minimum 25% PCR by 2026, and a minimum 60% by 2030.
  - Household cleaning products (PET, HDPE, or PP bottles, containers, spray bottles) have a minimum 25% PCR by 2028, and a minimum 50% by 2030.
  - Thermoforms (PET, PP) have a minimum 20% PCR by 2028, and a minimum 40% by 2030."
- Target 5: Identify viable reusable packaging systems and increase their implementation and scale by 2030, as part of reducing the use of virgin plastics.

Globally, and related to the U.S. Plastics Pact and 10 other plastics pacts internationally, the Ellen MacArthur Foundation's New Plastics Economy Global Commitment (launched in 2018 by the Ellen MacArthur Foundation and the UN Environment Programme) is also a key document to consider. "The Global Commitment unites businesses*, governments, NGOs, and investors behind a common vision of a circular economy in which we eliminate the plastic we don't need; innovate towards new materials and business models; and circulate all the plastic we still use, to keep it in the economy and out of the environment. To help make this vision a reality, all business and government signatories of the Global Commitment set ambitious 2025 targets and publicly report progress every year."* For more information, see *The Global Commitment Five Years In: Learning to Accelerate Towards a Future Without Plastic Waste or Pollution*," (Ellen MacArthur Foundation, n.d.-b)) and the *Global Commitment 2024 Progress Report* (Ellen MacArthur Foundation, 2024)

Circular Great Lakes (an initiative of the bi-national Council of the Great Lakes Region) released *A Great Lakes Circular Economy Strategy & Action Plan for Plastics: Forging a Future Without Plastic Packaging Waste & Pollution* in January 2022. The report proposes a five-year strategy and action plan to target cleanup, plastics collection, processing, end-markets, policy, and consumer actions. The plans goals and key findings (pp.9-10) related to collection, processing, end markets, education and engagement, supporting policies, and public-private funding will be of interest to policymakers. The plan outlines three priorities. Each priority has objectives and suggested steps for achieving those objectives. The priorities are:

- Priority One: Clean-up and End Plastics Litter and Pollution
- Priority Two: Accelerate Development of Great Lakes Flexible Plastic Packaging Recycling Supply Chains and Markets
- Priority Three: Achieve a Step Change in Plastics Recycling with Technology, Policy, and Education

The UN Sustainable Development Goals (SDGs) and targets also relate to sustainable plastics production and management and/or plastics impacts on environmental and human health. Any efforts within Illinois to improve plastics recycling and diversion, practice plastics source reduction, and mitigate the impacts of plastics throughout their lifecycle will contribute to progress toward these SDGs.

- Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
- Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable
- Goal 12: Ensure sustainable consumption and production patterns
- Goal 13: Take urgent action to combat climate change and its impacts
- Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development
- Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Existing Funding Opportunities

The following funding opportunities could provide support for plastics source reduction and improved recycling and diversion. Though some closing dates have already passed, the opportunities may be offered again in subsequent years.

Tribal

Office of Land and Emergency Management Program Tribal Support Cooperative Agreements. (Closing date, October 10, 2024). Solicited applications for two separate projects to provide training, technical assistance, research, and tools to Tribal environmental staff to build Tribal capacity to develop sustainable waste management programs and implement cleanup, prevention, and response programs in Indian country. As of April 2024, Illinois is once again home to a federally recognized tribal nation, the Prairie Band Potawatomi Nation. The U.S. Department of the Interior placed portions of the Shab-eh-nay Reservation land into trust for the Prairie Band Potawatomi Nation, confirming the land as an "Indian country.

Federal

U.S. EPA Inflation Reduction Act Community Change Grants Program. (Closing date, November 21, 2024). This opportunity was funded with $2 billion dollars through the Inflation Reduction Act (IRA). The agency looked for environmental and climate justice activities that would benefit disadvantaged communities through projects that reduce pollution, increase community climate resilience, and build community capacity to address environmental and climate justice challenges. These place-based investments will be focused on community-driven initiatives to be responsive to community and stakeholder input.

U.S. EPA Solid Waste Infrastructure for Recycling (SWIFR) Grant Program. (Closing date, December 20, 2024 for local governments; March 14, 2025 for tribes and intertribal consortia.). This program provides grants to implement the National Recycling Strategy to improve post-consumer materials management and infrastructure; support improvements to local post-consumer materials management and recycling programs; and assist local waste management authorities in making improvements to local waste management systems. The program includes funding for, local governments and tribes and intertribal consortia. The funding opportunity for states and territories closed in 2023.

U.S. EPA Consumer Recycling Education and Outreach (REO) Grant Program. In 2024, this program is focused on composting and food waste reduction. However, round one of the grants in 2023 included other recyclables. If it's offered again, it may again be more broadly focused.

Nonprofit

Plastic Free Restaurants Subsidy. Plastic Free Restaurants is a non-profit organization dedicated to eliminating petroleum-based single-use plastic from restaurants and schools by subsidizing the purchase of reusable replacements, with strong success. They are also building a database of plastic-free restaurants across the country. Their subsidy program is available to any food service establishment that currently gives single-use items containing either petroleum-based plastic or PFAS to its customers (or students), is willing and ready to switch to reusables, and is not required by (local, county, state) law to discontinue using the single-use plastic. Funding is available for restaurants & for-profit entities, schools, and other non-profits. They've not yet subsidized any entities in Illinois, so IEPA might consider raising awareness of this opportunity.

Model programs elsewhere in the U.S. focused on promotion of reusables over single-use plastics include:

- ReuseSeattle (WA) Reuse Incentive: Businesses can apply for a reuse incentive (up to $500 in dishware).
- StopWaste (Alameda County, CA) Reusable Foodware Minigrants: This grant program closed its most recent round of funding in March 2024. The reusable foodware grant provided up to $2,500 and free, hands-on technical support from their nonprofit partner, ReThink Disposable, to providethe grantee with … reusable foodware and related expenses, such as minor kitchen upgrades, take-out reusable foodware provider fees, and other services. Case studies include Sparkl Reusables and Alameda County School Districts.

Upstream, a non-profit fostering reuse in the U.S. and Canada, maintains a "US & Canada Reuse Incentives and Grants Tracker." This spreadsheet-based tool monitors incentives and grants offered by municipalities, states/provinces, federal governments and private sources that could be used to support projects related to source reduction of disposable packaging and foodware. It focuses on opportunities within the United States and Canada. While the tracker primarily highlights funding opportunities specifically for waste reduction and reuse, it also includes funding programs that encompass broader initiatives aimed at promoting environmental stewardship, environmental projects, or waste management.

NextCycle

A service offered by Resource Recycling Systems (RRS), NextCycle is a circular economy and recycling market development program that could be a tool for developing statewide markets development for PCR PET, HDPE, and PP, as well as other materials. NextCycle is a collaborative initiative that identifies, recruits, evaluates, and accelerates projects that focus on waste prevention, material reuse, recycling/composting collection and processing, and developing material end markets. NextCycle is a customizable, state-wide, accelerator-style program led by state and/or local governments and powered by RRS and local partners to nurture ideas and facilitate connections that develop a pipeline of investable projects for public and private sector partners working to improve local and regional circularity. RRS designs, implements, and facilitates the program based on the goals of the host location. The program leverages investments from public and private partners. NextCycle may provide gap analysis, partner & funder outreach, communications, recruitment, development, and design to new programs.

Outcomes of the Statewide Recycling Needs Assessment could lay groundwork upon which gap analyses for plastic packaging-related end markets associated with a NextCycle effort in Illinois could build. The states of Colorado, Michigan, and Washington have already collaborated with RRS to establish NextCycle programs. An overview of NextCycle was provided at the 2024 ILCSWMA conference. Attendees (mostly local government representatives, recycling industry professionals, and academics) expressed interest in seeing a program like it being developed for Illinois. According to that presentation, 42 collaborative teams have been supported in CO, 158 in MI, and 29 in WA. NextCycle Washington began at the local government level in King County and expanded to a statewide initiative, so there is precedent for piloting the platform on a smaller scale and gradually expanding statewide.

Existing Education & Resources

RecycleCoach is the main educational resource worth highlighting even though it isn't specifically focused on plastic. As described in the Illinois Recycling Association/Foundation website, this desktop and mobile tool is available for free for Illinois local governments, thanks to funding and support from IEPA. Its core features include *collection schedules, a what goes where tool, a* *direct communication platform for municipalities, and educational content like quizzes and games.*

At the 2024 ILCSWMA conference in October 2024, RecycleCoach shared that over 8,000,000 Illinois residents will soon have access to RecycleCoach in their communities. The Solid Waste Agency of Lake County (SWALCO), Solid Waste Agency of Northern Cook County (SWANCC), and DuPage County are all working on deployment, with DuPage likely being the first among those three to deploy. The Ecology Action Center in Bloomington-Normal has been using RecycleCoach in McLean County since 2017.

IEPA Interactive Curbside Bin Recycling Guide. This website helps Illinois residents identify what is and is not acceptable in curbside recycling programs.

IEPA Customizable Factsheets & Posters. Local governments can use these templates to inform residents about what materials are acceptable in curbside recycling programs. SWALCO customized them and uses them on their website.

U.S. EPA Model Recycling Program Toolkit. Compiled to assist entities applying for Recycling Education and Outreach (REO) grants, this is an interactive collection of EPA and other materials which can help communities increase participation in recycling programs and reduce contamination in the recycling stream. Toolkit materials include case studies from communities with effective programs, training materials on how to create educational messages and campaigns to drive behavior change, standardized terms with examples for use in communication regarding acceptable recyclables, and a grantee evaluation guide to measure increased participation, reduced contamination, and change in volume of recyclables collected. In the toolkit under “Which Materials Interest You?” there are 45 results for plastic.

Massachusetts Department of Environmental Protection (DEP) Municipal Waste Reduction Toolkit. This is a comprehensive collection of strategies, tips and techniques for planning, implementing, building and promoting programs aimed at throwing away less and recycling more. This resource was highlighted by Cook County in its recent solid waste management plan update.

Prince George’s County Waste & Recycling Toolkit. From Maryland, this resource was highlighted by Cook County in its recent solid waste management plan update.

U.S. Plastics Pact: Why and how to buy products with PCR. Includes sections on "What is PCR and is it Safe?"; "Recyclable vs. Recycled"; "Why Buy Products with PCR?" and "Identifying Products with PCR".

Challenges & Solutions/Best Practices

This section will highlight key information pulled from materials previously discussed in this chapter. There is also a table that summarizes challenges discussed previously in this chapter as well as points that emerged from stakeholder conversations at ISTC's plastics-focused listening session. In that table, the challenges are presented with possible solutions or best practices for IEPA and other stakeholders to consider.

Key Information from Previously Discussed Resources

Authors of *State of the Science on Plastic Chemicals: Identifying and addressing chemicals and polymers of concern* (Wagner et al, 2024) laid out key knowledge gaps that prevent plastic chemicals from being adequately assessed and controlled. As a result, they made four policy recommendations, with more details and context available in the text:

- Regulate plastics chemicals comprehensively and efficiently
- Require transparency on plastic chemicals
- Simplify plastics toward safety and sustainability
- Build capacity to create safer and more sustainable plastics. (p. 80)

U.S. EPA Recycling Infrastructure and Market Opportunities Map

Information about this map and details of its technical methodology are available on the EPA website. The data included in the tool may be used to support some solutions mentioned in this chapter. Most data used for the map are from 2018-2021 and are not updated in real time. It identifies and displays multiple layers of data, including:

- Estimated generation, recycling, and recycling potential by ZIP code and material.
- Locations of recycling and municipal solid waste infrastructure.
- Potential primary and secondary end markets for recycled materials.
- Market factors such as landfill tipping fees and bottle bill deposit prices.

U.S. EPA suggests the following uses for this tool:

- Assisting developers with recycling infrastructure site selection.
- Visualizing the distribution of available recycled material generated by geographic region to inform facility development and expansion sites, including EJ considerations.
- Identifying recycled material feedstocks for circular economy entrepreneurs.
- Developing or expanding hub-and-spoke collection systems to help provide economies of scale to rural recycling programs.
- Aiding local governments in designing recycling programs by estimating gaps in required recycling capacity.

Potential Solutions/Best Practices Table

This table highlights challenges discussed previously in this chapter as well as points that emerged from stakeholder conversations at ISTC's plastics-focused listening session. While those are summarized in the Stakeholder Engagement chapter, some are included here for convenience and to incorporate information that might lead to implementation. Similarly, recommendations made in the MMAC report will not be included here unless it is to offer notes or examples that may encourage their implementation. Challenges that relate to MMAC recommendations are marked in the table. See MMAC Report, pp. 54-68 for the full list of recommendations.

Table 16. Addressing Challenges Related to Recycling PET, HDPE, & PP

Note: Items marked with a green asterisk (*) were presented or discussed by stakeholders during ISTC's plastics-focused listening session. These ideas are paraphrased in the table and do not necessarily represent stakeholder comments exactly. Items marked with a red dagger (†) relate to recommendations included in the MMAC report but may be worded differently than in the report.

	Categories	Challenge/Issue	Potential Solution(s)/Best Practice(s)	Notes/Examples
1	Data Gaps End Markets	Lack of centralized, state-level recycling reporting mechanism and/or recycling reporting protocol. † This makes it difficult to accurately track landfill diversion data and compare of trends over time.	Promote/explore voluntary or required use of system for local governments to share data with IEPA, such as Re-TRAC.	• Michigan • Florida

2	Data Gaps End Markets	Lack of up-to-date statewide waste characterization data.†	Conduct a new audit/analysis. †	This is being pursued as part of the Statewide Recycling Needs Assessment Act. This aligns with an MMAC recommendation for regular statewide waste characterizations (MMAC, 2021, p. 63).
3	Data Gaps Lifecycle Impacts Funding	A great deal is unknown about the numerous chemicals present in plastics, as well as impacts of human exposure to plastic particles and other pollution. See relevant key knowledge gaps and blind spots identified by the authors of the "State of the Science on Plastic Chemicals" report listed under "Impacts on Environmental &	Fund state researchers investigating health impacts of plastics, safer alternatives, or safer processes, and/or raise awareness of federal or other funding opportunities that support such research.	The "Existing Funding Opportunities" section of this chapter includes those related to improved recycling and diversion. Examples of non-state programs to promote among state researchers which are focused on health impacts or safer processes include (but are not limited to): • National Institute of Environmental Health Sciences (NIEHS) Notice of Special Interest (NOSI): Understanding Exposure and Health Effects of Micro and/or Nanoplastics Notice of Special Interest (NOT-ES-23-002). Applications accepted through November 16, 2027. • NSF Dear Colleague Letter-Critical Aspects of Sustainability (CAS): Innovative Solutions to Sustainable Chemistry (CAS-SC). • NSF Molecular Foundations for Sustainability: Sustainable Polymers Enabled by Emerging Data Analytics (MFS-SPEED). Letter of Intent due 12/5/24. • Monitor the REMADE Institute & U.S. DOE's Strategy for Plastics Innovation pages for future funding opportunities.

		Human Health" earlier in this chapter.	Coordinate a statewide consortium of researchers and manufacturers.	Beyond Benign, a non-profit dedicated to green chemistry education, hosts the Green Chemistry Teaching and Learning Community (GCTLC) to foster networking and idea sharing among educators (k-12 and higher education), chemistry students, and industry stakeholders. Beyond Benign may be willing to collaborate and encourage participation in the GCTLC among Illinois educators and manufacturers of plastic products and PCR pellets to share ideas.
4	End Markets Education/ Stakeholder Engagement	Need to boost confidence in PCR materials & PCR content product claims.	Raise awareness of and participation in PCR content certification/certified PCR programs & standards among Illinois manufacturers, recyclers, and consumers	Examples include the APR PCR Certification, the Recycled Material Standard, etc. See the "End Markets" section of this document for additional examples and details. The importance of purchasing products produced with PCR that conserves the embodied carbon, water, and other resources associated with plastics production can be integrated into consumer education and outreach campaigns.
5	Lifecycle Impacts End Markets PET	Need to develop non-food-contact end markets for PCR PET due to complexity & hazards of chemical additives present in plastics	Raise awareness of existing manufacturers/products in this space. Explore funding, incentives, and matchmaking to connect supply and demand.	Examples of non-food-contact end markets for PCR PET: • Automotive components, as outlined in Table 6, p. 28 of *"Towards recycled plastic content targets in new passenger cars and light commercial vehicles"* • Plastic strapping, e.g. Greenbridge (formerly Polychem) polyester strapping. • Carpet backings, e.g., Ege Ecotrust or Mohawk EcoFlex • Consult the Recycling Partnership PET Recycling Coalition's inaugural annual report for additional ideas.

		& plastic particle shedding.		Encourage Illinois stakeholders to participate in the PET Recycling Coalition.
6	Lifecycle Impacts End Markets HDPE	Need to develop non-food-contact end markets for PCR HDPE due to complexity & hazards of chemical additives present in plastics & plastic particle shedding.	Raise awareness of existing manufacturers/products in this space. Explore funding, incentives, and "matchmaking" to connect supply and demand.	Examples of non-food-contact end markets for PCR HDPE: • Outdoor furniture, e.g. Tailwind Furniture (Illinois company) • Waste & recycling collection bins, e.g., Max-R (WI company; they also produce site furnishings & outdoor furniture) • Cable jacketing, e.g., Dow's Revoloop line of PCR resins. Note that some of these resins are certified on a mass balance basis by the International Sustainability & Carbon Certification (ISCC). See narrative (under "PCR Content Certification Programs & Standards") for discussion of issues related to mass balance certification.
7	Lifecycle Impacts End Markets PP	Need to develop non-food-contact end markets for PCR PP due to complexity & hazards of chemical additives present in plastics & plastic particle shedding.	Raise awareness of existing manufacturers/products in this space. Explore funding, incentives, and "matchmaking" to connect supply and demand.	Examples of non-food-contact end markets for PCR PP: • Automotive components, as outlined in Table 6, p. 28 of *"Towards recycled plastic content targets in new passenger cars and light commercial vehicles"* • Paint cans & lids, e.g. Pact Group & Dulux or Berlin Packaging hybrid paint cans (Belin Packaging North American HQ is in Chicago). • Consult the Recycling Partnership Polypropylene Recycling Coalition's inaugural annual report for

				additional ideas. Encourage Illinois stakeholders to participate in the Polypropylene Recycling Coalition.
8	End Markets Funding Education/ Stakeholder Engagement	Need for central collaborative platform to foster innovation/end market development for PCR plastics in general.†	Explore development of a NextCycle program for Illinois.	See NextCycle's existing programs in CO, MI, & WA for inspiration. This could compliment the MMAC recommendation to develop a materials management market development advisory board. This would also compliment the three potential solutions/best practices immediately above this one, related to development of non-food-contact end markets for PCR plastics.
9	Source Reduction Funding	Need to reduce single-use plastics.	Pilot/study efficacy of reusable foodware (e.g. cups, to-go containers) systems.	Case studies of reusable foodware systems in Illinois include: • The Chicago Bears recently collaborated with Bold Reuse to introduce reusable cups at Soldier Field. • The University of Illinois is using resuable to-go containers in dining halls on its Chicago and Urbana-Champaign campuses. • Forever Ware is being used by multiple locations in the greater Chicago area, including restaurants and the staff cafeteria at Evanston Township High School. • r.world has assisted multiple communities and venues in deployment of resuable foodware. The University of Illinois Urbana-Champaign campus is tentatively exploring the introduction of their reusable cups in athletic arenas. • Just Salad uses reusable bowls and has several locations in Chicago.

				• Companies like Kadeya & Farmer's Fridge employ reusable packaging in vending machines. The City of Petaluma, California recently implemented a city-wide reusable cup system.
			Create incentives to return containers.*	Upstream outlines four ways to incentivize returns, including insights from U.S. and international case studies.
			Raise awareness of existing funding opportunities for reusable foodware purchases and/or create opportunities based on models elsewhere in the US.	Plastic Free Restaurants Subsidy (for restaurants & other for-profit entities, schools, & other non-profits) is an existing program which has yet to subsidize any organizations within Illinois. Model programs elsewhere in the U.S. include ReuseSeattle (WA) Reuse Incentive and StopWaste (Alameda County, CA) Reusable Foodware Minigrants. See the Upstream US & Canada Reuse Incentives Grants Tracker.
10	Source Reduction Policy	Need to reduce single-use plastics.	Explore amendment to Illinois Large Event Facilities Act to allow/require reusable containers at venues.*	• The New York City Council has enacted legislation requiring sports stadiums & arenas to allow attendees to bring refillable beverage containers into venues. • Illinois food code does allow (but does not require) food establishments to allow consumer-owned containers for bulk food, food service, or refills.

11	Source Reduction Lifecycle Impacts End Markets	Need to reduce single-use and unnecessary plastics, use of problematic resins, & foster circular economy for plastics.	Encourage participation among Illinois stakeholders in the U.S. Plastics Pact.	The Solid Waste Agency of Lake County (SWALCO) participates, as do Illinois based corporations such as ALDI and other key stakeholders in the U.S. Plastics Pact.
12	Source Reduction Education/ Stakeholder Engagement Funding	Reducing unnecessary consumption of durable (non-single-use) plastic products could result in less disposal/need for recycling.	Encourage development of "sharing economy" projects, through education campaigns, grant programs, and/or recognition of successful projects.	Examples of such projects in Illinois include: • Tool libraries in Chicago, Lake County (Mundelein), & Bloomington. • Rental services for reusable items, such as The Festive Frog. The Reusies, coordinated by Upstream, is an existing recognition program for reuse projects. Illinois stakeholders could be encouraged to participate or this could be used as a model for an Illinois-specific recognition program. The University of Guelph (Ontario, Canada) published "Navigating the sharing economy: A 6-decision guide for municipalities" in 2017.
13	Data Gaps End Markets Lifecycle Impacts	Need to compare locations of plastics manufacturing (products as well	Explore the use existing and forthcoming information to add a layer related to plastic-	The results of the forthcoming statewide waste characterization study, part of the Statewide Recycling Needs Assessment Act, may support such an effort. Additionally, the following existing resources should be consulted: • Asset maps created for the MMAC Report.

	Collection Processing	as virgin & PCR feedstocks) & collection facilities to EJ communities in Illinois.	related facilities to the IEPA EJ Start map.	• U.S. EPA Recycling Infrastructure and Market Opportunities Map • Environment Illinois 'Where is Plastic Produced?' Map
14	Processing Lifecycle Impacts	Potential for microplastic pollution releases from mechanical recycling facilities.	Pilot/consider funding filtration upgrades at recycling facilities to prevent point source pollution.	See previously mentioned research on this topic (Brown et al., 2023).
15	Collection Processing Lifecycle Impacts End Markets	Need to collect cleaner streams of consistent materials (e.g. all PET bottles, all thermoform PET, etc.) to improve processing, end market value & applicability, and potentially reduce mixing chemicals of concern with unknown results.	Create collection infrastructure and/or events based on end market and/or material type.* †	• The MMAC recommended that the state re-establish recycling & composting grants, including a round of grants that could support drop-off recycling facilities (p. 60 of MMAC Report. This could not only expand access to recycling, but also foster cleaner streams if properly implemented. The Recycling Partnership offers a toolkit for contamination reduction at drop-off sites. • Special collection events, similar to targeted car-seat collections, for specific types of containers/packaging. • Reverse vending machines for beverage containers can help incentivize recycling & keep streams cleaner.
			Explore deposit return systems.*	• The Container Recycling Institute Bottle Bill Resource Guide website provides comprehensive information about beverage container deposits in the U.S. and worldwide. • The APR supports bottle bills.

	Education/ Stakeholder Engagement Policy			• Upstream provides resources related to deposit-return systems. • Reloop Factsheet: Deposit Return Systems Generate Cost Savings for Municipalities
			Pilot/study efficacy of municipal or institutional systems that limit the number of resin codes accepted & form types (e.g. "only bottles, jugs, & jars #1 & #2")*	Information to assist in identification of locations for such studies includes: • Appendix G.7-Table 13: Supporting data and individual site information for asset maps (Drop-Off Recycling Locations) of the MMAC Report (pp. 180-205) • Results of the forthcoming statewide waste characterization being pursued as part of the Statewide Recycling Needs Assessment Act.
			Accelerate deployment of Recycle Coach to local governments in Illinois. Share lessons learned from early adopters.* †	Recycle Coach would reduce confusion among residents regarding materials accepted for recycling and related geographic inconsistencies. As mentioned previously in this chapter, an update on deployment was provided during the 2024 Illinois Counties Solid Waste Management Association (ILCSWMA) conference. Organizations such as ILCSWMA and the Illinois Recycling Association/Foundation should continue to work with IEPA to foster deployment and networking among local government officials.
16	Processing End Markets Funding	MRFs throughout the state have inconsistent technology and	Provide funding for MRF improvements/upgrades.	The advanced sortation capabilities of LRS and Rumpke were discussed in the main narrative of this chapter as potential models to emulate. This proposal also relates to the previously stated potential solution of deploying a NextCycle Illinois program, since such programs can incorporate funding for

		sorting capabilities.* †		ways to improve the state's recycling system. For example, [NextCycle MI offers low/0% loans for recycling facilities and matching funds for collection & recycling of target materials.]().
			Provide guidance and oversight for proper deployment of equipment at MRFs.*	In 2010, the Illinois Recycling Association published "Best Operational Practices Manual for Materials Recovery Facilities and Recycling Drop-off Facilities." IEPA could work with or fund updated guidance.
17	Collection End Markets Education/ Stakeholder Engagement	Private sector haulers sometimes opt to collect all plastics rather than educating the public on what is truly recyclable (economically).*	As RecycleCoach is deployed, ensure that haulers are involved.	During the update on deployment of RecycleCoach at the 2024 ILCSWMA conference, it was noted that RecycleCoach tends to work with local governments. So local governments should be encouraged to get haulers in their area involved in deployment/implementation. Local governments control the information served by RecycleCoach, and they can choose to give haulers permission to assist with maintenance of local information if they wish.

Textiles

This chapter focuses on textile recycling and reuse. As with other materials, the hierarchy of waste necessitates the reduction and reuse of textiles before recycling or landfilling. This chapter acknowledges reduction as a primary goal but focuses on reuse and recycling.

Definitions

The 2018 Materials Management Advisory Committee (MMAC) Report (MMAC, 2021) listed four major categories in the Textile Category: clothing, carpet, carpet padding, and "other textiles." **Textiles** include cloth and fabrics made of organic or synthetic materials. The most common source of textiles in municipal solid waste streams is discarded clothing (U.S. EPA, n.d.-o) but the category also includes furniture, carpets, tires, footwear, sheets, and towels. **Fiber** is also sometimes used (Recycling Fibers, n.d.) to refer to this stream but should not be confused with paper fibers.

Textile reuse and **resale** refer to various ways to prolong the practical service life of textile products by transferring them to new owners or modifying (e.g., mending, DIY additions, "**upcycling**" (Blaazer, 2024)). Renting, reselling, trading, swapping, borrowing and inheriting clothes and furniture are all ways to reuse textiles. They are aided by secondhand shops, consignment stores, flea markets, garage sales, online marketplaces, charities and clothing libraries, among others (Sandin & Peters, 2018). Textile reuse may also refer to recycling that does not break down the textile itself, such as cutting fabric into cleaning rags.

Synthetic textiles are made of polymerized plastic, most often from fossil sources. Examples include polyester, acrylic, and nylon fibers. **Natural textiles** come directly from plants or animals. Examples include cotton, bamboo, hemp, silk, and wool of various animals. Fibers (usually cellulose) may also be processed more heavily (Abadjieva, 2021) to create **semi-synthetic textiles** such as lyocell, rayon, and viscose.

Textile recycling refers to the deconstruction and reprocessing of products that no longer serve their original purpose but are turned into another usable product (e.g. clothing shredded and compressed into carpet padding, and vehicle sound insulators (Cintas, 2023)). A small percentage of textile recycling operations create a high-quality product suitable for like-new textile items (e.g. clothing-to-clothing streams.) Textiles generally cannot be recycled infinitely. Most synthetic and natural textile recycling is considered irreversible **downcycling** (Sandin & Peters, 2018) because fibers wear and shorten over time through laundering and wear. Some recycled synthetic textile feedstocks are themselves downcycled from other products, such as the 98% of recycled polyester fleece (Textile Exchange, 2024) sourced from PET water bottles.

Resale stores, also called thrift stores, secondhand stores, consignment stores, and charity shops, collect clothing, furniture, home goods and other items for local resale. These stores can be run as **for-** or **not-for-profit.**

Textile waste is discarded or unwanted material from the production and use of fiber, textile, and clothing, which can be categorized into pre- and post-consumer waste. **Pre-consumer textile waste** is produced as a by-product of manufacturing, such as off-cuts, misprints, and unsold merchandise. It generally consists of large quantities of the same material, making it potentially easier to sort and reprocess. **Post-consumer textile** waste consists of discarded garments or household textiles (sheets, towels, rugs, furniture, and pillowcases) that are worn-out, damaged, and of no value to consumers after their service life. Some items are **unwearable/unusable** without significant mending, while some are simply **unwanted** or **unsellable**, often due to being out of style.

Environmental justice means the just treatment and meaningful involvement of all people, regardless of income, race, color, national origin, Tribal affiliation, or disability… [providing] protection from disproportionate and adverse human health and environmental effects (including risks) and hazards… and [providing] equitable access to healthy environments" (U.S. EPA, n.d.-j). Too often, high-income countries' demands for large quantities of cheap, rapidly produced, low-quality, "disposable" clothing (a recent and highly profitable business model known as **fast fashion**) exports ethical and environmental harms to **low- and middle-income countries** (LMICs) by incentivizing unsafe, unjust, and unhealthy environments in the creation and disposal of those materials (Bick, Halsey & Ekenga, 2018).

The Organization for Economic Co-Operation and Development defines **Extended Producer Responsibility** (EPR) as "a policy approach under which producers accept significant responsibility - financial and/or physical - for the treatment or disposal of post-consumer products. Assigning such responsibility promotes circular (durable, mendable, recyclable) product design and supports recycling" (OECD, 2024).

Generation

U.S. EPA estimated (U.S. EPA, n.d.-y) that only 14.7%, or 2.5 million tons of textiles were recycled in the U.S. from the 17 million tons that entered municipal solid waste (MSW). This accounts for around 6% of all MSW by weight. The other 85% ended up in landfills and incinerators. Notably, this calculation did not include reuse streams in its "waste" generation rates. The following data are from the U.S. EPA's 2018 Facts and Figures and are measured in tons.

Table 17. Generation, Landfill/Combustion, and Recycled tons of textile items in U.S. MSW.

Material	**Recycling Rate**	**U.S. Tons Generated**	**U.S. Landfilled & Combusted (Total tons)**	**U.S. Recycled Tons**
Clothing and Footwear	13%	12,970,000	9,070,000 & 2,210,000 (11,280,000)	1,690,000
Towels, Sheets, and Pillowcases	15.8%	1,520,000	1,030,000 & 250,000 (1,280,000)	240,000
Carpets and Rugs	9.2%	3,370,000	2,460,000 & 600,000 (3,060,000)	310,000

The 2015 Illinois Waste Characterization report (CDM Smith, 2015) identified the following data (p.91), extrapolated from national averages and Illinois data. CDM Smith did not specify whether textile reuse counted as recovery but its high recovery rate might imply that reuse was included. The national and state categories are split differently, so only ”Carpets and Rugs” can be compared with ”Carpet” and ”Carpet Padding,” showing carpet recycling rates lower than the national average.

Table 18. Generation, Landfill/Combustion, and Recovery tons of textile items in Illinois MSW. (CDM Smith, 2015, p.91)

Material	Recovery Rate	IL Tons Generated	Generation in lbs/c/yr	IL Disposed Tons	IL Recovery Tons
Clothing	34%	425,775	53	279,188	146,587
Other Textiles (Footwear and Linen)	4%	246,597	30.7	235,523	11,075
Carpet	7%	196,599	24.5	182,039	14,559
Carpet Padding	6%	53,185	6.6	49,825	3,360

Textiles refers to all fabrics from furniture to carpeting, but clothing is the source that contributes most heavily to textile waste and is most prevalent in the municipal solid waste stream. Rates of textile consumption and waste have exploded due to the rise of cheap fast fashion and global supply chains. In 2000, global annual textile fiber production was 64.96 million U.S. tons. By 2023, it was 138.88 million, an increase of more than double in 23 years (Textile Exchange, 2024). America has the highest per-capita consumption (Grandview Research, 2023) of new textiles and apparel in the world. The average American purchases 53 new items of clothing per year (Horvath, 2024), which is 60% more clothing (Wicker, 2016) than 15 years ago and quadruple what they bought in 2000.

Americans aren't just buying more clothing. They're wearing it less and trashing it faster. Between 1998 and 2005, "the mean useful life of apparel was reduced by 35%" (Piribauer & Bartl, 2023, p.114). A 2018 study by Movinga found that Americans wear only 18% of the clothes they own (van Elven, 2018).

A 2017 report by the Ellen MacArthur Foundation estimated that clothes are worn an average of 7-10 times (p. 18) before they are trashed. The average American disposes of 80 lbs of clothing every year (U.S. EPA,n.d.-y).

Statistics on global textile production and waste generation do not include the huge reuse, repair, and resale markets that shape textile life cycles—in fact, these markets lack clear research on their size and effectiveness! EBay's 2024 Recommerce Report found that 86% of consumers surveyed said that they had bought or sold secondhand ("pre-loved") goods in the last 12 months. ThredUp's 2024 Resale Report estimated that consumer spent almost half of their 2023 clothing budgets on secondhand items, and that the global secondhand market would reach $350 billion by 2028. Goodwill alone handled almost 3 million tons of material (Chiu, 2023) (not all textiles) in 2021. That would add another 20% to the U.S. EPA's estimation of waste generation for 2018, but is not included their rates, which indicates a huge gap in waste management research.

Other sources of clothing waste include institutional garments such as uniforms and medical textiles, which have fewer outlets for reuse and may contain hazardous medical waste or chemical contamination. Data is lacking on these waste streams.

Other Textile Waste Generation: Carpets, Mattresses, and Furniture

Other, lower-volume textile sources are not as closely monitored as fashion, but some statistics exist.

American carpet companies produce around 12 billion square feet of carpet and rugs per year; according to one estimate (As You Sow, n.d.), 91% is landfilled, 4% is incinerated and only 1% is turned back into carpet. The U.S. EPA estimated more optimistic numbers (U.S. EPA, n.d.-g) in 2018. They reported 71% went to landfill, 17.8% was combusted with energy recovery and 9.2%

was recycled, but did not specify circular (i.e. carpet-to-carpet) recycling. Estimates of national carpet waste generation range from 4 billion (Aquafil, 2022) to 5 billion (CARE, n.d) tons of carpet per year. Carpet America Recovery Effort (CARE) (Sikorski, 2015) estimated that annual Illinois carpet waste generation was around 175 million pounds in 2014, with 8 million pounds collected and reprocessed into 3 million pounds of recycled output (p. 16). Extreme weather events such as flooding can cause an increase in carpet waste.

The Illinois Product Stewardship Council reports that, “An estimated 2,000 mattresses are thrown away every day in Illinois. Averaging 25 cubic feet and 60 pounds each, these discarded mattresses accumulate at a rate of 25,000 tons and 20 million cubic feet per year.”

Furniture items also contribute to textile waste, although their textile type and content vary. Like mattresses and clothing, the labor costs of deconstruction and reconstruction of furniture tend to outweigh the cost of new furniture, especially if the original furniture was not built to last.

Impacts on the Environment and Human Health

Impacts of Synthetic and Natural Fiber Production/Recycling

The fast fashion industry alone is responsible for 10% of global greenhouse gases (McFall-Johnsen, 2019. Regardless of material, processes like textile dyeing and tanning (Ammayappan & & Jeyakodi Moses, 2007) can cause acute environmental harms to local environments. Nearly 20% of all global water pollution and 3% of global carbon emissions (Piribauer & Bartl, 2019) come from the dyeing and treatment of textiles.

Oil-based clothing and natural fiber clothing have upsides and downsides for wear, emissions, biodegradability, and recyclability. Synthetic textiles can be moisture wicking, durable, and resilient. They can provide better elasticity than natural fibers while being stain or heat resistant.

- Depending on material and decomposition conditions, polyester does not decompose under normal conditions, but degrades into microplastics (Common Objective, 2021).
- Recycling synthetic textiles often shortens fiber length, creating a “fluffy” texture that is more prone to shedding microplastics (Okamato, 2021). Washing and even wearing synthetic textiles puts plastic microfibers (Weis, 2024) in environments and bodies. Textile sources account for around 9% of microplastic (Ryberg, Laurent & Hauschild, 2018) entering the world’s oceans annually.
- Virgin production drains finite petroleum resources, necessitating the emissions and environmental damage associated with fossil fuel extraction and processing.

Natural plant and animal fibers such as cotton, bamboo, and wool come from renewable resources, can biodegrade naturally, and provide thermal and electrical insulating properties.

- Farming these resources (Piribauer & Bartl, 2019), especially in monocultures with heavy use of toxic pesticides and herbicides, can drain water resources, harm biodiversity, and adversely affect waterways and soil. On average, a single t-shirt requires 2,700 liters (713 gallons) of water (Handle with care, 2014).
- Natural origin doesn't always mean biodegradability. Dyeing, bleaching, coating, and processing natural fibers into semi-synthetic materials can make it harder for textiles to decompose or cause harm to soil ecosystems (Harrison, 2024) when they do.
- Even natural fibers may be coated with chemicals to preserve or waterproof the fabric, as in protective clothing used in industry. To recycle these fabrics safely, effectively, and circularly, the contamination should be removed before inclusion in broader textile recycling streams.

Environmental Justice and Human Rights in Textile Production

Human health and rights concerns abound in the production and disposal of clothing and other textiles. Ninety percent (90%) of the world's clothing (World Benchmarking Alliance, 2023b) is produced by low and low-middle Income Countries (LMICs), where the cost of labor is lower and lack of regulations allow global brands to outsource unfair and dangerous working conditions to LMICs to provide cheap clothing for richer countries. "Extending the environmental justice framework to encompass the disproportionate impact experienced by those who produce and dispose of our clothing is essential to understanding the magnitude of global injustice perpetuated through the consumption of cheap clothing," write Bick et al (2018, p.2).

Brands often demand unreasonably low prices (Kashyap, 2019) from suppliers in LMICs, forcing them to cut costs by taking advantage of workers. Occupational and safety standards, fair pay, maternal leave, unionization, and overtime pay are too frequently disregarded in this globalized race to the bottom. In 2013, the Rana Plaza collapse in Bangladesh killed 1,138 garment workers and injured over 2,000. When a representative from a major brand flew in the next day, as one employee noticed, it was not to help the factory – it was to make up for the lost production by striking a new deal with a different factory with even worse working conditions.

America's cheap clothing habit also harms people and environments downstream. An average of 15 million secondhand garments (Marc, 2023) arrive in Ghana, the world's biggest importer of secondhand clothes, every week. Secondhand vendors, report that purchasing each bale of compressed clothing is "like gambling," since unwearable, unsellable clothing makes up an average of 40% (Ricketts, 2022) of each bale. This waste material then overwhelms waste management systems (Johnson, 2023), informal landfills, and environments of developing countries instead of the countries who wore it. Vendors note that clothes from the U.S. are the lowest quality (The OR Foundation, n.d.). As long as international importers lack the political and economic power to demand higher-quality clothing, higher-income countries can get away with poor sortation and quality control.

Circular textile recycling will provide many opportunities (van Duijn et al, 2022) for the creation of just and fair collection, sorting, transport, and reprocessing jobs both domestically and internationally.

Collection

Textiles are unique. Although U.S. demand drives production, most pre-consumer and many post-consumer waste issues harm other countries if mismanaged. Therefore, it is critical that the U.S. take steps to reduce consumption and improve quality of domestic and international reuse and recycling streams.

In Illinois, textiles may be diverted from landfills through drop-off bins, centers for resale/donation/recycling, resale and consignment stores, clothing drives and collection events, sometimes curbside collection, retail takeback programs and mail-in return programs. However, these programs primarily accept wearable clothing. For an excellent analysis of these and more potential landfill diversion pathways, see Fashion for Good and RRS's *Sorting For Circularity USA* report (Adler & Vellanki, 2024), sponsored and advised by major fashion brands and Goodwill.

Thrift and Consignment Resale Stores

Brick-and-mortar resale stores are a primary stakeholder in Illinois' textile waste management because they are a primary channel for reuseable and potentially recyclable post-consumer clothing, linen, and furniture waste. Consignment stores often pay original owners for high-quality items which can be resold for a profit, while thrift or charity stores receive donated items of variable quality that require more quality control and sorting before resale. When the Salvation Army and Goodwill were founded, their business models included hiring people to mend the clothes, not just stock and sell them. With rising labor costs and global trade, this model has faded.

Large corporate thrift store chains include Goodwill, the Salvation Army, and Savers. Eighty percent (80%) of the U.S. population lives within 10 miles of a Goodwill, and Goodwill handled 5.7 billion pounds (Goodwill Industries International, 2024) (almost 3 million tons) of donated goods (not just clothes) in 2021 alone.

Resale store staff sort incoming items by quality and salability, putting the best items out for resale. Estimates vary, but only 10%-50% of donated items (Chiu, 2023) are resold at storefront locations. The roughly 5% of Items that are dirty, wet, mildewed, contain pet allergens, or are otherwise unusable are most often trashed (Porter, n.d.). Items that are wearable but not sold may be transported to a different area, outlet store, or salvage recycler. These practices vary widely from store to store, especially for smaller chains or individual businesses which may not have the infrastructure for longer, more comprehensive recycling streams.

Goodwill has stepped up in the last few years, hosting its first sustainability summit (Quinn, 2024b) in 2024 and collaborating with other organizations on pilot recycling projects, traceability studies, and EPR conversations. Goodill and WM announced a partnership with Reju (Goodwill Industries International, 2024) in October 2024 to domestically reprocess some unwearable, recyclable polyester items from Goodwill stores into recycled feedstock. In September 2024, Reju opened their first facility in Germany, which will produce recycled PET in 2025. "Reju anticipates building a U.S.-based regeneration hub to serve the American market, with certain material collected through Goodwill and WM that are not viable for resale," said Waste Advantage Magazine (Goodwill Industries International, 2024).

ThredUp's 2024 Resale Report reported that digital resale platforms such as ThredUp, Depop, and EBay grew by 23% in 2023, estimating a market of $40 billion in 2028.

Retailer and Third-Party In-Store and Mail-In Programs

As part of sustainability efforts, some corporations have started in-store drop-off and mail-in programs for clothing resale and recycling. Examples of major retailers (Kane County Recycles, n.d.) with in-store drop-offs and/or mail-in programs include Nike, DSW, Fjällräven, Levi's, H&M, The North Face, Madewell, Carhartt, Torrid, Bombas, and Patagonia, with more added every week. Retailers may accept only their own brands or include other retailers. Retailers may offer store credit for resalable trade-ins and/or restrict donations by item or fiber content. Retailers may sort the clothes, reselling some while recycling others. Several brands have partnered with jeans-to-insulation company Blue Jeans Go Green. ThredUp tracks which brands have launched "branded resale" shops through ThredUp in its Recommerce 100 review.

Some third-party recyclers such as Retold and TerraCycle offer third-party mail-in textile donation service for resale and recycling.

Curbside, Drop-Off and Donation Boxes

"Drop-off bins are commonly found in communities across the U.S., providing the most accessible collection option for people living in urban and rural areas. These bins are typically located in public spaces such as shopping center parking lots and may be owned by charities, private companies, or be part of municipal-run programs," reports the RRS Fashion for Good Report (Adler, 2024. p. 21). These boxes can provide 24/7 donation opportunities for local circulation of reusable goods in the same way as resale stores. However, Illinois stakeholders noted that poor upkeep, contamination, and lack of supply chain transparency for these bins may create suspicion and concern about proper sortation and potential export of contaminated clothes.

Some collectors (mostly in the Chicago area) accept curbside pick-up and drop-off donations, such as Chicago Textile Exchange, Chicago Textile Recycling, and Simple Recycling. These have more transparency and trust than boxes alone, but at a higher price due to labor and transportation costs. Simple Recycling provides free pickup service to residents in several municipalities in the Chicagoland area.

Most clothing drop-off boxes do not accept other textile items such as carpets, mattresses, and furniture. Some, but not all, encourage the inclusion of unwearable clothes for recycling along with wearable clothes for resale/redistribution. SWALCO's network of 75 Chicago Textile Recycling bins (SWALCO, n.d.-a) across the Lake County region and Kane County's Rewearable boxes, for example, do collect unwearable items. They suggest that all clothes be contained in bags so that different donations might not stain or damage other clothes in the box. Responsible management of drop-off boxes should include clear signage of acceptable items and transparency in logistics and end markets.

Mattress Collection

Mattresses are generally under-collected for resale in Illinois for hygienic and cost reasons. The sale of used and reconstructed/recycled mattresses is permitted under Illinois law (ILSPC, n.d.), with stipulations (410 ILCS 68 et seq). Resellers must register annually with the Department of Public Health, they must deconstruct, inspect, and sanitize each individual foam and fabric layer, then must clearly label the item as used or secondhand before selling it. Due to these restraints, processors who do take mattresses for deconstruction and recycling rarely reconstruct them into mattresses. Stakeholders said that increased education on disposal/recycling/reuse of mattresses could play a big part in increasing collection rates. Services for reselling, refurbishing, and sanitizing mattresses could also contribute to bedding circularity in Illinois in the future.

Mattress recycling for commodities is also labor-intensive and inefficient; although the steel springs, wood frame, cotton padding, and natural/synthetic textiles are all hypothetically recyclable, the cost of labor and logistics are often greater than the cost of the recovered materials. However, businesses like A Bedder World and Green Spring Recycling offer paid mattress pickup, drop-off, and recycling programs for individuals and businesses.

Carpet Collection

Carpet is collected at a limited number of drop-off points in Illinois, including CLEAR in Chicago. The Carpet America Recovery Effort (CARE) compiled a list in 2018 of all active carpet recyclers in Illinois.

In some cases, floor rugs may be accepted at locations where furniture is accepted. Broadloom carpet and tiles are unlikely to be accepted, although this varies by location.

Infrastructure

Textiles involve interstate and international production processes and waste streams. Fabric can be grown or refined in one country, turned into consumer ready textiles (pre-consumer textile waste) in another, shipped to the U.S., worn, donated, and be reused, recycled, and or landfilled in the U.S. or abroad. Pre-consumer streams such are generally "cleaner," (Piribauer & Bartl, 2019) with fewer material types, than post-consumer waste which may include a wide variety of sources, styles, designs, and material content and require more sorting for effective processing. Salvage markets in the U.S. are often opaque, meaning that it can be hard to determine where items go (Porter, n.d.) after they enter the system.

Textile sorting systems include collectors, sorters/graders, and recyclers that handle different types and grades of material. Collection can occur through secondhand stores, drop-off boxes, mail-in programs, and occasionally scheduled curbside service (see "Collection of Textiles in Illinois" above). More research is needed on the extent of sorting/grading in Illinois and where items go from there.

Textile recycling occurs through mechanical, chemical, and thermal processes and may involve the deconstruction of textiles (Sandin & Peters, 2018) down to fabric, yarn, fiber, and even basic molecules (Syre, n.d.) for reprocessing into new items. The less processing needed, the more cost- and energy-efficient it will be (Piribauer & Bartl, 2019), up to and including reuse of garments or fabrics.

Sorting reuseable, salable consumer textile goods from textiles unusable in their current form is already a labor-intensive task for Illinois donation drop-offs and resale stores. Preparing textiles for high-quality recycling can be even more tedious: zippers and buttons must be removed, items must be sorted by material and color, and recycling destinations adjusted by material. For example, the chemical depolymerization and extrusion techniques used to reprocess synthetic PET fibers do not work on cotton fabric, which requires mechanical separation and reweaving (Piribauer & Bartl, 2019) with a longer carrier fiber. The added costs of sorting, dye removal, depolymerization, carding, and overall conversion of the recycled materials into new, clean feedstock far exceeds the cost of virgin materials (Leal Filho et al, 2019), resulting in shredding for downcycling at best and landfilling and incineration of textiles at worst.

Illinois (and the U.S. in general) is not a major clothing producer and so deals with more post- than pre-consumer waste. The availability of cheap imported textile goods disincentivizes the expensive and labor-intensive work to domestically produce, repair, or recycle textiles, especially clothing-to-clothing. As a state which lacks robust production and reprocessing infrastructure, Illinois can contribute most effectively to textile recycling systems by reducing consumption, reusing existing goods, advocating for responsible textile design, and providing infrastructure and education that ensure clean streams for recyclers and resellers downstream.

Illinois Recyclers

Illinois is home to several recyclers turning clothing and home textiles into rags, insulation and low-grade blankets. Recycling or downcycling some materials can reduce the amount of virgin material needed for Illinois-made textile products but does not create an infinite, closed loop of recycling.

Carpet recyclers in Illinois were last publicly compiled by the Carpet America Recovery Effort (CARE) in 2019.

End Markets

In 2023, 64% of the 138.88 million tons (Textile Exchange, 2024, p. 10) of textile fibers produced globally were derived directly from petrochemicals. 7.7% of global textiles were made of recycled materials, but less than 1% (~1.232 million U.S. tons) of that came circularly from pre- and post-consumer recycled textiles. The other 7% came from downcycling plastic bottles into polyester. With less than 1% of global textile markets coming from recycled textiles, the circular fashion economy has a long way to go (p. 11).

In a circular textile economy, durable, reusable textiles may change hands within families and friends or through commerce, then mended or altered by a professional or amateur. When the material is too worn, the article may be deconstructed for fabric or fiber recycling. Interpersonal and individual action play an important role in extending the lives of textiles but are difficult to quantify into end markets. Even the role of secondhand stores in the reuse economy is an emerging and under-researched field.

For a long time, labor and technology limitations have restricted textile fiber recycling to downcycling (i.e. not clothing-to-clothing). Wiping rags, carpet, and insulation are a few areas with established post-consumer feedstock options. However, sortation and reprocessing advancements are making it possible to recycle more items more easily.

Reuse, “Diamonds,” and Upcycling

Any textile item that is still in good condition (with no stains or damage) has the potential to be reused or reworn, although shifting trends may make it unfashionable. Many textiles are thrown away while still wearable, usable, and (in cases of historical furniture or designer clothes) sometimes worth a lot of money. These rare items, known colloquially to thrifters as “diamonds,” are the rarest in waste streams but can provide the most environmental, economic, and even historical benefit (Hawley, 2006) for their diversion.

Even items that are unwanted or damaged in their current form may be desirable for alterations, mending, additions, or recreation into a new garment (all considered “upcycling.”) (Greenhive, n.d). This market is generally small, highly creative, and labor-intensive. It includes individual alterations of personal garments, brick-and-mortar repair and tailor stores, and individual creators selling bespoke pieces. Alterations, mended clothes and one-of-a-kind items often do not compete directly with fast fashion or interior design trends (Blaazer, 2024) because they are more expensive and tend to prioritize personal style over shifting trends. Recyclability of these upcycled items may vary by original material content and quality of additions.

Fabric and Fiber Recycling Products

If the garment is unsellable/unwearable/unfixable but the fabric or fiber is still in good condition, deconstruction of fabric begins with sorting by material content and removing non-textile items like zippers, buttons and embellishments. These fabrics may be resold for their fabric or broken down mechanically or chemically into yarns or base fibers to be respun. Not all post-consumer recycled textiles are recycled again after this second life due to contamination or irregularity in their material.

- Absorbent natural fibers such as cotton and viscose can be cut or otherwise converted into wiping rags (Piribauer & Bartl, 2019), often used as reusable/launderable wiping rags or as single-use rags for harmful chemicals or oil in automotive and manufacturing industries.
- Recycled, shredded textile fiber, also known as "shoddy," is a versatile recycled textile feedstock. The term "shoddy" originally referred only to shredded wool, but now may refer to shredded cotton rags or mixed-material-content scrap of variable quality (Singh, n.d).
- Shoddy is most often compressed into colorful felted pads used as insulation, carpet and mattress padding, shipping cushions, or sound dampeners. Depending on their material content and quality, shoddy pads may or may not be biodegradable or recyclable at the end of their second life.
  - Recycled fiber pads can also be used as clean-up materials in industrial applications. Examples include spill socks, absorbent pads, etc. These vary in size and application from small pads to large booms used on oil spills.
- Textile fibers can be re-spun into new clothing-quality yarn or textiles. Some brands are beginning to seek out post-consumer recycled content as part of broader commitments to sustainability.
- Fibers that are too short to be re-spun are referred to as "flock" or "mungo" and can be used to adjust the viscosity in liquids, as a coating to produce a fluffy, flocked surface, or as an additive in construction materials.
- Petroleum-based textiles may be depolymerized and broken down into their base components through thermal or chemical reactions for reprocessing into textiles or for another use. Polymers degrade with each recycling and require energy-intensive reprocessing, making it difficult to compete with virgin material in cost and quality despite carbon and resource savings.

Other Sustainable Textile Waste Management

- Some naturally sourced, minimally processed fabrics could be composted when their fibers are too short to be re-spun to divert them from landfills. However, synthetic (petroleum-based) and semi-synthetic (processed cellulose) fibers may not break down as easily or safely, and all textiles may potentially hold chemical dyes or processing remnants.

- Oil-based textiles may be reduced and refined into fuel, which ranks low but higher than landfilling on the waste hierarchy.
- Flame-retardant, waterproof, or otherwise coated fabrics require additional processing to remove chemical coatings prior to usual textile recycling processes. Research into recycling these kinds of textiles is underway (Tarasafe Workwear, 2022).

Existing Policy/Regulations

There are currently no Illinois or national laws or regulations that govern the disposal of textiles generally. The Illinois Safe and Hygenic Beds Act (410 ILCS 68 et seq) regulates mattress labeling of recycled/new materials, but does not establish recycling streams.

Textile EPR in Other States/Countries

The Ellen MacArthur foundation (Boiten, Magnani & Moggs, 2024a) calls extended producer responsibility (EPR) a "crucial policy mechanism… to cover the net cost associated with managing all discarded textiles, not just the fraction with high reuse value." For more information, see the Foundation's pages.

In September 2024 California passed a bill (SB 54) to create a statewide general textile collection/recycling program and require producers to join a Producer Responsibility Organization, summarized here (Garno & Yuan, 2024). This was the first all-textile EPR bill passed in the U.S. (Deppen, 2024), setting the tone for other programs. The California program requires qualified producers (generally, brands) of clothing, fabric accessories (backpacks, scarves, etc), and linens (towels, wall hangings, tablecloths, etc) to form and join a producer responsibility organization (PRO) by July of 2026. This PRO will submit a plan for "free, accessible and convenient drop-off or collection systems" to be approved by the California Department of Resources Recycling and Recovery. Fees to producers will be eco-modulated (a term borrowed from French legislation) with lower fees for more environmentally preferable programs like repair and reuse. Stores that sell only secondhand products are exempt from the fees (Garno & Yuan, 2024). California has encouraged other states and the global community to address fast fashion and fragmented, inadequate textiles recycling infrastructure (Deppen, 2024).

Mandatory Textile EPR has also been passed in France (in 2007) (Boiten, Magnani & Moggs, 2024a), the Netherlands (2023) (Boiten, Magnani & Moggs, 2024a), Hungary (2023)(Deutche Recycling, n.d.), and Latvia (2024)(Go4Recycling, 2024). These new requirements mandate that producers and importers of clothing, footwear, and furniture to participate in planning and funding to create more circular, less wasteful life cycles for their items. This includes waste management via recycling and collection but also may involve companies in designing longer-lasting clothes and addressing unsustainable consumption habits. France aims for a 15% reuse rate (Boiten, Magnani & Moggs, 2024a) within 1,500 km of the collection point by 2027, annual collection of 60% of waste quantity by 2028 and collects data on reusability, export rates, and fates of used textiles. France also maintains a public dashboard of collection, reuse, and recycling rates (République Française Agence de La Transition Écologique, n.d.). As of November 2024, collection rates are around 30% of annual clothing production. In France's and other EPR systems, textile producers' fees may be eco-modulated (SGS Corp, 2023) or reduced by brands' upstream sustainability improvements, such as making more durable, well-labeled, clothes from recycled materials.

Both California and New York have passed EPR policy for carpets in 2010 and 2022, respectively (Product Stewardship Institute, n.d). New York's carpet law requires carpet producers or their representative organizations to submit their own self-funded carpet collection program plan including educating buyers and sellers of carpets. The New York law also establishes goals (NYS DEC, n.d.) that increase in scope every 5 years. After 15 years, all producers must achieve a 75% recycling rate on their own products with 40% going back to carpet and make their own products with at least 30% post-consumer content.

Twelve U.S.states have passed mattress recycling legislation (Mattress recycling laws and regulations in USA, n.d.) which require mattress manufacturers to establish and fund take-back programs for mattresses either at retail locations or other facilities. Mattress producers and sellers may offset costs with fees collected at sale.

Other Policy

Some policy that primarily addresses workers' rights and American-made goods impacts the textile industry. The proposed bipartisan Americas Trade and Investment Act (Garden, 2024) supports a circular textile economy including reshoring operations currently based in China as well as creating a 15% tax reduction for businesses withing the U.S. that handle collection, reuse, repair, recycling or rental of textiles.

Similarly, the Fashioning Accountability and Building Real Institutional Change (FABRIC) act encourages domestic textile production (HEY FASHION!, n.d.) by establishing workplace and pay protections for American garment workers and by creating multiple new national organizations: a new $50 million per year Domestic Garment Manufacturing Support Program and a garment industry registry that would ensure adherence to the new labor standards.

Existing Goals

No national, state, or county-level goals related to textile waste reduction and management were uncovered.

International

The United Nations Sustainable Development Goal 12 (Responsible Consumption and Production) applies to textile waste, although textiles are not specifically named for reduction or recycling goals.

Corporate & Industry

Many apparel companies and some other producers of textile goods (i.e., furniture, linens) have set environmental and social sustainability goals related to increasing percentages of recycled materials, establishing take-back programs for reuse/recycling, reducing overall carbon emissions, and ensuring ethical working practices in their factories.

Despite many companies' unfortunate trend of greenwashing their successes, greenhushing and hoping nobody notices, and/or moving the goalposts of their sustainability targets, some brands are setting appropriate goals and sticking to them. Sites like Science Based Targets and Good On You have compiled directories of companies' goals and progress. Large sports company Puma, for example, recently released their VISION 2030, which commits to, among other goals, using 100% recycled polyester fabric (30% from recycled textiles) and 20% recycled cotton, working with industry peers on sortation and recycling solutions under EPR laws, reducing GHG emissions by 90% from 2017, and training 400,000 workers on human rights by 2030.

A smaller subset of companies has set more ambitious goals of circularity including ethically sourcing natural and post-consumer recycled material, phasing out synthetic materials, designing more durable and/or easily recyclable clothes (made from one material, deconstructable, compostable) and intentionally creating versatile, "timeless" styles that encourage personal style over latest trends. These goals are not as common among fast fashion retailers because their business model depends on quickly made, cheap clothing.

The fashion industry is aware of sustainability issues in fashion, with industry groups like the Global Fashion Agenda pushing for environmental and ethical improvements.

Existing Funding Opportunities

Relatively fewer funding opportunities exist for textiles than for any other recyclable commodities in Illinois and nationally. Although they make up 7.7% of annual landfill material and 9.3% of items that are combusted, textiles are a broad category requiring a diversity of management approaches. However, some private and public funding sources are investing in textile waste solutions.

- The Walmart Foundation grant Accelerating Circularity is being implemented across the U.S. and Europe to help fuel textile recycling programs.

- U.S. EPA's Consumer Recycling Education and Outreach Program provides funds to help educate consumers to improve both residential and community recycling.

Existing Education & Resources

Reuse Economy

Many reuse strategies have been around for as long as clothing. Hand-me-downs, mending, altering, resale stores, and borrowing items are all strategies for using the same items for longer. Although learning these skills can occur at the individual level, educational programs are increasing in popularity as people re-learn how to mend and alter their own clothes. Community centers, sewing stores, public libraries, community maker spaces, and online classes may teach such skills.

Similarly, methods for sharing clothing are growing and changing. Some newer methods for reuse include virtual platforms for renting clothes for a short period of time (ex. formalwear, unique styles), online centralized resale stores, and peer-to-peer clothes sales platforms.

Donation Education

Illinois has a long way to go in knowing how and where to donate textiles for reuse and dispose of materials for recycling. General recycling map tools such as IEPA's Beyond the Bin and SWANCC's Reuse and Recycle Directory include clothing/textiles/carpet as options. However, these directories are far from complete. No resource currently available has compiled all thrift stores and drop-off locations in Illinois.

Consumer, Producer, and Reprocessor Education

Industry groups, governments, and retailers all play a role in educating consumers and producers on sustainable textile recirculation and waste management. None can do their part alone, so stakeholders "are encouraged to work together to share information and pool the resources needed to make systems level change," as put in the Sorting for Circularity report (Adler & Vellanki, 2024, p. 63). That report also outlines some responsibilities of each group:

- Brands set the bar for sustainable material sourcing practices that are ethically sourced, reycled, recyclable, and traceable. Brands should provide clear and transparent information and end-of-use guidance.
- Governments can implement EPR for textiles, altering the cost-revenue dynamics of current textile recovery systems to incentivize circular fiber-to-fiber recycling.
- Retailers can carry products that meet minimum environmental and sustainability standards and comply with local legislation, including EPR.
- Consumers can be intentional and thoughtful about the products they buy, including responsible disposal and organizing grassroots efforts.

- Collectors can begin tracking tonnages and collection markets, tracing downstream flows, and providing transparency into services available, while tailoring collection methods to optimize consumer participation.
- Sorters and pre-processors can help the industry understand business models of sorting textiles for recycling, including factors such as feedstock costs, technology and equipment, and more.
- Recyclers can conduct techno-economic and life cycle analyses of their processes and work hand in hand with the manufacturing supply chain to ensure compatibility with existing production facilities and process flows to reduce friction and avoid parallel cost.
- Financial institutions can unlock investment for collection and processing infrastructure by working with government and industry to conduct due dilligence studies and understand risk levels associated with different forms of innovations and technologies.

Advocacy Groups

These groups provide support, education, and collaboration between industry and individuals.

- The Secondary Materials and Recycled Textiles Association (SMART) works with 150+ pre- and post-consumer textile collection, resale, and recycling companies to sort clothing into rewearable/exportable, rags, and fiber reprocessing. SMART has published resources for schools and for communities.
- The American Circular Textiles Group advocates for aligning the textile industry on key circular aspects and seeks to educate consumers and businesses on steps necessary to reduce textile waste and create a more circular industry.
- The Textile Exchange has many resources about the benefits and negative impacts of specific types of textiles and lots of educational resources which could help inform companies but also customers about making smart decisions with creating and purchasing.
- Aggregator websites like Science Based Targets and Good On You have compiled directories of companies' goals and progress on sustainability goals.
- Groups like Recycle Refashion and Reverse Resources connect individuals and companies in the textile industry to better achieve circularity and recycling opportunity for textiles.
- The Northeast Recycling Council held a forum series in September 2024 addressing four aspects of the textile life cycle (NERC, 2024).

Case Studies

- Exploring the Business Case for Textile to Textile recycling using post consumer waste in the U.S (McCauley & Jestratijevic (2023)

Solutions & Research Gaps

The primary research gap for textiles is a lack of transparent data on reuse and recycling streams. EPA's current generation, disposal, and recovery estimates do not address reuse streams, in part because accurate data for the supply chains of post-consumer textile management are complex, opaque, and international. The Sorting For Circularity Report (Adler & Vellanki, 2024) states, "Textile waste management is unregulated and neither generators nor collectors [n]or sorters are required to report tonnage or composition data... In addition, few textiles that are collected for re-use, repurposing, and recycling remain in the U.S. for sorting and grading. The majority of them are exported in aggregate to other countries where this categorization occurs. As a consequence, there is little to no visibility into how much is sorted as rewearable versus non-rewearable. This is in contrast to Europe where regional sorting operations can provide an indication of the split between rewearable and non rewearable" (pp.15-16).

You cannot manage what you do not measure. Individual states and the U.S. at large would benefit from more robust, traceable waste data that could inform regulation for better management.

Technological Solutions

Artificial intelligence and Near Infrared (NIR) (Sortile, n.d) optical sorting systems can sort large quantities of post-consumer textile waste by color and material more quickly, cheaply, and reliably than humans (Adler & Vellanki, 2024). Reliable feedstock of well-sorted materials might open new doors for domestic recycling and resale in the U.S. and abroad.

Until recently, mixed-material fabrics (e.g. 70% cotton, 30% polyester) could not be recycled easily. Innovative technologies are allowing for recovery of both synthetic and natural fibers from one mixed-material article. Companies in this novel area include Syre, Circulose, Circ, Refiberd, and WornAgain. Many of these companies emphasize the importance of changing current take-make-waste fashion systems to a more circular model (Circ, n.d.-a), even as they work to create solutions for addressing the waste of current systems.

Policy Solutions

Extended Producer Responsibility is currently being pioneered in California and in other countries. Future EPR legislation may include stipulations for:

- Transparent labeling of material blend, recyclability and recycled content, possibly through blockchain for traceability and verifiability
- Contributions to funding for a collection and recycling program
- Mandatory design for durability, repair, and recyclability
- Collaborative stakeholder and consumer education on responsible disposal

Stakeholder Engagement

ISTC supplemented materials management research with written and verbal stakeholder engagement in several stages of the project. As noted in the introduction, ISTC solicited feedback from stakeholders involved in the original MMAC report to provide comment on the draft list of materials. ISTC also conducted one virtual listening session on Zoom for each of the 5 materials.

The listening sessions were advertised via email blasts, newsletters, individual emails, and by tabling and presenting at the Illinois Recycling Foundation (IRF) Conference in early June 2024. ISTC sent 6 email blasts on June 12th and 13th: one for each material, and one with information for all materials. Reminder emails were sent one week before each listening session. ISTC made efforts to invite stakeholders throughout the manufacturing, distribution, collection, and reprocessing of each material. Total invites included:

- Stakeholders invited to all five listening sessions included municipal and county leaders, haulers, recyclers, and others that may have input on more than one material. ISTC recognizes there was likely overlap in the below email blasts.
  - 233 people invited via ISTC email blast
  - 235 people invited via IRF newsletter
  - Over 100 people invited via the IRF conference
  - 206 people invited via Illinois Counties Solid Waste Management Association newsletter
- Stakeholders invited to specific listening sessions were invited via ISTC-curated lists and included industry experts.
  - Organics: 50 people invited via an email blast and/or individual emails
  - Glass: 10 people invited via an email blast and/or individual emails
  - Textiles: 14 people invited via an email blast and/or individual emails
  - Plastics: 20 people invited via an email blast and/or individual emails
  - Metals: 55 people invited via an email blast and/or individual emails

The listening sessions were facilitated by the ISTC lead researcher for each material. A standardized presentation and list of questions were presented during each listening session and participants were encouraged to share their thoughts and ideas by coming off mute or by typing into the chat. The list of questions used at each listening session included:

- What are the barriers to diverting this material from the landfill?
- What are the opportunities to further divert this material from the landfill?
- What types of support and investment form the Illinois EPA would be most impactful to diverting this material from the landfill?

Table 19: Registration and Attendance numbers (attendees only) for Listening Sessions

Material (Date)	Registrants	Attendees
Organics (June 25)	42	42*
Glass (June 27)	39	21
Textiles (July 9)	21	9
Plastics (July 11)	35	16
Metals (July 16)	23	8
Total	160	96

Listening sessions had registrations of between 21 and 42 people and attendance between 8 and 42. Between 35% and 100% of registrants attended meetings, which were held via Zoom.

On July 24, ISTC sent a follow-up email thanking everyone who participated and giving those were unable to participate an opportunity to submit feedback via email or a one-on-one call. Through this process and facilitated invitations by leadership at the Illinois Food Scrap & Composting Coalition (IFSCC), ISTC met with an additional eight individuals to discuss organics diversion. These individuals were primarily compost processers, a group that was underrepresented during the listening session.

The remainder of this chapter summarizes the feedback and identifies themes that emerged from each listening session. While ISTC attempted to clarify stakeholder comments during listening sessions, ISTC did not change wording or intended meaning of comments in this summary document. Due to the nature of each material and the content of discussions taking place at each listening sessions, themes for each material are not all organized the same way.

Glass Stakeholder Engagement

1. What are the barriers to diverting glass from the landfill?

Cost

- There is no financial incentive to recycle glass, especially when companies are paying extra for a container/hauling and landfill tip fees are so low. A deposit system might help address this.
- Strategic Materials Inc.'s (SMI - glass recycler) biggest competitor is landfill due to low tipping fees and permission to use glass as alternative daily cover in Illinois.

Contamination

- Contaminated glass streams are a problem for MRFs and processors. Glass breaker screen is first step in single-stream recycling process. Anything non-glass the size of a hockey puck or smaller winds up in glass collected (i.e., bottle caps, shredded paper, etc.).
- A lot of MRFs lack glass cleanup systems so quality of product depends on how clean material is coming in. Generally, around 13%-50% contamination.
- Recycled glass is priced on a sliding scale based on contamination. If a MRF doesn't have the infrastructure to clean the glass well enough to be worth the cost, they are unable to process/accept glass in some cases. Often the same in small and/or rural areas.
- Single-stream recycling leads to more contaminated glass and glass not separated by color

Access & Collection

- Lack of service to multi-family units throughout the state, even in urban places where residential glass is collected
- Lack of participation in glass recycling among high-producing commercial sectors such as bars, restaurants, hotels.
- Nowhere local to take glass so MRFs/municipalities just don't accept it

Education

- Acceptability confuses consumers about whether it is recyclable/recycled. Ex. Chicago does not accept broken glass curbside because it is a hazard to waste workers. Consumers may also trash broken glass because they think that the bottle is supposed to be refilled. However, broken glass is recyclable and more density-efficient for transportation.

- Post-consumer recycled (PCR) content glass doesn't have the same social awareness and "weight" behind it as PCR plastic & metal. People are less likely to promote or care about the circular aspect.
- Lack of data and transparency on where materials are going, how much and what type of glass is ending up in landfill, and why (contamination, costs to haul, etc.)

End Markets & Infrastructure

- Lack of local markets and processing infrastructure. Processors are not geographically nearby, particularly outside the Chicago metropolitan region and in southwestern Illinois. St. Louis area is urban, but still has little infrastructure.
- Long-distance transportation for residential haulers and recycling middlemen may operate under financial loss since glass is so heavy
- MRFs often don't know/have any local processors to send sorted product to
- Waste haulers are often smaller and independent vs. a large scale modern MRF – hard to standardize rules for capacity, structure, collection, etc.
- SMI processes over 100,000 tons of glass per year in greater Chicago area. They could accept more glass from Central and Southern Illinois for processing, but contamination levels in glass prevents them from picking up more – if MRF can't separate clean enough, then it doesn't have enough value to cover the cost of logistics.

2. What are the opportunities to further divert glass from the landfill?

Access & Collection

- Deposit system could improve collection rates
- Access to collection to other types of glass (glass not typically collected via single stream systems). SMI and the Center for Harms to Recycle Materials (CHaRM) in South Holland, Illinois collect:
  - Flat glass (ex. Window panes) can be much cleaner and is usually collected postindustrial, not as much post-consumer. SMI is working with large window manufacturer to collect window glass from rehab projects.
  - SMI is starting to collect dinner glass from partners like Goodwill, which has different chemistry and temperatures from container glass. Potentially large quantities (25 tons/week) from 96 locations.
  - Car windshields is a challenge because of logistics and because they contain laminated plastics– one facility in IN is doing this

Contamination

- Rewarding generators/municipalities for better cleaning and sorting = cleaner glass.

Education

- People don't know basics of where their glass goes, what is acceptable/recycled and why, or how effective recycling is. Transparency would create trust.
- Any food container, broken or not, can be recycled – color and size doesn't matter, contrary to popular myth.
- Many resources to build on

Infrastructure

- Prioritize infrastructure near borders (ex. St. Louis and southwestern Illinois), possibility to work across state lines
- Longer term contracts and partnerships between MRFs and municipalities encourage MRFs to invest in upgraded/modern sorting equipment knowing that they will have feedstock coming in

End markets

- End markets are very strong. Cannot supply enough glass to customers including bottlers, they are always asking for more. Demand is just about equal across all three colors. Focus needs to be on collection and processing, not end markets
- Untapped markets include urban multi-family dwelling collection, downstate areas that currently have no local end market
- Glass is highly circular, and turnover is fast. Glass going to SMI will become a new bottle or fiberglass insulation in less than 14 days.
- Alternative use of contaminated glass is in place: Reflective road beads, blasting material, foam glass aggregate, landfill drain systems (uses ceramic, stones, porcelain, etc.)
- End markets for all colored glass are strong right now.

3. What types of support and investment from the Illinois EPA would be most impactful to diverting glass from the landfill?

Cost

- Make grants available not only to local govt, but other recycling managers. Build on grants from Glass Recycling Foundation.
- Need municipalities to have "strong, long contracts with processors and MRFs" so municipalities can understand and communicate to residents/businesses where their commodities are going – would also support faith in recycling
- Downstate, a lot of municipalities don't have contracts, and independent waste haulers deal with distribution of commodities to processors themselves.

Access, Collection, & Infrastructure

- Establish transfer stations throughout the state to make overall cost go down and increase overall volume of collectable glass.
- Identify or support establishing drop-off centers/bunkers in each county, similar to the goal for HHW. Possibly place at multi-family complexes as well. Source-separation could lead to higher-value materials.
- Investment in smaller and more rural MRFS to clean up glass
- Mechanisms and technological improvements that can support volume, Ex. Laser-induced spectroscopy for material density sorting
- Determine what other help MRFs need to get glass to processors
- Regional bunkers to decrease cost of long transportation (at least one to serve each county)
  - Make data available on where county bunkers and/or aggregators are located so that processors can collaborate and implement strategies on how to move it.
  - Update directories of open facilities that accept glass; most of the facilities in SW Illinois that are on directories are long closed

Education

- Education MRFs, program managers and other recycling industry experts about where glass is accepted, how it is processed, and potential end markets, including the value of PCR content. Bottlers, fiberglass, etc. do want more glass, but you hear a lot about glass “not being recyclable” -- ex. Broken glass. Refer to Glass Recycling Coalition for guidance
- Better awareness of PCR content, similar to plastics recycling
- Make sure people know glass is recyclable and there are markets. You hear a lot about glass being very recyclable but not being recycled for some reason
- Address myths that they can’t process broken glass or certain colors of glass
- Transparency about where things go and where they come from. Consumer products companies should tell circularity story/recycled content.
- Increasing education on circularity and transparency of glass will decrease doubt in recycling system as a whole
- Transparency about where things go and where they come from. Consumer products companies should tell circularity story/recycled content.
- Increasing education on circularity and transparency of glass will decrease doubt in recycling system as a whole

Policy

- Bottle deposit would better incentivize residents and businesses to return glass instead of putting it in the trash. Ordinances can be ignored, but financial incentives are self-supporting.

- Address comparative lowness of tipping fees – possibly by increasing Illinois's very low landfill tipping fees (and putting that money toward recycling infrastructure).
- Restrict permission to use glass as landfill alternative daily cover in Illinois.
- Develop incentive programs for bars/ restaurants/ hospitality to recycle glass.

Resources

After the three questions were discussed, participants stayed on the call to share resources with one another and ISTC. Some examples were:

- Best practices for MRFs for reducing glass contamination
- Municipal glass case studies
- SMI video of MRF glass being sorted
- Glass Recycling Foundation grants
- SMI end markets (now Sibelco, as of February 2024)
- Don't Trash Glass Program

Metals Stakeholder Engagement

1. What are the barriers to diverting metals from the landfill?

Contamination

- Mixed-Material Composition: many products (e.g. packaging, electronics, car seats, aerosol cans, etc.) are a mix of metals and plastics/other materials which makes for labor-intensive processing/sorting, especially for smaller, lower-tech recycling operations. Also safety concerns involved.
  - Even for technologically advanced MRFs, mixed materials (e.g. a sticker label on the outside of an aluminum can) can be misidentified and thus contaminate a stream.

Education

- Many people have a lack of faith in recycling due to media and aren't sure if it is worth, even though the issues addressed in media reports tend to focus on plastics. As trust in the efficacy of recycling fades, people may not bother trying to recycle materials.
- Circularity of metal and use of PCR content isn't widely advertised or known about, may change public outlook
- MRFs and other recyclers make money from selling certain metal commodities and consumers aren't always aware of the value that metals can have/ benefits of recycling

Access & Collection

- Most people are hesitant to go to scrap yards to recycle larger items as they can have long lines at times and aren't inviting/ seen as an industrial place most regular people are hesitant of
- Some local governments provide a separate drop-off bin. Consumers are not paid for the material. Quality is not great because materials are mixed ferrous and non-ferrous, and again, some products are mixed materials (e.g. a ladder typically has rubber feet). So, the collection coordinator does not receive a lot of funding from that.
- Collections for homeowner scrap within municipalities are not very widespread and often aren't profitable due to contamination/ mixed materials on metal.

Cost:

- MRFs with more advanced technology are able to have more efficient collection and sorting processes, but that doesn't always translate elsewhere.
- The financial incentive to recycling scrap usually isn't worth it to most people due to travel time, waiting in line etc.

2. What are the opportunities to further divert metals from the landfill?

Education/ Marketing

- Since plastic has a bit of a negative reputation in terms of packaging, swapping certain products to (recyclable) metal packaging is an opportunity in the manufacturing realm for a greener alternative
  - Education may be more effective at the organizational/institutional level
- Could increase education campaigns on swaps that companies, schools, venues have done from plastic to metal (such as water bottles). Make people aware of why and the benefits.
- Financial incentives (i.e., paying consumers for scrap metal) do work; there is a "scrapper industry" of people who go around picking items off the curb and taking it to a scrap yard to make money.
  - However, for many people that small financial incentive isn't currently worth it because of time spent in line (e.g. if a large truck comes in the line may move very slowly at a scrap yard), the uninviting atmosphere of scrap yards (dirty, smelly), etc.
- Education is needed on a more industrial/ organizational level to assist in purchasing
- Manufacturer goals related to PCR content for plastic packaging are widely publicized, but the successes of PCR content in aluminum/metal packaging are not highlighted. The PCR/ recycled metal vs. virgin information may be helpful to get consumers to know why metals and specifically recycled metals are beneficial
- U.S. EPA REO grant funding—several Chicago-region counties are going to be working on a regional recycling ad campaign soon.

Infrastructure

- Easy to establish pilot municipal drop-off points
- Potential to provide drop-offs at multi-family buildings
- Deposit return schemes involving metals could be beneficial at bringing in money and having a clean valuable stream of material
- MRFs that are technologically advanced (e.g. using eddy currents, magnets, and other tech) tend to recover metals. Metals are high value, so recovering them is desirable.

3. What types of support and investment from the Illinois EPA would be most impactful to diverting metals from the landfill?

Funding

- Grants should benefit municipalities/ people and programs that have momentum and a proven record to help divert even more materials, not to "administrators"

Access & Collection

- Single item drop-offs for larger household metal scrap would be beneficial to many communities as it keeps streams cleaner and makes materials more profitable for community
- Convenient, local drop-off points may also combat hesitation to take items to a salvage yard.
- Single-stream metal drop-offs are not as financially feasible as single item drops off containers. Lots more volume in single-stream drop-offs, but the quality collected goes down and brings in less money.

Collaboration & Partnerships

- Stakeholders want to see a sort of "think tank" for metals solutions which involves a wide variety of stakeholders from different industries and parts of the state. This would be helpful to ensure that efforts support all areas.

Organics Stakeholder Engagement

1. What are the barriers to diverting organics from the landfill?

Cost

- Affordability of hauling and tipping
- Cost relative to landfilling
- Cost for municipalities and counties
- Low landfill tipping fees
- Lack of route density makes it expensive
- Processing facilities uninterested in moving into areas with low landfill tipping fees as they cannot compete

Access & Collection

- People have to sign up for a separate service
- Not always convenient
- Lack of consistent, year-round access
- Not enough haulers willing to handle organics

Infrastructure

- Need more facilities to accept food scraps
- Permitting needs to be easier; it prevents some facilities from taking food scraps
- Location of facilities – not always reasonable to haul to a different county
- Barriers to upgrading from yard waste facility to one that accepts food scraps
- Limited dock and trash room space
- Need for facilities in southwestern Illinois
- Lack of consistency in hauler container colors – different colors in different communities and different acceptable items
- Lack of infrastructure funding for compost processors (de-packagers, equipment to remove contaminations)
- Ability to handle compostable products

Contamination

- Lack of equipment to deal with contamination. Prevents end markets from developing

Education

- Don't have the same cultural change as they do in northeastern United States
- Ick factor
- Don't know what compost means

- Lack of education on why composting is important
- Lack of education on benefits of compost use
- Donation education – liability
- Confusion on backyard composting vs commercial/collection composting
- Lack of education on methane generation
- Perceived public health risks (rats and pests)
- People think current waste hauling is free
- Not enough people doing food waste education work

End Markets

- Lack of end markets

Regulations & Policy

- Illinois regulatory structure inhibits aggregation of organics loads, making handling and transportation prohibitive compared to landfilling
- Tax incentives that don't apply to sustainable options
- Lack of enforcement on yard waste ban

2. What are the opportunities to further divert organics from the landfill?

Cost

- Financial incentives that prioritize food waste recycling over landfilling
- Tax deduction for haulers who recycle organics through an approved facility
- A tax for every ton of organic waste brough to landfill
- Case studies that show the business case – saving money

Access & Collection

- Specialized micro haulers
- Community composting
- Drop-off programs
- Increase participation in existing programs
- More haulers need to handle organics

Infrastructure

- More localized infrastructure
- Local community composting

- Yard waste composting is spread across the state and could be a good opportunity to add food scraps if regulatory/permitting challenges can be addressed
- Extrusion technologies for post hoc removal of organics from waste stream
- Drop-off sites as an intro and good opportunity to visible education

Contamination

- Need standardized certifications on what is compostable

Education

- Work through schools – kids take info back to households
- Behavior change campaign
- Consistent education to prevent and teach past greenwashing
- Need specific calls to action
- Local demonstration projects
- Statewide PSA
- Growing interest in composting among young people
- Transparency – currently tracking the full pathway from home/generator to processing facility is almost impossible
- Education specifically about contamination

Regulations & Policy

- Enforce yard waste ban
- Organics ban
- Pay as you throw models
- Food waste to animal feed policy should be revisited
- Revise and simplify permitting
- Better monitor what gets tipped at landfills and fine landfill yard waste drop-offs to landfill

Partnerships

- Regional cooperation for infrastructure and education
- Financial modeling for public/private partnerships to increase and operate infrastructure
- Public/private partnerships can be a useful tool to leverage strengths of each stakeholder group

Focus Areas

- Need to redirect responsibility away from consumers and to corporations
- Focus on industrial and commercial food prep sectors – large volume, opportunity for contamination prevention
- Outreach, education, enforcement with event venues (over 3,500) that need to comply with new state law

- Grocery Stores

Food recovery and donation

- Feed hungry people
- Invest in logistics networks to connect surplus food with donation partners or byproducts with processors

3. What types of support and investment from the Illinois EPA would be most impactful to diverting organics from the landfill?

Cost

- Statewide financial inventive – directly to customers and/or to municipalities and counties
- Cover costs for additional personnel or equipment to address contamination at processing facilities
- Make finished compost cheaper via subsidies
- Funding from state to focus on organics diversion – to build infrastructure and deal with contamination
- Seed money that sets up sustainable businesses practices that can operate beyond the grant

Infrastructure

- Develop facilities in southwestern Illinois to process organic waste

Education

- Work more with K-12 schools
- Work through kids to reach their parents
- Targeted education for residents vs commercial businesses
- Targeted education for different areas of the state
- Educate businesses
- Calls to action
- Outreach, education, enforcement with event venues (over 3,500) that need to comply with new state law

End Markets

- Tax incentives for corporations that buy compost created in Illinois
- Requiring earth disturbing projects to use compost
- Certifications of finished compost
- IDOT should incorporate use of compost in projects
- Provide marketing for compost facilities

- Enforce current policy on government using finished compost

Regulations & Policy

- Simplify, streamline, and reduce permitting costs and processes
- Make permitting revisions easy
- Revise Illinois Environmental Protection Act to remove barriers and incentivize organics collection, transportation, and processing
- Loosen regulations on small scale composting and drop-off sites

Partnerships

- Technical assistance to large generators
- Partner with schools
- More IEPA share-outs to the public
- More engagement from IEPA – Q&A

Food recovery and donation

- Resources for municipalities to navigate through food policy on what is acceptable to donate

Plastics Stakeholder Engagement

1. What are the barriers to diverting plastics #1, #2, and #5 from the landfill?

Cost

- Competing with landfills in rural areas. There is a large cost associated with transporting material and the need for a large volume with low population density.
- High recycling tip fees and low landfill tip fees in Illinois incentivize trashing over circular management, especially for haulers who just want volume and aren't interested in policing materials. "And we can't increase landfill fees."
- It's still too cheap to produce virgin plastics compared to PCR equivalents
- Labor costs for proper recycling of plastics, especially when accepting a wide variety of items and when hand-sorting (which one recycler said they prefer).

Transparency

- Inconsistent handling from MRF to MRF and hauler to hauler.
- As a recycler, knowing your limitations in terms of what you can process/ handle. Be up front about only collecting what you can actually recycle.
- Needs to be more accountability with haulers and MRFs in order to make sure technology is being run and maintained and that they are effective. Keeping them accountable to materials they are promising to recycle.
    - Could help avoid rate hikes in the event that they aren't recycling a specific material.
    - Need more data on pounds diverted--where is it being diverted to? Full disclosure on what is being incinerated. Where does it eventually end up?

Contamination

- Need to value quality over quantity because some plastics are not at all recyclable. It would boost the entire system.
- A lot of private sector haulers (at least in northeast Illinois) have decided that accepting all plastics/recyclables and sorting out contamination is easier than educating the public on proper sorting and what is truly recyclable. This is often in conflict with local government recycling coordinators who prefer to educate the public to avoid putting problematic materials/contamination into recycling collection bins (e.g. the "yes/no" posters developed by Recycling Contamination Task Force, which are customized for location.)
- There's no incentive currently for haulers to work with the community to increase recycling. Making recycling available seems to be 'good enough' (at least in southwest Illinois).

Access & Collection

- Complete lack of consumer consistency for acceptable materials across haulers and locations. Messaging needs to remain consistent.
- Recycling isn't available across Illinois – some curbside, some drop-off, some have none
- Acceptable materials vary even between municipalities in the same county, from home to work, etc. Which causes confusion/distrust at best and contamination at worst. Compare to Europe.
- Lack of consistent, convenient infrastructure to return/recycle.

Education

- Lack of education on what is accepted in recycling facilities.
- Lack of consistent messaging on common points to help simplify for consumers (caps on vs. caps off for example)
- Myths and Misinformation: For years, packaging manufacturers have put resin code numbers inside the chasing arrows symbol on products that are not accepted in curbside programs. This adds to confusion.
- Residents and consumers aren't aware of the different types of plastics, and especially unaware that resin code or chasing arrows aren't the only things influencing recyclability
- Misconceptions persist that plastic isn't recycled even though we collect it.
- Consumers don't know what products recycled materials are going into. Reports that lead to health concerns that recycled-content plastic has more toxins than original plastics. Contributes to customer confusion/ reluctance to use products with PCR content.
- PCR in food grade applications has stringent requirements. There are cases where there are clean streams and closed loop systems and the process of incorporating recycled content is easier, but it is more difficult to maintain.
- Green Guide update is needed, possibly a federal move on changing the labeling standard nationally
- Many complex plastics have been introduced into the manufacturing industry which make recycling/ reuse even more difficult.

2. What opportunities exist to further divert plastics #1, #2, and #5 from the landfill?

Policy

- In CA/nationally, they're working on stricter rules for the "chasing arrows" symbol only being allowed when the item is actually recyclable in the area.
- Recent IEPA partnership with Recycle Coach should help some with this

- Possibility to limit what MRFs can take – standardize and simplify acceptable materials across the board, at the cost of some more specialty materials.
- New Illinois event facility recycling law – strengthen by allowing reusable containers at events.
- New Illinois food code law that allows consumer containers at restaurants/businesses.

Access & Collection

- Collections based on where things go for diversion or via specific events for recycling specific materials, such as car seats
- Drop-off sites for collection of recyclables. This would be easier in rural areas where curbside collections would not be feasible. Expansion of recycling opportunities in those areas could go hand-in-hand with collections that could result in cleaner streams.
- Deposit return systems. Create incentives to return containers - decreases litter and increases recycling, even for containers that aren't associated with a deposit
- Reverse vending machines as used in NY, CA, OR - some new programs use QR codes now so you are not feeding bottles into machine, which could help make things easier/ more straightforward for those who have trouble identifying recyclable materials. Only take a few materials, simple stream. This decreases litter and increases recycling

Consumer Advocacy

- Social pressure on large corporations to use a lot of packaging to use PCR plastic.

3. What types of support and investment from the Illinois EPA would be most impactful to diverting plastics #1, #2, and #5 from the landfill?

Reuse

- Developing better systems for recycling needs to go hand in hand with reuse to give value to the materials and help people understand the value of recovering those materials.
- Set ambitious goals for reusables, such as only using reusables in-store. "If restaurants would move towards washing more dishes and having less disposable service ware or figure out re-use more effectively. Incentivize using reusable material and don't make it the consumer's problem."

Funding

- Grants for schools and restaurants so they can switch to reusable dishware as well as enough dishwashers to accommodate reusables.
- Illinois Board of Education should help set policy.
    - Example—Seattle has provided $500 grants to restaurants for reusables.

Access & Collection

- As with other materials, source-separated deposit or drop-off systems are a good way to get cleaner streams.
- Education towards benefits of deposit type system for collecting specific material types
- Campaigns are more effective when they focus on creating a clean stream for one resin code/material at a time and go from there.

MRF Support

- Need to bring those who have bottom line issues to the table to help make this process beneficial for all to help build a bill that works for everyone
- Update the economic impact study for the state in terms of recycling and plastics. Could help get idea of which plastics are most valuable and where the most opportunity is financially.
- Oversight of haulers and MRFs. Make sure equipment (ie. AI) is properly being deployed. In a perfect world, IEPA would be oversight. Realistically another body.
- Make sure to address bottom lines of recyclers and haulers – get them at the table

Policy

- EPR and Bottle Bills (for glass, aluminum, and plastic) could also be an answer
- Illinois could be a leader/ example to help get a bottle deposit bill implemented in other smaller states and maybe even nationally.
- The economics are daunting for MRFs knowing that they may see reduction of materials/ loss of income.
- Municipalities may have to pay increased rates
- IEPA might use EPR for packaging process to help fix the broken economics.

Chemical Recycling

- Probably not a good idea for IEPA to support/subsidize chemical recycling processes, let others do that who have the money already
- Produces a lot of toxins, uses more energy than it gains, seems silly to reduce the plastic, add extra petroleum and get very little benefit for all toxins that can come from it, even solvent-based instead of heat
- Illinois has done a good job so far to 'keep pyrolysis at bay'
- Chemical recycling startups often don't understand how the waste management system works. For example, they might contact municipalities hoping to obtain all their plastics, instead of contacting the MRFs which would actually own/have access to the materials.

Education

- Address consumer concerns on toxicity of plastic and PCR. Create a unifying message to inform consumers.

- Northeastern Illinois using "Bottles, Tubs, Jugs, and Jars" as shorthand for rigid recyclable plastic – already an established message
- Stakeholders glad to hear about Recycle Coach

Resources

After the three questions were discussed, participants stayed on the call to share resources with one another and ISTC. Some examples were:

- The U.S. Plastics Pact
- The Recycling Partnership has several grant opportunities
- New project launched in a city in California to create a reuse system, with collaborations with several companies
- Fact Sheet: Deposit Return Systems Generate Cost Savings for Municipalities
- NYC law allowing refillable containers in venues
    - Illinois legislation: Solid Waste Event Facilities Act

Textiles Stakeholder Engagement

1. What are the barriers to diverting textiles from the landfill?

Education

- Education of public
- Textiles are not thought of as traditional recycling stream
- Lack of education on how to properly dispose of mattresses
- Misconception about donating higher/ lower quality items: Lower quality items will still be moved into recycling stream even if not sold/ reused.
- Some people assume donated clothing just gets dumped in other countries, negative connotation

Access & Collection

- Thrift stores are big collectors, but many people are suspicious of textile bins and where material goes if it is not resold as clothing
- Lack of take back programs for textiles/ limited accepted material content types
- Trash in collection bins/ contamination
- Pickup type collection services are slowing down due to labor, transportation and mailing cost.
- Not having thrift stores/ donation options near within a reasonable distance
- Trash bins are more convenient/easier to find than clothing donation bins/drop-off locations.
- Limited number of retailers offering take back programs

End Markets

- If community isn't participating, then local processing companies lack feedstock
- Fast fashion leads to many low-quality items and perceived low quality of secondhand items
- Fiber content – anything except 100% synthetic or 100% natural fibers are harder to separate and recycle. Especially for draperies & clothing
    - Most recyclers want specific content/ blends and a lot of it
- Furniture: disassembly is labor-intensive because of wood, stuffing, etc.
    - Lots of effort needed to disassemble/ remove things like zippers
- Most sorting is done by hand currently, time and labor intensive
- Graders get sold excess from thrift stores and usually downcycled into rags, insulation
- Chemical recycling could be an option, but plastic has limited recycling potential/ negative impacts

Cost

- High sorting cost with various material compositions
- Waste haulers don't have specific programs for textiles and current programs are limited due to cost
- Retailers that refurbish often lead to extra cost for consumer

Data

- Waste characterization should better inform composition of stream
- What percentage is material that recyclers/ processors want?
- General lack of info on what type of a facilities take things like fluff from a pillow for example

2. What are the opportunities to further divert textiles from the landfill?

Access & Collection

- Company called Simple Recycling does curbside bag pickup
- Most donations and pick-ups are run by charitable partners, especially thrift stores – could expand to more of the retail sector
- Could build off programs like "Waste management at your door" program. They take chemicals, batteries, etc. Add textiles.
- Encourage residential waste haulers to offer special collection services.
- More localized CHaRM Centers.
- Locations like hospitals and jails are not integrated into recycling network

Education

- Push the message of long-term consequences of waste
- Education related to plastics in clothing and what challenges/ opportunities that presents
- Need and transparency, example - companies like Patagonia are transparent about materials
- Education to consumers on what happens to the textiles once placed in a bin

Extended Produced Responsibility/Repair/Resale

- Mattresses: Illinois Product Stewardship Council is working on EPR for mattresses
- Work with Mattress Recycling Council
- Encourage companies to repair/recycling their clothing, example - companies like Patagonia
- There is an opportunity to cycle "out of demand" or non-trendy materials back into play after they are determined as such as opposed to throwing them out to keep things circular and reduce waste

3. What types of support and investment from the Illinois EPA would be most impactful to diverting textiles from the landfill?

Policy

- Consider landfill ban on commercial sector waste generators. (Not allowing chain stores to slash/bleach and trash their product.) This could force manufacturers to help with the process.
- Support destruction programs that are necessary (phased out uniforms, old logo etc.) to keep materials in use vs. get thrown out
- Support an Extended Producer Responsibility feasibility study

Data

- Support landfill study. Categorize what types of textiles are going to landfill.

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