



CREATING CIRCULAR ECONOMIES IN NORTHWEST ARKANSAS

FULL REPORT
2020



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City of Bella Vista	Madison County Solid Waste and Recycling Center
City of Fayetteville	Marck Recycling
City of Gravette	Northwest Rag, Inc.
City of Prairie Grove	ORE Material Recovery

As this goes to publication, some of the programs have experienced changes due to COVID-19. The recommendations remain the same and addressing them will make the region more resilient after future catastrophies.

Walmart  **org**

Funder: Walmart Foundation

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EXECUTIVE SUMMARY

The following provides a synopsis of the Northwest Arkansas Council and The Sustainability Consortium “Creating Circular Economies in Northwest Arkansas” recycling study.

The Walmart Foundation provided a grant to the Northwest Arkansas Council to pursue recycling-related objectives described in the Greater Northwest Arkansas Development Strategy, a document published in mid-2018 that guides much of the Council’s work. Soon after, The Sustainability Consortium (TSC) proposed a project that would evaluate and make recommendations about how to improve the region’s circular economy, and the Council engaged TSC for that project.

The Northwest Arkansas Council wants to reduce waste in a cost-effective way and to establish an environment for new economic activity and technology advancements that promote waste reduction and recycling. A more circular economy creates jobs and provides ways for Northwest Arkansas communities to be more sustainable.

TSC’s detailed recommendations are at the end of the report, starting on Page 25. Some of the recommendations to the Northwest Arkansas Council were:

-  **COORDINATOR:** Hire a program manager to coordinate recycling- and circular economy-related activities across Northwest Arkansas.
-  **MATERIALS EXCHANGE:** The Northwest Arkansas Council should collaborate with the solid waste districts, the Arkansas Marketing Board for Recyclables, and the Arkansas Recycling Coalition to establish a recycled materials exchange.
-  **VISION DEVELOPMENT:** Utilize the more than 70 stakeholders who participated in this project to continue developing a recycling and circular economy vision. Stakeholders benefited from shared learning and expressed a desire to stay engaged.
-  **BETTER DATA:** Improve data about what and how much recycled material is collected in Arkansas. The Northwest Arkansas Council should work with the Arkansas Division of Environmental Quality to make it easier to collect information from cities and solid waste districts, utilizing an electronic reporting form created by TSC.
-  **INFORM COMPANIES:** Work with the University of Arkansas or NorthWest Arkansas Community College on a project to characterize materials recycled by businesses, industries and institutions. The project would inform companies interested in using recycling materials what’s available in the region.
-  **CONTRACTS:** Work with Northwest Arkansas cities to improve trash-hauling and recycling contracts. In the long term, cities should look to maintain ownership of recycled materials so they can be active in determining the fate of collected recyclables.

With the complexity of more than 30 cities, two solid waste districts and hundreds of private businesses each controlling waste and recycling streams, pursuing TSC’s recommendations won’t be without challenges.

Yet, the region has a track record of successfully working on big, collaborative projects, including Northwest Arkansas National Airport, the Benton-Washington Regional Public Water Authority, and the Razorback Regional Greenway. Those past successes coupled with stakeholders’ high interest in building a more complete circular economy suggest the recommendations described in this report can be achieved.

INTRODUCTION

Northwest Arkansas has a solid foundation in the recycling systems operated by cities and its two regional solid waste districts to support the development of a more fulsome circular economy. Based on the Greater Northwest Arkansas Development Strategy published in 2018 by the Northwest Arkansas Council, The Sustainability Consortium (TSC) proposed a study to investigate how to improve on the existing recycling management system within the context of the circular economy. TSC's proposal became this work.

The purpose of this work was to understand the pathways available to the Northwest Arkansas region to become a circular region. The recommendations developed for this work serve as a map for the region, identifying actions and opportunities for sustainable development in Northwest Arkansas based on the circular movement of recycled and recovered materials.

There were three primary objectives:

- To understand the current state of recycling in the region through mapping the existing waste management systems, identifying and engaging relevant stakeholders and determining which recyclable materials are collected and in what volumes;
- To fill gaps in data through research and stakeholder interviews and work with the University of Arkansas Center for Business and Economic Research to understand economic potential of the sector and the current waste stream in the region;
- To provide direction for the region to leverage existing strengths to start a transition to a circular economy and recommend next steps toward achieving such a transition.

Because of the range of materials that are recyclable, this study was limited to those materials at the end of their useful life that are recoverable through municipal systems, including those materials sourced from industrial or commercial sources. For the Northwest Arkansas region this includes metal (e.g., aluminum cans, steel cans), fiber-based materials (e.g., paper, cardboard), plastics (e.g., soda bottles (#1 PET), milk jugs (#2 HDPE), and glass. Plastic film (e.g., grocery bags, dry cleaning bags) collection was considered in parallel with the commodities noted as an example of an alternative material flow. As plastic film is predominantly collected directly from commercial and industrial sources or specific consumer drop-off locations rather than through municipal systems, it is not covered in this report. The Sustainability Consortium will publish an additional report dealing with this material soon.

Opportunities related to reuse and refurbishment are not covered, and neither are food waste, yard waste, and composting. Other commercial or industrial streams that would not be encountered in a typical municipal system or would require separate, specialized treatment such as construction and demolition debris are not included, either.

CIRCULAR REGIONS



Imagine for a minute the following:

Consumers buy and use a wide range of goods and end up with used packaging and products. When finished with these materials, they are collected, sorted, and fed into a regional network of material processors. The materials, that in many places would end up in a landfill, are instead converted to useful products to sell locally or whose production supports the regional economy. Because outlets for recycled materials were developed in the region, there are opportunities for glass, metal, paper, and cardboard to be processed and turned into construction and building materials as well as new packaging. Plastics are a particular bright spot – new business models and technology developed in response to the global plastic waste situation took root in the region and now produce building materials and an array of consumer goods limited only by the imagination of the area’s inventors and entrepreneurs. Materials enter, are used, and then recirculated without leaving the region to the benefit of citizens and businesses.

This is an ideal example of a circular region – the products and packaging are created, used, recycled and reused in the same area. A circular region builds on the foundation established by circular economy concepts. A “circular economy” refers to a system whose design is driven by three principles: 1) design out waste and pollution; 2) keep products and materials in use; and 3) regenerate natural systems (EMF, n.d.). Figure 1 shows what circular economy systems look like. The goal is to keep products and materials circulating in the smallest circles of the diagram (e.g., reuse or repair) for as many cycles as possible before the products and materials are recycled back into new uses.

Since this circular flow of materials is a key part of circular economy work, material reuse and recycling systems are often the focus of circular economy projects. Most municipalities already have some system in place that can serve as the base for new circular activities. Additionally, recycling can contribute directly to economic development by opening new business opportunities in collection, material processing, or manufacturing.

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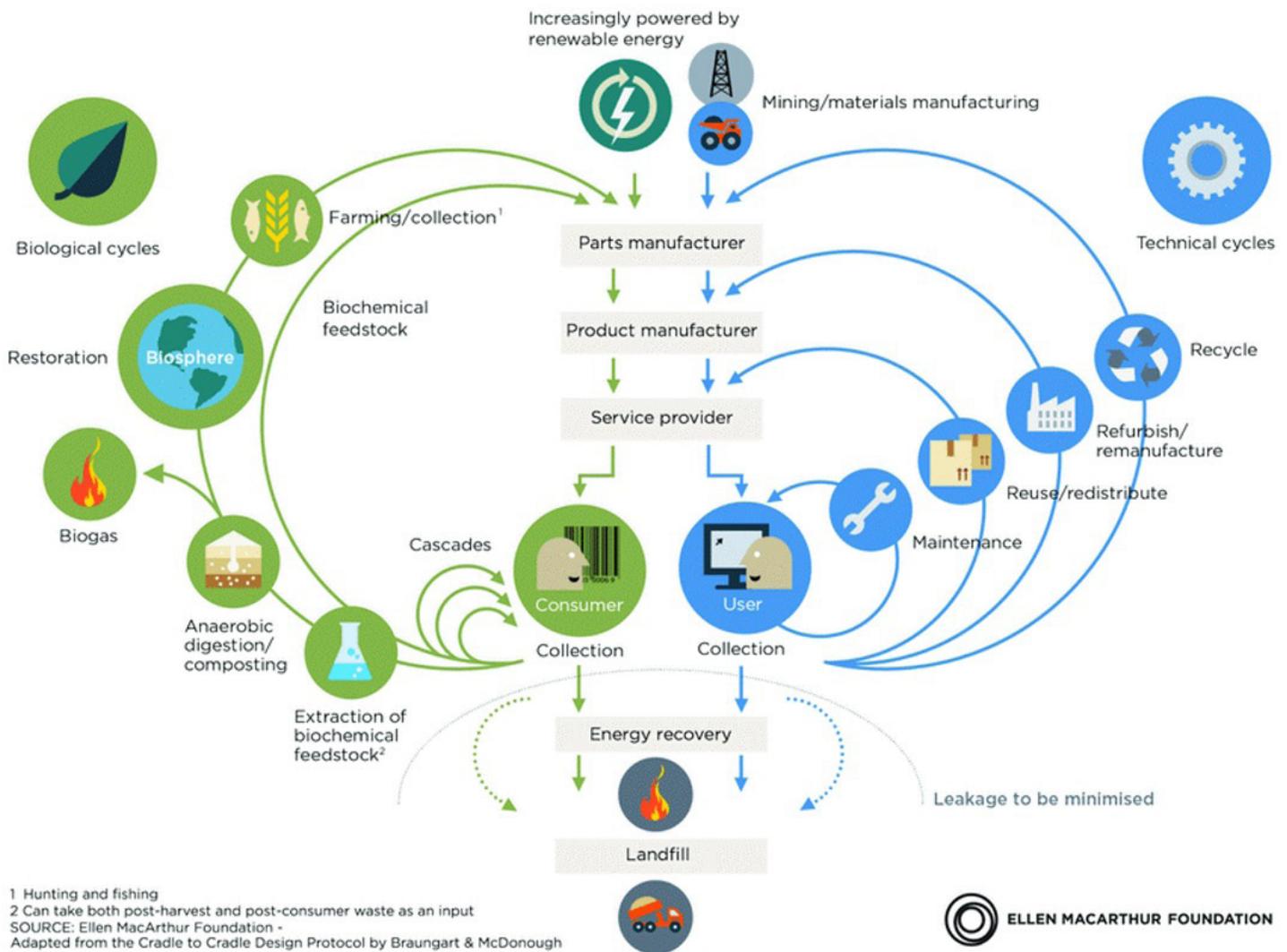


FIGURE 1: ELLEN MACARTHUR FOUNDATION CIRCULAR ECONOMY DIAGRAM
 This demonstrates the different types of material flows that support circular economy models. The green loops represent biological flows – materials that can be grown and then composted or otherwise returned directly to the biosphere at the end of their useful life. The blue loops represent technical flows – materials extracted then used by humans to manufacture products. The recycling loop, shown as the largest circle in blue, is the one of note for this work. More information on the diagram can be found on the Ellen MacArthur Foundation website. (EMF, n.d.)

In recent years, circular economy thinking has expanded beyond products to how cities and organizations can be circular and contribute to fostering a circular economy. “Circular cities,” as referred to by the Ellen MacArthur Foundation, are those that incorporate the circular principles described as part of designing their urban systems, where activities fall into the following area of focus: Buildings (e.g., infrastructure, housing), Products, and Mobility (e.g., transport activities) (EMF, 2019). Each area of focus is then defined by actions during one of five phases in a circular material cycle: Planning, Designing, Making, Accessing, and Operating & Maintaining. Each activity, in turn, reinforces the three primary principles and creates a more circular city.

In pursuing circularity, large cities have an advantage because they have only one solid waste division, one decision-making body, and each large city likely has some control over the recycled material whether handled by a public or private entity. Case studies on how large cities are becoming more circular are also available on the [Case Studies page](#) of the Circular Economy in Cities website. Moreover, the volumes of potential recycled materials in a large city are large enough to support current recycling technologies. Coordinating stakeholders toward a shared goal would be less complex than in a region, but significant investment in infrastructure may be necessary to launch new programs.

In the United States, the concept of a circular city has been tested in larger cities such as Austin, Texas and New York City (EMF, 2019). Case studies describing what these cities and others around the globe are doing can be found on the [Circular Economy in Cities website](#). Solutions developed in primarily dense urban areas are not likely to transfer easily to low-density urban or rural areas such as Northwest Arkansas or even suburban towns and cities.

A circular region would have the same goals as a circular city – eliminating waste and pollution, keeping products and materials local and in use as long as possible, and regenerating natural spaces – but the objectives and programs pursued would differ. Expanding to a region opens new opportunities that a single town or city may not be able to realize alone, but it also greatly increases the complexity. For any given proposal, the number of stakeholders increases, the number of decision-making bodies increases, and multiple existing operational systems need to be coordinated toward the same outcome. The challenge for a region is coordinating across different municipal systems and stakeholders to optimize use of existing infrastructure and to find and fill gaps to reach a circular vision.

NORTHWEST ARKANSAS

So why is Northwest Arkansas a strong candidate as a circular region? Two factors create the opportunity – the strong foundation laid by the existing municipal recycling system as well as those of the two solid waste districts, combined with passionate, dedicated stakeholders across the region. In this section, the existing system in the region is presented and the next section will cover stakeholder engagement activities related to this project.

For purposes of this report, the Northwest Arkansas region consists of Benton, Washington, and Madison counties. It includes all areas served by the Benton County Solid Waste District (SWD) and the Boston Mountain Solid Waste District. There are also 35 cities, each with the option to design and manage its own recycling programs.

The recycling and waste management facilities constitute the current infrastructure for the region (Figure 2). Not surprisingly, most facilities are on a path that is generally near Interstate 49, with a cluster of facilities in the area with high population density around the cities of Bentonville, Springdale, Rogers, and Fayetteville. Fewer facilities are in rural areas, and these tend to be collection sites rather than material-processing operations. Table 1 on page 10 summarizes the facilities that are part of the infrastructure mapped in Figure 2 plus additional locations that are available to residents of the region.

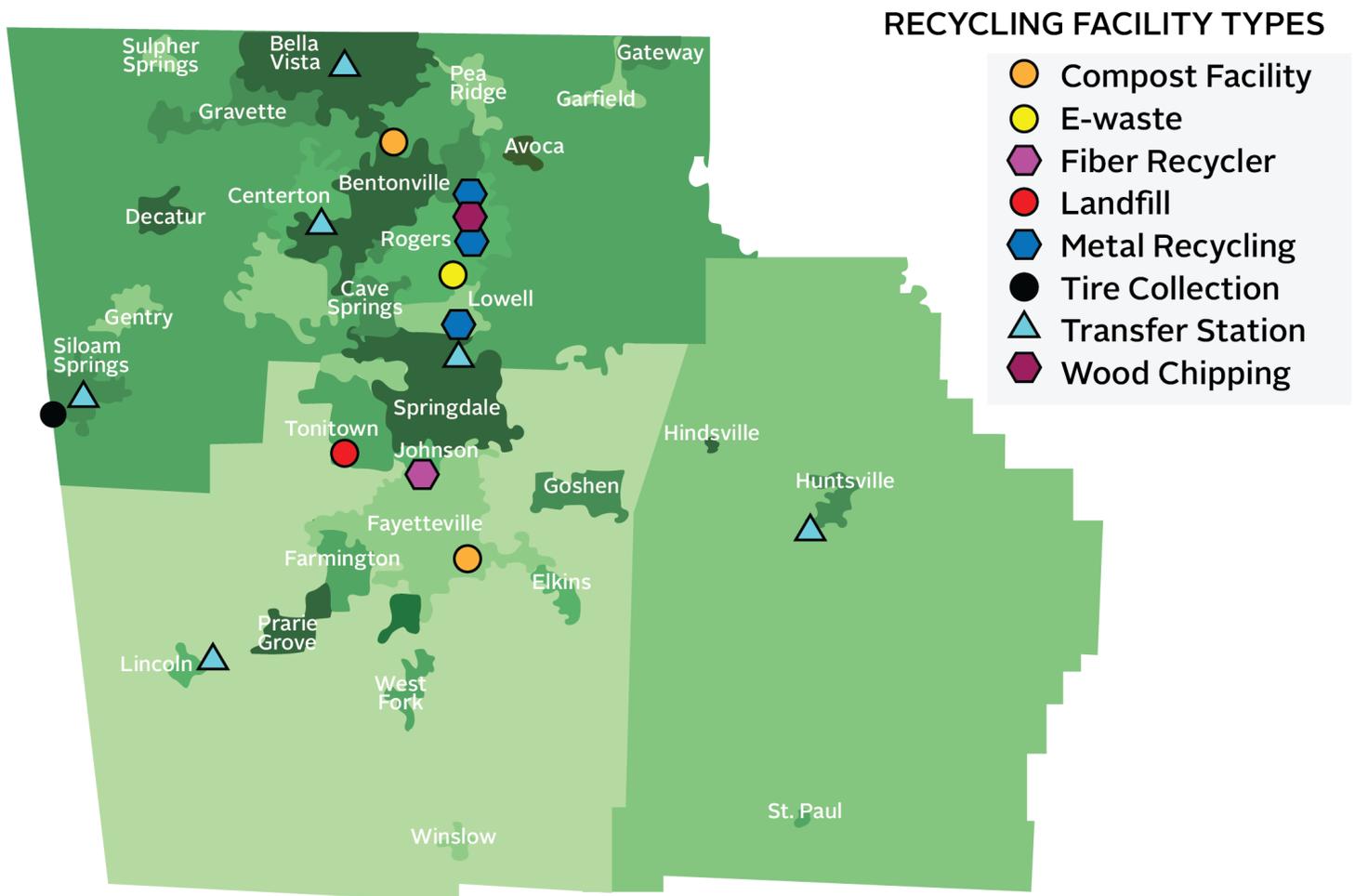


FIGURE 2: NORTHWEST ARKANSAS RECYCLING
 Recycling centers are included under the transfer station category (blue triangle) as this is how they are defined by the state. The Benton County facility in Centerton and Boston Mountain facility in Prairie Grove serve as hubs for their respective solid waste districts that collect a wider range of materials, including household hazardous waste, tires, and batteries, than other identified facilities.

FACILITY	LOCATION	FUNCTION
Bella Vista Recycling Center	Bella Vista	Staffed drop-off site
Benton County Recycling Center	Bentonville	Hub for Benton County SWD; transfer station accepting trash, recycling
Benton County Tire Collection	Bentonville	Automotive tire collection
Boston Mountain Recycling Center	Prairie Grove	Hub for Boston Mountain SWD; transfer station accepting trash, recycling
Ecovista	Tonitown	Landfill
Elkins	Elkins	Staffed drop-off site
eSCO Processing	Rogers	Electronics recycling
Goshen	Goshen	Monthly staffed drop-off site
James R. Welch Recycling Center	Rogers	Staffed drop-off site; includes styrofoam recycling
Madison County Recycling Center	Huntsville	Staffed transfer station accepting trash, recycling of all types, commercial material
Marck Recycling	Rogers	Drop-off/ Materials Recovery Facility
Rogers Iron & Metal	Rogers	Metal Recycling
St. Paul Convenience Center	St. Paul	Staffed drop-off site
Siloam Springs Recycling and Transfer Station	Siloam Springs	Staffed recycling center available to residents
Springdale Recycling Center	Springdale	Staffed drop-off site
Tennebaum Recycling Group	Rogers	Metal recycling
USA Iron and Metal	Lowell	Metal recycling
Winslow	Winslow	Monthly staffed drop-off site
UNSTAFFED DROP-OFF CENTERS		
Cave Springs		Bins available 24/7 to residents to drop off recycling
Decatur		
Garfield		
Pea Ridge		
COMPOSTING OPTIONS		
Bentonville Compost Facility	Bentonville	Composting: yard waste, food waste
Fayetteville Composting	Fayetteville	Composting: yard waste, food waste

 **TABLE 1: NORTHWEST ARKANSAS RECYCLING INFRASTRUCTURE**
List of facilities from 2018 Special Needs Reports for Benton County SWD and Boston Mountain SWD (Arkansas Division of Environmental Quality, 2018).

The two SWDs are the centralizing authorities for the region. These districts were established by Arkansas State Regulation 22 to permit and site waste management facilities and license haulers and other organizations handling trash or recycling (Regulation 22, 2007). The SWDs also ensure citizens have access to disposal options and execute state-regulated mandates regarding waste management and recycling. They are responsible for annual data collection under Arkansas State Regulation 28 regarding the types and volumes of material recycled in districts. They do not have regulatory power to compel cities and towns to manage their recycling and waste management in a particular fashion or with a particular vendor, but the SWDs can provide cities within their districts with valuable guidance in planning and executing programs.

Table 2 includes all the various types of materials that are recycled in the region. The main variation in materials collected across the region is whether glass is accepted in curbside collection processes. Most cities in the region offer curbside recycling to their citizens. These “single-stream” recycling programs collect all materials in a single container. The recycled materials are then sorted mechanically at a material recovery facility (MRF). The programs collect high volumes of material, but the recycled material produced tends to have high contamination rates, averaging around 28% for the programs in Northwest Arkansas. The contamination is partly tied to the material that residents put in recycling bins that isn’t recyclable, but also to material separation challenges related to current sorting techniques used at recycling facilities. The quality of material produced by single-stream programs has become problematic in the past few years as China, once a primary export market for recyclables, has greatly decreased the levels of contamination it will accept, if not banning the import of a particular material altogether (Staub, 2020).

In contrast to the single-stream systems, Prairie Grove, Siloam Springs, and Fayetteville have recycling programs where people sort material curbside rather than mechanically at a facility. In Siloam Springs and Fayetteville, this is done by city employees, whereas Prairie Grove asks residents to do the sorting. See the sidebar, “Curbside sorting: Back to the future” for more details on these programs.

ACCEPTED CURBSIDE & DROP-OFF LOCATIONS:

Aluminum

Ferrous (steel, iron, stainless, tin cans)

Cardboard

Office paper

Mixed paper (junk mail, phone books chipboard boxes, magazines)

Newspaper

Plastic bottles

ACCEPTED DROP-OFF LOCATIONS ONLY:

Mixed glass*

Electronics

Cardboard

Large appliances

Batteries (lead-acid, lithium ion, alkaline, nickel cadmium)

LIMITED RECYCLING AVAILABILITY:

Light Bulbs

Textiles

Tiles

Across the region, drop-off locations provide residents with additional recycling options. Drop-off sites also may be the primary option for people who live in small cities and rural areas where curbside recycling is not available. The drop-off locations generally can accept a more diverse set of materials, including such things as household hazardous waste and difficult-to-recycle materials such as electronics, textiles, tires, and lead batteries. Moreover, glass is accepted at most drop-off locations.

Because residents must take the material to the facility, the overhead costs for the cities and SWDs related to pickup are eliminated and materials can be collected onsite until an economically-viable amount of material is ready to be transported to a processing facility (Bradley, 2020). Some drop-off locations are staffed with employees or volunteers who assist residents with proper sorting and recycling. While volumes of material from drop-off locations are not as high as in the curbside single-stream programs, the quality of the material is higher because it is less contaminated. Regionally, contamination rates for staffed drop-off locations is near 3%, as demonstrated by Siloam Springs. Clean material is more likely to find an end market regardless of the overall state of the market (Bradley, 2020).

 **TABLE 2: MATERIALS ACCEPTED IN NORTHWEST ARKANSAS**

**Fayetteville accepts glass curbside*

Accepted materials in both drop-off sites and curbside collection can vary by program. The website for each facility specifies what is accepted and can also be found on the recycling pages for the state of Arkansas

CURBSIDE SORT: Back to the Future

Before single-stream recycling systems became the standard, residential recycling was sorted curbside, often by the residents themselves. This system has remained in the cities of Fayetteville, Siloam Springs, and Prairie Grove. Fayetteville is one of the largest urban areas in the region, with a population of 88,000, whereas Prairie Grove and Siloam Springs are smaller, with populations of approximately 7,000 and 17,000, respectively. Fayetteville and Siloam Springs have their own material recovery facilities while Prairie Grove works with the Boston Mountain Solid Waste Transfer Station.

The cities find that having curbside sorting allows them to produce higher quality bales of recyclables due to extremely low contamination rates. Siloam Springs has a contamination rate of 3%, while Fayetteville sees rates less than 5%, both significantly lower than the regional contamination rate average of 28% (Dougherty, 2020). According to Don Tension of the City of Siloam Springs, “our curbside sort is a little bit labor intensive on the front end, but we do like our product. The low contamination is something we feel good about.”

In Fayetteville, a dual-stream system is in place where residents separate paper and cardboard from metals, glass, and plastics for collection. These materials are kept separate through collection and are further separated at the city’s material recovery facility. Unlike other programs, Fayetteville is required to publish annually how much of what type of material was recycled and where the materials went to be recycled. This information, usually held as confidential, is publicly available on the city’s website, allowing residents to see that the city is fulfilling its responsibility to recycle the material they have collected. According to Peter Nierengarten, Environmental Director for the City of Fayetteville, “transparency along with efforts to educate residents and business about the value of clean recyclables have helped maintain a contamination rate under 5% which helps Fayetteville maintain buyers and ensures that the city receives the highest commodity revenues for recyclables.”





The Siloam Springs program has those collecting the material sort it into different bins on the recycling truck. Materials are then taken to the recovery facility to be prepared for market. “Our overall program is excellent, and it’s something our community is proud of,” Tennison said. “If I could change anything, it would be our participation rate in our recycling program. It could be higher.”

Additionally, the city has utilized grant funds effectively over the years, improving the program consistently since it was first established in the late 1980s. The city’s recycling division has used recycling grants from the Benton County Solid Waste District to supplement what it does. A 2015 grant providing funding for a major expansion to the division’s cardboard recycling building. A grant last year paid for a new forklift.

Prairie Grove approaches curbside sort differently. Citizens are required to sort their recycling, or the city won’t collect it. This process keeps contamination rates very low because contamination is never collected. The city has 65% of residents participating in the curbside recycling program. The city boasts the second oldest recycling program in the region, starting with a drop-off site in 1988 and adding curbside recycling in 1994. During the shutdowns due to the COVID-19 pandemic, the city had the opportunity to reassess its program. Larry Oelrich, Public Works Director for the City of Prairie Grove, noted “we closed many things because of COVID. We closed city hall, closed parks, closed the library, but it was curbside recycling that was the most missed service. It’s the one we heard about.”

The standard single-stream recycling systems are under significant pressure to produce higher-quality, cleaner materials as markets for recycled material have collapsed. Multi-stream systems such as those highlighted here show that there is an alternative that produces market quality materials. In Northwest Arkansas, Fayetteville, Siloam Springs and Prairie Grove, and Prairie Grove have shown this type of system is feasible in small and large cities.

BEST PRACTICES

Within the variety of programs operating in the region, some efforts stand out as representing best practices or unique opportunities that contribute to the potential for Northwest Arkansas to become a circular region.

Finding local outlets for difficult-to-recycle material supports a circular region. Northwest Rags Inc. and Boston Mountain Solid Waste District have partnered to collect and process used textiles from the region. “Rags to Riches” describes how this partnership has created expanded opportunities for residents to reuse and recycle unwanted clothing and accessories.

RAGS TO RICHES: Northwest Rags, Inc.

A company in downtown Springdale has supported Northwest Arkansas’ circular economy for more than two decades, but most people in the region don’t know a thing about its pursuits. Northwest Rags makes 1.5 million pounds of white rags a year, selling them under the brand name Ozark Recycled Wiping Rags. The workers cut away T-shirts’ seams and logos to create 12- and 14-inch fabric squares. The white rags are then trucked to businesses as far away as Utah, Alabama, and Minnesota. Another 800,000 pounds of colored rags are produced the same way. The customers include painting businesses, lumber companies, restaurants, auto repair businesses, automotive parts stores, and manufacturers.

The material that is processed comes from destinations across the region, and Northwest Rags’ two box truck drivers pick up most of it at thrift shops in Northwest Arkansas, eastern Oklahoma, and southern Missouri. Other material destined for recycling comes from hospitals, other businesses and from individuals. Local municipal recycling facilities such as Boston Mountain Solid Waste District also send material there.

“We are a hidden secret in Northwest Arkansas,” said Vance Brock, a Springdale native who owns the business with his father and stepmother, Larry and Bonnie Brock. “We started off doing just [collecting and baling] the clothes and then we started doing the rags because we got so much bad clothing. If you look across a landfill, you see all the clothes in it,” Brock said. “It blows your mind.”

Investing in equipment that processes materials to create a new commodity stream supports a circular economy. In NWA, this approach has been used to handle expanded polystyrene (EPS), a common packaging material used to protect fragile equipment such as televisions. More commonly referred to as styrofoam, EPS is difficult to manage because it is so light (approximately 95% air) and it requires a large volume of material for recycling to be feasible, so access to recycling for this material is rare. Residents of the region can recycle rather than throw away EPS because of an investment in processing equipment by the city of Rogers. “A Drop-Off “Dream” on the next page describes this facility and its contribution to a circular region.

At a city level, Bella Vista is working on its contribution to circularity. The Bella Vista Recycling Foundation is a volunteer organization that coordinates recycling through a drop-off location at the local AARP. Materials collected are sold through a broker to the commodity market and proceeds are invested back into the community through grants to local organizations. The Bella Vista operation includes a program where local businesses pay to have cardboard picked up and recycled. This ensures the material is not landfilled and contributes directly to a circular region model when the cardboard is recycled at regional paper mills.

The state of Arkansas offers multiple programs to assist communities with recycling programs (ADEQ, n.d.). A [grant program](#) is in place for municipal programs where funding can be used to help offset the cost of recycling capital equipment, such as sorters, balers or forklifts, for education programs or for administrative overhead costs. There is also a [recycling equipment tax credit](#) available for organizations that provides a 30% income tax reduction on qualifying equipment purchases.

A DROP-OFF DREAM: Creating New Opportunities for EPS

The city of Rogers invested in expanded polystyrene (EPS) foam recycling to solve a waste problem – the large number of EPS-based boat docks that were replaced during a facility upgrade at Beaver Lake in Northwest Arkansas. While recycling EPS from boat docks didn't work out – the foam coming out of the lake was too contaminated to produce quality bales – the effort did create a way for city residents to recycle packaging material otherwise destined for landfill. The equipment is part of the James R. Welch Recycling Center, and open to anyone to drop off EPS to recycle. The machine, pictured here, grinds up the foam and produces bricks of polystyrene that are then sold into the commodity market. The challenge is that some components heat up during use, so it requires downtime to cool off, which is preferable to having the foam melt in the equipment. It may not be practical for all residents in the region to transport their foam to Rogers, but the cost of equipment is reasonable, and this facility has demonstrated that people will use it. The region may want to consider adding additional units elsewhere to increase access to this technology.

Because the goal for a circular region is to keep materials moving as locally as possible, another key service provided by the state is access to a materials marketplace. The Arkansas Marketing Board for Recyclables was established in 1991 to coordinate recycling and markets for recycled materials across the state, to provide information to communities and private organizations on how to utilize these resources, and to coordinate volunteers to assist with market identification. The board manages the state’s engagement with the Resource Exchange Network for Eliminating Waste (RENEW), which is operated by the Texas Commission on Environmental Quality.

MATERIAL TYPE	BOSTON MOUNTAIN SWD		BENTON COUNTY SWD	
	VOLUME %	ESTIMATED TONS	VOLUME %	ESTIMATED TONS
Paper & Cardboard	29	50,411	28.5	59,514
Food Scraps	13	22,994	13.9	29,026
Yard Trimmings	13	23,702	13.4	27,982
Plastics	12	21,933	12.4	25,894
Metals	9	15,919	9	18,794
Tires and Textiles	8	14,858	8.4	17,541
Wood	6	11,320	6.4	13,365
Glass	5	8,137	4.6	9,606
Other	3	6,014	3.4	7,100

 **TABLE 3: CATEGORY RECYCLING VOLUMES, NORTHWEST ARKANSAS SWDS**
 Material categories are based on the list found in ADEQ Regulation 28.602. As the list of materials reported by the two solid waste districts were slightly different, categories listed are a combination of similar materials to provide a reasonable comparison between the districts.

The state also requires that each county set up and manage a recycling program for its citizens. The Arkansas Division of Environmental Quality (ADEQ), which is part of the Arkansas Department of Energy and Environment, is responsible for managing Arkansas Regulation 28 for the state (Regulation 28, 2004). Regulation 28 provides the “minimum requirements for adequate recyclable materials collection centers or systems which are convenient for persons to use and which will provide citizens of the State of Arkansas the opportunity to recycle” (Regulation 28, 2004). The solid waste districts are responsible for complying with this regulation for the counties within their jurisdictions. Annual reporting requirements are laid out in Section Reg 28.701. Required recycling program data includes how much of each material is collected, infrastructure information, and available education resources. Each solid waste district is responsible for collecting data from the public programs under its jurisdiction for the state. This information is then included in a searchable database on ADEQ’s website. A summary of the data reported for the solid waste districts in Northwest Arkansas is provided in Table 3.

The Sankey diagram in Figure 3 shows the region’s flow of material. The full breakdown of different material types and their volumes collected through the different municipal programs is presented in Appendix A. These numbers do not represent a complete accounting of current recycling volumes in the region because data from private haulers that handle some of the single-stream collection programs was not available to researchers.

This reporting in Arkansas is on par with requirements of other states. A comparison of state-level recycling reporting efforts can be found in Appendix B. While the right information is requested, the process of collecting the data and its usability is far from ideal. Further details on data reporting issues and the impact it has on the region is discussed further later in the report.

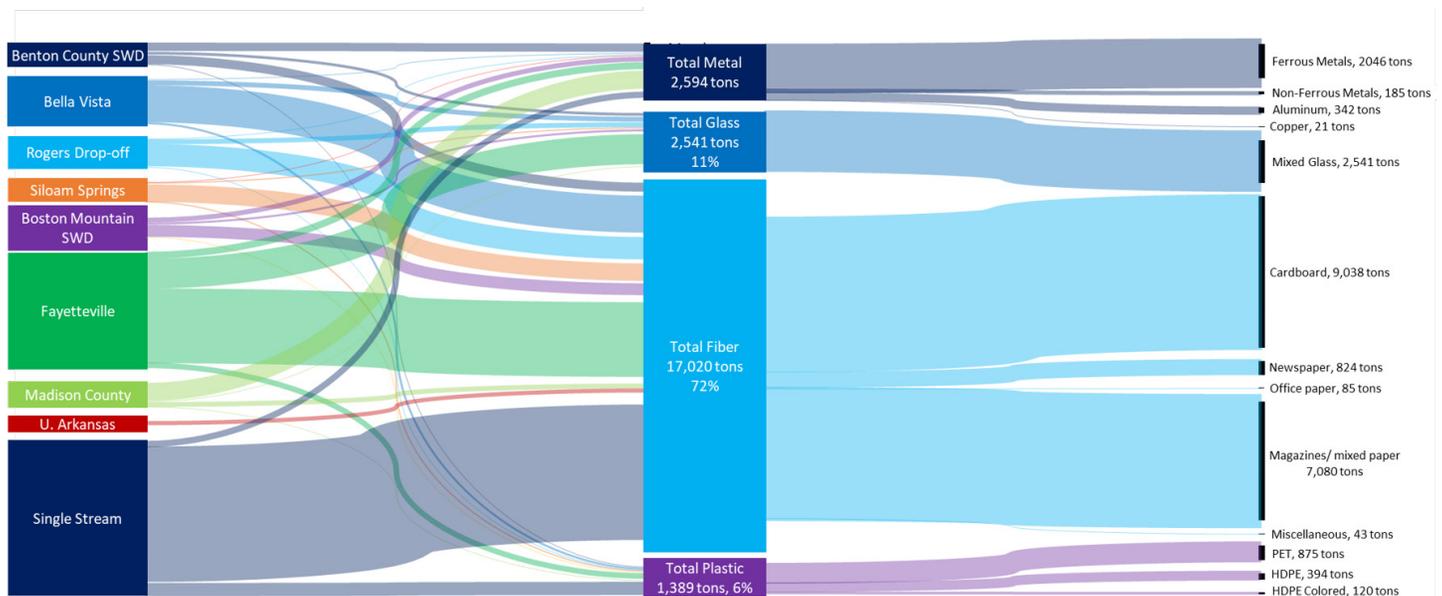


FIGURE 3: SANKEY FLOW DIAGRAM, NORTHWEST ARKANSAS 2018-2019
 The left-hand column shows the programs required to report under Reg 28. The right-hand side shows which commodities are collected and how much for the same reporting timeframe. The diagram only shows the major commodity streams rather than all materials collected by a given program. The “Single Stream” indication in the left column represents the materials collected from single-stream curbside collection programs in Bentonville, Rogers, Lowell, and Springdale and processed by Marck Recycling.

CHALLENGES

While there are many positive actions and processes underway that would support a circular region, there are challenges to be addressed. The overall lack of recycling data hurts the region’s ability to capitalize on its existing infrastructure and processes. To build local end markets for reclaimed material, a much better understanding of what and how much is being handled is necessary. As noted above, the state has already instituted a data reporting program as required by law. ADEQ distributes paper forms to the solid waste districts annually that the districts are then expected to distribute to the public programs required to report. The existing paper form distributed annually by the state is shown in Figure 4 on page 18. The process is highly inefficient – each organization must print and fill out the form and then send the information back to the districts. The solid waste districts then aggregate the data by hand and report it to the state.

Name:		Quantity	Unit of Measure	Destination or Buyer (If more than one, percentage sent to each)
Batteries	Lead Acid from vehicles	21.82	Tons	TRG
	Other Batteries (Specify)		Tons	
Electronic Waste	Computers- Printers-Fax-Copier-TV	35.57	Tons	Boston Mtn.
Glass	Mixed Glass	24.48	Tons	Kippie Glass
Hazardous Waste	Includes Universal Waste & HHW	7.25	Tons	Boston Mountain, Stericycle / WST mgmt (60% liquid)
Metals	Ferrous (steel, iron, stainless, tin cans)	881.45	Tons	TRG / ORE
	Other nonferrous (brass, zinc, lead, etc.)	25.16	Tons	TRG
	Aluminum	66.79	Tons	TRG / Midland Davis / CUI MARK
	Copper	10.69	Tons	TRG
Mixed Recyclables	Mixed Materials (metal, plastic, etc.)		Tons	
Oil	Oil-Motor	1950	Gallons	
	Oil-Cooking		Gallons	
Paper	Cardboard (OCC)	184.31	Tons	ORE
	News (ONP Regular)		Tons	
	Office Paper (SOPY) White Ledger (SWL)	34.09	Tons	ORE
	Other Paper (Specify) BOOKS		Tons	
	Magazines/ Mixed paper	41.42	Tons	ORE
Plastic	Mixed (co-mingled bottles)		Tons	
	HDPE (milk jugs, laundry detergent)	7.85	Tons	ORE
	LDPE (stretch wrap, grocery sacks)		Tons	
	LDPE (poly pipe)		Tons	
	Other Plastics & Styrofoam (Specify)		Tons	
	PET (soda/ water bottles)	6.14	Tons	ORE
Road Material	Road Material		Tons	
	Asphalt		Tons	
	Shingles		Tons	
Rubber	Tires	213.92	Tons	Boston Mtn.
	Tire Derived Fuel (TDF)		Tons	
	Other Rubber (Specify)		Tons	
Textiles	Carpet Padding, Fabric, Leather	25100	Pounds	NW Glass / ORE
Wood Waste	Wood-pallets, lumber, sawdust, other		Cubic Yards	
Yard Waste	Limbs, Leaves, Brush		Cubic Yards	

* Previously reported as the following items: Fluorescent Lamps, Household Hazardous Waste, Paint and Solvents (Turpentine, Paint Thinners, Antifreeze)

 **FIGURE 4: COMPLETED REG 28 ANNUAL REPORT FORM**

For this work, the information submitted in the annual reports was combined with that submitted as part of the 2018 Special Needs Assessment conducted by the state of Arkansas (ADEQ, 2018). These assessments are used by the state to update its waste management strategic plans every four years. These sources provided a detailed look at what organizations were involved in recycling, what infrastructure was available, and how programs are organized and operated in the region. Unfortunately, it was unnecessarily complicated to detangle and collate the information into a useable format due to lack of standardization around what information was required and how it should be submitted.

Not only are the current forms difficult to work with and require someone to aggregate the information by hand, they are also susceptible to double counting. The current form asks where collected material is sent by the program, but there is no indication of whether the material is moving to another site within the state that would also be required to report the material weight. For example, recycling that is collected in Prairie Grove is handled by Boston Mountain Solid Waste District at its facility located there. BMSWD counts the weight of material in its reporting because it is handled at its facility and the city of Prairie Grove submits the same weight on its form because it is required by the state to report as well. One solution to this is seen in the reporting system implemented in the state of Minnesota – in the annual recycling report there is a space to designate not only where the material goes but what type of facility it is and whether this second facility is within the state and required to report. This allows an analyst to avoid double counting. To help address this challenge, a new standardized form for annual reporting was developed in partnership with regional stakeholders and ADEQ to provide consistency between different organizations that report to the solid waste districts and streamline the process of aggregating and analyzing the data once collected. More on this effort can be found in the Recommendations section later in this report and in Appendix C.

Beyond the challenge of data collection, there are other barriers to a complete picture of material flows in the region. Public and private organizations disagree on who is required to reply to the annual data request. Municipal residential programs are required to report, and they believe that private entities that handle residential programs by contract are also required to report annually. Private haulers understand the request to report annual data as strictly voluntary and do not typically submit information to the districts or to the ADEQ. There is also a sizeable information gap related to material recycled by industrial, commercial, and institutional organizations. Some material, such as cardboard, already may be included because it is collected from businesses by a municipal program required to report. Currently, there is no mechanism for capturing this information in the state. An example of how this information gap could be addressed is illustrated by the reporting in the state of Tennessee, where recycling (covering metals, paper, plastic, etc.) and diversion (covering yard waste, composting, etc.) is reported annually by counties for both residential and commercial sources, as discussed in Appendix B.

Regulations that require annual reporting are a critical piece of creating a robust data collection system. Improving the reporting process, resolving ambiguities around which entities are required to report, and aggregating data in a form that avoids double counting and increases access would enable the region to plan for a more circular future.

A second challenge that could be a barrier to Northwest Arkansas circularity are the contracts signed between waste haulers and the cities they serve. Fifteen contracts were reviewed. The contracts cover what will be collected when and from where, the rate structures for residential recycling and solid waste collection, performance requirements for contractors, and liability. Commercial and industrial collection is not included in the contracts. Individual businesses are responsible for making their own arrangements for recycling with private haulers or (in rare cases) municipal programs. Overall, the contracts were basic, provided minimal guidance for execution, and turned over ownership of the materials to the private haulers.



An exception comes from the city of Gravette, which could serve as a model for other cities in the region. See the sidebar, “Effective recycling contract” for more information on Gravette’s approach. Among the reviewed contracts, only the city of Johnson had a provision for data reporting, and none of those reviewed had any requirements around program performance assessment. This complicates the ability of the region to understand what is being collected, program effectiveness, or the fate of the materials. In short, stakeholders who were engaged in this process want transparency and being able to tell the story of where materials end up is critical toward advancing transparency.



GRAVETTE: Effective Recycling Contract

The contract for the city of Gravette illustrates how a city can negotiate a good deal for recycling services instead of accepting a standard contract offered by private haulers. Gravette utilized the resources at its disposal from the Benton County Solid Waste Management District for contract development. The 2016 contract with Republic Services is customized and specific to their community’s needs and obtains a better rate for collected materials. The city also accounts for changes in both situation (e.g., emergency events, new residences) and the contract terms. A series of small, considered differences, such as these, add up to a more robust contract when compared to others in the region.

END MARKETS & EXTERNAL FACTORS

Without having destinations for materials collected, recycling does not attain its promise as a key part of resource conservation and enabler of circularity. End markets provide an economic incentive for collecting and sorting materials. They can be as complex as the commodity market that moves materials to end uses on a potentially global scale, or very localized, where plastics are processed in a regional facility that turns them into a new product or package. The important thing is that there is somewhere for recycled materials to go. For many materials, there may be a process to recycle them, but they are either not routinely collected or able to be aggregated at volumes that can support the existing processes cost effectively. Some materials, such as polypropylene plastic, are not commonly sorted out of single-stream recycling systems so the volumes available are not enough to support end markets. There is an effort by the plastics industry to increase the incentives to collect material by creating demand for recycled polypropylene plastic to meet recycled content requirements in packaging (Leif, 2020).

Since commodity markets are an integral part of recycling systems, no system can be fully independent of external factors. Commodity markets fluctuate due to demand at a global scale. A recent powerful reminder of this was the National Sword initiative from China. The Chinese government banned imports of recycled material except for the cleanest, highest-quality grades. This caused upheaval in the recycling industry in the United States because a large amount of material, especially low-grade and contaminated materials, was being sold into China.

Where material collected from the region is processed can be determined to a certain extent from the solid waste district reports submitted to the state. Most of the plastic and fiber-based materials (cardboard, office paper, magazines, etc.) are handled through brokers, who find the highest prices for the recyclables on the open market. These end-market destinations vary over the course of a year depending on where the most value can be gained. Where these markets are and how much is moved to a particular end-market processor is considered confidential business information that's not shared publicly by private materials brokers. The city of Fayetteville has self-imposed transparency rules that require the city to disclose its end markets so citizens can know the city is responsibly handling the collected material. Table 4 breaks down the end markets for Fayetteville. Some fiber-based material (e.g., cardboard, office paper) does remain in the region, but no plastic is processed locally or even in nearby regions. The end markets reported by Fayetteville are typical of the mix of destinations for materials that leave the region.

Name:	City of Fayetteville	Quantity	Unit of Measure	Destination or Buyer (If more than one, percentage sent to each)
Batteries	Lead Acid from vehicles	n/a	Tons	n/a
	Other Batteries (Specify)	n/a	Tons	n/a
Electronic Waste	Computers- Printers-Fax-Copier-TV	31.6	Tons	ESCO, Rogers, AR, 100%
Glass	Mixed Glass	1632.76	Tons	Ripple Glass - Kansas City, MO, 100%
Hazardous Waste	Includes Universal Waste & HW	n/a	Tons	n/a
Metals	Various Metal Items	107.15	Tons	Scrap Metal Services - E. Chicago, IN, 80%; TMS International- Granite City, IL, 20%
	Other nonferrous (brass, zinc, lead, etc.)	158.06	Tons	Rogers Iron and Metal - Rogers, AR, 100%
	Aluminum	100.812	Tons	Constellium-Muscle Shoals, AL, -50%; Service Aluminum-Russellville, KY, 50%
	Copper	n/a	Tons	n/a
Mixed Recyclables	Mixed Materials (metal, plastic, etc.)	n/a	Tons	n/a
Oil	Oil-Motor	n/a	Gallons	n/a
	Oil-Cooking	n/a	Gallons	n/a
Paper	Cardboard (OCC)	2932.4	Tons	AR Kraft-Morrison, AR, 90%; Georgia Pacific- Monticello, AR, 9%; National Gypsum-Pryor, OK, 1%
	News (OHP Regular)	338.57	Tons	Fiberite Technologies- Joplin, MO
	Office Paper (OHP) White Ledger (94L)	n/a	Tons	
	Other Paper (Specify) BOOKS	n/a	Tons	
	Magazines/ Mixed paper	823.61	Tons	Georgia Pacific- Muskogee, OK, 66%; Pratt Ind - Shreveport, LA, 16%; Stephen Paper, Stephens, AR, 11%; Phoenix Paper Products, Lostant, IL, 2%; Fiberite Technologies, Joplin, MO, 2%; Waco, TX, 3%
Plastic	Mixed (no-mingled bottles)	n/a	Tons	
	HDPE (milk jugs, laundry detergent)	128.7	Tons	Avon Plastics-Seuk Rapids, MN, 33%; Greenline Polymers, Waterloo, IA, 33%; Master Mark, Albany, MN, 17%; Bedford Technologies, Worthington, MN, 17%
	LDPE (stretch wrap, grocery sacks)	n/a	Tons	
	LDPE (polyprop)	n/a	Tons	
	Other Plastics & Styrofoam (Specify)	n/a	Tons	
Road Material	PET (bottle water bottles)	192.36	Tons	Mohawk, Industries-Rome, GA, 33%; Carbon Lite Recycling- Dallas, TX, 33%; Prime Plastics-Vista, CA, 11%; Indorama Ventures- Athens, AL, 23%
	Road Material-Concrete	169.6	Tons	Material Depot- Springdale, AR, 100%
Rubber	Asphalt	n/a	Tons	
	Shingles	n/a	Tons	
	Tire Derived Fuel (TDF)	n/a	Tons	
Textiles	Other Rubber (Specify)	n/a	Tons	
	Carpet Padding, Fabric, Leather	n/a	Pounds	
Wood Waste	Wood pallets, lumber, sawdust, other	n/a	Cubic Yards	
Yard Waste	Grass, Leaves, Brush & Debris	8276.01	Tons	Fayetteville Compost Site - Sold to Customers

Except for that collected in Fayetteville, the majority of metal collected remains in the region. Tenenbaum Recycling Group, Total Recycling Group, and Vaughn Metal Recycling are all regional or state-based companies that handle the variety of metal streams. This does not guarantee that the metal is fully processed within the region or the state, but these companies do provide a local outlet for the region that have established access to broader commodity markets.

 Table 4: Fayetteville Annual Recycling Report

Glass, while not handled regionally, has a relatively close outlet. Of all the glass that's collected in city programs, 94% of the material goes to **Ripple Glass Recycling** in Kansas City, MO (Tigue, 2018). Ripple Glass Recycling was started by employees of Boulevard Brewing Company which, in 2009, saw that 150 million tons of glass were going to landfills for lack of a recycling facility in the Kansas City region. The company now serves 80 communities. Its processing facility feeds a local Owens-Corning facility that uses recycled glass in its insulation products. It also sorts and sends amber bottles to a company in Tulsa, OK that manufactures new beer bottles, used at Boulevard as well as other companies.

There is still a significant environmental and financial burden due to transporting the glass to Kansas City. By shipping the glass outside the region, any potential value from second use goes elsewhere. In an ideal circular region, there would be a local outlet that could process glass and provide it to local construction companies or other organizations that could use it to the immediate benefit of the region. For Northwest Arkansas, having a nearby option for recycling is good and initial focus should be on material streams that do not have viable options. Still, the situation underscores an important point when considering a circular region – a clearly valuable stream of material was going to landfills, and someone within the community stepped up to make a business of diverting that material. It wasn't that new technology was needed, but that someone needed to take the lead in establishing a circular system.

LESSONS LEARNED

A project on this scale does not happen without challenges. Data is always a challenge – knowing what is available and where to find it determines much of what can be done in a project such as this. Not taking time to understand the extent of the data reporting system already in place in the state was a mistake. The annual report, as discussed earlier in this report, does collect valuable information about the range of material collected and where that material goes. Because the information is not collected or aggregated in a robust, standardized way, it is difficult to know exactly what is available and how it can be used to understand recycling in the state and region. A critical first step for similar projects that leverage the methods used in this one for different regions is to fully understand the regulatory environment, including how political structures such as solid waste districts are created and their scope of responsibility, the scope of existing laws and who is held accountable to them, and what local and state programs already exist to support reuse and recycling activities. Future work would also need to account for material collected and processed by private haulers, as they provide routes for material flow out of the region.

The stakeholder engagement was also on a scale under appreciated during the planning stages. TSC's previous work at a city level (e.g., the Consortium work with the city of Phoenix, AZ) required working with fewer stakeholders because there was only one municipal system to engage. Coordinating many people in a variety of roles with a variety of agendas needed time and patience and was not accounted for in creating project plans. A strong recommendation for any project moving forward would be to have the project manager "on the ground" in the region. This would be a far better way to build the relationships necessary for this work, provide a better perspective on what is needed by having someone interacting directly with stakeholders in informal venues, and allow for a more responsive team to engage with the community.

PURPOSE OF COMMUNITY

In systems science, a system will self-regulate if there is a shared vision and goal among actors in the system (Hieronymi, 2013). A key part of this project was building a community of practice to create a shared vision for a circular region and the momentum to carry specific recommendations forward. A community of practice facilitates connections between individuals involved in recycling activities in the region and emphasizing the role of each in the common vision. One of the unanticipated outcomes of this project was to demonstrate that people who lead and work in recycling programs have a high interest in seeing more accomplished in Northwest Arkansas. People in recycling talk often about how important their work is toward long-term sustainability goals, but it was more than words in this case. Through the stakeholder meetings and other activities, this work has established a foundation for better coordination and collaboration to improve the recycling system and advance as a circular region.



COMMUNITY ENGAGEMENT

Three stakeholder workshops were hosted over the course of the project. During the workshops, TSC and the Northwest Arkansas Council brought 122 attendees together. There were 72 unique individuals engaged, who represented 50 businesses, communities, and organizations. The workshops served as a time to introduce and provide updates on the project, provide the attendees with a chance to share what was and was not working in their programs, and to bring in external experts to provide ideas on potential opportunities. Circularity thought leaders from Closed Loop Fund, Recycling Partnership, and Arizona State University's Resource Innovation and Solutions Network (RISN) shared lessons learned and potential models that could be of use to the region where there are good recycling programs in place that could use additional coordination and transparency.

In the first workshop, hosted in June 2019, participants were asked what important features in a future vision for the region would be and what was needed to reach that vision. These ideas became recurring themes through the other meetings:



Vision

- Northwest Arkansas establishes a regional identity as an innovation and supply chain hub
- Build on what already works regionally to create more circularity versus bringing in a standardized system
- Its programs can serve as a pilot and model for other regions



Needs

- Better understanding of the current legislation, incentives, and culture of recycling in the region
- Establish champions within different stakeholder groups, sectors, and communities to pursue the idea of a circular region
- Establish a cohesive regional recycling education and coordination program
- Align communication across municipalities and trash - and recycling-hauling companies
- Increase transparency around the fate of collected materials, particularly around end markets found for material
- Develop markets in the Northwest Arkansas region for recycled materials

The October 2019 workshop was dedicated to project updates and refining the vision discussed at the June meeting. The final meeting, in February 2020, focused on the findings of the project and the context it created for transitioning the region to a more circular model. This included a wide-ranging discussion on innovative ideas already at play in the region and what gaps need to be addressed. To bring the group back to the original future vision discussion, participants were asked to create the front page of the local newspaper in 30 years, in 2050, when there is a fully circular system for managing materials in place. The international recognition for work in the region was a common theme, as well as the idea that recycling would no longer be impressive because it had become such a standard behavior throughout society. Examples of these front pages are included in Appendix D.

In follow-up conversations, participants shared that these gatherings were much-needed community-building activities for the materials management community. Feedback after the final meeting included statements like:

“It was the first time we’ve shared what we are doing and talked about working together.”

“It was exciting to think about a common vision for the region. I hope this group will continue to get together.”

“We need to keep these meetings going so that we can keep learning from each other.”

Overall, these engagements allowed individual city recycling program employees to see themselves as part of a larger regional system, and it helped build the foundation for collaborations on creating a circular region.

ADDITIONAL ENGAGEMENTS

In addition to the regional stakeholders, The Sustainability Consortium hosted workshops with its Flexible Film Task Force to provide updates and engage global stakeholders in the process. As a result of engaging this task force, corporate participants attended the regional stakeholder workshops, including participants from P&G, Walmart, Henkel, and Kao Brands. This engagement connected these supply chain actors with regional stakeholders and provided insight into the role of supply chains in regional circularity efforts.

Inspired by the work described here, the Northwest Arkansas Council partnered with the two solid waste districts to discover and rediscover key components of Northwest Arkansas’ recycling infrastructure. The Council’s collaboration with the districts led to four recycling-related field trips with plans for more of them. The field trips included visits to the Marck single-stream recycling operation in Rogers (May 2019), a two-day trip to meet with the city of Austin and single-stream operator Balcones Resources in Texas (September 2019), a tour of the Fayetteville recycling and solid waste division operations (October 2019), and a stop at the James R. Welch Recycling Center in Rogers (February 2020). The Council estimates 50 people participated in the field trips, and 30 unique individuals participated in at least one of the tours.

What is most meaningful is that the stakeholder meetings and the field trips were about learning best practices and seeing what is possible. Northwest Arkansas recycling leaders, mayors and others across the region did not want to just talk about recycling; they wanted to know what they could do better in recycling. Certainly, those who attended the meetings and participated in the field trips understood creating circularity is an important part of becoming an outstanding recycling region.

Because the Northwest Arkansas region is part of the state of Arkansas, any circularity efforts enacted locally would need to be visible to the larger set of stakeholders in the state. By way of connections at the Arkansas Division of Environmental Quality, the TSC team took part in the October 2019 Arkansas Recycling Coalition event in Eureka Springs. As a result of attending this event, the network of stakeholders aware and interested in this work expanded to include haulers, brokers, materials recovery facility managers, and state and national leaders in the space. These connections were important in better understanding the regional and state-level resources available and to better identify and understand gaps that need to be filled.

RECOMMENDATIONS: Overall

What would implementing a circular system look like? It would use the resources at hand and create its own end markets. This way, instead of competing to sell recyclables or resin into a depressed global market, products could be made and sold through existing retail channels in the area. Revisiting the ideal circular region introduced earlier to imagine what this could be for Northwest Arkansas:

Becoming a circular region is not out of reach for Northwest Arkansas, knowing that recycling technologies continue to improve and that it should become easier and more cost-effective in time. Political will, investment, and regional coordination across municipal, corporate, and university stakeholders combined with some imagination is all that is necessary. Creating a space to get existing processes off the ground also creates potential for the next great innovation in recycling to occur.

The economic analysis accompanying this report shows that a standard MRF coming into the region coming into the region would not only need to take in all material already collected in the region but also collect from a much wider area to be economically viable. Rather than moving directly to these types of technologies, these recommendations focus on creating a coordinated, distributed system of material handling that maximizes the existing flows and can expand to include new ones – a distributed network rather than a traditional hub-and-spoke model. Figure 5 illustrates the difference between a hub-and-spoke model and a distributed network model.

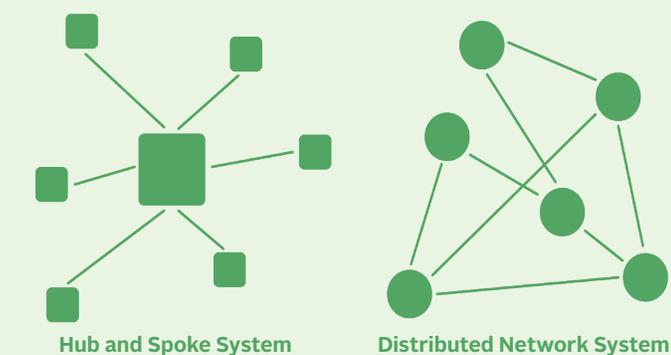


Figure 5: Network Systems

A traditional hub-and-spoke model consists of one central facility that receives material from a series of spoke facilities distributed across a given area where the material volume is large enough to make the facility economically viable. On the current commodity market, larger quantities of a single material are worth more than smaller quantities, so the goal is to collect and process as much material as possible to get the highest price when sold to end markets. This is the system underpinned by single-stream recycling in larger cities and metropolitan areas. There are a few challenges to

this model for the Northwest Arkansas region, starting with the fact that there simply isn't enough material available to run a single facility without bringing in material from other cities such as Tulsa, OK and Fort Smith, AR. A system like this would also require all existing material to flow into the central facility, circumventing the existing municipal programs. This would require the solid waste districts and cities to agree to a single system and support a single facility, which based on the politics of the region would be almost impossible.

Since the Northwest Arkansas region doesn't lack material handling infrastructure or room for expansion at existing facilities, the primary goal moving forward should be to bring together and coordinate the existing infrastructure to improve material flow and expand capabilities in the region to include processing and robust end markets. To this end, this proposal is built on the idea of distributed network of nodes (Figure 4). What would be a spoke facility becomes a node – a point where a particular material is aggregated and handled, or a particular processing technology exists, or a particular end user sets up a facility. Nodes already exist – for example, Madison County Solid Waste and Recycling Center and the central facilities for Boston Mountain and Benton County Solid Waste Districts are collection nodes, the EPS processing capability in Rogers is a material node, and Northwest Rags is an end-market node. These nodes already are connected, and some material already flows between them. The recommendations address what steps are necessary to get visibility on how more material could flow more effectively, establish communication paths to facilitate collaboration, and find the gaps where adding innovative technologies or new processes could increase the amount of material used and move the region toward a more circular economy.

These recommendations are divided into three parts:

-  What materials should be considered first?
-  Who should organize this effort and how?
-  What are starting recommendations for technologies that could be part of a pilot project in Northwest Arkansas?

RECOMMENDATIONS: Materials

Because the cost of advancing recycling and creating a circular economy makes it difficult to pursue all possibilities simultaneously, it's essential for Northwest Arkansas to invest in its best opportunities from the start. It should target its weakest areas and put off decisions about solutions that are sufficient for now.

To see which end markets could potentially be created in NWA, the materials that are already being collected and sorted locally should be considered.

The metal streams would not be likely candidates – the material is already handled locally, and metal recycling usually requires smelters or other types of processing equipment that may not be economically feasible for small amounts of metal captured in Northwest Arkansas. If local conditions change, such as a new manufacturer moving to the area that was producing metal scrap, this could become a more promising opportunity.

Since there is already a reliable processor for glass that has an established end user for its cullet, glass is not a priority market to develop. The exception here would be if a strong local end market was established that could use cullet. There are portable glass processing units that could handle smaller volumes economically if there was someone to buy the material. This would also save on the cost and impacts of transporting the glass to Ripple or other out-of-state locations.

The material generated by fiber recycling processes is most often fed back into a paper-making processes. This would require a mill willing to buy the material if new processing capability was established in the region. There are other outlets besides new paper products in which recycled fibers could be used, so whether this was a feasible business opportunity would depend on whether there already exists a manufacturer that could use these materials, or someone interested in starting a company that could.

PRODUCTS FROM RECOVERED PAPER	PRODUCTS FROM RECOVERED PAPER SLUDGE
Insulation	Fertilizer
Animal Bedding	Landfill Caps
Egg Cartons	Construction Material
Seedling Planting Pots	Animal Bedding
Lamp Shades	Ethanol
Ethanol	Energy
Energy	
Dust Masks	

Plastics is a logical place to start because this material is being sent out of state and so a local market would not replace an existing regional outlet. Rogers already has started down this path with EPS recycling that could be leveraged regionally to bring in more material. There also may be an opportunity to install a second machine farther south, so that the material does not have to be driven across the region to reach a processing point. There may be an opportunity to process the polystyrene plastic produced from EPS recycling. Agilyx, an Oregon company in the Portland suburb of Tigard, has developed a process to convert EPS into chemicals used to make new polystyrene plastic products. Such technology could create a new end market in the region.

 **FIGURE 6: POTENTIAL USES OF RECOVERED PAPER**

An additional advantage of the established drop-off system across the region is that expanding the types of materials collected is a matter of adding a dedicated bin for the material at the collection center. This ability to “turn on” additional streams is a strong advantage of the extensive drop-off system that already exists in the region. Adding bins for wide-mouthed HDPE containers or 3-7 plastics collection comes with far less overhead than trying to separate out these materials from single-stream collection.

The primary challenge would be educating citizens that a new material stream can be recycled. It may be that this is feasible only in staffed drop-off locations where recycling experts can guide the public, at least in the beginning. This kind of flexibility could facilitate prototype testing of new technologies that would be interested in one type of material not easily accessible from standard recycling streams. Polypropylene is one material that may be worth pursuing. It is highly recyclable and valuable in a clean, separate stream that is hard to get in a lot of places. Depending on what processing technologies are available that could handle the small volumes of material likely to be collected this way, local end markets may be developed. This could be an interesting development idea for the region – we will collect the material and make it available if you have a technology to test. The RENEW materials marketplace supported by the state might be a good platform to publicize such an effort.

While the primary focus of circular economy discussions is the economic benefits circularity can provide, deliberate development can also benefit the people and the environment beyond just economic growth. Economic growth needs to be sustainable growth, including a strong commitment to the health and well-being of communities and the environment.

Bringing in a technology that increases air pollution or expanding an existing facility without considering potential impacts on watersheds is not healthy development, even if economically favorable. Using the opportunity with a circular region development plan provides the opportunity to build in policies that protect people and the environment and not only grow the economy but improve the quality of life in the region.

RECOMMENDATIONS: Organization

Moving toward a circular region is not only about identifying processes or technologies that could be useful. It also requires coordination and communication across and between all stakeholders in the region. A program manager position should be created under the Northwest Arkansas Council that will be responsible for moving the work started as part of this project forward and implementing the recommendations below. This position will fulfill two needs – the first to have one individual on the ground locally to gain a deep understanding of the materials management programs and processes at the regional level. Second, to ensure that the engagement with stakeholders that has been a key part of this project continues and is leveraged to implement projects in the region.

The Northwest Arkansas Council is uniquely positioned to help the region in this regard. It has already established a close working relationship with the two solid waste districts in the region. It also has a history of coordinating stakeholders across the region on projects to benefit the region, such as Northwest Arkansas National Airport, and the nonprofit organization has a strong connection to the business community that would enable public-private partnerships. As the organizing entity, it can also leverage its membership, including Fortune 500 companies like Walmart and Tyson Foods, to enable commercial and industrial material integration and help develop a regional promotion plan to bring in innovative companies for end-market development.

The program manager would continue to engage regional stakeholders in regular dialogues about what is happening in their programs or communities, manage communications through a web portal and by other means, and facilitate the planning process for circular region development.

Stakeholder engagement recommendations are as follows:

-  **The Northwest Arkansas Council should hire a program manager to coordinate efforts across the region:**

The Northwest Arkansas Council has a strong history of coordinating work with regional stakeholders and already has established a good working relationship with the regional solid waste districts. The districts must be key collaborators for this effort. The program manager would be a single point of contact for stakeholders and provide project support to execute on the recommendations below. Ideally the program manager would be someone with existing connections and relationships with those working in the materials management industry across the region.
-  **The Northwest Arkansas Council should continue vision development with the established stakeholder group:**

During the project, three workshops were hosted that engaged 122 regional stakeholders, 72 of which were unique individuals, representing 50 different organizations. There was strong interest from participants to continue these interactions to ensure improved connection and coordination between stakeholders in the region. Decisions around what technologies or processes should be brought to the region and developing implementation plans will require continued dialogues between stakeholders. Working with a group such as the Resource Innovation and Solutions Network (RISN) at Arizona State University could help create a truly circular region (sustainability.asu.edu/resourceinnovation). The RISN staff is experienced in assisting municipalities with stakeholder engagement and planning and executing circular economy projects as well as engaging the university community to be a key part of the solution.
-  **Engage a broader community:**

Rather than focus only on private business development, explore creating a new entity or collaborating with an existing non-profit to create an end market business that would use recycled materials collected locally to create new products for local consumption. Because it is not a for-profit entity, this organization could then reinvest profits back into the community through grants or other mechanisms that would allow citizens to see the impact of their efforts directly. Whether the project was cost neutral or profitable, especially in the early days of the effort, would be less important since the proceeds from products sold provide benefits to the community.

Because the solution is not strictly technical, the program manager should also engage with stakeholders to improve processes currently in place. This work has identified the following as potential process improvements:

-  **Work collectively to set up a Northwest Arkansas materials exchange:**

A way to centrally coordinate and aggregate material from across the region currently does not exist. Some aggregation is done by brokers in the area, such as ORE Recovered Materials, but aggregation is challenging unless the broker is aware of what material is available. A stakeholder group led by the Northwest Arkansas Council should collaborate with the solid waste districts, the Arkansas Marketing Board for Recyclables, and the Arkansas Recycling Coalition to drive this effort.

A page on a website or similar forum where listings of available material could be submitted would allow people with material to notify others that the material is available. Municipal programs could do the same, preferably in the same place, so that it would be possible to easily identify when an opportunity to combine collected materials exists. This does not have to be publicly available but could be established just among programs that have materials and those working with the programs to move material. Setting up a place where programs in the region can post what materials they have collected would enable more systematic aggregation that could bring better prices on the commodity market. The RENEW exchange is a good example of how this is done across states; the objective would be to connect people within the Northwest Arkansas region for materials exchange rather than multiple states across the southeast United States.

Improve state data collection and clarify reporting requirements:

A detailed description of the issues related to current state level data collection and reporting can be found in the Challenges section of this report beginning on page 15. The project team has worked with local stakeholders and ADEQ to create a standardized reporting template. The final form has been designed and the state is interested in a pilot test. The new form is in line with those used by states such as Tennessee and Louisiana and a marked improvement over the existing forms. The Northwest Arkansas Council intends to work with the state to pilot this form to improve data collection and use. Clarifying whether private haulers are required to report under Regulation 28 would ensure that private companies handling recycling in the region report information to the state in the same manner as their public counterparts.

Each entity should commit to improving contract quality:

The current municipal recycling contracts have many gaps that hinder their effectiveness in developing circularity in the region. First, the quality of existing contracts can be improved to better define and clarify the roles of those entities entering the contract. As mentioned previously, Gravette's 2016 agreement with Re public Services should become a model for what a good contract should discuss, cover, and contain. Second, including a mechanism for collection volumes, recycling stream composition and material destination would be useful to provide the information necessary to assess the success of the collection program and help describe material flow through the region. The city of Johnson contract shows how this can be done. In the long term, municipalities should consider maintaining ownership of the materials so that they can be more active in determining the fate of recycled materials collected in their communities.

Longer term, the program manager would lead the effort to identify who should handle what material, based on existing collection capability and ability to site an end market or material processing facilities. There is also the possibility that this work could be used to scope similar projects in other regions. Appendix D provides an overview of the steps for such an effort.

RECOMMENDATIONS: Technology

The program manager would be the designated point contact for companies bringing technology to the region, and the one responsible for building relationships with companies the region would like to recruit. The recommendations listed below focus on activities and companies that enhance existing efforts or create new opportunities to provide short- to medium-term gains in the region's ability to collect and use material locally. Appendix E – Potential Technologies provides additional options or opportunities that may be of interest to the region.

Work with local university partners to quantify full materials flow for the region:

Work with the University of Arkansas or NorthWest Arkansas Community College to have a group of students characterize what types of materials are generated by commercial, institutional, and industrial and in what quantities. This would provide a better estimate for interested end-market companies to work with when deciding whether their technology is a good fit for the region. These analyses should be conducted on a regular basis to continue to monitor volumes and enable reporting to potential end-market companies.

Two promising technologies to pursue:

Recyclops: This company provides a platform to enable on-demand pick-up of recycling from customers in rural regions and is a graduate of the RISN Incubator program, a joint effort between Arizona State University and the city of Phoenix. The technology could be adapted to handle coordination of material aggregation. The company would be a valuable resource to help with the broader aggregation and coordination conversation. Working with local organizations that already understand how the region operates, its technology could streamline the process and complement the centralized listing or exchange as discussed above. Recyclops has multiple programs underway in the western United States and it has considered Arkansas as a potential new market, so it is likely to be responsive to inquiries regarding partnerships.

Precious Plastics: Founded in the city of Eindhoven in the Netherlands, this organization provides open source modular recycling system designs that can handle almost all plastic types. Its mission is to reduce plastic waste wherever and however it can through building networks of individuals and organizations to effectively collect, process, and find end-market value in plastics. The foundation piece for this are workspaces where the community comes together to process plastic and reuse it in new products. The different components of a workspace can be found on its [website](#), and it includes freely available designs for a range of plastics-processing equipment. Before investing in building equipment locally, machines can be purchased through the Precious Plastics network. In the United States, [Precious Plastic USA](#) builds equipment for plastics re-processing and production.

For Northwest Arkansas, the two regional solid waste districts are an obvious choice for this type of model. A recycling workspace, as described by Precious Plastics, could be established, as the centralized solid waste districts' facilities already serve as collection and community engagement points. As noted earlier, drop-off locations already collect and source-separate material, and those locations could add new material streams as interest or demand dictates. If plastics reprocessing or production equipment were installed, it could be visible to the public and not only recycle plastics but educate the community on how this is done. This could also be an opportunity to engage with an entrepreneur from the community or university students to start a new business using recycled material. If the first project is successful, it could serve as a template for a regional incubator for new technologies or businesses with similar technologies.

 **Design competition:**
In collaboration with student groups at the University of Arkansas or NorthWest Arkansas Community College, generate ideas for products that could be made with recycled materials and sold locally. The design criteria for the competition need to include how something would be recovered and recycled at end-of-life. For example, if the product being designed are floor tiles, the group would need to address questions about how the tiles would be recovered and recycled when they wear out or are removed.

 **Startups:**
Support a company that starts 3D printing consumer goods – there is huge range of interesting and useful products that can be printed, as can be seen at the website Thingiverse. Recruit entrepreneurs from University of Arkansas or from the community and provide grants and/or other support to launch a new idea. Alternatively, if there is someone in the community with a product idea that could use recycled plastic, draw on students to create or implement a process to support product production locally. Publicize widely.

NWA has a dedicated set of stakeholders, strong community engagement, and a robust recycling system in place. The region also has the advantage of being home to Fortune 500 companies with strong sustainability commitments. These are important base conditions for creating a circular region.

Lessons learned here will help other regions that are considering a circular region model. Appendix F – Circular Region Project Flow provides a list of project components that can be helpful when planning this type of project. This is the process TSC will follow as it expands this work into other regions.

As shown throughout this summary, the region has good recycling infrastructure that can be leveraged to collect and keep more material in the region to support end-market development. This existing strength comes from each program finding and continually improving on what works for its specific context and environment. Having local programs see themselves as part of a larger regional system lays the foundation for creating a circular region. Maintaining these programs and their successes is vital to the success of any regional effort. To move forward, focus should be placed on better understanding the interactions of the current system and designing a common future that meets the needs of the region and its citizens.

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APPENDIX A: Materials Recovered in Northwest Arkansas 2018-2019

The following tables present the data submitted by those entities required to report recycled material volumes to the state of Arkansas under Reg 28 (Regulation 28, 2004). The data are broken into two tables, one for each solid waste district. This information was submitted on the forms shown in this report. Note all materials are reported in tons unless noted otherwise.

Regulated materials (electronics waste, household hazardous waste, batteries, tires, automotive oil) have been removed, as these are only collected at the primary transfer station in each county. Other materials that are not covered in this report or did not have any material collected and reported were also removed (yard and woody waste, cooking oil, mixed recyclables, styrofoam, road materials).

Capture rate describes how much of the material available for recycling (i.e., how much material residents generate) is “captured” for recycling. Calculating capture rate requires waste sorts that look at not only what residents put in recycling bins but also what is thrown away. The capture rate numbers included in tables below are taken from the 2020 State of Curbside Recycling Report published by The Recycling Partnership (Mouw, Schwartz, & Yarkosky, 2020). Capture rates for other materials were not available. Similar information is not available for drop-off locations, as there is no direct way to determine how much material is going to landfill instead of being dropped off for recycling (Mouw, Schwartz, & Yarkosky, 2020).

The data in the lines highlighted in green in Table A-2 and A-3 were used for the study “Measuring the Economic Impact of Circular Material Flows in Northwest Arkansas” by the Center for Business and Economic Research at the University of Arkansas.

Material Recovered Tables

For each program reporting, two columns are presented. The first is the volume of material collected in tons. The second is the outlets, or end markets, for the collected material. Multiple outlets may be listed because if there is not a specific contract in place, materials will be sold to the outlet offering a combination of the best price, most convenient pick-up options, or other factors important to a program. Table A-1 provides a key to the abbreviations used in these columns in Table A-2 and A-3. If only one outlet is listed, 100% of the material collected went to that outlet.

ABBREVIATION	COMPANY	LOCATION
ARK	AR Kraft	Morrilton, AR
Avon	Avon Plastics	Sauk Rapids, MN
BT	Bedford Technologies	Worthington, MN
CLR	Carbon Light Recycling	Dallas, TX
Cons	Constellium	Muscle Shoals, AL
DG	Dlubak Glass	Upper Sandusky, OH
FIB	Fiberlight Technologies	Joplin, MO
GLP	Greenline Polymers	Waterloo, IA
GP	Georgia Pacific	6 sites in AR plus OK
Indo	Indorama Ventures	Athens, AL
Marck	Marck Recycling	Rogers, AR
MM	Master Mark	Albany, MN
MOW	Mohawk Industries	Rome, GA
NGP	National Gypsum	Pryor, OK
NWRags	Northwest Rags	Springdale, AR
PPL	Prime Plastics	Vista, CA
Pratt	Pratt Industries	Shreveport, LA
RIM	Rogers Iron and Metal	Rogers, AR
RG	Ripple Glass	Kansas City, MO
SA	Service Aluminum	Russellville, KY
SK	Smurfit-Kappa	Little Rock, AR
SMS	Scrap Metal Services	Chicago, IL
SSM	Siloam Springs Metal	Siloam Springs, AR
Steph	Stephen Paper	Stephens, AR
TMS	TMS International	Granite City, IL
TotR	Total Recycling	Fayetteville, AR
TRG	Tenenbaum Recycling Group	Rogers, AR
VG	Vaughn Group	Fayetteville, AR
BROKERS:		
ORE	Ore Recycling	Clinton, AR

In the Benton County SWD table, the column labeled “Marck Recycling” represents the average annual material volumes collected through the single-stream curbside collection programs in Bentonville, Rogers, Lowell, and Springdale. The data is an average of monthly volumes collected over a 12 month period. Inland Services and Waste Management hold the collection contracts with the individual cities. The haulers take collected material to Marck Recycling for processing and sale. No outlet for Marck Recycling is noted as they are the outlet and aggregate, process, and sell materials from their own facilities.

In the Boston Mountain SWD table, the column labeled University of Arkansas shows the volumes of cardboard and other paper grades collected by university facilities and the cafeteria. As this material is handled by Boston Mountain SWD, it is reported under Reg 28. Other recycling programs at the university are handled through contracts directly with recyclers as is typical with other institutional facilities.

The importance of commercial recycling in producing useful volumes of materials is visible in this data. For example, the amount of cardboard collected by Bella Vista or metals collected at the Madison County Solid Waste and Recycling Center are noticeably higher than would be expected when compared to larger programs. In both cases, the programs actively collect or accept material from commercial sources, raising the total volume collected. Understanding how much material is available through industrial, institutional, and commercial sources will be an important part of attracting innovative companies and new end markets to the region.

		Capture Rate	Siloam Springs		Bella Vista		Rogers Drop-off		BCSWD		Marck Recycling
Glass	Mixed glass (all colors combined)	62%	65.12	RG	260	RG	271	RG	162.45	DG	
Metals	Ferrous (incl cans)	37%	122.37	70% SSM 30% TRG	30	ORE	34	Marck	469.67	TRG	240
	Other non-ferrous (brass, zinc, lead, etc)										
	Aluminum	38%	13.71	SSM	17	ORE	13	TRG	5.83	TRG	120
	Copper										
Paper	Cardboard	62%	834.68	95% ORE 5% Marck	1557	ORE	918	Marck	357	ORE	1680
	News				221	ORE	100	Marck	77.43	ORE	
	Sorted office				138	ORE	110	Marck			
	Other	46%									
	Magazines/mixed paper		133.11	ORE	115	ORE	99	Marck	76.16	ORE	5760
Plastic	HDPE	53%	36.7	68% Marck 32% ORE	37	ORE	19	Marck	14.8	ORE	132
	HDPE Colored	46%									120
	LDPE (film)				1.0	ORE					
	PET	40%	31.22	Marck	68	ORE	38	Marck	27.09	ORE	480
Textiles	carpet padding, fabric, leather				335,456	ORE					

 **TABLE A-2: BENTON COUNTY SOLID WASTE DISTRICT REPORT**

		Capture Rate	BMSWD		Fayetteville		Madison County		University of Arkansas	
Glass	Mixed glass (all colors combined)	62%	123.5	RG	1632.76	RG	24.48	RG		
Metals	Ferrous (incl cans)	37%	262.56	99% TRG 1% Other	107.15	80% SMS 20% TMS	881.45	TRG		
	Other non-ferrous		4.08	VG	158.06	RIM	23.16	TRG		
	Aluminum	38%	5.26	85% ORE 11% GP 4% TotR	100.82	50% SA 50% Cons	66.79	TRG		
	Copper		3.91	VG			16.69	TRG		
Paper	Cardboard	62%	448.42	94% ORE 5% GP 1% Other	2932.4	90% ARK 9% GP 1% NatG	184.4	ORE	126.48	SK
	News		82.47	ORE	338.57	FIB			4.27	SK
	Sorted office	46%	52.21	ORE			34.7	ORE	53.61	SK
	Other		37.78	ORE					5.49	SK
	Magazines/mixed paper		18.99	87% GP 13% TotR	823.61	66% GP 16% Pratt 11% Steph 7% Other	41.4	ORE	54.08	SK
Plastic	HDPE	53%	17.06	83% ORE 10% GP 7% TotR	129.7	33% Avon 33% GLP 17% MM 17% BT	7.9	ORE	14.8	SK
	HDPE Colored	46%								
	LDPE (film)		2.78	74% ORE 14% GP 12% TotR						

 **TABLE A-3: BOSTON MOUNTAIN SOLID WASTE DISTRICT REPORT**

APPENDIX B: State Reporting Requirement Comparison

In Arkansas, Regulation 28 defines what materials should be collected and recycled as well as requiring reporting to the state on recycling program performance. The recycling program is included in the statewide solid waste management plan that is required by law to be updated every four years. The last cycle was completed in 2018. For the planning process, all solid waste districts are required to submit special needs reports, describing in detail their programs, which can be found on the program page on the Arkansas Division of Environmental Quality website.

As part of the planning process, the division's special recoverable materials committee selected nine states to survey regarding what other materials Arkansas might consider diverting from landfill in the future. While reporting requirements were not part of this survey, the nine states selected did provide a good peer group against which to benchmark the existing reporting scheme in Arkansas. Table B-1 summarizes the results of this analysis, which considered whether there were state regulations requiring recycling programs, what kind of reporting, if any, is required, and who is responsible for reporting. It also includes links to the state websites that describe the programs.

State	Recycling Law?	Reporting?	Format	Description	Requests end markets?	Website
Arkansas	Yes	Yes	Paper form, annually	County programs run by solid waste districts required by law	Yes	https://www.adeg.state.ar.us/poa/
Louisiana	Yes	Yes	Online	Parish programs required by law; municipalities may if they would	No	https://www.deq.louisiana.gov/page/recycling
Minnesota	Yes	Yes	Online	All organizations handling recovery or recycling	Yes	https://www.pca.state.mn.us/waste/recycling-minnesota-score-report
Mississippi	No	No	--			
Missouri	No ¹	No	--			
Oklahoma	No ¹	No	--			
Oregon	Yes	Yes	Excel form	All organizations handling recovery or recycling	Yes	https://www.oregon.gov/deq/recycling/
Tennessee	Yes	Yes	Online; PDF available for reference	All having recycling programs; voluntary	No	https://www.tn.gov/environment/program-areas/solid-waste/materials-management-program/annual-progress-report.html
Texas	No	No ²	--			https://www.tceq.texas.gov/p2/recycle/recycling.html
Washington	Yes	Yes	PDF form	All facilities handling recyclable material	Yes	https://ecology.wa.gov/Waste-Toxics/Reducing-recycling-waste

 **TABLE B-1: SUMMARY OF STATE REPORTING REQUIREMENTS**

1 – Missouri and Oklahoma do not have laws facilitating statewide recycling for citizens. Both have regulations requiring state agencies to have recycling programs and purchase products with recycled content.

2 – Texas does not have a state law that requires recycling, but it does run the Texas Recycling Data Initiative, a biannual voluntary effort to assess recycling in the state.

Overall, the Arkansas recycling reporting program falls mid-range between a very progressive program in Minnesota and no program or public information on recycling in Mississippi. Of the states assessed, the two that were the most like Arkansas were Tennessee and Louisiana. The annual reporting forms are similar and ask for the same information. All three are organized at the county or parish level, but reporting is voluntary in Tennessee. Tennessee does request information from all facilities, including commercial and industrial facilities, that have recycling available. The form used would be a good guide on how this could be done in Arkansas.

Oregon, Washington, and Minnesota have the most progressive programs in the U.S. All three states have made commitments to sustainable materials management and make available annual reporting information on their websites. This includes all facilities that handle recovery, reuse, or recycling. Minnesota has, by far, the most advanced report for citizens to see how the state is performing and has invested in an online reporting system that eliminates the need for annual reporting on paper or digital forms.

Mississippi, Missouri, and Oklahoma do not have any recycling programs. Interestingly, both Missouri and Oklahoma have regulations that require state agencies, including schools, to have recycling programs in place and to purchase products with recycled content. Both states leave most recycling efforts to the cities. Mississippi has made little progress on recycling programs in the state.

Texas does not have legal requirements at the state level for recycling, either, but it actively supports material recovery efforts. As mentioned in the report, the Texas Commission on Environmental Quality (TCEQ) does sponsor the RENEW materials marketplace. On its website, TCEQ lists a range of resources that are available to citizens and businesses to recycle. TCEQ also convenes a stakeholder group on a biennial basis for the Texas Recycling Data Initiative, a voluntary effort to survey and assess the state's recycling industry.

One similarity across all states were in the hazardous materials required by the state. Electronics, lead batteries, tires and household hazardous waste are all regulated to some degree by each state.

APPENDIX C: Standardized Reg 28 Reporting Form

The inadequacy of the existing process to collect useful recycling data from the solid waste districts led to the creation of a new form to help standardize and streamline data collecting in the state. The new form allows organizations to input their numbers directly into the PDF and then allows solid waste districts or the state to extract the information into a database where it can be aggregated and analyzed. The new form will make data collection less burdensome and require less time to manage than the current system.

During the spring of 2020, TSC worked with regional stakeholders and the ADEQ to develop this form, which ADEQ is interested in piloting. The form has been passed on to the Northwest Arkansas Council, which will request the state use this form for the next reporting cycle.

Solid Waste and Recycling Annual Report Form

Data Collection Period _____

Organization Name _____
 Street Address _____ City _____ State _____ Zip Code _____
 Contact Person _____
 Email Address _____ Phone _____

Facility Name _____
 Street Address _____ City _____ State _____ Zip Code _____
 Contact Person _____
 Email Address _____ Phone _____

Organization type public private – choose one
 Material Source city county commercial industrial – choose all that apply
 Type of Operation collection recovery - choose one, if both fill out one form for each

Service Type (choose all that apply)

Household waste	<input type="checkbox"/>
Household Recycling	<input checked="" type="checkbox"/> Mixed waste
Waste drop-off	<input type="checkbox"/>
Recycling drop-off	<input type="checkbox"/>
Yard Waste	<input type="checkbox"/>
Compostable	<input type="checkbox"/>
Roll-Off	<input type="checkbox"/>
Front End Loader	<input type="checkbox"/>
Other	<input type="checkbox"/> Describe _____

Solid Waste District West River Valley

Service Area _____

Number of accounts (collection only) Household _____ Multi-Family _____
 Commercial _____ Industrial _____

APPENDIX C: Standardized Reg 28 Reporting Form Continued

Recycling Materials Accepted – Check the box next to the types you receive

	Quantity	Units	Quantity Sold	Origin	Destination
Batteries (lead-acid)	<input type="checkbox"/>	tons			
Batteries (other)	<input type="checkbox"/>	tons			
E-waste	<input type="checkbox"/>	tons			
HHW (household hazardous waste)	<input type="checkbox"/>	tons			
Metal (Ferrous)	<input type="checkbox"/>	tons			
Aluminum	<input type="checkbox"/>	tons			
Copper	<input type="checkbox"/>	tons			
Metal (other)	<input type="checkbox"/>	tons			
Mixed Materials	<input type="checkbox"/>	tons			
Cardboard (OCC)	<input type="checkbox"/>	tons			
Newspaper (ONP)	<input type="checkbox"/>	tons			
Sorted Office Paper (SOP)	<input type="checkbox"/>	tons			
Magazines/Mixed paper	<input type="checkbox"/>	tons			
Paper (other)	<input type="checkbox"/>	tons			
Plastic (mixed)	<input type="checkbox"/>	tons			
Plastic (PET)	<input type="checkbox"/>	tons			
Plastic (natural HDPE)	<input type="checkbox"/>	tons			
Plastic (colored HDPE)	<input type="checkbox"/>	tons			
Plastic (LDPE film)	<input type="checkbox"/>	tons			
Plastic (LDPE polypipe)	<input type="checkbox"/>	tons			
Plastic (other & Styrofoam)	<input type="checkbox"/>	tons			
Asphalt	<input type="checkbox"/>	tons			
Shingles	<input type="checkbox"/>	tons			
Road material (other)	<input type="checkbox"/>	tons			
Rubber (tires)	<input type="checkbox"/>	tons			
Rubber (tire-derived fuel)	<input type="checkbox"/>	gallons			
Rubber (other)	<input type="checkbox"/>	tons			
Textiles (carpet padding, fabric, leather)	<input type="checkbox"/>	cubic yards			
Wood Waste (pallets, lumber, other)	<input type="checkbox"/>	tons			
Yard Waste (limbs, leaves, brush)	<input type="checkbox"/>	cubic yards			
Glass (All)	<input type="checkbox"/>	tons			
Oil (Motor)	<input type="checkbox"/>	gallons			
Oil (Cooking)	<input type="checkbox"/>	gallons			
Other (describe)	<input type="checkbox"/>	cubic feet			
Other (describe)	<input type="checkbox"/>	cubic feet			
Other (describe)	<input type="checkbox"/>	cubic feet			

APPENDIX C: Standardized Reg 28 Reporting Form Continued

Landfill information: Name _____ Address _____ City _____ State _____ Zip _____
Phone _____ Contact Person _____ Email address _____
Percent of material landfilled _____

Landfill information: Name _____ Address _____ City _____ State _____ Zip _____
Phone _____ Contact Person _____ Email address _____
Percent of material landfilled _____

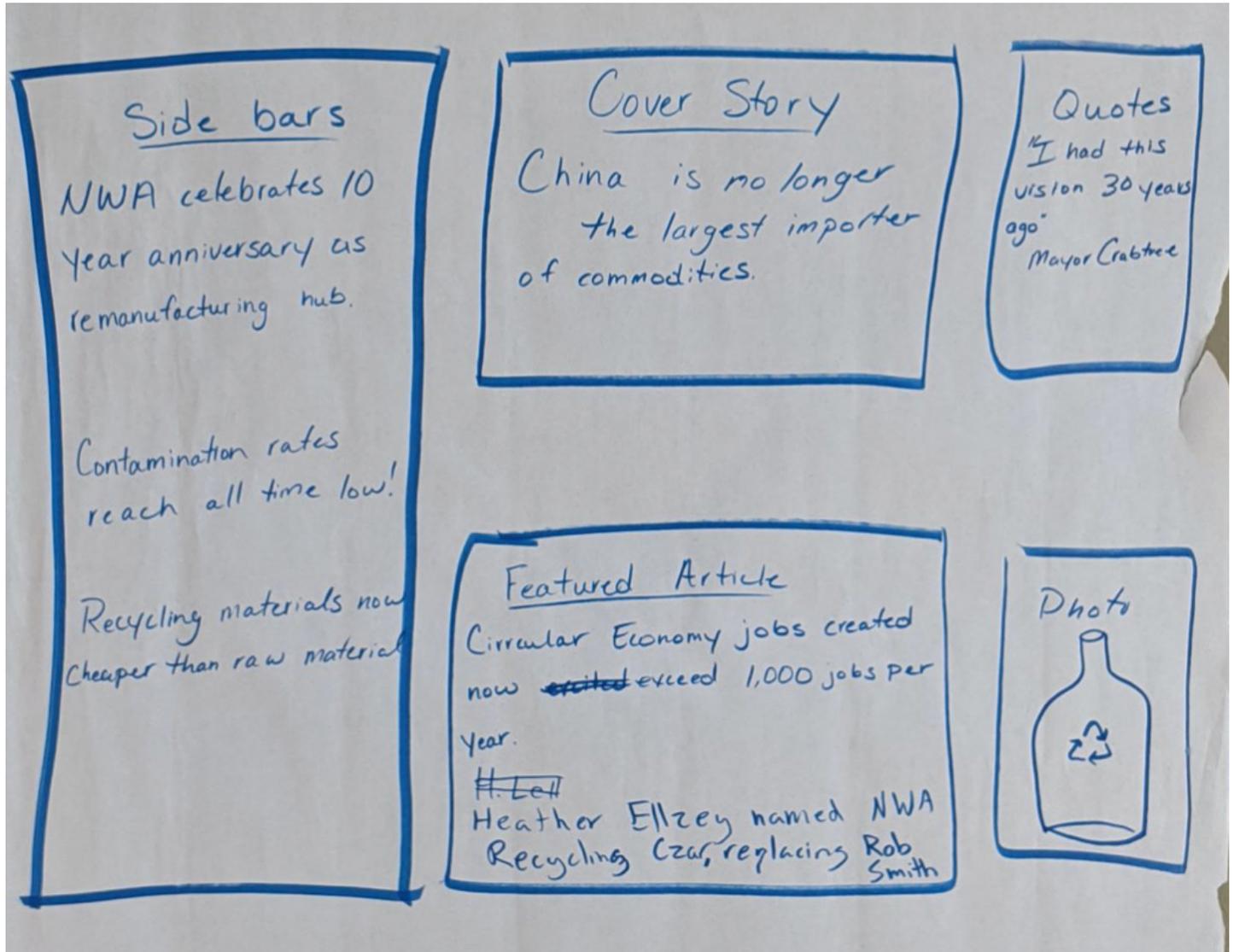
Landfill information: Name _____ Address _____ City _____ State _____ Zip _____
Phone _____ Contact Person _____ Email address _____
Percent of material landfilled _____

Total material received _____ tons
Quantity of material landfilled _____ tons
Tons Sorted _____ Tons sold _____

Additional Information

APPENDIX D: Northwest Arkansas Front Pages, 2030

Convening regional stakeholders was an important part of this project. The stakeholder meeting provided the research team an opportunity to discuss progress and gave attendees an opportunity to share about their current programs and challenges related to recycling. These meetings also provided a forum for attendees to think big about what the future of recycling in the region could be. At the February 2020 stakeholder meeting, the visioning exercise was to imagine what would be on the front page of regional newspapers in the year 2030. Participants were asked to write a headline, a sidebar with big news stories of the day, and provide a picture and a quote to go along with the day's news. The final results, included in this appendix, show a region that isn't afraid to dream big and get international recognition for its efforts to create a circular region.



APPENDIX D: Northwest Arkansas Front Pages, 2030 Continued

SIDE STORY

DATA TRANSPARENCY
i REPORTING

FUNCTIONING/
PLENTIFUL END
MARKETS FOR
MATERIALS

RECYCLING IS A
NORM, IT'S
WEIRD NOT TO

MATERIALS FLOW
THROUGH THE
SUPER-REGION IN
SCALE PLAY FOR
END MARKETS.

GOOGLE GLASS
RECYCLING INFO

H₂ POWERED AUTONOMOUS
VEHICLE AGGREGATE
OUR MATERIALS

COVER STORY

NWA MATERIAL
MANAGEMENT IS
FULLY INTEGRATED.

BUILDS ON SEEDLINGS
PLANTED IN 2020.

NWA'S NATIONAL MODEL FOR
A REGION HAS BEEN
WORKING FOR 25 YEARS.

FEATURE ARTICLES

LEON HALL STORY-

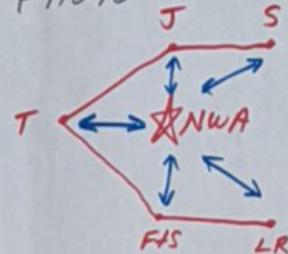
GRUMPY OLD MAN IS
THE LAST HOLD-OUT
TO RECYCLING. REFUSES
TO USE HIS
RECYCLING BIN.

QUOTES

"NO ONE IS IMPRESSED
BY GREAT RECYCLING"
ANY MORE

"ELON MUSK'S PURCHASE
OF FOOD LOOPS WAS
A STEAL 'AT \$1B"

PHOTO



SUPER-REGIONAL
MATERIAL TRADING
PARTNERS

APPENDIX E: Recycling Technologies

The technologies presented here represent alternative paths to the primary recommendation provided in this report. The technology itself may be new, like chemical recycling, or may consider different stakeholders, like a trade group, that could partner on circular projects. These organizations have not been contacted directly about working with Northwest Arkansas on a project, so if these are attractive to the regional stakeholders, the program manager would need to reach out and establish a relationship with them.

Revolution Systems, a company in Colorado, builds mini-MRFs that are capable of cost-effective handling of recycling in cities or regions that cannot support the full-scale facilities. There is also an option where the technology can be used to perform a waste sort, rather than relying on manual sorts that are common now. This would provide any municipality a view into what is and is not getting captured by their current recycling system. It also could enable a project where multiple facilities or flows were assessed in the region to paint a complete picture.

Secondary sorting: In 2018, the Plastics Industry Association coordinated a project to determine if there was value in using a second sorting system to capture additional material from recycling streams. The key piece of equipment was a portable secondary materials recovery facility that could further sort residual materials from existing MRFs, sort mixed plastic streams, and recover low-volume materials like cartons to be recycled separately. Since it is portable, county or city could have an opportunity to use the secondary sorting MRF for their plastics stream to create higher-value bales of materials. This project was focused on how this technology could scale up to handling material inputs from multiple full-scale MRFs in a larger region than the smaller scale that would be appropriate for Northwest Arkansas. The full project report can be found at the Plastic Industry Association website.

Trashpresso makes small-scale processing equipment that can transform any type of plastic into tiles for building applications. The fact that it can handle any plastic is important because this means it could take plastics that are already available, like polypropylene, or materials not collected or difficult to recycle like food-handling gloves, as feedstock rather than exclusively requiring PET or HDPE streams. This technology would be useful in the same types of applications as are discussed for.

Trade group collaboration: Trade groups such as the Carton Council are looking at how to better divert packaging into material-appropriate recovery technology. A second one is the Vinyl Sustainability Council (VSC), which is looking at how to divert and manage PVC waste from construction and demolition material recycling facilities. If the region decides to site a construction and demolition material recycling facility, connecting with VSC in the planning stages could open an opportunity to test how PVC can be captured and create a valuable recycling stream. While work like this may provide opportunities for the region to serve as a testbed for such experiments, this is a longer-term project and would require finding the right project, as mentioned above with respect to PVC. The commitment from the region may involve both changes in sorting processes to isolate the material and investment in recovery technologies to process it.

Chemical recycling may provide another option for regional development that also works with a variety of recycled material and turns them into new chemical that can be used in new plastics manufacturing, as a substitute for petroleum based ingredients, or in pharmaceutical manufacturing. The Closed Loop Foundation published a report in 2019 that considered the opportunities and challenges of this emerging technology. Right now, these systems require working in batches, which requires less material at any given time compared to a continuous process. This is where partnering with a local manufacturer could be very powerful. Supplying bespoke feedstocks from hard-to-recycle materials sourced locally would be a very circular business model to establish.

Because the companies in this space are predominantly start-up, moving in this space would require collaboration with someone like Closed Loop Foundation to identify high-potential partners and provide the necessary introductions and potentially funding for a pilot project. Companies with pilot project-level technology:

Agilyx (Tigard, OR): polystyrene and expanded polystyrene (EPS) process that produces an alternative to petroleum-based oils or creates styrene, the chemical precursor to polystyrene plastic.

BioCellation (Menlo Park, CA): process accepts polyethylene materials, most notably plastic film, and produces polyurethane, a rubber-like plastic commonly found in footwear.

Loop Industries (Quebec, Canada): uses PET plastic in forms other than bottles (e.g., strawberry containers) and polyethylene textiles. The chemicals produced can be used as inputs for manufacturing new PET.

Recycling Technologies (Swindon, United Kingdom): can use plastic film, flexible packaging, or even contaminated food packaging and produces Plaxx®, a “liquid hydrocarbon feedstock” that is an alternative to petroleum-based oils and chemicals traditionally used to make plastics.

APPENDIX E: Circular Region Project Flow

Solid waste management is a hyperlocal process that depends on the existing system, stakeholders, motivations, laws, and politics in a city or a region. The work required to create regional circular systems will be heavily dependent on the local environment. There is, however, a general process flow used in this project that could guide efforts in other regions. The goal is to thoroughly understand the local context for recycling and material recovery, involve key stakeholders involved to guide the vision and project choices, what resources and infrastructure exist, and what gaps need to be filled in data, infrastructure or other aspect of the recycling system. Understanding the context then allows for recommendations to be developed that address the needs of the stakeholders in such a way that a more circular system can be implemented.

Key components to consider when developing a Circular Region:

1. Identify and activate a regional economic decision-making body.
2. Identify end-users of information
3. Identify existing workstreams related to regional circularity
4. Identify and understand state and local laws and regulations related to recycling and material recovery
5. Identify key stakeholders that champion recycling and sustainability in the region
6. Build a team that understands circularity, stakeholders, data collection, and data organization
7. Identify partners and leaders working on similar issues
8. Dig – find data, review existing programs, meet with and interview stakeholders
9. Convene – build community of practice, build shared vision
10. Map – Map out existing resources and understand relationships
11. Maintain close connection with the identified economic decision-making body
12. Create storyline of what is happening in the region, including visible data flows, key players, locations, and existing infrastructure
13. Create recommendations for how to best coordinate data and materials within the region, using existing players and recommending ways to fill gaps.
14. Develop ownership by local stakeholders to carry forward the vision and the actions.



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