



# Fort Collins Circular Economy Concepts and Existing Conditions Analysis

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## Introduction

Fort Collins is updating its Economic Health Strategic Plan with a first-ever focus on the circular economy (CE). While the City of Fort Collins has already integrated circular economy strategies into some of its other environmental plans like Our Climate Future and the Municipal Sustainability and Adaptation Plan, the Economic Health Strategic Plan offers a significant opportunity to advance Fort Collins' circular economy and zero waste goals, as well as close planning gaps, including gaps around:

- *Economic health dimensions* of the circular economy (cluster support, wealth generation, skills and training, business attraction, etc.).
- *Manufacturing sector* strategic gaps.
  - o Other plans have focused primarily on individuals, small businesses, institutions, and the construction and demolition sector.
  - o The manufacturing sector has the greatest global impact and opportunity for innovation.
- *Non-regulatory strategies* that support businesses transitioning to circular business models.

The following sections offer the conceptual framework Fort Collins is using, examples of local and regional successes to date, materials available for integration into manufacturing processes, known opportunities and barriers to circularity, as well as recommendations.

## Conceptual Framing for Fort Collins

The circular economy elements of the Economic Health Strategic Plan are focused on local manufacturers. They are intended to provide opportunities for local manufacturers to transform their production processes from linear ones into connected loops with a little help from the City organization.

The circular economy also includes non-manufacturing businesses, other institutions, and individuals. Strategies for these entities are included in Our Climate Future, the City's waste, energy, and climate plan. Our Climate Future is a living document that will grow over time with the community's awareness and capacity to build a circular economy.

### Circular Economy Definition

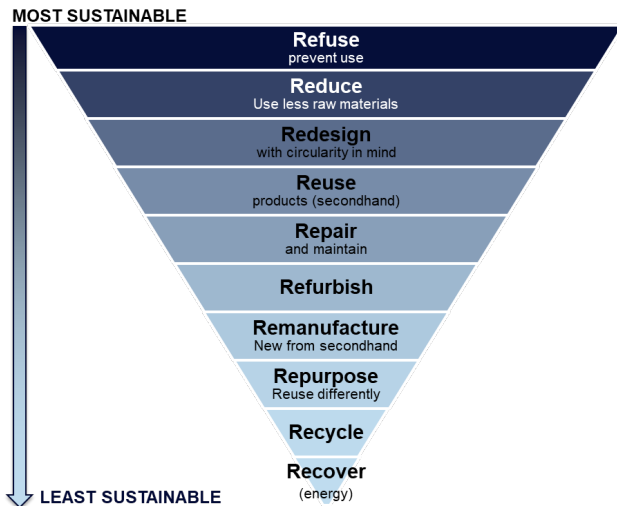
For Fort Collins, the definition of circular economy is *rethinking products and processes to eliminate and reduce waste while effectively utilizing natural resources to increase supply chain resilience, create sustainable employment opportunities to enable wealth stability, and ensure the resilience of our natural and built environment.*

## Key Concepts

There are a few key strategic frameworks for achieving a more circular economy, including applying “R” strategies and creating systems for *industrial symbiosis*.

“R” strategies. Expands on the adage of “reduce, reuse, recycle” to include a variety of other approaches to preventing waste. “R” strategies are organized into a hierarchy based on how waste can be prevented. For example, refusing means preventing material from being used in the first place. A material never mined, processed, used, and disposed of has the least environmental impact. On the lower end of the hierarchy is recycling. Recycling is important, yet it still requires energy and other resources to collect, transport, and manufacture something new.

Figure 1: “R” strategies to prevent waste



Industrial symbiosis. Is similar in concept to recycling but cuts out the middleman and brings companies into a direct relationship by sharing outputs from one manufacturing process as the inputs to another.

## Baseline Research

### Cluster Study: Understanding Local Industries

Hickey Global conducted a cluster study on behalf of the City of Fort Collins to enhance our understanding of industries operating in Fort Collins. They identified four key industries as a focus in the overall updated Economic Health Strategic Plan.

#### Top Four Clusters Overall:

- Professional Services
- Information Technology (Software Development)
- Distribution & E-Commerce
- Manufacturing

For the circular economy portion of the revised Plan, the cluster study helped to understand Fort Collins’ extensive and robust manufacturing cluster, which has opportunities for circularity.

#### Within the Manufacturing Cluster:

- Food & Beverage Manufacturing
- Computers and Electronic Products
- Machinery
- Plastics and Rubber Products
- Furniture and Related Products - Wood Manufacturing



The study showed examples of and opportunities for industrial symbiosis in Fort Collins. An important next step in expanding opportunities for industrial symbiosis is to identify barriers the manufacturing sector encounters to achieve circularity as well as what support the City could provide to address those barriers.

One known opportunity is to foster cluster activities to promote innovation, identify research, create jobs, and attract capital within a particular industry and generally enhance regional economic growth.

## Initial Engagement and Peer Learnings

Initial engagement on the circular economy has included connections in the U.S. and abroad.

- U.S. connections
  - Fort Collins has connected with U.S. cities with circular economy plans
- International collaborations:
  - The City's participation in the International Urban and Regional Cooperation (IURC) program has enabled Fort Collins to connect about circular economy strategies with other international cities, conduct site visits, and attend international conferences.
  - Fort Collins continues its circular economy collaboration with friendship city Vila Nova de Famalicao in Portugal.
  - This engagement has included learning:
    - About frameworks for advancing the circular economy
    - What businesses most need from cities to make the transition
      - Business panel featured local and international businesses
    - What types of strategies cities should prioritize, including;
      - Awareness and education
      - Convene and coordinate
      - Connect to funding
      - Municipal procurement
      - Policy
      - Infrastructure

## Local Manufacturers Survey

Fort Collins is conducting a survey to better understand local manufacturers' current circular economy work and their interest in future circular economy work, as well as materials they may generate as waste and/or be able to use as feedstocks. This information will be central to recommending strategies for the local manufacturing sector.



## Existing Conditions

### Circular Economy Strategies in City Strategic Plans

Several City strategic plans already include strategies that will support Fort Collins’ transition to a circular economy. Strategies span actions for individuals, small businesses, manufacturers, the construction industry, and the City organization. Examples of strategies already in plans include:

- Our Climate Future
  - Examples: Explore collaborative consumption apps and platforms; Explore policies and incentives for more local green jobs; Establish a dedicated innovation platform for the circular economy
- Municipal Sustainability and Adaptation Plan
  - Examples: Require recycled/recyclable construction materials in city projects; Update Purchasing Procedure No. 08, Sustainable Purchasing

Not all identified strategies have the same potential or foundation to start from. For example:

- Strategies for individuals and small businesses are mainly focused on improving recycling and reuse behavior and are largely underway.
- Strategies for the City organization and the construction industry are largely planned strategies that will be integrated into workplans and budgeting processes in coming years.
- Manufacturing strategies represent significant potential but also emerging practices and more exploration through the Economic Health Strategic Plan is needed.

A full overview of existing strategies is attached at the end of this document.

### Examples of Circularity in Fort Collins and Colorado

The following table illustrates known examples of circularity in Fort Collins and Colorado.

*Figure 2: Examples of circularity in Fort Collins and Colorado*

Strategy	Local example	Material recycled or avoided
<b>Refuse</b>	<b>Businesses</b> <ul style="list-style-type: none"> <li>• HP Inc allows customers to select if they need accessories when purchasing a laptop to avoid them being wasted.</li> </ul>	E-waste
<b>Reduce</b>	<b>Businesses</b> <ul style="list-style-type: none"> <li>• New Belgium Brewing has ongoing efforts to light-weight their beer bottles, reducing glass.</li> </ul> <b>City of Fort Collins</b>	<ul style="list-style-type: none"> <li>• Asphalt</li> <li>• Plastic film</li> <li>• Building materials</li> <li>• Plastic</li> <li>• Cardboard</li> </ul>

	<ul style="list-style-type: none"> <li>Adopts locally and advocates for State waste prevention regulations. <ul style="list-style-type: none"> <li>Policy requiring use of Class IV hail-resistant Shingles</li> <li>Disposable Bag Ordinance</li> <li>Durable material policy in building code</li> </ul> </li> </ul> <p><b>State of Colorado</b></p> <ul style="list-style-type: none"> <li>Colorado Producer Responsibility Program</li> <li>Colorado Plastic Pollution Reduction Act</li> </ul>	<ul style="list-style-type: none"> <li>Glass</li> <li>Metal</li> <li>Paper</li> </ul>
<b>Redesign</b>	<p><b>Businesses</b></p> <ul style="list-style-type: none"> <li>Extended guarantees on Otterbox products drives increased product durability <ul style="list-style-type: none"> <li>Reduces e-waste by better protecting phone.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Plastic</li> <li>E-waste</li> </ul>
<b>Re-use</b>	<p><b>Businesses</b></p> <ul style="list-style-type: none"> <li>Leapin Lizards Labels re-uses their label backing as packing cushion for shipping.</li> </ul> <p><b>City of Fort Collins</b></p> <ul style="list-style-type: none"> <li>Streets Department runs a crushing yard to recycle municipal- and community-generated asphalt, concrete, and soil. Products are used by the City or sold back to the community.</li> <li>Forestry Department mulches City trees that must be cut down and provides the mulch back to the community for no charge.</li> <li>Streets Department composts leaves collected from public street sweeping and uses the compost in City parks and flower beds.</li> </ul>	<ul style="list-style-type: none"> <li>Plastic</li> <li>Wood</li> <li>Soil</li> <li>Asphalt</li> <li>Concrete</li> <li>Leaves</li> </ul>
<b>Repair</b>	<p><b>Businesses</b></p> <ul style="list-style-type: none"> <li>Fjaell Raven runs a repair shop in Denver.</li> </ul>	Textiles
<b>Refurbish</b>	<p><b>Businesses</b></p> <ul style="list-style-type: none"> <li>HP Inc takes back and refurbishes laptops, then distributes them into Fort Collins schools.</li> </ul>	E-waste
<b>Remanufacture</b>	<p><b>Businesses</b></p> <ul style="list-style-type: none"> <li>Lightning eMotors converts vehicles to electric in Loveland.</li> </ul>	<ul style="list-style-type: none"> <li>Metal</li> <li>E-waste</li> <li>Plastics etc.</li> </ul>
<b>Recycle</b>	<p><b>Businesses</b></p> <ul style="list-style-type: none"> <li>Rocky Mountain Bottling in Wheat Ridge and the Colorado beer industry successfully recover, recycle, and recycle beer bottles and other glass.</li> <li>Owens Illinois in Windsor recycles glass from Colorado into new glass products</li> <li>Evrax Rocky Mountain Steel in Pueblo uses local recycled content to create new steel items</li> </ul>	<ul style="list-style-type: none"> <li>Glass</li> <li>Metal</li> </ul>
<b>Industrial symbiosis</b>	<p><b>Businesses</b></p> <ul style="list-style-type: none"> <li>New Belgium Brewing provides spent brewing grain to</li> </ul>	<ul style="list-style-type: none"> <li>Spent grain</li> <li>Water treatment</li> </ul>



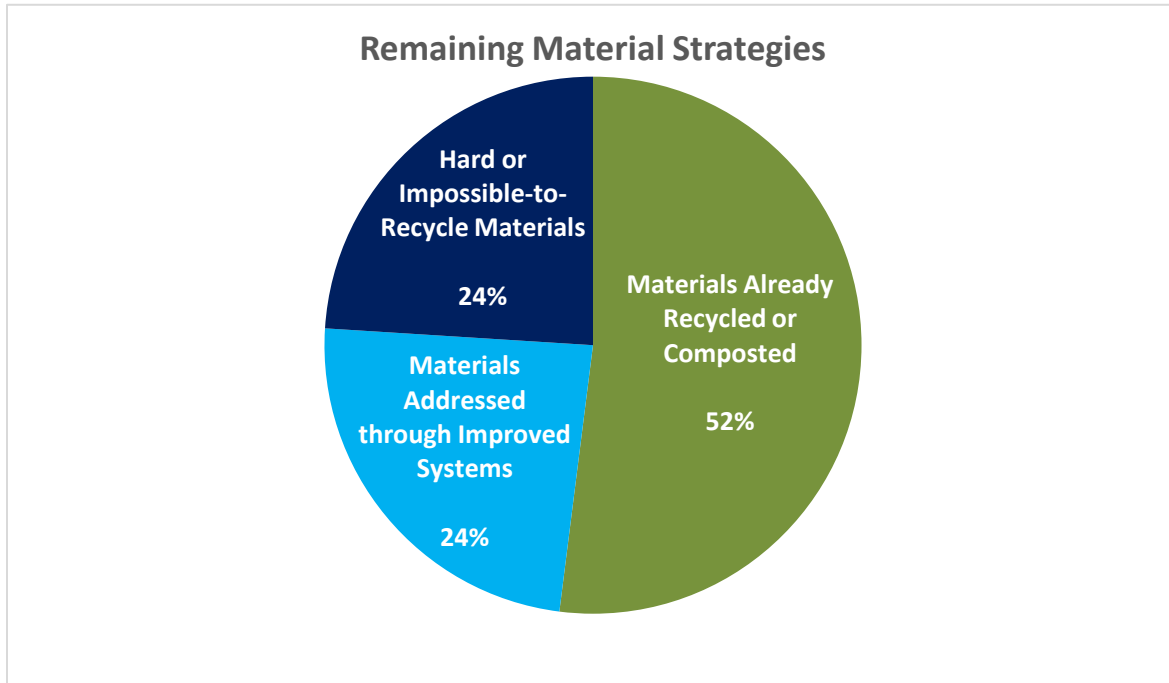
	<p>local livestock operations as animal feed.</p> <p><b>City of Fort Collins/Institutions</b></p> <ul style="list-style-type: none"> <li>• The Fort Collins water treatment facility is using an internal innovation fund grant to reuse water treatment residuals to remove phosphorous from stormwater (project status is pre-implementation as it is seeking regulatory and legal approval).</li> <li>• The Fort Collins wastewater treatment facility uses a biogas digester to create heat for on-site uses.</li> <li>• Colorado State University recovers waste heat on campus and at the National Western Center</li> </ul>	<p>residuals</p> <ul style="list-style-type: none"> <li>• Heat</li> </ul>
<p><b>Awareness and innovation</b></p>	<p><b>City of Fort Collins</b></p> <ul style="list-style-type: none"> <li>• Hosts periodic Innovate Fort Collins Challenge to provide start-up funds for innovative sustainability concepts. <ul style="list-style-type: none"> <li>○ Funded have included a circular economy focus such as funding a food waste project utilizing Black Soldier Flies.</li> </ul> </li> <li>• Provides ongoing awareness and education programming to the community around reusing, reducing, and recycling. <ul style="list-style-type: none"> <li>○ One key asset is the City’s A-Z list that provides recycling and other diversion options for a host of materials.</li> </ul> </li> </ul>	<p>Varied</p>

### Fort Collins’ Landfilled Materials

Fort Collins adopted a goal to be Zero Waste (i.e., send no materials to the landfill) by 2030. Currently, the community recycles or composts a little more than 50% of its waste, leaving the other half still to be diverted.

About half of the remaining materials can be addressed by improving existing recycling systems or developing new ones (such as food scrap composting). The other half is hard or impossible-to-recycle materials, such as complex consumer goods or hazardous materials, that can be tackled through circular economy strategies.

Figure 3: Materials generated in Fort Collins



### Opportunity Materials

One way to view circular economy opportunities is through materials that are generated in large quantities. The Figure below includes the top materials landfilled in Fort Collins by weight.

Figure 5: Top Fort Collins materials landfilled by weight

Material	Percentage	Anticipated reduction pathway(s)
Soil and aggregates	18%	Municipal industrial waste reuse and recycling
Consumer goods	15%	Circular and sharing economy strategies
Yard trimmings	12%	Regional and home composting
Food scraps	13%	Regional and home composting; food waste reduction (e.g., food rescue organizations, behavior change and education)

Another lens through which we can view materials is their impact. The following figure includes materials in Fort Collins’ waste stream that could be a focus for circular economy work.

Figure 6: Top Fort Collins materials landfilled by CE priority



Material	Percentage	Context and current end-of-life recommendations
<b>Consumer goods</b>	15%	<p>Challenging because they are so diverse and designed with many compound materials not intended to be recyclable.</p> <p>Existing recommendations direct consumers to thrift stores and online platforms to sell/trade.</p>
<b>Treated/painted wood</b>	8%	<p>Due to the toxicity of most wood treatments and paints, this type of wood cannot be used for mulch or other land applications or recycled into paper products.</p> <p>Existing recommendations are to donate usable materials to thrift stores that accept building materials and to place unusable materials in the trash.</p>
<b>Clean wood</b>	6%	<p>Because contractors require specific quantities and types of lumber, small batches of wood are unattractive.</p> <p>Homeowners can donate and shop for clean wood at the Habitat Restore.</p> <p>Existing recommendations are to donate usable clean wood to thrift stores that accept building materials or recycle unusable materials for mulching.</p>
<b>Textiles</b>	2%	<p>There is not a textile recycler in the Fort Collins region that meets the City’s criteria to recommend as a viable recycling option. Textile recycling can be associated with negative impacts on textile markets in developing countries where much of the U.S.’s “recycled” clothing ends up. When clothing floods local markets, it puts local producers out of business and often negatively impacts traditional fashions.</p> <p>Existing recommendations are to reuse clothing or bring it to a thrift store or other donation options.</p>
<b>E-waste</b>	1%	<p>While e-waste already has a recycling option in Fort Collins and is a small waste stream by weight, the mining and extraction of rare minerals for electronics production has such a significant impact on human and ecosystem health that they are also a CE priority.</p>

### Future Materials At-Risk of Being Landfilled

The figures above reflect the materials Fort Collins landfills today, however there are additional materials to consider when looking a few years out.

*Figure 7: Materials at risk of being Landfilled in the future*

Future material	Context
<b>Ash trees infected with Emerald Ash Borer</b>	<p>Emerald Ash Borer is now in Fort Collins. It is estimated that 30% of the Fort Collins tree canopy will be affected over time. The City of Fort Collins Forestry Division already has a robust wood reuse program that first separates and coordinates with a sawmill to mill logs into higher value products such as lumber, with the ultimate end goal of reusing higher value products back into City facilities. Wood material not suitable for milling is then mulched and used by the City in Parks and City facilities, is shared with Poudre School District for its facilities, and mulch is also placed at the Timberline Recycling Center and Gardens on Spring Creek for residents to self-load and use at their homes.</p> <p>However, the amount of wood anticipated to be generated from private property by the Emerald Ash Borer (EAB) will exceed the capacity of these systems.</p> <p>The Forestry Division is seeking regional partners to identify space and processes needed to handle the large volumes of wood that will be generated by EAB impacts.</p>
<b>Solar panels</b>	<p>Occasional solar panels are already disposed of as electronic waste; however, most are recent enough that they have many more years on the rooftops of Fort Collins homes. Eventually, solar panels will present a significant source of hazardous waste to be managed.</p>
<b>Electric vehicle batteries</b>	<p>While behind solar panels in terms of adoption rates, electric vehicle batteries will present a similar issue to solar panels. There is likely to be a high volume each year that will be disposed of as hazardous waste.</p>

## Barriers and Opportunities to a Circular Economy

### Barriers to Increased Circularity in Fort Collins

The sections above have illustrated the existing conditions around materials available (currently landfilled as waste) and examples of local and regional manufacturers making strides in the circular economy. While there are success stories, there is currently a greater supply of materials than demand by manufacturers. The following elements have been identified thus far as barriers to circular economy progress.

Lack of recycling markets. Cities, policymakers, industry, and recycling advocacy groups are working to develop recycling markets and connected/coordinated supply chains for various materials. However, today’s lack of these markets and coordinated supply chains is a major barrier to regional recycling. Globally, the lack of recyclers and end users (producers who purchase recycled materials for remanufacturing) are key barriers, especially to low-grade plastic recycling.



Local vs. Regional vs. Global scales. In working to understand how Fort Collins manufacturers and the City as a large institutional user of materials can best contribute to the circular economy, scale is a major piece of the puzzle. For example, creating loops around agriculture, uneaten food, and nutrient recovery is locally and regionally possible. In contrast, other materials may be mismatched in terms of supply and demand at the local and regional scales.

Regarding remanufacturing and industrial symbiosis, products are produced locally but distributed globally. In these cases, distance becomes a greater barrier or, at best, supports more indirect strategies like strengthening global recycling markets. A few international brands have introduced global take-back programs that are exceptions; however, those types of programs are likely not accessible or practical for all types of manufacturers.

Strategies like refusing, reducing, and redesigning require the greatest transition away from traditional business practices and the most innovation, regardless of scale.

Other barriers to implementing circular economy strategies. While not all local barriers are well understood, some emerging themes from other global cities include:

- Regulatory barriers to circularity
- Lack of awareness broadly, or specifically at the implementation level
- Proprietary information or trade secrets that prevent material sharing.
- Lack of connections between industries preventing industrial symbiosis opportunities
- Market/consumer trends that incentivize the production of low-quality, short-lived consumer goods.

## Opportunities to Support Circular Economy

### Regulatory Strategies

There are many ways cities can influence circularity. Many strategies focus on regulations that are most effective when implemented at a State or Federal level. Cities can and do organize to influence the passage of these types of regulations.

A recent example is Colorado's passage of a Producer Responsibility Program in 2022 focused on packaging. A Fort Collins City Councilmember and staff member testified in support of this Bill, as did elected officials and staff members from local governments across Colorado.

Further opportunities include:

- Expanding and leveraging producer responsibility regulations
  - o Beyond packaging, producer responsibility regulations could be implemented for other hazardous or hard-to-recycle products like e-waste, household and automotive cleaners and chemicals, and low-grade plastic packaging materials.



- Producer responsibility helps develop strong regional markets for recycled materials, making it easier for producers to access recycled content and achieve corporate sustainability goals.
- Producer responsibility can be a precursor to more systematized take-back systems like bottle deposits.
- “Right-to-repair” regulations
  - A type of consumer protection that gives consumers the right to repair consumer goods they purchase; may also require producers to provide repair manuals.
- Lifespan and/or recyclability disclosure regulations
  - Like the disclosure of fuel efficiency in cars, other types of environmental disclosures are being adopted. One Fort Collins example is a requirement to disclose the energy efficiency of homes at the time of sale. Indicating the anticipated lifespan of products could increase consumer awareness of how often they will have to reinvest in the product.
- State Waste Diversion and Circular Economy Development Center
- Fort Collins’ Our Climate Future and Municipal Sustainability and Adaptation Plan
  - Include 31 strategies that support the transition to a circular economy.

Recyclability disclosures could put guardrails on how companies describe recyclability and indicate when products are not recyclable so consumers could make more informed choices. For context, many products are labeled with a “recycling” chasing arrows symbol when recyclability depends on local recycling systems rather than the product’s physical properties.

### Non-Regulatory Strategies

The following are best or emerging practices from cities around the world:

- Convening and raising awareness about circular economy with key accounts and local business partners.
- Creating a process for producers to request temporary exceptions to existing regulations from their local municipality to remove policy barriers that stand in the way of circularity.
- Circular economic development support that is tailored through City-business partnerships.
- Leveraging the City’s purchasing power and procurement practices to create markets.
- Circular coordination of municipal industrial materials.



## Recommendations

Taking into consideration the existing conditions noted in this document, the Circular economy-focused updates to the Economic Health Strategic Plan should consider strategies that build on these existing conditions to:

- Focus on non-regulatory options that support Fort Collins manufacturers in implementing the circular economy.
- Highlight and scale existing local and regional success stories and business leadership.
- Integrate lessons learned and best/emerging practices from cities in Fort Collins' network.
- Continue to learn about and address local barriers to business circularity.
- Be clear about the City's role and identify roles that the business community can or should play.
- Design work through the Economic Health Strategic Plan to work in tandem with and complement the strategies and work identified in Our Climate Future
- Leverage circular economy strategies to prevent the creation of materials that cannot be recycled or composted.

# Circular Economy Strategies in Existing City Plans

Key	
	Strategies in progress
	Planned strategies
	Future Exploratory Strategies

		Individuals	Small/local businesses	Manufacturers	Construction industry	Leading by example/ City of Fort Collins
		Greatest culture change levers		Greatest global waste reduction levers	Greatest local waste reduction levers	
Plan	Chapter	6 strategies	5 strategies	4 strategies	9 strategies	7 strategies
Our Climate Future	Council Action Roadmap				Increase Construction and Demolition materials recycling compliance	
					Construction and Demolition sorting facility and related policy	
Our Climate Future	Big Move 2: Zero Waste Neighborhoods	Facilitate the sharing of commonly needed items through libraries	Highlight businesses who reuse, reduce, and recycle			
		Explore collaborative consumption apps and platforms				
		Expand recycling and reuse education campaign				
		Explore additional community-needs donation options				
		Explore barriers to accessing reuse and recycling systems				
		Support sharing, repair, and reuse				
Our Climate Future	Big Move 9: Healthy Local Economy and Jobs		Explore policies and incentives for more local green jobs	Explore policies and incentives for more local green jobs		
			Reimagine a sustainable business recognition program			
			Support small businesses and workforce development in times of crisis			
			Support small businesses and workforce development in times of stability			

		Individuals	Small/local businesses	Manufacturers	Construction industry	Leading by example/ City of Fort Collins
		Greatest culture change levers		Greatest global waste reduction levers	Greatest local waste reduction levers	
Plan	Chapter	6 strategies	5 strategies	4 strategies	9 strategies	7 strategies
Our Climate Future	Big Move 10: Zero Waste Economy			Establish a dedicated innovation platform for the circular economy	Prioritize retaining and improving existing buildings	Continue to explore ways to further reuse and recycle soil from City projects
				Build a reuse-focused innovation hub	Establish or support materials reuse facilities	Require recycled/recyclable construction materials in city projects
				Support work on a digital marketplace for industrial waste	Explore prefabricated or modular construction opportunities	
					Require circular and affordable land use development	
					Expand construction and demolition waste ordinance	
					Explore reuse partnerships for exclusive salvage rights of reusable materials from transfer stations with local partners	
Municipal Sustainability and Adaptation Plan	Goal 4: We are Zero Waste					Update Purchasing Procedure No. 08, Sustainable Purchasing
						City departments adopt systems for comprehensive Sustainable Materials Management
						Educate employees on how to sustainably utilize products and services.
						Implement waste reduction and recycling at all City facilities and operations.
						Adopt comprehensive best management practices to handle and reduce municipally generated industrial waste.