



COLORADO NEEDS ASSESSMENT

EXECUTIVE SUMMARY

JANUARY 30, 2024



THANK YOU

CAA, HDR, and Eunomia thank the Advisory Board, municipalities, waste haulers and processors, nonprofit organizations, and Colorado stakeholders who have provided valuable insight into the Needs Assessment. The Needs Assessment is stronger due to your input.

The Needs Assessment was undertaken according to Colorado's Producer Responsibility Program for Statewide Recycling. Any views expressed in this document do not necessarily reflect the views or positions of Circular Action Alliance's members.



COLORADO NEEDS ASSESSMENT

On June 3, 2022, Colorado's Governor signed House Bill 22-1355, an ambitious extended producer responsibility (EPR) law that requires producers of packaging and paper products to fund and implement a program for statewide recycling. Under this law, the Colorado Department of Public Health and Environment (CDPHE) approved Circular Action Alliance (CAA) on May 1, 2023, as the Producer Responsibility Organization (PRO) responsible for administering and implementing an EPR program.

As the approved PRO, ultimately, CAA will work with companies that are defined as producers to collect packaging data for covered materials, fund recycling activities, and meet recycling performance targets.

CAA was required to select an independent third party to assess the recycling services currently provided in the State and evaluate recycling needs. Following a competitive procurement process, CAA selected HDR and Eunomia in August 2023 to carry out the Needs Assessment. In preparing the Needs Assessment, CAA has consulted with the Advisory Board, which is responsible for reviewing and providing technical feedback on the Needs Assessment and the PRO's proposed program plan.

PURPOSE OF NEEDS ASSESSMENT

The Needs Assessment aims to evaluate existing services and infrastructure in Colorado that manage single-use packaging and paper products at the end of their product life cycle. The CAA, HDR, and Eunomia team (referred to throughout as the "project team") analyzed the process from when packaging is collected curbside or at a drop-off collection to its management at transfer stations, material recovery facilities (MRFs) or compost sites, and its journey to in-state and out-of-state end markets.

The Needs Assessment also identified gaps in existing services and evaluated opportunities to improve systems to drive towards meeting and exceeding Colorado's statewide waste diversion rate. The Needs Assessment provides the analysis and data required to develop recycling system scenarios - one of which will be recommended to the Joint Budget Committee and, if approved, it will then be implemented by the PRO.

PROJECT TEAM



**Circular
Action
Alliance™**

Circular Action Alliance (CAA) is a 501(c)(3) nonprofit Producer Responsibility Organization (PRO) dedicated to implementing effective Extended Producer Responsibility (EPR) laws for paper and packaging across the United States and is approved as the single PRO in California and Colorado. The organization is led by 20 companies from the food, beverage, consumer goods, and retail industries.



HDR was founded in 1917 and specializes in engineering, architecture, environmental, and construction services. With 65+ years of experience providing engineering, planning, and design solutions for public and private clients in Colorado, HDR had the depth of local staff and expertise necessary to conduct the Colorado Needs Assessment.



Eunomia has over 21 years of global experience designing EPR policy and modeling EPR and recycling systems for a broad range of materials and six years operating in North America working on EPR-related projects for Washington, and the provinces of British Columbia, Alberta, Ontario, Yukon, and Quebec.

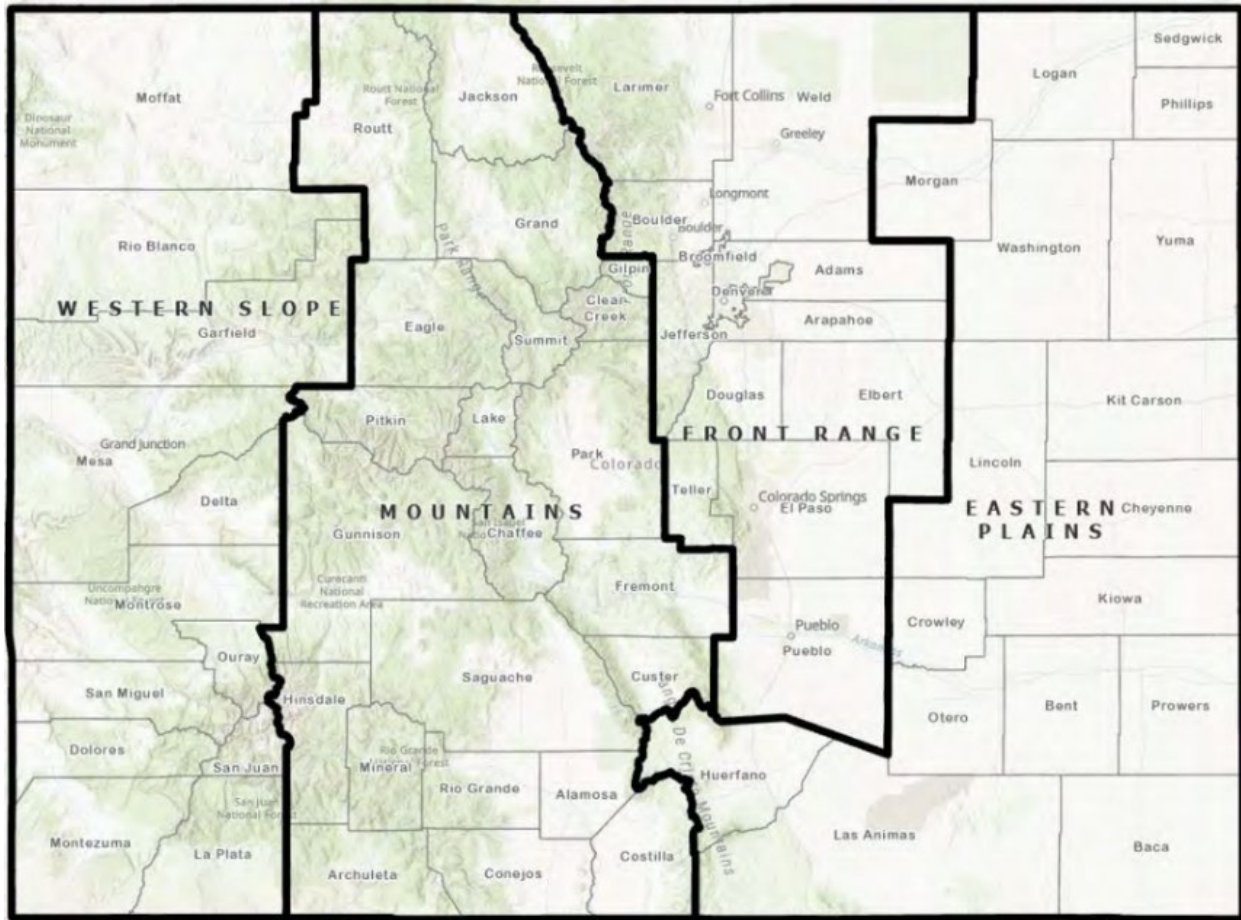
APPROACH

The project team understands that Colorado has knowledgeable, passionate practitioners in the waste, recycling, and composting industries and has assembled an internal group of experts to support and inform the Needs Assessment. The team also met regularly with the Statewide Recycling Advisory Board (Advisory Board), on a schedule set by the Advisory Board, to provide regular updates on the project and seek feedback.

The project team evaluated the services provided through a statewide and regional lens. Colorado's 2016 Integrated Solid Waste and Materials Management Plan identified four Regions, shown in **Figure 1**, based on socioeconomic and geographic factors: the Western Slope, the Mountains, the Front Range, and the Eastern Plains. This lens was used to evaluate variations in recycling services in each Region.



Figure 1: Map of Colorado's Four Regions



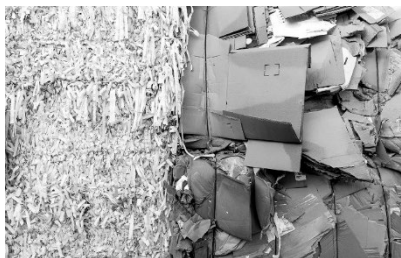
The project team also evaluated data from municipalities, rural areas, and census-designated places (CDPs). Municipalities and CDPs have boundaries set by the US Census but only represent a small share of the area in the State. Outside of municipalities and CDPs, there are rural and remote areas. About 74% of the population live in municipalities, 12% live in CDPs, and 13% live in rural and remote areas. The breakdown between Colorado’s four Regions is shown in **Table 1**.

Table 1: Regional Population Distribution

	Front Range	Mountains	Western Slope	Eastern Plains	Total
Percent of Total Population	84%	6%	7%	3%	100%
Number of Municipalities	92	71	42	67	272
Population Within Municipalities	78%	46%	59%	67%	74%
Number of CDPs	105	50	22	33	210
Population Within CDPs	13%	14%	12%	2%	12%
Population Within Rural Areas	9%	40%	29%	31%	13%

To understand Colorado's existing system and identify gaps, the project team conducted outreach and data-gathering activities, which produced more than 100,000 data points on Colorado's residential recycling and composting services. These include the following:

- Over 75 tours and interviews with Colorado service providers, end markets, and other key stakeholders;
- Receipt of 130 municipal surveys;
- Multiple webinars for various stakeholder groups within Colorado to seek feedback;
- Extensive desktop research (e.g., visiting and evaluating information from the websites for all 272 municipalities and 64 counties);
- Participated in 13 CDPHE Advisory Board meetings since the contract was awarded to provide updates and seek feedback;
- More than 200 comments received and responded to;
- On-going discussions with Colorado based stakeholders throughout the process to qualify inputs;
- Developed a webpage with frequently asked questions on Recycle Colorado's website and
- Distributed an interest form via multiple channels where interested parties could sign up for updates.



The data gathering and analysis results were used to develop a Minimum Recyclables List and an Additional Materials List. The Minimum Recyclables List is a list of materials that must be collected in a manner that is as convenient as the collection of solid waste, and the Additional Materials List is a list of materials that may be collected in different geographic areas through curbside services, drop-off centers or other means.

The results also provided data inputs to develop three Scenarios, as required by law. The PRO is required to propose three different Scenarios for how recycling systems could be improved to increase Colorado's recycling rate and the anticipated costs associated with each. To develop these Scenarios, the project team had to understand and outline the cost and performance of the current system and consider the capital and operating cost, investment profile, and performance of three potential future systems over time. The Scenarios were built into a recycling system options model that allowed CAA to assess the implications of different service delivery and investment options.

PROJECT OUTCOMES

The project team developed the following summary of each component (Element) of the Needs Assessment, a Minimum Recyclables List, and three Scenarios for consideration. This Needs Assessment will be used to select an approach for the statewide recycling program and will inform CAA's program plan proposal.

Table 2 below shows the estimated performance of recycling in Colorado for the baseline year (2022) and for 2030 and 2035 for the low, medium, and high scenarios.

- At the baseline year (2022), it is estimated that Colorado had a recycling rate between 22% - 28% for covered packaging from covered entities.
- In the low Scenario, Colorado could achieve a recycling rate between 32%-38%in 2030 and 47%-53% in 2035.
- In the medium Scenario, Colorado could achieve a recycling rate between 34%-40% in 2030 and 51%-57% in 2035.
- In the high Scenario, Colorado could achieve a recycling rate between 39%-45% in 2030 and 54% - 60% in 2035.

Note there may be other factors that impact the ability of CAA to implement on a schedule that could affect performance. These include, but are not limited to:

- When CDPHE provides regulatory approval of the program plan; and
- The time necessary to implement collection and processing improvements (e.g., tender and receive new collection vehicles to service new residences; establish new drop-off sites; contract of servicing for new locations that may also need new carts or bins; establish agreements with various service providers and collection sites).

The scenarios are modeled based on achieving certain milestones, not on potential operational considerations.

Table 2: Estimated Recycling Outcomes per Scenario

		2022 (Baseline)	2030	2035
Low	Recycling Rate (%)	22% - 28%	32% - 38%	47% - 53%
	Recycling Tonnage (k tons)	~310	~450	~660
Medium	Recycling Rate (%)	22% - 28%	34% - 40%	51% - 57%
	Recycling Tonnage (k tons)	~310	~480	~710
High	Recycling Rate (%)	22% - 28%	39% - 45%	54% - 60%
	Recycling Tonnage (k tons)	~310	~550	~750

Table 3 outlines the estimated costs associated with each Scenario.

- At baseline (2022), the total system cost is estimated to be between \$80 million and \$140 million.
- In 2030, the estimated system cost could be between \$130 and \$200 million in the low Scenario, \$130 and \$ 210 million in the medium Scenario, and \$150 and \$240 million in the high Scenario.
- In 2035, the estimated system cost could be between \$160 and \$250 million in the low Scenario, \$160 and \$260 million in the medium Scenario, and \$180 and \$290 million in the high Scenario.

Table 3: Estimated Costs per Scenario (\$ in millions)

		Baseline (2022) Lower	Baseline (2022) Upper	2030 Lower	2030 Upper	2035 Lower	2035 Upper
Low	Total Annualized Cost (\$ millions)	80	140	130	200	160	250
	Cost Per Household (\$)	60	90	60	90	70	110
	Cost Per Household (\$)	60	90	60	90	70	110
Medium	Total Annualized Cost (\$ millions)	80	140	130	210	160	260
	Cost Per Household (\$)	60	90	60	90	70	120
	Cost Per Ton Recycled (\$)	260	430	260	430	230	370
High	Total Annualized Cost (\$ millions)	80	140	150	240	180	290
	Cost Per Household (\$)	60	90	70	110	80	130
	Cost Per Ton Recycled (\$)	260	430	270	430	240	390

The system factors that contribute the most to increased recycling rates are:

- Providing residential households with recycling services equivalent to trash,
- Performance benefits due to education programming,
- Advanced sorting at MRFs, and
- Collecting materials on the additional materials list.

The system factors that contribute the most to cost increases are:

- Providing residential households with recycling service equivalent to trash,
- Investment in education programming, and
- MRF technology investment.

ELEMENT 1: RESIDENTIAL

PURPOSE

The purpose of Element 1 was to understand the recycling and waste services provided in Colorado based on property type, geographic area, and other factors, such as frequency of collection, method of collection, and payment mechanisms used in each of the four Regions of Colorado. In addition, the project team evaluated the type of recyclable materials collected in each Region through curbside and drop-off collection.

APPROACH

The project team used primary and secondary research to evaluate how waste and recycling services are provided to residential-covered entities. The approach included reviewing existing studies on waste and recycling in Colorado, a comprehensive survey of municipalities and counties in the State, desktop research and review of municipality websites and annual reports, and interviews with municipality staff. The project team promoted participation in the survey by hosting webinars to explain the survey to respondents, developing a webpage with frequently asked questions, hosting drop-in sessions with the project team, sending weekly reminders, and calling municipalities to encourage them to participate. One hundred twenty-one municipalities completed the survey, and respondents represented communities covering 60% of the total population.

FINDINGS

- Single-stream recycling is the most common curbside collection method, followed by dual-stream, with glass separated from other materials. Approximately two-thirds of the population live in municipalities that provide single-stream recycling. This data is provided in **Table 6**.
- The most common frequency for recycling collection was every other week. The second most common collection frequency was weekly.
- Larger multi-family structures are typically classified as commercial waste in city ordinances and are not commonly included in residential recycling programs.
- More than 95% of households in municipalities and approximately 90% of households overall have access to curbside garbage collection.
- Based on the convenience standard of the Producer Responsibility Program for Recycling, all households with curbside garbage collection are anticipated to receive curbside recycling collection following program implementation. Based on HB22-1355, approximately 500,000 additional households will receive curbside recycling in municipalities, and an additional 100,000 - 200,000 households will receive service in other areas (census-designated places and Rural Areas).

Table 4 represents the households and populations located within the 272 municipalities and their access to curbside trash and recycling. Approximately 74% of the population in Colorado lives within municipalities. **Table 5** breaks the data down further by dwelling units and region.

Table 4: Active Service for Waste and Recycling Services in Colorado

	Total		
	Single-family	Multi-family	Total
Number of Households Within Municipalities	1,119,375	522,927	1,642,302
Percent of Households With Curbside Trash	96%	98%	97%
Percent of Households With Curbside Recycling	68%	60%	66%

Table 5: Active Service for Waste and Recycling Services By Region

	Front Range		Mountains		Western Slope		Eastern Plains	
	Single-family	Multi-family	Single-family	Multi-family	Single-family	Multi-family	Single-family	Multi-family
Number of Households Within Municipalities	989,406	477,518	39,745	19,743	58,220	18,984	31,004	6,683
Percent of Households With Curbside Trash	98%	99%	87%	95%	94%	98%	39%	36%
Percent of Households With Curbside Recycling	71%	62%	50%	68%	69%	28%	18%	18%

Table 6: Recycling Collection Method by Region (Percent of Population)

	Front Range	Mountains	Western Slope	Eastern Slope
Single Stream	75%	62%	36%	5%
Dual Stream - Fiber and Containers	0%	2%	0%	0%
Dual Stream - Glass and all other material	0%	9%	43%	8%
Multi-Stream	0.2%	4%	1%	0%
Curbside service but unknown how it's collected	23%	5%	12%	11%
No curbside service	2%	19%	8%	76%

SCENARIO CONSIDERATIONS

1. The use of residential factors in the modeling, such as the method of collection (single stream or dual stream), frequency of collection (weekly or bi-weekly), and the types of materials that are collected in different recycling programs allowed the project team to analyze the differences in performance between different systems in Colorado.

2. Colorado's EPR legislation requires that recycling collection should be as convenient as trash collection in a jurisdiction, meaning that if a household has curbside trash collection, it should also have curbside recycling. Based on this standard, approximately 31% of households in the municipalities evaluated that do not have curbside recycling are expected to receive curbside recycling services following program implementation.
3. Additional recycling services would most significantly impact the Eastern Plains Region. Currently, only 18% of households receive curbside recycling services. Following the implementation of the modeled program, curbside recycling access could increase to an estimated 38% of households in municipalities in the Eastern Plains.

ELEMENT 2: SERVICE COSTS

PURPOSE

Element 2 memo outlines service costs for packaging and paper products collection service costs, including contractual terms, service option levels, frequency, and materials collected based on information provided by recycling service providers (haulers) servicing each Colorado Region. From large and nationwide to small and local, haulers are directly involved with collecting recycling from generators, transporting the materials to MRFs, and transporting recycled goods to end markets. Therefore, haulers have direct and in-depth knowledge of recycling infrastructure and can provide insight into the current State of recycling across each Region in Colorado.

APPROACH

The project team leveraged several engagement methods to learn from and engage with haulers, including a webinar targeted at the hauling community, an online survey, and individual emails and phone calls for detailed information-gathering interviews. Hauler engagement and information sharing are key to the project, and the team strived for authentic and open communication. The project team conducted an initial desktop review to identify which haulers are servicing the four Colorado Regions. The team then contacted fifty-one (51) haulers and completed fifteen (15) phone interviews, including three (3) large/national haulers, two (2) medium-sized regional haulers, and ten (10) small/local haulers.

FINDINGS

- Most of Colorado is serviced by subscription-based, cart-based, open-market hauling.
- Due to variable MRF tipping costs and volatility in recycling markets, financial planning is difficult for haulers, particularly in the long-term range (five or more years).
- Haulers who bring material to MRFs noted a recent rise in MRF tipping costs as a challenge, up by 50% in the last five years.
- Haulers reported that the State of Colorado has strict laws regarding truck weight-to-axle ratios on Mountain roads, which applies to recyclable commodities. These ratios reduce the amount of material transported per truck in these Regions.

- Mountain and Western Slope roads can be steep and rugged, increasing fuel usage and truck maintenance costs.
- High wildlife activity requires special containers (carts and dumpsters) and more frequent services. Animal-resistant containers add significant costs for rural haulers as opposed to more urban areas.
- Most hauling trucks in each of the four Regions use diesel fuel, with some compressed natural gas (CNG) and electric vehicle trucks (EVs) in the Front Range.
- Larger haulers typically use automated side-load trucks, and smaller haulers use rear-load trucks that require multiple employees for collection.
- Commodities are hauled directly to end markets via dump trucks, tractor trailers, and sometimes via rail from larger MRFs.
- In collaboration between the efforts of Element 1 and 2, the cost of services ranges significantly from a low of \$5 per Household per month to more than \$90 per Household per month when bundled with waste collected. Overall costs were found to be higher in the Mountains and lower in other regions.

SCENARIO CONSIDERATIONS

1. Data captured from municipalities and haulers were used in cost regression analysis to benchmark the modeled costs of curbside collection across jurisdictions.
2. The frequency of collection impacts the quantities of materials collected and the cost of collection. Research in Colorado found that when collection is provided more frequently, more material is collected overall.
3. Future scenarios consider the impact of more efficient collection routes on the total cost of the system. These efficiencies can potentially lead to fewer trucks or less fuel needed in the system, increasing its economic efficiency.
4. The enhancement of collection services was modeled through the rollout of trash equivalency and improvements to drop-off collection. These improvements result in capital and operational costs informed by this element's results.

ELEMENT 3: DEMOGRAPHICS

PURPOSE

Element 3 outlined the demographic data with an environmental justice focus to be considered part of the Colorado Needs Assessment. The data collected builds on the four Regions defined by the State of Colorado's 2016 Integrated Solid Waste Materials Management Plan (2016 ISWMMP). The environmental justice analysis dove deeper into the characteristics of the four Regions to encourage transparency and informed decisions surrounding policy, infrastructure, and access to services. These demographic factors are to be considered in developing reimbursement rates for service providers per subsection (4)(j) of section 25-17-705 of the Producer Responsibility Program for Statewide Recycling Act.

APPROACH

The project team began by conducting a desktop review of available demographic data. The evaluation included a desktop review of Colorado's solid waste planning regions and equity goals to assess the work that the State has completed historically. The project team then analyzed data from the U.S. Census Bureau, the EPA's Environmental Justice Screening and Mapping Tool, Colorado EnviroScreen, the Association of People Supporting Employment First, the County Health Rankings & Roadmaps program, and community analytics data on service access. The project team met with the Colorado CDPHE staff to vet the data findings. Additionally, the HDR project team worked with Eco-Cycle to conduct two stakeholder workshops with diverse recycling advocates and environmental organizations from across Colorado. The goals of these workshops were to (1) gather information regarding local package recycling programs accessible to the organizations' constituents/members and/or that the organizations directly implement, (2) seek input on strategies to enhance the reach of existing or upcoming services within their communities and among underserved demographics, and (3) to record how these organizations' see the implementation of Producer Responsibility for Recycling Packaging leveraging the successes in their areas and improving recycling in the ir areas and other similar parts of the state.

FINDINGS

- About 16% of Colorado's population and 77% of the landmass is considered Rural. However, 84% of Colorado's population and almost 80% of businesses exist in the Front Range.
- Spanish is the second most spoken language (11%) across all regions. The third and fourth most spoken languages are Chinese (including Cantonese and Mandarin) and German, which are spoken by less than 1% of the population each.
- Seasonal population fluctuations, including visitors and labor, peak in Summer (June-August) and Winter (December through March) for many Mountain communities.
- Significant urban and rural trends exist: The Front Range has the highest income per capita and is the "healthiest " Region. The Western Slope and Eastern Plains Regions exhibit higher poverty levels and have poorer health. Income and unemployment data is summarized in **Table 7**.
- The Front Range has the highest percentage of multi-family buildings, making up 30% of the housing. The majority of single-family homes are found on the Western Slope and Eastern Plains. Housing unit data is provided in **Table 8**.
- Over 70% of residents in the State of Colorado use a computer, and over 80% use a cellphone. Facebook is the most utilized social media platform, with over 60% of Colorado residents maintaining accounts.
- The highest concentration of businesses, nearly 70%, are located in the Front Range.
- The Front Range has the highest number of households and highest per capita income. The Eastern Plains has the highest low-income population, followed by the Western Slope and the Mountains. The unemployment rate is similar across the four Regions at approximately 5%.

- 11.6% of the population in Colorado has a disability. The Eastern Plains Region contains the highest percentage per capita of disabled people in the State at 17%.
- Recycling education should be tailored to the local geography, demographics, and most common recycling contaminants. Additional care should be taken to develop messaging and tactics to reach Environmental Justice (EJ) communities in coordination with community leaders and the Colorado Department of Public Health and Environment’s (CDPHE) Environmental Justice Action Task Force.

Table 7: Income and Unemployment Summary

Region	Number of Households	Income per Capita	Low-Income Population	Unemployment Rate
Front Range	1,876,500	\$44,360	22%	5%
Eastern Plains	59,140	\$26,300	39%	5%
Western Slope	160,270	\$35,600	29%	5%
Mountains	132,000	\$39,128	27%	4%

Table 8: Housing Unit Breakdown

Region	Total Households	Percent Single Family Units	Percent 2-9 units	Percent 10+ units	Percent Mobile Home and all other types of units
Front Range	1,790,240	69%	9%	19%	2%
Eastern Plains	153,588	78%	7%	5%	9%
Western Slope	183,677	71%	10%	7%	11%
Mountains	100,427	67%	10%	17%	6%

SCENARIO CONSIDERATIONS

1. Scenario considerations focused on the impact of access and education on recycling performance. Specifically, the impact of providing equivalent opportunity and appropriate communication and dialogue pathways on the recycling collection services in each of the four distinct regions within Colorado on system performance. The following controls were developed for the modeling:
2. The EPR legislation requires that recycling access should be equivalent to trash, meaning that if a household has curbside trash collection, it should also have curbside recycling. This control relates to how quickly this equivalency is met. When more households have access to recycling, the overall number of households participating is likely to increase, which impacts the total volume of material collected and the cost of collection.

3. The equivalency impact for each of the four regions was modeled to be achieved by 2030, with the largest increase in access recognized by the areas in the State with the lowest income per capita.

ELEMENT 4: CONTAMINATION

PURPOSE

Contamination is a major operational issue for material recovery facilities (MRFs), compost facilities, and material end markets. Contamination can include incorrectly disposed of materials in recycling or composting, incorrectly sorted materials, soiled recyclable containers, and over-compacted materials. The purpose of the contamination element of the Colorado Needs Assessment was to estimate existing contamination rates at MRFs and compost sites in Colorado, identify challenges associated with contamination, identify common contaminants, and evaluate methods to improve the quality of material received by end markets to improve the overall efficiency of Colorado's material processing systems.

APPROACH

Project team members conducted site visits at MRF specialty recycling and compost facilities and asked facility staff questions about incoming and outgoing feedstock, the trends they have observed in contamination, and the impact of contamination on their operations and operational costs. The project team additionally reviewed past reports and studies to assess available information on contamination. Finally, the team conducted a desktop study to identify best management practices for limiting and handling contamination, thereby improving the end product's quality and quantity to align with the objectives of the Producer Responsibility Program for Statewide Recycling Act.

FINDINGS

- MRFs surveyed for the Needs Assessment reported between a 10% and 20% contamination rate. Estimated contamination rates were based on total contamination, not necessarily contamination associated with packaging materials.
- Compost facilities surveyed for the Needs Assessment reported a contamination rate below 10% by weight with most reporting <3% by weight. Estimated contamination rates included total contamination, not necessarily contamination associated with compostable plastics or packaging materials.
- The survey identified that confusion about which materials are recyclable or compostable, wishful recycling, and varying levels of commitment to recycling can impact contamination rates.
- MRF facilities reported that contamination causes equipment downtime, contaminated commodities, lost revenue, worker injuries, increased residue costs, reduced throughput, reduced efficiency, and equipment wear and tear. This data is displayed in **Figure 2**.

- Common contaminants at MRF facilities include non-recyclable plastics, ceramics, fabric, and medical waste.
- Plastics (rigid and flexible packaging) and glass were the most common contaminant reported by compost facilities.
- Recently, some compost facilities in Colorado have responded to contamination in incoming feedstocks by rejecting compostable service ware and other single-use materials. Data on contamination levels from residential and commercial streams at compost facilities is provided in **Figure 3**.

Figure 2: Impacts of Contamination on MRFs

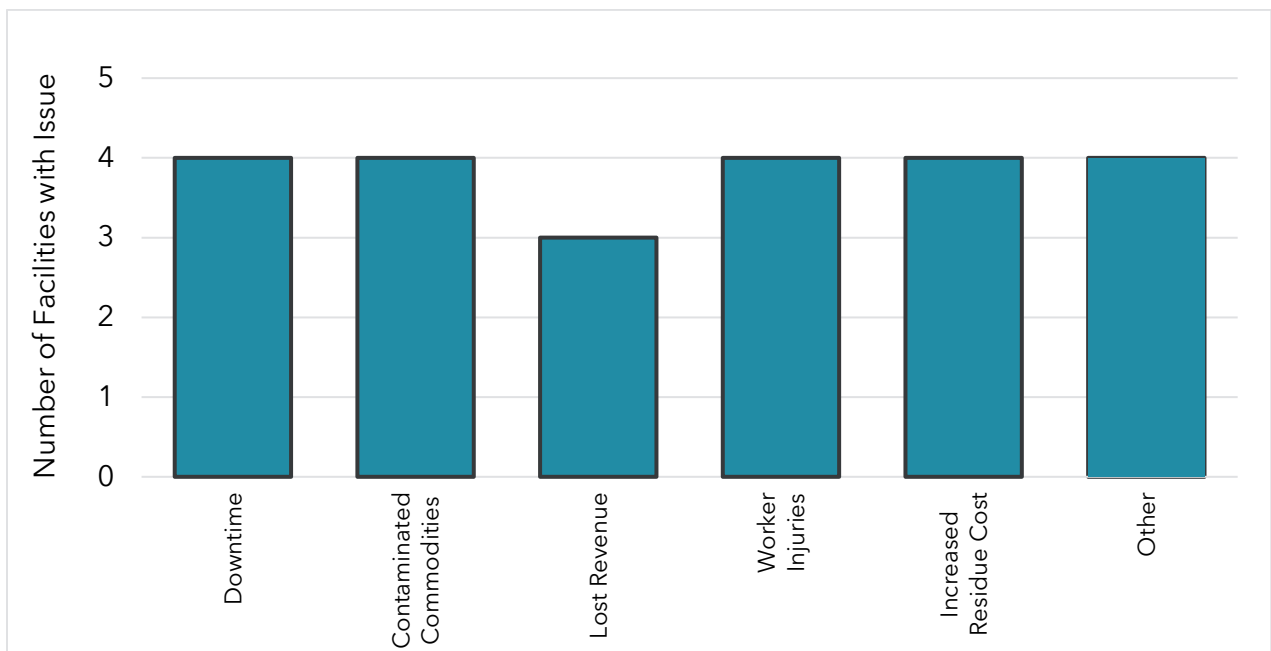
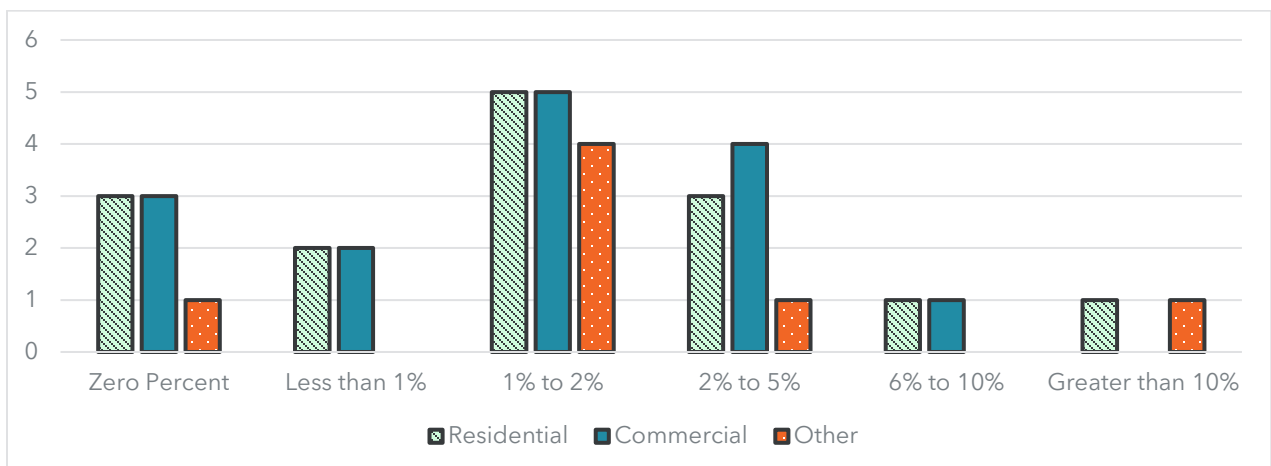


Figure 3: Contamination Rate by Feedstock Source at Compost Sites (percent by weight)



SCENARIO CONSIDERATIONS

1. This analysis found that contamination rates varied between regions within Colorado. Consequently, the contamination model was adjusted according to region-specific contamination rates that were influenced by collection and processing type. The average contamination rates were 15% at single-stream facilities and 7.5% for dual-stream or source separation. Contamination rates are modeled to stay consistent between Scenarios.

ELEMENT 5: NON-RESIDENTIAL

PURPOSE

The objective of the Element 5 memo was to understand service availability, gaps, and recycling services costs associated with providing recycling services to non-residential entities covered under the Colorado Needs Assessment. Non-residential covered entities, which are entities in the legislation that require collection, include hotels and other accommodations; event spaces and stadiums; food and drink establishments; small businesses; schools; outdoor and indoor public places; and government buildings. The project team evaluated how recycling services are currently provided to non-residential entities, the performance of the recycling programs, and their estimated costs.

APPROACH

The project team prepared and distributed a municipal survey that was sent to 272 municipalities in Colorado. While the survey included questions on non-residential entities, respondents provided limited information on the topic. The project team conducted desktop research to evaluate non-residential recycling collection, including using North American Industry Classification System (NAICS) codes to evaluate information and regional locations associated with the specified types of non-residential entities. The project team additionally conducted interviews with key stakeholders who provided more detailed information. Twenty-seven (27) total interviews were conducted with municipality officials, school district officials, nonprofits, an airport official, a hotel official, resort officials, an event venue manager, restaurant owners and managers, small business owners and employees, and a green business organization.

FINDINGS

- At hotel accommodations and ski resorts, recyclable materials ranged from 20% to 50% of the total waste generated. Resort accommodations often have ambitious sustainability goals.
- Events and stadiums frequently have recycling infrastructure and signage to help attendees properly sort materials. However, some technically recyclable materials get thrown out as garbage because they are too contaminated with food, as there is no infrastructure for rinsing containers.
- Restaurants typically collect materials such as cardboard and empty drink containers. They reported that, on average, approximately 35% of the total waste collected is recyclable.

- Compostable containers, particularly coffee cups, are often used in restaurants. However, these materials often end up in the garbage or as contaminated in compost bins, as many Colorado composters do not accept compostables.
- In 2023, there were 1,934 public schools with 883,264 students and 746 nonpublic schools with 56,821 students in Colorado. Waste in schools is mainly generated in cafeterias and classrooms. Cafeterias produce food waste and packaging, and classrooms generate paper, cardboard, and some food and plastic waste.
- Interviews with school districts representing about 26.5% of the student population indicate an average of 28 pounds of recycling per student annually, with diversion rates ranging from 17% to 42%.
- Reuse practices, particularly in cafeterias, involve reusable trays, cutlery, and food service ware. However, some schools face budgetary challenges and rely on disposable service ware.
- Streets, sidewalks, town squares, downtowns, plazas, and business development districts (BDD) are not often required to provide access to recycling services, even when there is a universal ordinance.

SCENARIO CONSIDERATIONS

1. Data collected from non-residential entities were used to estimate the volume of recyclables collected under future scenarios and the consequent cost of increasing recycling access across the State. Access to recycling to covered non-residential entities is modeled to start by 2028. This control relates to how quickly those covered entities will receive service. Modeling inputs included recycling service access to covered non-residential entities by 2030, which significantly impacts the total volume of material collected.

ELEMENT 6: PROCESSING CAPACITY

PURPOSE

Recycling facilities, commonly referred to as MRFs, are critical infrastructure for recycling. The capacity, type of feedstocks accepted, material processing capabilities, location, and proximity to end markets of Colorado's MRFs largely determine which materials are collected at curbside and depot or drop-off locations. The purpose of the Element 6 memo was to identify the MRFs currently operating in Colorado and their current permitted capacity, throughput, feedstocks accepted, contamination rates, equipment use, end-market products, costs, and potential expansion opportunities.

APPROACH

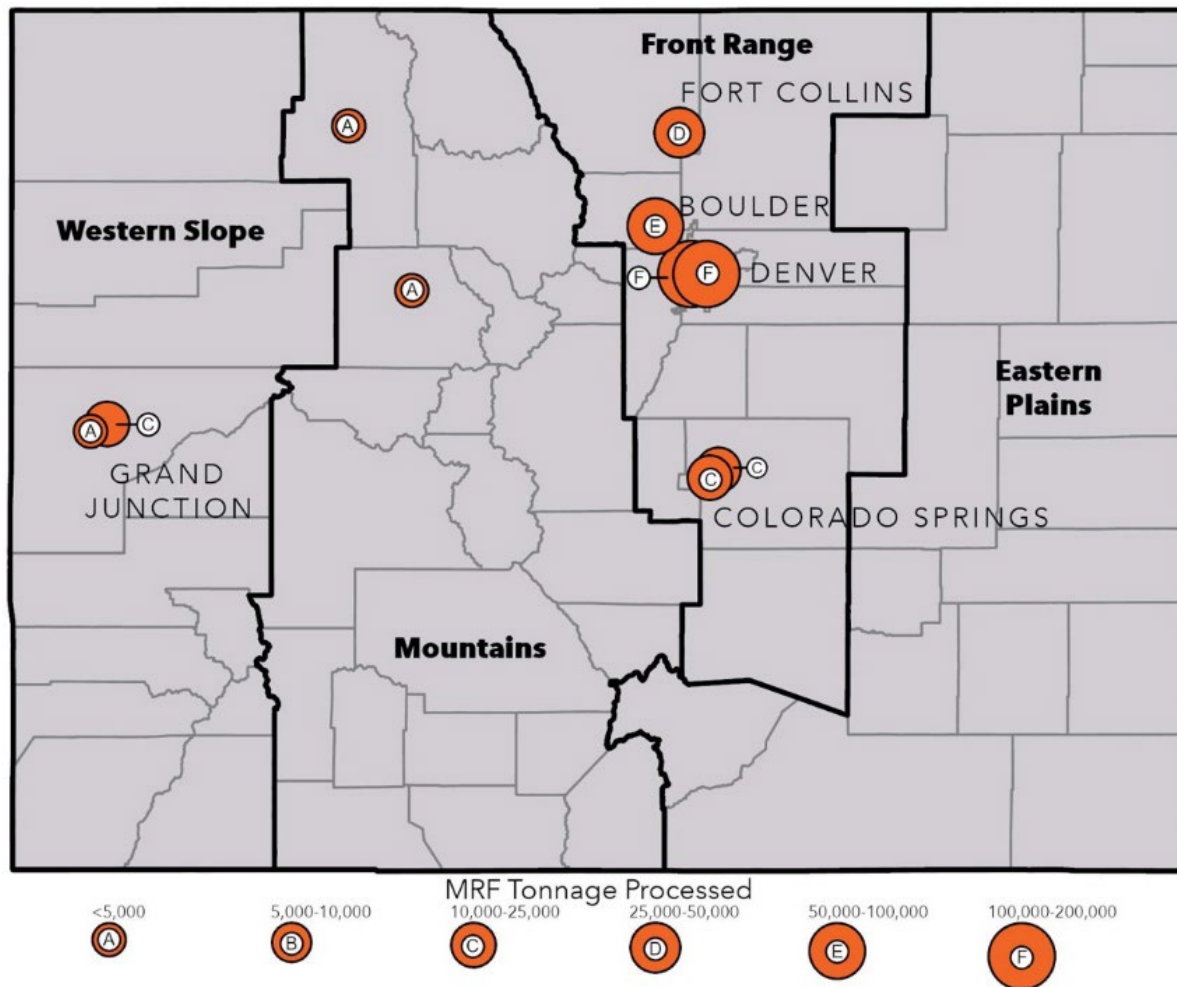
The project team reviewed CDPHE's list of registered recyclers to assess which facilities were subject to the Colorado Needs Assessment. The review was specifically focused on facilities with sorting and baling capabilities. The project team developed a survey to request information. The

survey included questions on operations, cost, processing capacity, and expansion potential, among other topics. The project team selected representative MRFs from the State and conducted site visits and phone interviews to gather information. The project team also identified potential expansion opportunities at each site based on interviews and a visual assessment of site operations.

FINDINGS

- The project team visited nine (9) MRFs in Colorado that sort single- or dual-stream feedstocks. The MRFs visited both public and privately owned facilities.
- The project team surveyed three (3) additional MRFs in Colorado as part of the Needs Assessment.
- A majority of the MRF processing capacity in Colorado is located in the Front Range Region, as seen in Figure 4.
- In general, MRF operators were reluctant to share data on feedstock, end market contracts, revenues, specific contamination rates, capital costs, operating costs, or site layout with the project team due to the highly competitive nature of the solid waste industry in Colorado. The MRFs report data to the Colorado Department of Public Health and Environment (CDPHE), but that data is considered confidential and was only available to the project team in aggregate via the CDPHE website.
- Several owners and operators noted that Colorado has an "open market" arrangement and that establishing flow control and protecting a service area is very difficult.
- MRFs visited for this Needs Assessment indicated they could take more feedstock if packaging recycling increases due to the Producer Responsibility program. This could be accomplished via facility expansion, additional shifts, and equipment improvements.
- Some MRFs may require upgrades to existing equipment, incorporation of new sorting technologies, and/or process lines to expand capacity and adjust to current incoming feedstocks.
- A majority of the end markets are located out of State. Information on end markets is further captured in Element 9.

Figure 4: MRF Tonnage Processed in Colorado



SCENARIO CONSIDERATIONS

1. This element identified upgrade needs during site visits and interviews to handle the increase in throughput of feedstocks and increase end-market product quality. The scenario modeling used this information to estimate additional costs from upgrades to existing equipment at varying levels.

ELEMENT 7: OPPORTUNITIES AND COSTS

PURPOSE

The Element 7 memo used findings from other Element research within the Needs Assessment, including municipality surveys, hauler interviews, and material recovery facility (MRF) and compost facility site visits and interviews to evaluate the opportunities and costs of enhancing Colorado's existing recycling and composting infrastructure. The equipment and facility additions for recyclable and compostable packaging are expected to increase tonnage throughput capacity

and material types for management. The estimated costs for these improvements inform the scenarios developed during the Needs Assessment.

APPROACH

The project team developed high-level estimates of the cost of expanding and/or improving existing MRF, compost facility, and transfer station infrastructure. The project team made the following assumptions to provide those costs.

- Each of the MRFs evaluated for the Needs Assessment has the ability to upgrade their facilities to process more material. Equipment recommendations also include technology improvements allowing MRFs to sort and process new materials.
- The compost facilities evaluated could accept compostable packaging in the future, with varying degrees of capital upgrades based on facility size.
- Transfer stations could be upgraded to manage more recyclables, compostables, or both. Cost ranges to upgrade a single transfer station were included in the analysis.

FINDINGS

- Based on survey data and industry knowledge, the project team estimates that the total cost of capital upgrades to the existing MRF infrastructure in Colorado is approximately \$85M-\$100M, also displayed in Table 9. These costs apply to the nine (9) MRFs that provided data for the Needs Assessment and represent the major recycling facilities in Colorado, yielding approximately 600,000 tons of estimated additional capacity for all-comingled recyclable materials (tonnage not specific to program covered materials). This would be accomplished via facility expansion, additional shifts, and equipment improvements.
- Three (3) new MRFs in the Front Range are planned to begin operation in 2025-2026. Two are currently permitted and expected to add 243,000 tons of processing capacity for all-comingled recyclable materials (tonnage not specific to program covered materials) in Colorado. This additional capacity is not included in the 600,000 tons estimated from upgrading existing facilities.
- Based on survey data and industry knowledge, the project team estimated that the total cost of capital upgrades to Colorado's existing compost facility infrastructure is approximately \$49M for these sites to process additional food waste and compostable packaging.
- Capital upgrades for existing transfer stations will range between \$1.3M and \$2.3M per transfer station to add more recyclable materials (up to 70 additional tons/day) with varied levels of infrastructure and equipment improvements.
- Capital upgrades for existing transfer stations to begin accepting compostable materials, specifically food waste with compostable packaging, will range between approximately \$1M-\$2.3M per transfer station, depending on a range of infrastructure and equipment improvements.

Table 9: MRF Opportunities and Costs

Region	Current Material Processed (TPY)	Projected Total Capacity (TPY)	Estimated Cost Range
Front Range	394,500	700,000	\$45M - \$50M
Mountains	2,000	95,000	\$6M - \$12M
Western Slope	15,300	190,000	\$35M - \$40M
Eastern Plains	N/A	N/A	N/A
TOTAL	411,800	1,000,000	\$85M - \$100M

SCENARIO CONSIDERATIONS

1. The MRF upgrade costs are used in the modeling to estimate capital investments necessary under future scenarios to process the increased volume of material. This control is related to the technology available in all MRFs (new and existing) to sort incoming material properly. This control impacts the expected yield of the inbound collected material, which impacts the recycling rate. This control also impacts the cost of the system due to capital and operational investments.
2. Facility and equipment upgrades were modeled at varying levels for Class III level composting facilities to manage covered compostable packaging utilizing the capital insights from this element.

ELEMENT 8: MINIMUM RECYCLABLES LIST

PURPOSE

The purpose of the Element 8 Memo was to propose a list of covered materials, based on data collected through the research on the other Elements, that can be included in a minimum recyclable list (MRL) and an additional materials list (AML). The minimum recyclables list is a list of materials that must be collected in a manner that is as convenient as the collection of solid waste. The additional materials list includes materials that may be collected in different geographic areas through curbside services, drop-off centers, or other means.

House Bill 22-1355 stipulates that the list is based on the availability of recycling services, recycling collection and processing infrastructure, and recycling end markets for covered materials. These lists are required to be re-evaluated each year, which provides an opportunity to adjust the list as part of the program plan as new technologies or end markets become available.

APPROACH

The project team developed a list of materials to be evaluated, which was shared with and refined by the Colorado Producer Responsibility Advisory Board. Each material on the updated list was evaluated on the following criteria:

- Availability of Recycling Services
- Recycling Collection and Processing Infrastructure
- Sortability of Materials at the MRFs
- Recycling End Markets
- Detriments

The project team developed metrics to denote high performance (no issues), medium performance (some issues), and low performance (greater level of issues). The draft assessment criteria were shared with the Colorado Producer Advisory Board, and the project team adjusted criteria metrics based on feedback from the Board. Each was assigned a score after the materials were evaluated against the criteria. Lower scores were more favorable. The scoring threshold for each list is included in **Table 10** below.

Table 10: Material Scoring

Material Total Score	Recyclable List
4-6	Minimum Recyclable List
7-10	Additional Materials List
11-16	Not collected

FINDINGS

The following lists are proposed for the minimum recyclables list (**Table 11**), additional materials list (**Table 12**).

Table 11: Proposed Minimum Recyclables List

Packaging Type	Collection Method
Paper for General Use (uncoated)	Curbside
"Low grade" Printing and Writing Paper (e.g., bulk mail, envelopes, notebooks, cards)	Curbside
Other Printed Paper (e.g., flyers, calendars, brochures)	Curbside
Newspaper, Newsprint	Curbside
Magazines and Other Coated Paper (e.g., catalogs)	Curbside
Bound Directories (e.g., telephone)	Curbside
Packaging Paper	Curbside

Packaging Type	Collection Method
Corrugated Cardboard (except wax-coated)	Curbside
Kraft Packaging (e.g., paper-padded mailers, grocery bags)	Curbside
Paperboard Boxes and Packaging	Curbside
Molded Pulp Packaging excluding Food Serveware (e.g., egg cartons, other protective packaging)	Curbside
Gable-Top	Curbside
Aseptic Cartons	Curbside
Non-Metalized Gift Wrap	Curbside
Clear PET Bottles, Jars, and Jugs (including Transparent Green or Blue)	Curbside
Clear PET Thermoform Containers (including Transparent Green or Blue)	Curbside
Natural HDPE Bottles, Jars, and Jugs	Curbside
Colored HDPE Bottles, Jars and Jugs	Curbside
Other Polyethylene (PE) Packaging (e.g., ice cream/butter containers) Except Pails and Lids and Squeezables	Curbside
Polypropylene (PP) Packaging, Except for Pails and Lids (e.g., deli containers, cleaning products)	Curbside
Large HDPE & PP Pails & Lids (e.g., cat litter)	Curbside
Steel Aerosol Containers (empty)	Curbside or drop-off
Steel Containers	Curbside
Aluminum Aerosol Containers (empty)	Curbside or drop-off
Aluminum Non-Beverage Containers	Curbside
Aluminum - Beverage Containers	Curbside
Clear or Colored Glass	Curbside or Drop-off

Table 12: Proposed Additional Materials List

Packaging Type	Collection Method
Shredded Paper (bagged)	Curbside, Drop off, or Other Means
Molded Pulp Food Serveware (e.g., takeout “clamshells”)	Curbside, Drop off, or Other Means
Paper Cups, Coated and Uncoated	Curbside, Drop off, or Other Means
Other Polycoated Packaging (e.g., some freezer and butter boxes)	Curbside, Drop off, or Other Means
Paper Laminate (e.g., paper/aluminum wrappers, poly-lined deli wrap, and other plastic-coated paper wrappers, including burger wraps)¹	Curbside, Drop off, or Other Means
Paper “cans” (spiral-wound containers) with steel ends	Curbside, Drop off, or Other Means

¹ Note there should be consideration in future assessments to create a separate category for flexible paper that meets the requirements for recycling.

Packaging Type	Collection Method
Colored Opaque PET Bottles, Jars and Jugs	Curbside, Drop off, or Other Means
Colored opaque PET Thermoform Containers	Curbside, Drop off, or Other Means
PE Squeezable Tubes (e.g., toothpaste, lotions/sunscreens)	Curbside, Drop off, or Other Means
LDPE Colored Nursery Containers (e.g., pots, trays, etc.)	Curbside, Drop off, or Other Means
PP Nursery Containers (e.g., pots, trays, etc.)	Curbside, Drop off, or Other Means
LDPE/HDPE Film (e.g., monoPE recycle compatible pouches)	Curbside, Drop off, or Other Means
Other Aluminum Packaging (Foil and Foil Trays)	Curbside, Drop off, or Other Means
Other Metal Packaging	Curbside, Drop off, or Other Means

SCENARIO CONSIDERATIONS

1. The minimum recyclables list developed under this element determined the list of materials in the scope of the modeled scenarios. This impacted the quantity of materials estimated to be managed by the system and directly fed into the following controls: collection of minimum recyclables list and collection of additional materials list.

ELEMENT 9: END MARKETS

PURPOSE

The purpose of the Element 9 memo was to evaluate the current State of end markets for recyclable material collected in Colorado. Viable, sustainable end markets for recycled and sorted material are a critical component of the life cycle of recyclable material. The project team evaluated the main markets for materials collected in Colorado, whether materials are transported in-state or exported out-of-state for end market processing, potential challenges and weaknesses in current markets, and market development efforts.

APPROACH

The project team conducted primary and secondary research to identify the end market for materials. The evaluation included an internal processor database; the EPA's Recycling Infrastructure Market Opportunities map; Circular Colorado's member directory, University of Colorado Denver's Manufacturing, Associations, Organizations, and Company Information; surveys of material recovery facilities (MRFs); interviews with industry stakeholders such as brokers, MRFs, and recyclers; and the U.S. Census Bureau's USA Trade Online database. The project team attempted to identify which in-state and out-of-state end markets accept and process recyclable material generated in Colorado.

FINDINGS

Table 13 summarizes the end market feasibility for materials considered in this Needs Assessment. The RAG score labels most materials as green, where end markets are possible; yellow, where end markets are more difficult; and brown, where end markets are most difficult to find.

- Glass is the only collected material with a Colorado end market that could accommodate increased volume. Glass to Glass, O-I Glass Inc., and Rocky Mountain Bottling Company (RMBC) are Colorado's major glass end markets.
- Mills within the State do not accept steel or tin cans and instead tend to process scrap metal. The integrated steel mills in the US, which accept steel and tin can packaging material, are located in the Midwest. The nearest end market is approximately 850 miles from Denver.
- There are no local markets for aluminum in Colorado, but strong domestic markets exist. Material typically stays in the U.S. for processing due to its high market value and is generally shipped to the southeastern U.S.
- There are no paper mills in Colorado. End markets are currently located in the Midwest, South, and Western U.S. End markets can be relatively local to Colorado (i.e., neighboring states) if the material is sorted into ISRI standard bale grades. In contrast, lower-grade fibers may have to be sent to mills further away.
- End markets for post-consumer plastic material are limited in Colorado. There are only plastic recycling facilities for post-industrial materials. End markets for plastic are currently in the southeastern U.S. The cost to run non-bottle PET plastics through a recycling facility is high and could require the cost to be subsidized. PET thermoforms and bottles are, therefore, baled together. HDPE bottles are sorted into separate bales and sold to end markets across the US.

Table 13: End Market Evaluation by Material

Material	RAG Rating for End Markets	In State End Markets	Stable End Markets
Glass	Possible	Yes	Yes
Aluminum Packaging	Possible	No	Yes
Steel Packaging	Possible	No	Yes
Fiber - OCC	Possible	No	Yes
Fiber - Other Paper Products	Possible	No	Yes
Plastic - PET	Possible	No	Yes - for bottles
Plastic - HDPE	Possible	No	Yes
Plastic - PP	More Difficult	No	No
Plastic - Other #3-7	Most Difficult	No	No

SCENARIO CONSIDERATIONS

1. Due to the presence of strong local end markets for container glass, the scenarios will evaluate improvements in the recycling system to increase the quality of material to reduce downstream costs, increase the quantity of quality material by investing in glass cleanup equipment, and evaluate different collection methods for glass.
2. The insights from this element support the findings from Element 6 on the need to invest in MRF equipment to sort resin and format specific bales effectively. This could improve local end markets for used beverage containers and fiber.

ELEMENT 10: NEW TECHNOLOGIES

PURPOSE

The Element 10 report aimed to evaluate recycling solutions in North America and globally that can potentially expand or improve the collection, sorting, and processing of recyclable packaging materials through technology solutions. The processing technologies identified in this report are at the commercial stage. This means that the equipment or system has been in service at several operating facilities long enough to have gone through several operation cycles and proven it can reliably achieve the anticipated level of performance. While development risk is never eliminated, the risk of technology failure drops substantially once commercial operation is reached. Innovative collection and reuse options have also been identified to improve Colorado's existing recycling system.

APPROACH

The project team developed a list of technology options that not all facilities or haulers currently use in Colorado for consideration as part of this Needs Assessment. Technology gaps were determined through the surveys and site visits conducted during the Needs Assessment. The project team contacted reputable vendors for technology information, commercial availability, and cost estimations. The project team used the lens of new technologies to understand how the current Colorado infrastructure could be maximized to increase processing capacity, expand the accepted materials, and reduce the impact of contamination.

FINDINGS

- Benefits of new technologies in Colorado include increased safety, optimized efficiency, potential processing of additional material types, ability to adapt to changing markets, potential for increased diversion through more accurate capture, reduced contamination, and reduced staffing needs.
- The technologies identified are at the commercial stage, meaning they are in service at existing facilities and have proven performance in a commercial setting.
- Improved MRF technologies, such as optical sorting, glass cleanup systems, screening technology, robotics, artificial intelligence (AI), and fire detection systems, can optimize the efficiency and safety of existing MRFs. These technologies can also improve the quantity and quality of output materials and reduce contamination.
- New MRF technologies have the potential to expand the types of material accepted and adapt to changing feedstocks over time.
- Glass has a local end market in Colorado, so glass cleanup systems may be a priority. Some existing facilities complete some glass cleanup, but improved equipment could potentially achieve an 80-90% glass yield. This additional cleanup equipment would assist MRFs in removing fines (small glass pieces that are difficult to recover, grit, gravel, etc.), shredded paper, and other light material that normally contaminates the glass before selling to the end market.
- Fire detection systems can protect processing capacity at existing MRFs. Current systems and practices may be reviewed to protect against risks adequately.
- While dual-stream facilities tend to produce cleaner products, resident participation rates are typically higher in areas with single-stream collections. Thus, dual-stream facilities may consider converting to single-stream to increase material availability.
- Advancements such as contamination software, routing software, automated collection, and scheduling tools improve data collection, route efficiency, and worker safety.

SCENARIO CONSIDERATIONS

1. Current technology gaps were determined through surveys and site visits in Colorado to inform new technologies, commercial availability, and cost estimations. Findings informed potential advancements in the collection, sorting, and processing of recyclable packaging

materials. This helped inform the impact of access, collection, and materials controls in the model.

ELEMENT 11: REUSE AND REFILL

PURPOSE

Reuse and refill systems are gaining consumer and business interests as an alternative to single-use packaging models. The transition to reuse systems for packaging could significantly impact waste diversion targets, climate goals, and extended producer responsibility legislation. The purpose of the Element 11 effort was to understand the availability and scope of reuse and refill systems in Colorado that may affect the use of materials covered under this Needs Assessment. The project team documented the current deployment of reuse and refill services, formats available to residential and non-residential covered entities, and major packaging types. The project team also developed insights regarding trends and opportunities for migration to reusable and refillable product delivery and how that could potentially change the recyclable material stream.

APPROACH

The project team began by assembling a database of reuse and refill programs in Colorado, including the major types of packaging and paper formats impacted and the types of residential and non-residential entities to which they are available. The project team also interviewed internal and external reuse and refill experts, key Colorado stakeholders, and several reuse service providers to identify additional programs and to discuss trends, challenges, and opportunities for reuse and refill systems already in place in Colorado and systems that could be implemented in the future.

FINDINGS

- There are 52 existing reuse and refill operations in the State. These include packaging-free shops with bulk dispensing models, reusable cup and container programs run by restaurants, stadiums, schools, and campuses, and pre-filled refill systems for dairy products.
- The project team could not quantify these operations' current source reduction benefits, but source reduction is likely if there is continued expansion in reuse programs.
- Challenges to reuse and refill include the availability and cost of infrastructure such as washing facilities.
- Nationally, reusable cup and container programs and package-free shops are typically local (city- or town-based) initiatives rather than statewide or regional programs. They also capture a small portion of the market and have a negligible total impact on statewide waste streams.
- The number of reuse and refill companies and programs in Colorado fluctuates in this period of early growth. A few larger players in the reusable cup and container space are

gaining a firm foothold, including r. World and Deliver Zero. An interesting development is the collaboration between these companies, which speaks to the economic value of shared infrastructure.

- Colorado has two main funding initiatives that can be used to support reuse and refill initiatives. Recycling Resources Economic Opportunity (RREO) grant funding promotes economic development by managing materials that would otherwise be landfilled. The Front Range Waste Diversion (FRWD) enterprise fund provides funding and technical support to local governments, nonprofits, businesses, institutions, and other entities on the Front Range that contribute to waste diversion activities within the Front Range.

SCENARIO CONSIDERATIONS

1. The future scenarios consider the impact of increased reusable packaging on waste prevention and the generation of packaging materials.

ELEMENT 12: EDUCATION

PURPOSE

Education is critical to the success of recycling programs for packaging materials. Recycling collection and sorting rely on individual residents and businesses to place materials in the correct cart or bin, and recycling education can give residents the tools they need to sort material correctly. The education element of the Colorado Needs Assessment was to evaluate current recycling education programs in Colorado, evaluate the cost of recycling education, and identify best practices and recommendations for recycling education.

APPROACH

The project team reviewed existing reports and studies that address recycling education in Colorado and the U.S. The project team also reviewed Colorado municipalities to assess what, if any, recycling education is being offered on their website. As part of the Needs Assessment, the project team conducted a comprehensive survey of municipalities, material recycling facilities (MRFs), compost facilities, and collections companies in Colorado, which included questions about recycling education. Additionally, Eco-Cycle conducted two stakeholder workshops in coordination with the HDR project team. The goals of the workshops were to gather information on local recycling programs, seek input on strategies to enhance existing services and record each organization's perspective on producer responsibility legislation. The information collected from stakeholder events and the sources mentioned above are summarized in the findings below.

FINDINGS

- Approximately two-thirds of municipal survey respondents noted that they provide recycling education.
- Material lists of what can and cannot be recycled were among municipalities' most commonly available educational tools.

- Survey respondents reported that websites or social media campaigns are most commonly used for recycling education. Still, municipalities also use print, radio, television, in-person events, and other methods to provide recycling education.
- Most recycling education was targeted toward single-family rather than multi-family households.
- The surveys and the project team's desktop research indicated that some recycling education was offered in multiple languages, primarily Spanish—these range from pre-translated printable materials to videos with Spanish narration. Several municipalities had websites that were translated into multiple languages via Google Translate.
- Survey respondents asked where they obtain solid waste and recycling educational materials. Most respondents said they develop materials in-house or partner with local recycling organizations.
- Several survey respondents commented that a third-party provider, contractor, or contracted hauler provided recycling education.
- Few municipalities have data on recycling rates and recycled material quantities readily available on their website.
- 26% of the municipalities surveyed had recycling coordinators on their staff.
- The amount spent on recycling education was reported to be between \$500 (San Miguel County) and \$1 million (City of Longmont) per year. Calculated per-Household cost ranged from less than \$1 to \$25 per household (City of Longmont).
- Nonprofit recycling and zero waste advocacy organizations in Colorado are also providing educational support for recycling programs and can continue to play a role in the future to improve outcomes. This includes assistance with communication in multifamily buildings, resort/destination communities, and underserved communities. There are opportunities to leverage developed materials, specific understandings of local communities, and different communication channels.

SCENARIO CONSIDERATIONS

1. Education programs for recycling impact the likelihood that a household with access to recycling will participate in the program, how much material will be recycled from each Household, and the quality of the material collection. This impact is related to the investment in the education program modeled in each Scenario at a rate equivalent to the high-performing communities in the State and in alignment with The Recycling Partnership's recommended per-household investment of \$10/household. This investment aligns with the high performing diversion communities in both the Front Range and Mountain regions within Colorado.
2. A common statewide Minimum Recyclables List with consistent education can help to improve participation rates, set- our rates, and reduce contamination.

ELEMENT 13: SCENARIOS

PURPOSE

The objective of this element is to estimate the impact of three (3) projected scenarios on the recycling rate and collection rate of covered materials in Colorado. This includes recycling rates and collection rates that the State can meet by 2030 and 2035, as well as the operating and capital costs to reach each Scenario, in accordance with House Bill 22-1355. The modeling conducted in this element is the culmination of the findings from the other elements of the Needs Assessment.

APPROACH

The model was developed according to a bottom-up approach and systematically considered variables across the waste and recycling value chain. The model flow is a comprehensive tracking of packaging materials, from generation through consumption to eventual recycling or disposal. Cost estimates focused on accumulated costs in each stage of the lifecycle of packaging waste.

As the model was developed, the project team identified factors that impact collection and costs. These factors fell into the following categories: access, collection, materials, education, infrastructure, and waste generation. Using these factors, a low, medium, and high Scenario were developed to understand the potential future performance and cost of EPR in Colorado.

There are several controls that are the same across all three scenarios.

- **Access:** Recycling access is equivalent to trash collection for all residential households. This means if a household has access to curbside trash collection, they will have access to curbside recycling.
- **Access:** Recycling service is offered to all non-residential covered entities by 2030.
- **Collection:** All new curbside service is collected through single-stream processes
- **Materials:** All materials are collected on the minimum recyclables list at the start of the program
- **Education:** Recycling education is implemented across the State based on best practices
- **Generation:** The population is expected to grow similarly in all scenarios in addition to a 10% waste reduction by 2035

Low Scenario:

- **Collection:** New collection service is biweekly, and the current service collection frequency does not change
- **Collection:** There will be minor efficiencies made to collection routes
- **Materials:** Materials on the additional materials list will be collected by 2035

- **Materials:** Glass is collected in curbside for new service and remains the same for existing service
- **Infrastructure:** Additional MRF capacity growth based on new volume but no investment in advanced technology

Medium Scenario:

- **Collection:** New collection service is biweekly, and the current service collection frequency does not change
- **Collection:** There will be medium efficiencies made to collection routes
- **Materials:** Materials on the additional materials list will be collected by 2035
- **Materials:** Glass is collected curbside for new and existing service
- **Infrastructure:** Additional MRF capacity growth based on new volume, greater investment in infrastructure including drop off sites in addition to advanced technology upgrades at MRFs

High Scenario:

- **Collection:** New and existing collection service are weekly
- **Collection:** There will be major efficiencies made to collection routes
- **Materials:** Materials on the additional materials list will be collected by 2030, including curbside flexible plastic collection
- **Materials:** Glass is collected in curbside for new and existing service
- **Infrastructure:** Additional MRF capacity growth based on new volume, greater investment in infrastructure including drop off sites in addition to advanced technology upgrades at MRFs

FINDINGS

- At the baseline year (2022), it is estimated that Colorado had a recycling rate between 22% - 28% for covered packaging from covered entities.
- In the low Scenario, Colorado could achieve a recycling rate between 32%-38% in 2030 and 47%-53% in 2035.
- In the medium Scenario, Colorado could achieve a recycling rate between 34%-40% in 2030 and 51%-57% in 2035.
- In the high Scenario, Colorado could achieve a recycling rate between 39%-45% in 2030 and 54% - 60% in 2035.
- The recycling rate is the highest in the Front Range, followed by Mountains, Western Slope, and Eastern Plains.

- At baseline (2022), the total system cost is estimated to be between \$80 million and \$140 million.
- In 2030, the estimated system cost could be between \$130 and \$200 million in the low Scenario, \$130 and \$ 210 million in the medium Scenario, and \$150 and \$240 million in the high Scenario.
- In 2035, the estimated system cost could be between \$160 and \$250 million in the low Scenario, \$160 and \$260 million in the medium Scenario, and \$180 and \$290 million in the high Scenario.
- The system factors that contribute the most to increased recycling rates are providing residential households with recycling services equivalent to trash, performance benefits due to education programming, advanced sorting at MRFs, and collecting materials on the additional materials list.
- The system factors that contribute the most to cost increases are providing residential households with recycling services equivalent to trash, investment in education programming, and MRF technology investment.
- Efficiencies in collection routes have overall cost savings.

Table 14: Estimated Recycling Outcomes per Scenario

		2022 (Baseline)	2030	2035
Low	Recycling Rate (%)	22% - 28%	32% - 38%	47% - 53%
	Recycling Tonnage (k tons)	~310	~450	~660
Medium	Recycling Rate (%)	22% - 28%	34% - 40%	51% - 57%
	Recycling Tonnage (k tons)	~310	~480	~710
High	Recycling Rate (%)	22% - 28%	39% - 45%	54% - 60%
	Recycling Tonnage (k tons)	~310	~550	~750

Table 15: Estimated Recycling Rates by Region per Scenario

	Baseline (2022)	Low		Medium		High	
	2022	2030	2035	2030	2035	2030	2035
Front Range	24% - 30%	33% - 39%	49% - 55%	36% - 42%	52% - 58%	41% - 47%	56% - 62%
Mountains	17% - 23%	27% - 33%	39% - 45%	30% - 36%	44% - 50%	33% - 39%	46% - 52%
Western Slope	15% - 21%	25% - 31%	38% - 44%	29% - 35%	44% - 50%	32% - 38%	46% - 52%
Eastern Plains	8% - 14%	19% - 25%	31% - 37%	21% - 27%	34% - 40%	23% - 29%	36% - 42%

	Baseline (2022)	Low		Medium		High	
Front Range	24% - 30%	33% - 39%	49% - 55%	36% - 42%	52% - 58%	41% - 47%	56% - 62%

Table 16: Estimated Costs per Scenario

		Baseline (2022) Lower	Baseline (2022) Upper	2030 Lower	2030 Upper	2035 Lower	2035 Upper
Low	Total Annualized Cost (\$ millions)	80	140	130	200	160	250
	Cost Per Household (\$)	60	90	60	90	70	110
	Cost Per Ton Recycled (\$)	260	430	280	450	240	380
Medium	Total Annualized Cost (\$ millions)	80	140	130	210	160	260
	Cost Per Household (\$)	60	90	60	90	70	120
	Cost Per Ton Recycled (\$)	260	430	260	430	230	370
High	Total Annualized Cost (\$ millions)	80	140	150	240	180	290
	Cost Per Household (\$)	60	90	70	110	80	130
	Cost Per Ton Recycled (\$)	260	430	270	430	240	390

ELEMENT 14: COMPOSTING

PURPOSE

Composting diverts organic material from landfilling and produces a usable end product. The composting process is a way to manage compostable single-use packaging, including compostable service ware. The Element 14 memo outlined the capacity and feedstocks of composting facilities in Colorado. The Colorado Needs Assessment analysis evaluated whether facilities accept compostable packaging and service ware, the capacity of composting facilities, and the potential for expanded capacity.

APPROACH

The project team took a two-fold approach to assess existing capacity, organic trends, and associated costs. First, the project team conducted a literature review of existing studies and regulations impacting Colorado's composting programs. The team then developed and executed onsite assessments of representative composting facilities in Colorado. The assessments covered a range of factors related to the composting facility's operations, such as processing capacity and expansion opportunities, capital and operational costs, and feedstock types and sources.

FINDINGS

- Based on a high-level review of municipal codes from the most populated counties in the four (4) Colorado Regions, composting is not a clearly defined use. It is most often grouped up with solid waste facilities. This, in turn, may limit access to properly zoned land for composting facilities.
- Nearly all composting facilities surveyed accept a mixture of green and food waste. While only two (2) surveyed reported composition data for compostable packaging, several facilities currently accept or are willing to accept compostable packaging.
- The most common processing approach was windrow composting, although aerated static pile systems are currently being piloted or used in conjunction with windrow composting at a few facilities.
- The leading recommendation from feedstock generators was to focus on education to reduce contamination.
- Facility operators suggested that receiving pads, de-packagers, sortation lines, shredders, and associated operation buildings would be the primary need for facilities to process compostable packaging more effectively.
- The State of Colorado has a current organics processing capacity of roughly 400,000 tons per year and a potential capacity of roughly 1,100,000 tons per year. These values include weights of materials from residential and commercial generators, including feedstocks comprising green waste, food waste, wood waste, biosolids, and compostable packaging materials.
- Approximately one-quarter of the current processing capacity and potential capacity are associated with facilities currently accepting or willing to accept compostable packaging at the time of the survey. Additionally, approximately 20% by weight of that capacity is dedicated to feedstocks or generators that include compostable packaging products.
- Consistent end markets impact processing capacity, as it is necessary to move material to end markets to allow room for processing additional feedstock.

SCENARIO CONSIDERATIONS

1. Facility and equipment upgrades were modeled at varying levels for Class III level composting facilities to manage covered compostable packaging. Investments in facility upgrades varied by Scenario, with the low Scenario incorporating upgrades by 2035 and the medium and high Scenarios incorporating upgrades by 2030.